

Integrated Pest and Pollinator Management for Maine's Wild Blueberry

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My path to Maine

2003- BSc, MSc & PhD

2016- Postdoc at MSU
Working on Blueberry IPM

January 2020- Assistant
Professor of Agricultural
Entomology



Past work.....

- Focused on mostly on pest management including:
 - Spotted-wing Drosophila
 - Blueberry Maggot
 - Blueberry Stem Gall wasp
- Studying the
 - Biology and Ecology
 - Economic impacts
 - Efficacy testing
 - Market accesses issues
- Drift Reduction Technology (DRT) to conserve pollinators



Annual Blueberry IPM targets



Pre-bloom - Leaf expansion - Early bloom - Full bloom - Green fruit - Fruit ripening - Fruit ripe & harvest

Spanworm larva

Flea beetle larvae

Flea beetle adults

Leaf beetle larvae

Leaf beetle adults

Strawberry rootworm

Strawberry rootworm

Sawfly larvae

Thrips - juveniles and adults

Red-striped fireworm Larvae

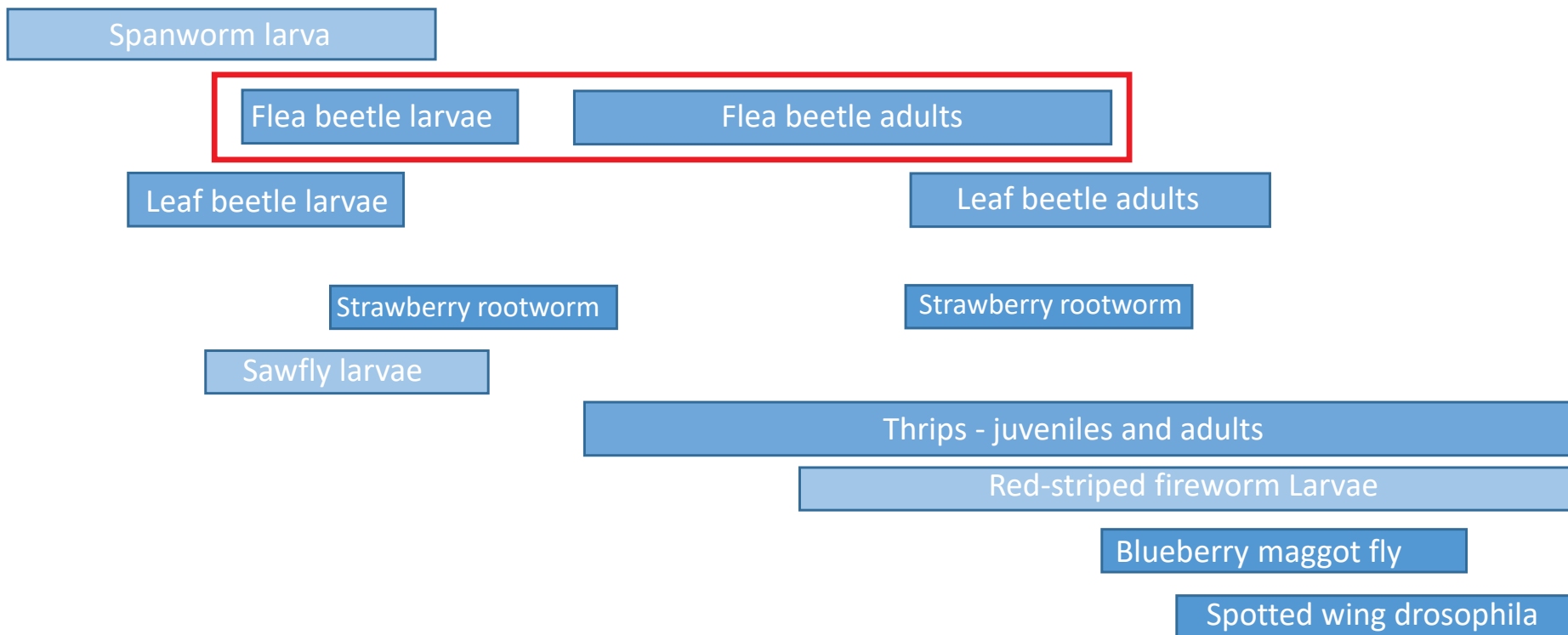
Blueberry maggot fly

Spotted wing drosophila

Annual Blueberry IPM targets



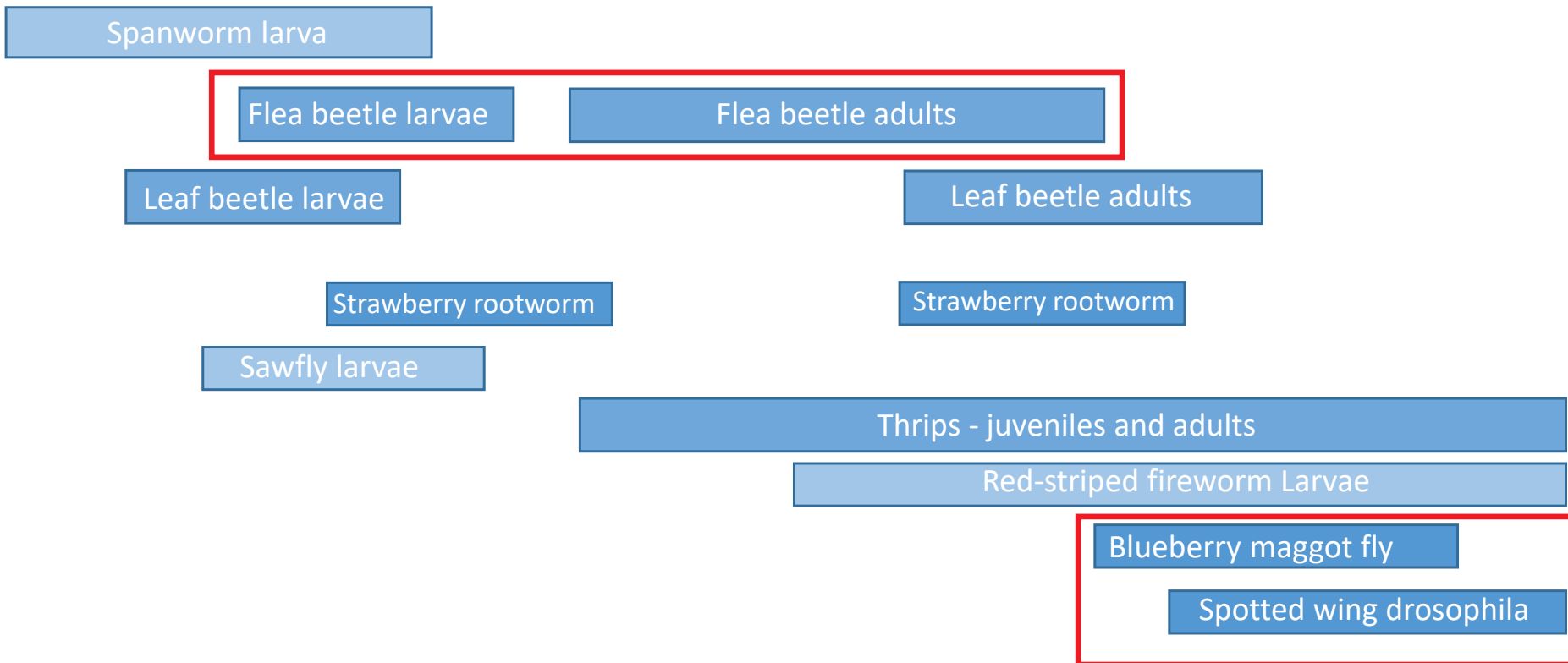
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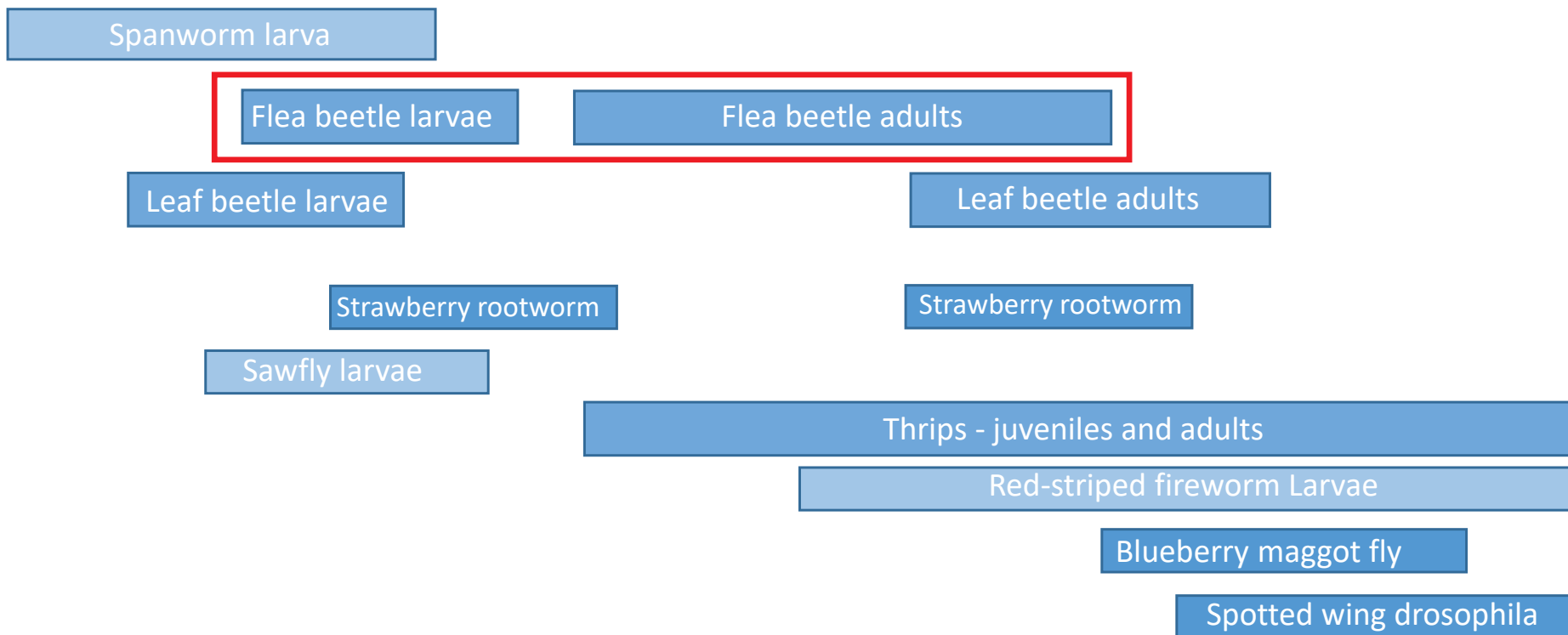
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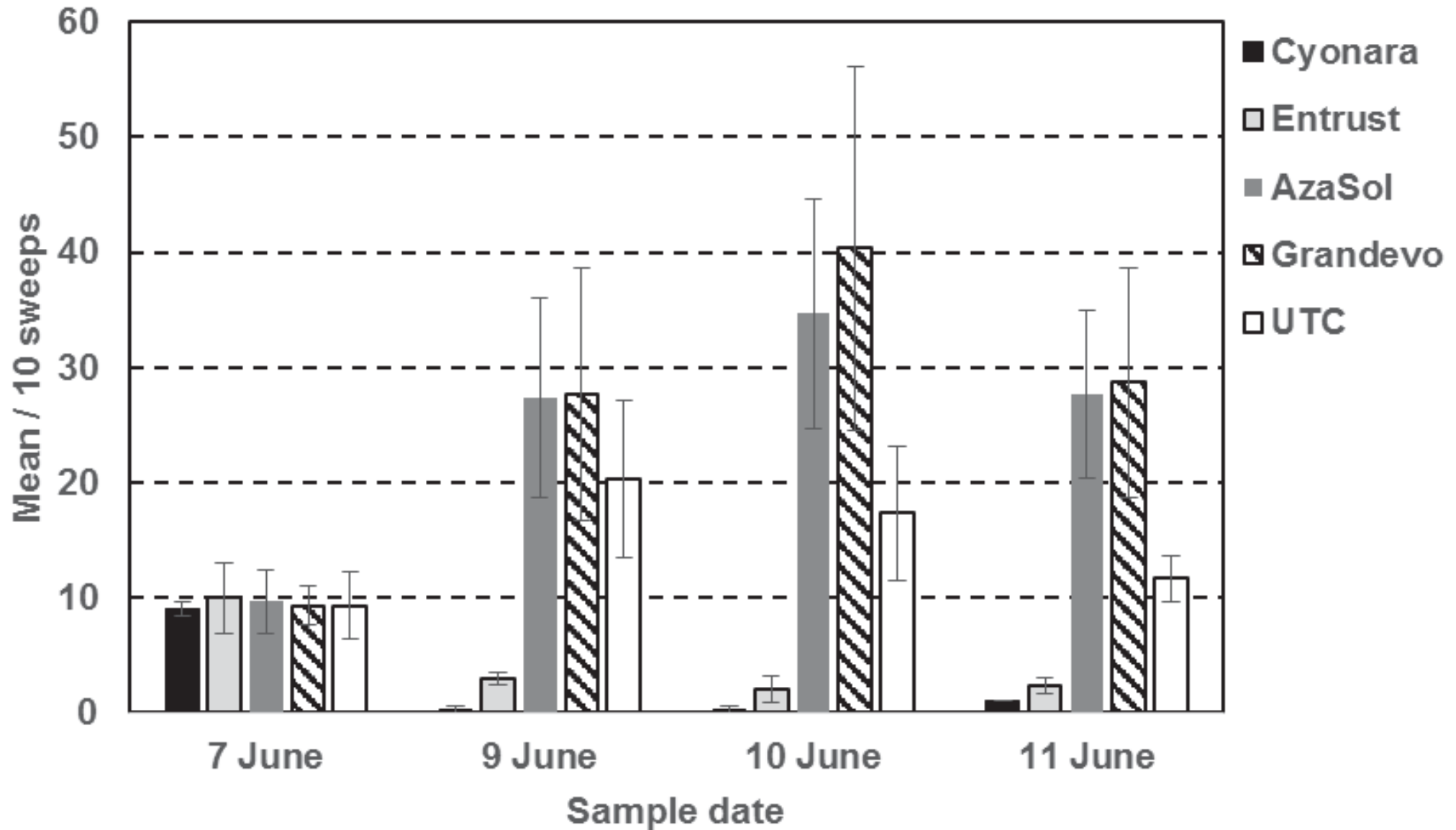
Flea beetle spray trial

- Three replications of each treatment plus three untreated checks. Each plot measured 20 x 20-ft.
- Applications on 7 June when blueberry plants were ca. 1 to 1.5 inches tall.
- Flea beetle larvae were mid to late instar.



Photo Credits: Michigan State University
Cooperative Extension

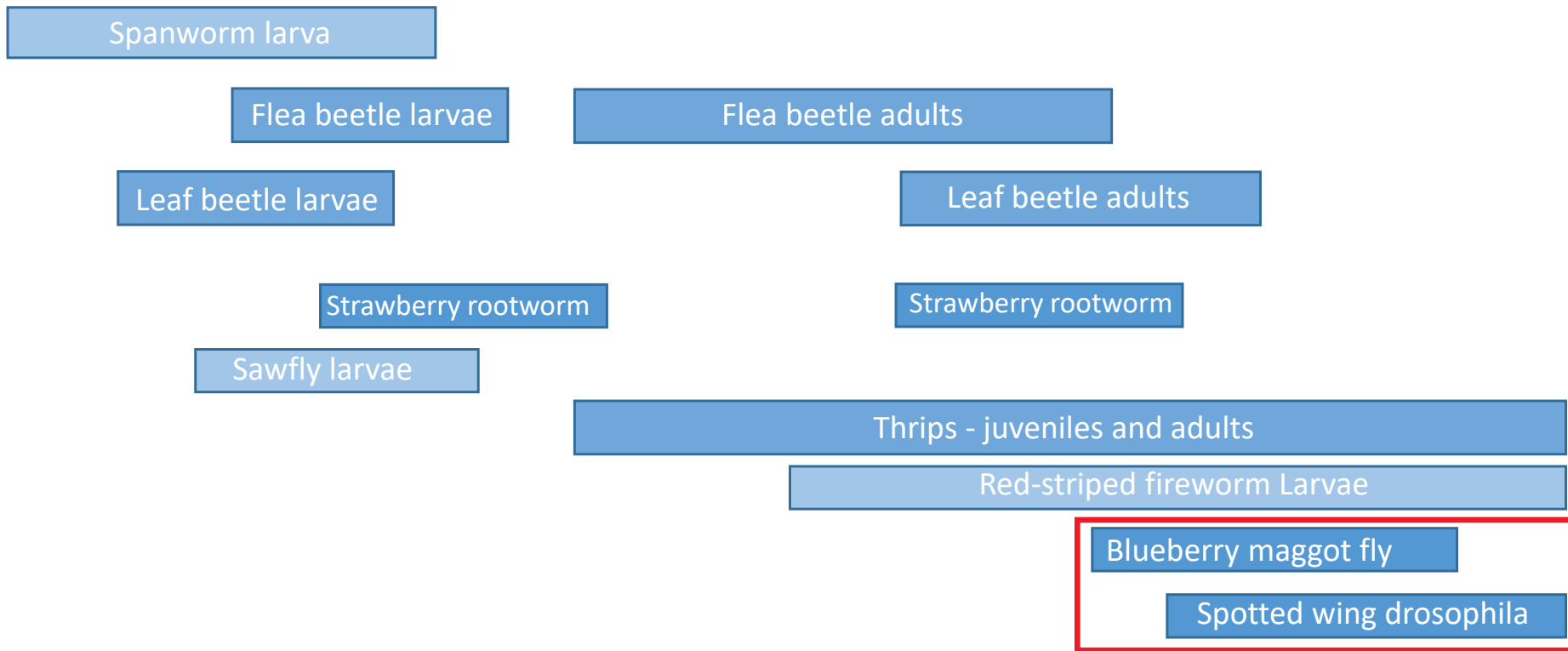
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Annual Blueberry IPM targets



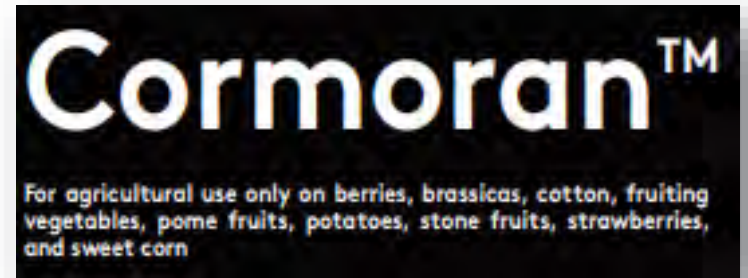
Pre-bloom - Leaf expansion - Early bloom - Full bloom - Green fruit - Fruit ripening - Fruit ripe & harvest



New Registrations for wild blueberry

CORMORAN

EPA Reg. No. 66222-264.



Active ingredients: acetamiprid and novaluron.

- IRAC groups 15 and 4A.
- Active on aphids, blueberry gall midge, blueberry maggot, spotted wing Drosophila, and thrips.
- Labelled rate: 9-12 fl.oz/A.
- **REI: 12 hours. PHI 1 in Blueberry.**
- **Maximum allowed per year: 35.0 fl.oz/A.**

New Registrations for wild blueberry

GROUP 28 INSECTICIDE

CYCLANILIPROLE 100SL



EPA Reg. No. 71512-34.

CYCLANILIPROLE 100SL

Active ingredients

INSECTICIDE

**Check with who you are
marketing you fruit with
regarding MRLs etc.**

- IRAC group
- Active on b... and spotted wing Drosophila.
- Labelled rate: 8.2 to 11 fl.oz/A.
- **REI: 4 hours. PHI 1 in Blueberry.**
- **Maximum allowed per year: 33.0 fl.oz/A.**

Blueberry maggot fly management

UNIVERSITY OF MAINE

The Maine Agricultural Experiment Station

ORONO, MAINE

BULLETIN 500

MAY, 1952

Fighting the Blueberry Fruit Fly in Maine

F. H. Lathrop



Blueberry maggot fly management



Blueberry maggot fly management

RECOMMENDATIONS FOR CONTROL

For the control of the blueberry fruit fly in Maine the following program is recommended.

Dust the infested, bearing land with 50-10-40 (50 per cent calcium arsenate, 10 per cent monohydrated copper sulphate, and 40 per cent hydrated lime) dust mixture.

Two applications of dust are recommended on land where the larval count of the berries, during recent years, has not exceeded 8 or 10. In rainy seasons, or on land where the larval count has been high, it may be advisable to make 3 applications of the 50-10-40 dust.

Weed removal also important!

Blueberry maggot fly management

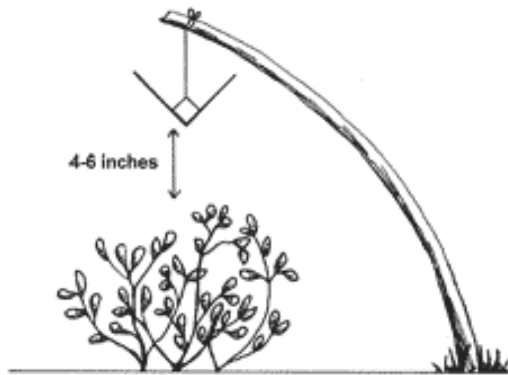
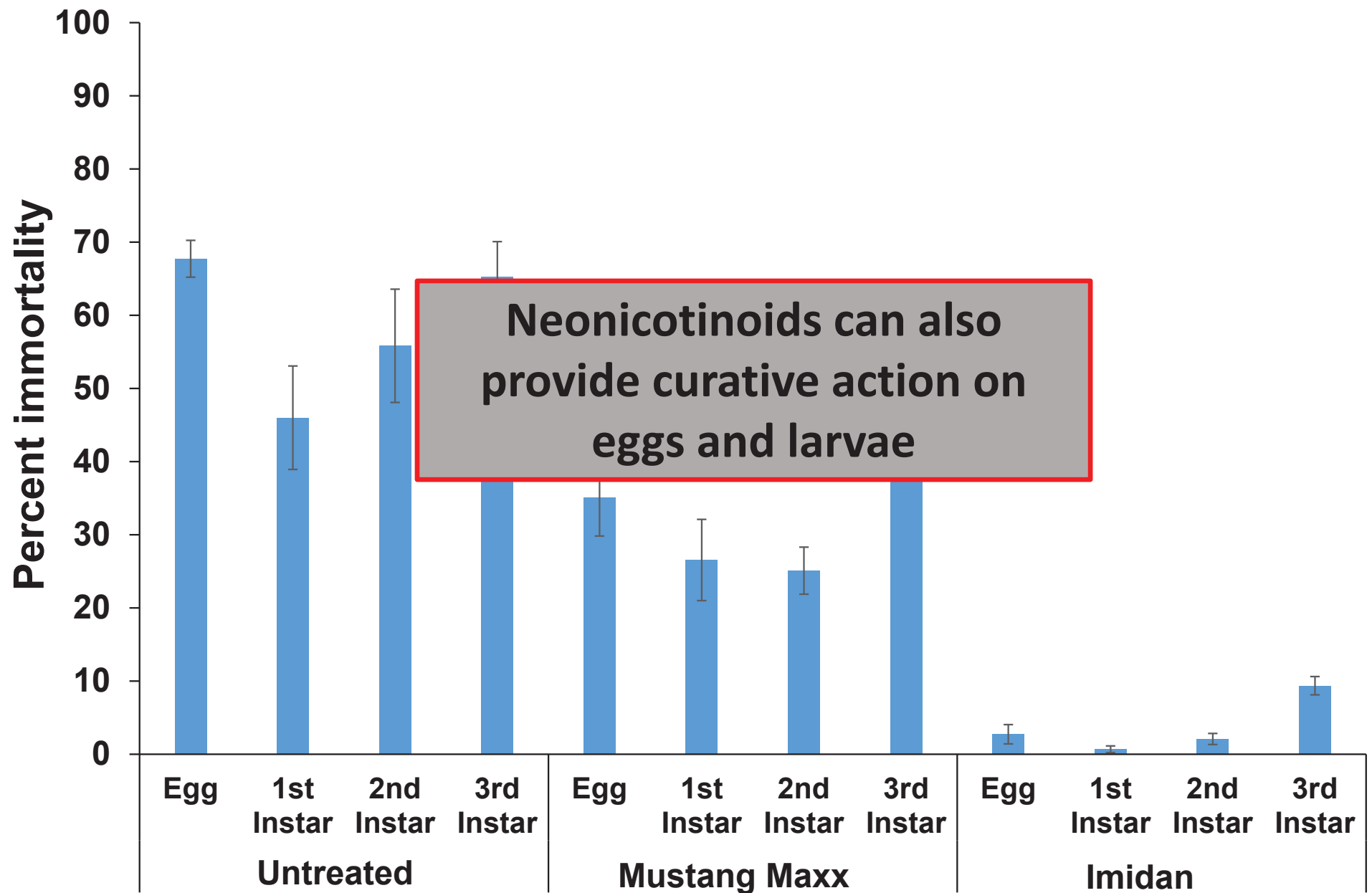


Figure 6. Field trap placement.

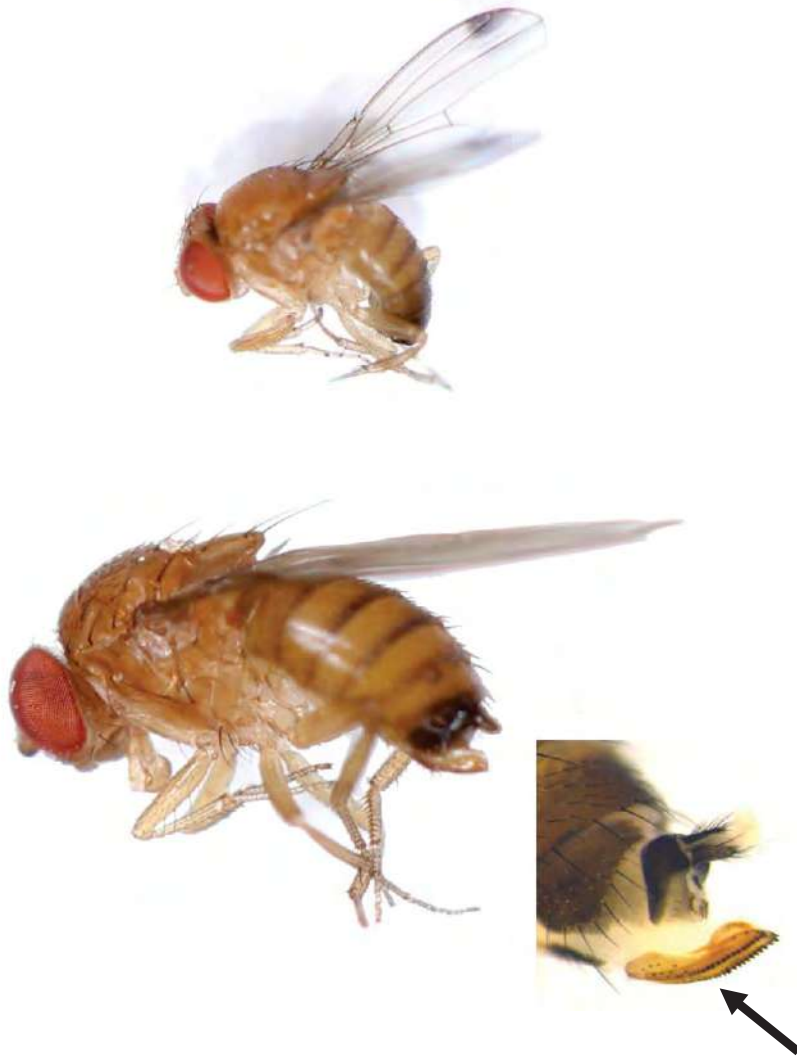


- Degree-days can be used to decide when to place traps.
- Place traps 7-10 days before anticipated fly emergence.
- Recommended action threshold reached average of the cumulative total of **ten flies** or more are captured on all the traps in more than one visit.
- But if threshold is reached will treatment help SWD control too?

Could BMF insecticides effect SWD?



Spotted wing Drosophila (SWD)



Winter morphs have longer wings and are darker in color

SWD management after 10 years



1. Learned a lot about SWD biology.
2. Identified effective insecticides.
3. Developed programs that control SWD.
4. Control difficult and too expensive in some year!

SWD control is most successful when:

- Fields are away from wild habitat
- Monitoring and scouting guide the control program
- Effective insecticides are applied with excellent coverage
- Weather forecasts are used to guide product selection
- Reapplication is made after rain
- Fruit are harvested in a timely manner

Monitoring for thresholds



ACTION THRESHOLDS. Data from 2012-2017 that show the frequency (# fields) of cumulative SWD male captures in fields that the following week had infested fruit.

CUMULATIVE MALE SWD FLIES CAPTURED (average from three traps/field)	Probability of NOT having infested fruit the following week
0.25	99.9%
0.5	99.5%
1.0	99%
2.0	95%
3.5	90%
7.0	75%
16.0	50%

SWD Thresholds 2019

- SWD thresholds record:
 - 2016: ✓
 - 2017: ✓
 - 2018: ✗
 - 2019: ?
- Adults and larval infestation monitored weekly at 11 farms.
- Trapping for adult SWD began early July and continued until larval infestation of fruit was detected/harvested.



SWD Thresholds

Fruit Infestation, male SWD capture, and PREDICTED probability of fruit infestation based upon mean cumulative SWD captures.

Field (Mid-Coast)	first male SWD detected	status of fruit infestation before or at harvest	date fruit infestation found or field harvested	mean #SWD males week before infestation detected	probability of fruit infestation week after male SWD threshold ^a
1	6-Aug	YES	16-Aug	17.7	50%
2	5-Aug	YES	19-Aug	12.3	40%
3	29-Jul	YES	23-Aug	91.3	90%
4	29-Jul	YES	18-Aug	20.0	60%
5	22-Jul	YES	12-Aug	7.5	28%
6	22-Jul	YES	12-Aug	4.7	15%
7	28-Jul	no	5-Aug	0.3	0.10%
8	6-Aug	no	16-Aug	6.3	20%
9	5-Aug	no	12-Aug	2.0	5%
10	no males	no	5-Aug	0.0	0
11	no males	no	5-Aug	0.0	0

^a approximate probabilities based upon interpolation of the probability density function.

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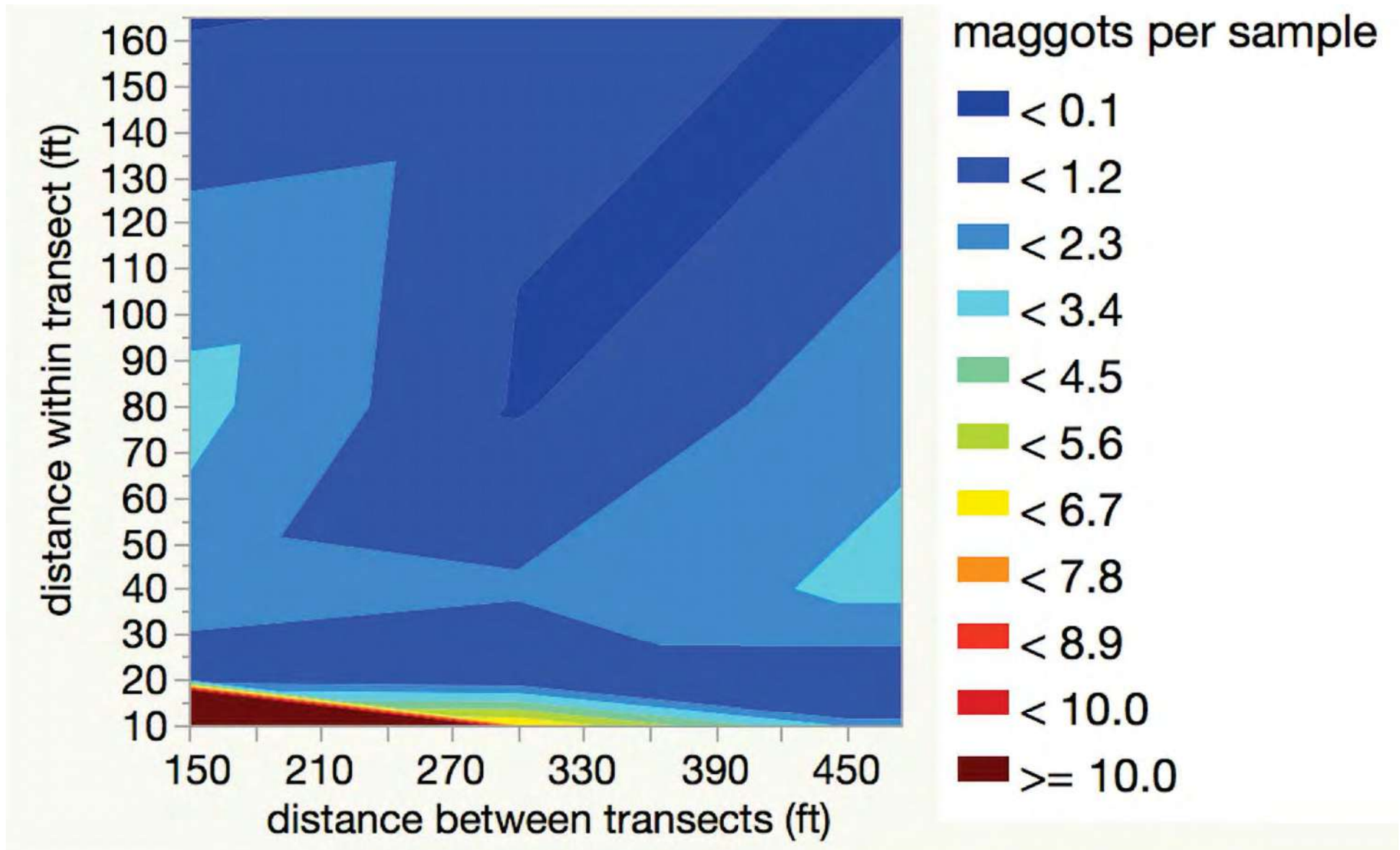
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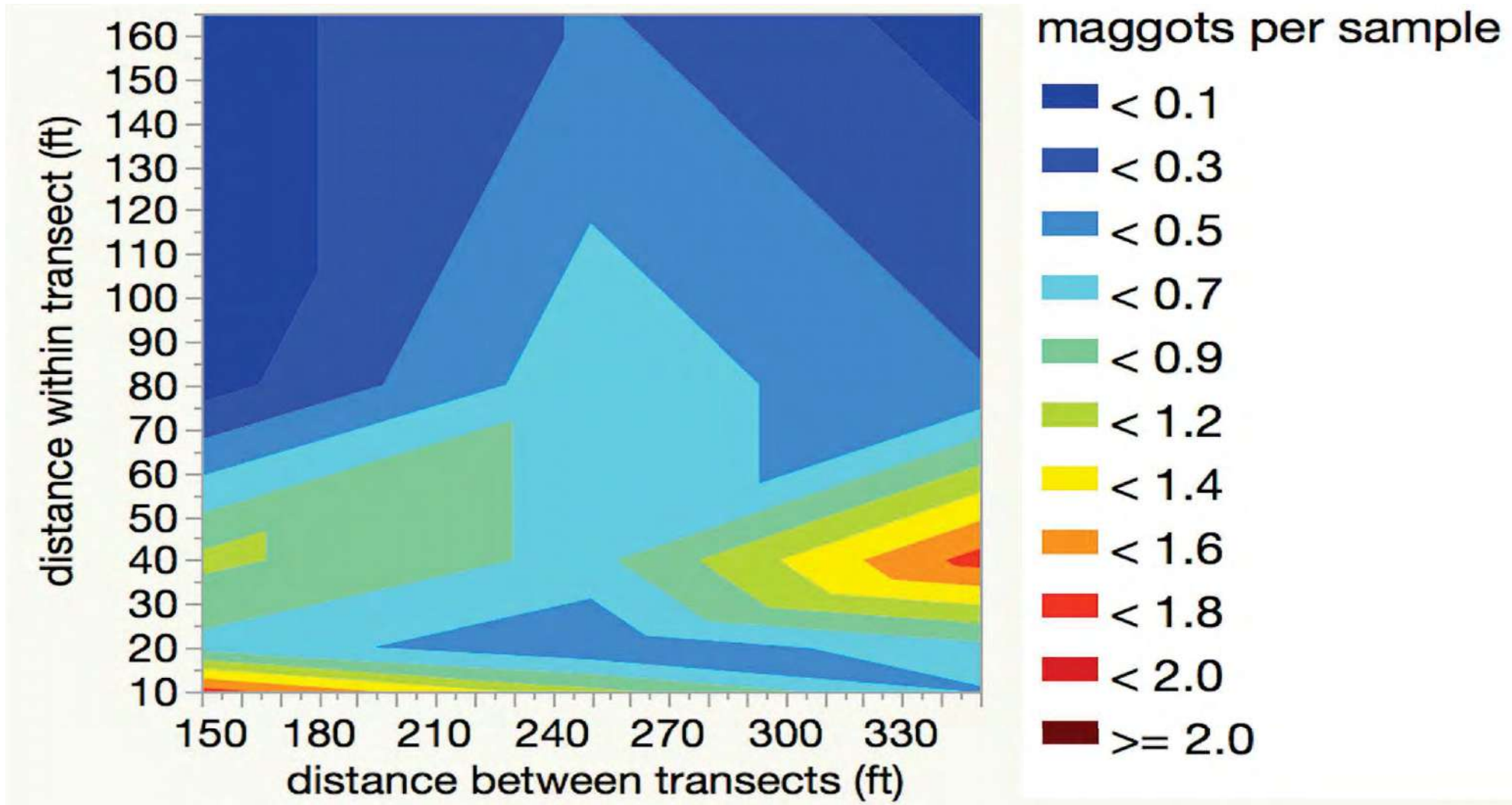
Spatial distribution of SWD infestation

- Fruit was sampled in a grid pattern in three fields (2 crop and 1 hold-over year).
- Three 165 ft. long transects/field spaced 150 to 175 ft. apart from one another.
- Three fruit samples (ca. 500 berries/sample) were collected at 10, 20, 40, 80, and 165 ft. from the field edge
- Salt floatation was used to assess larval infestation.

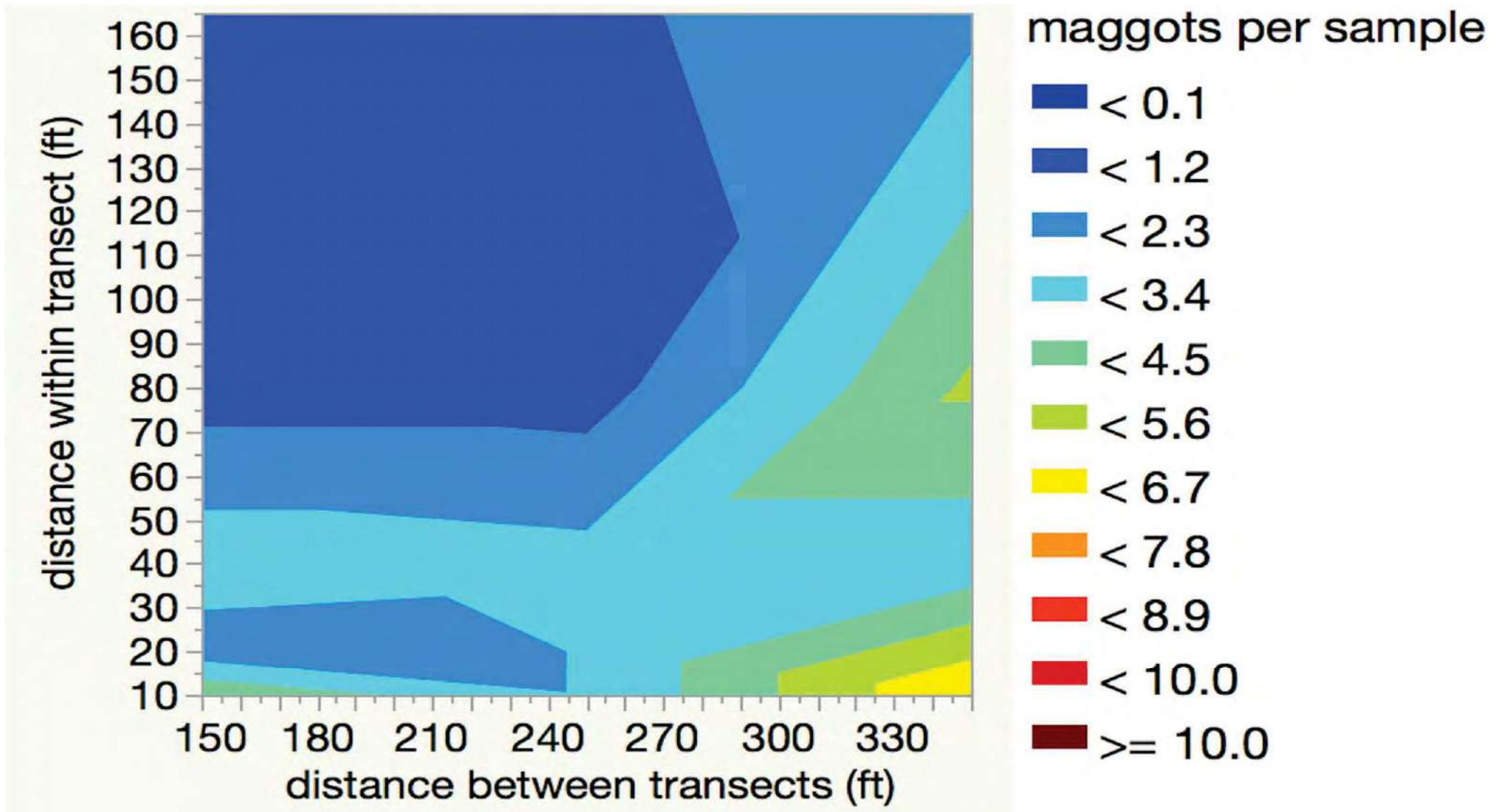
Spatial distribution of SWD infestation



Spatial distribution of SWD infestation



Spatial distribution of SWD infestation



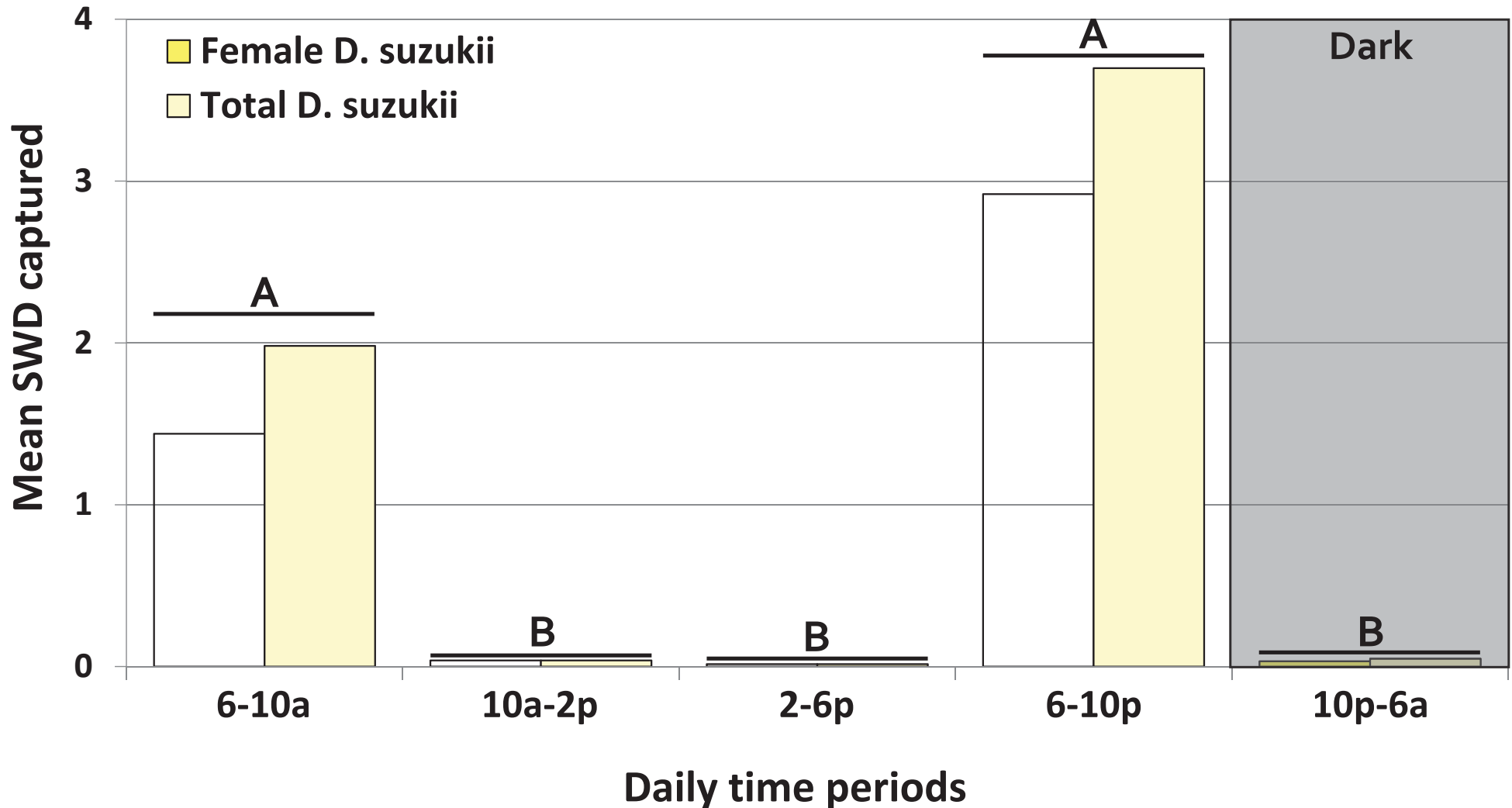
When and where are SWD active during the day?

Methods

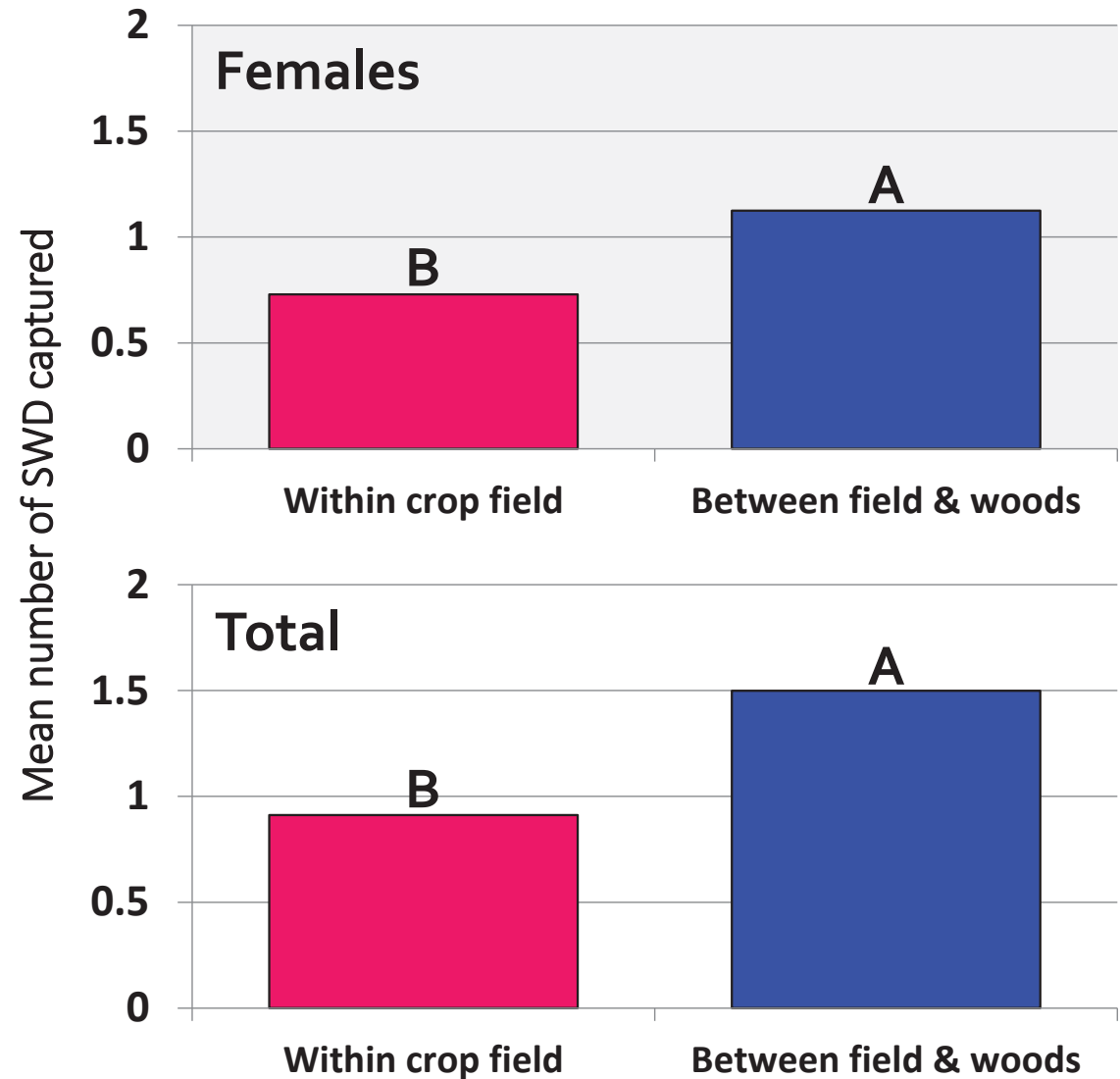
- 2-headed Malaise traps
- Monitoring traps with a fermentation-based bait
- Two farms in western NC in 2014 & 2015
- Biweekly samples at each farm
- 24 hours except when dark



SWD are caught in monitoring traps during the morning & evening hours



More SWD are caught in monitoring traps placed between the field & woods



Plans for 2020

- Continue evaluation of SWD thresholds to assess them as a tool for growers.
 - Can environmental factors explain year to year variation?
- Repeat study on Spatial distribution of SWD infestation.
- Novel strategies for SWD control.
- Baseline *Drosophila* parasitoid monitoring in advance of classical biological control.

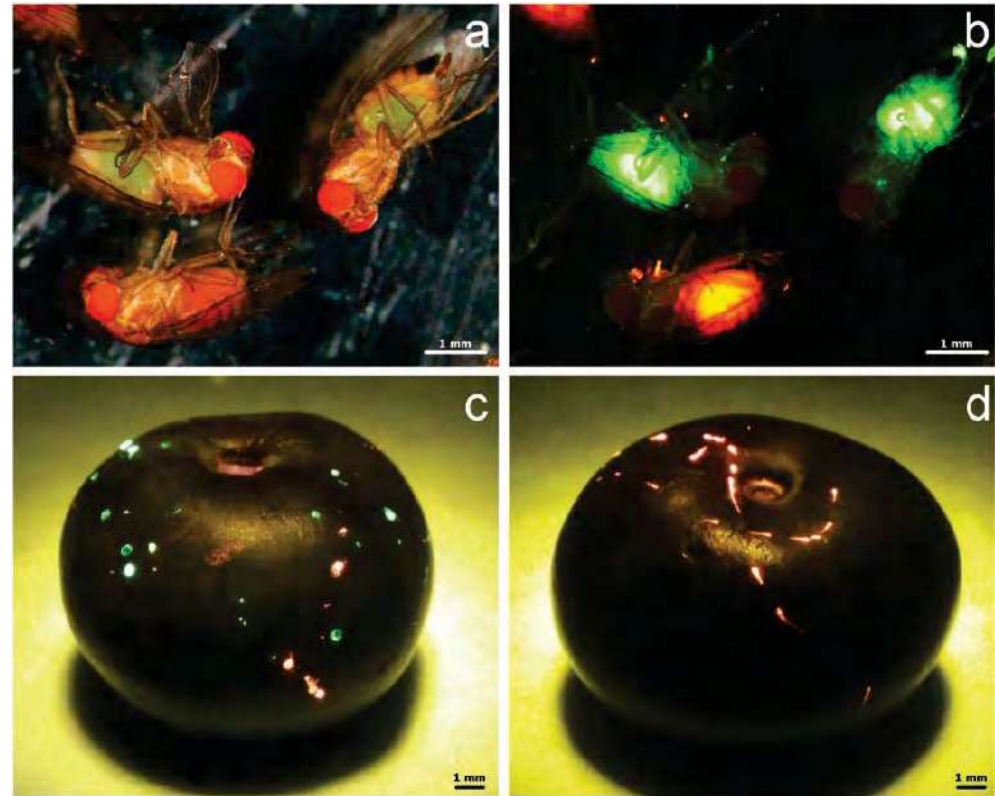
Boarder control strategies for SWD

- Two products to be tested:
 - SWD HOOK
 - Decoy gum
- Can treatments will be placed at boarder locations?



Novel Attract and Kill – Decoy gum

- Gum developed based on chemical left on the fruit by SWD females.
- Multiple compounds left after females interact with the fruit.
- Alters their behavior-aggregation.



Novel Attract and Kill – Decoy gum

2019 trials

- In Blueberry in Oregon, infestation reduction of 67% (range 47-90%) compared to the UTC, over a 4 week trial.
- In Grape, 71% reduction in damage in Pinot Noir in Willamette-Valley.
- More field experiments are needed.



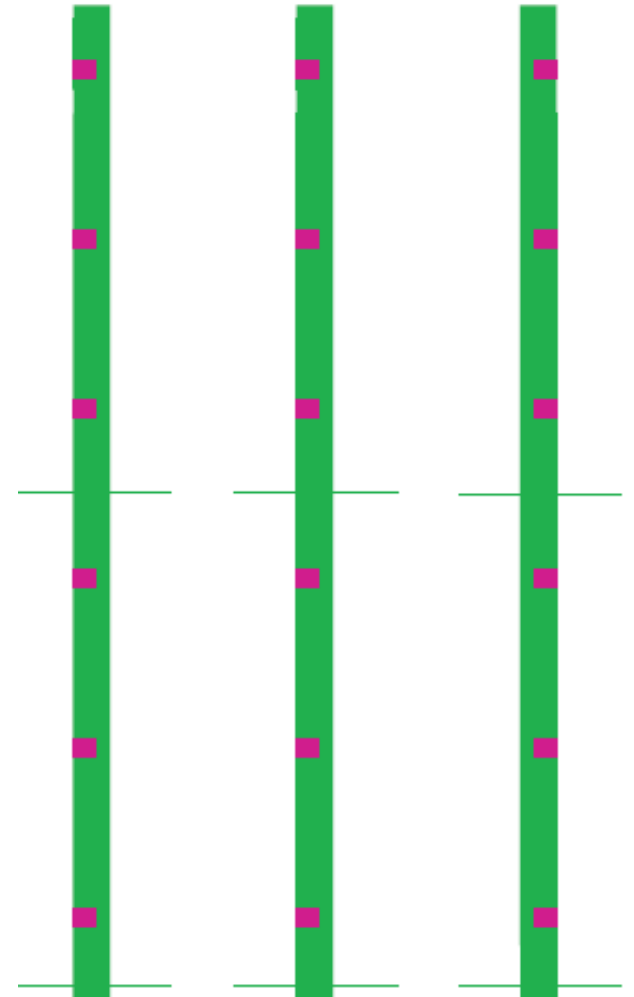
Decoy gum disperser developed by OSU

Novel Attract and Kill- SPLAT SWD

ISCA

SPLAT[®]
SWD

Klick et al. 2017

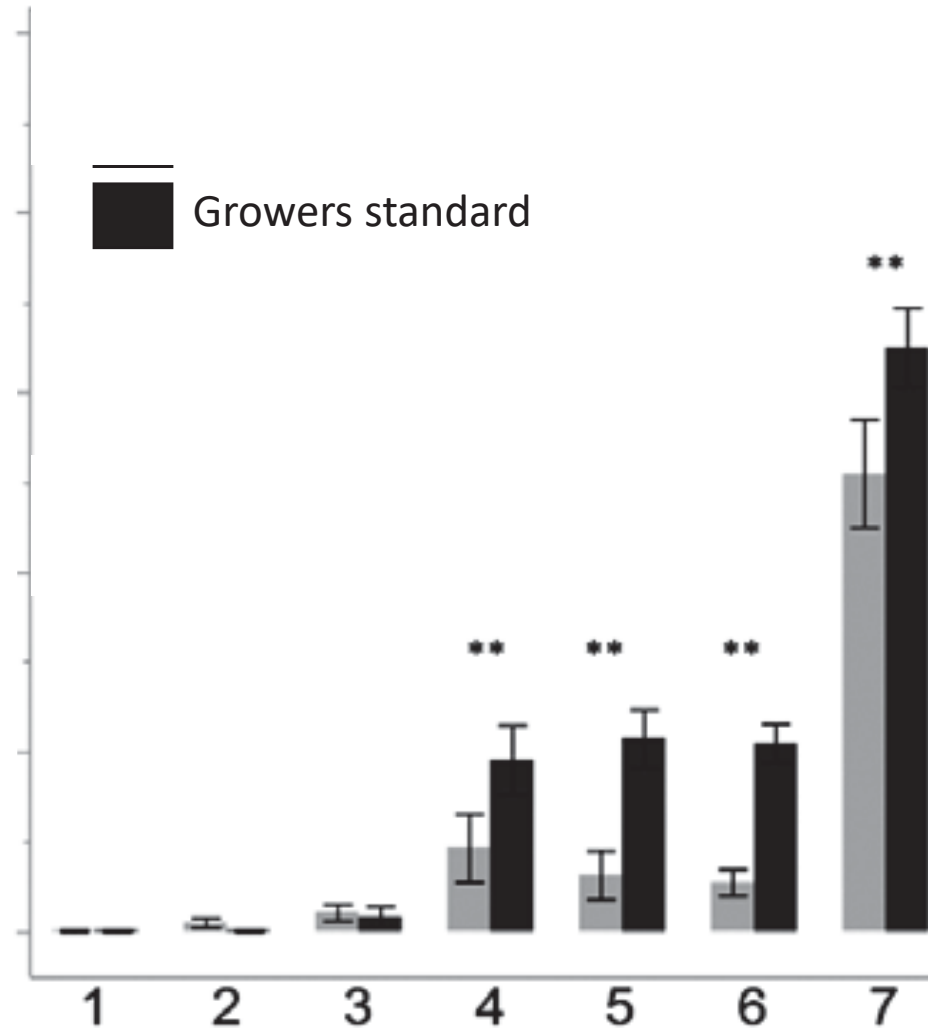


Novel Attract and Kill- SPLAT SWD



Klick et al. 2017

Larvae/fruit

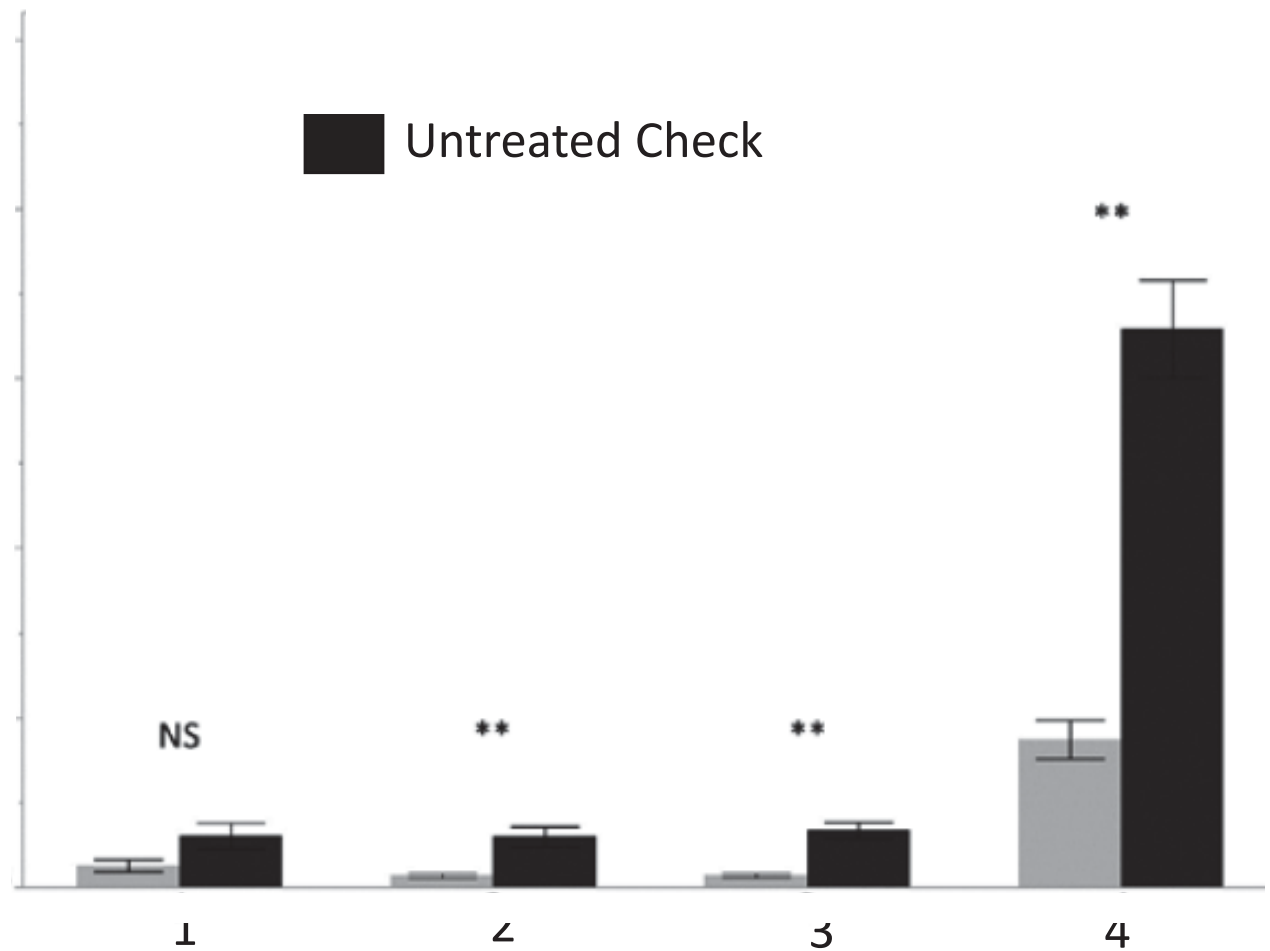


Average number of *Drosophila suzukii* larvae per raspberry fruit (\pm SE) of the fall trial in Oxnard, CA, with grower standard alone and biweekly HOOK SWD-A + standard

Novel Attract and Kill- SPLAT SWD



Klick et al. 2017



Average number of *Drosophila suzukii* larvae per berry (\pm SE) collected from a commercial blueberry field in New Lisbon, NJ treated weekly with HOOK SWD-A and untreated control in 2016.

How long will the SPLAT last?

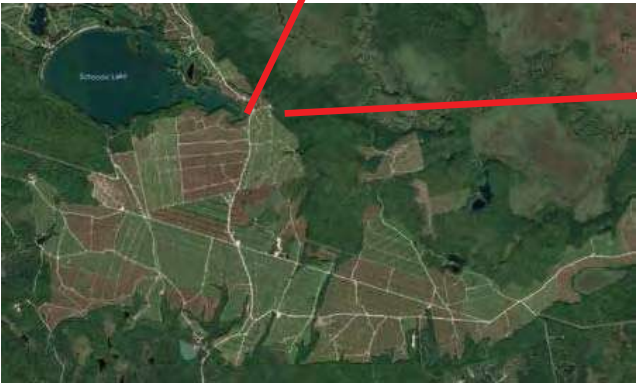
Field aged residues in Raspberry tunnels


Percentage mortality of SWD adults

Treatment	1 DAT		7 DAT		29 DAT		35 DAT	
	%	SE	%	SE	%	SE	%	SE
Untreated control	0.3b	0.2	8.1b	1.2	6.8c	1.4	2.5b	0.7
HOOK SWD-A	88.6a	2.6	87.0a	2.2	78.3b	3.2	92.6a	1.3
HOOK SWD-B	87.1a	1.9	91.1a	1.7	88.6a	2.5	91.9a	1.8

Klick et al. 2017

Boarder Attract and Kill in wild blueberry



 Attract and Kill placement

Can fruit sanitizers help reduce SWD infestation?

Sanitizers containing Peroxy Acetic Acid and Hydrogen Peroxide

Applied to Blueberry bushes (Bluecrop) June 18 and August 13

Jet-Ag 1% by volume



Oxidate 2.0 1%



Sporequell 0.39%

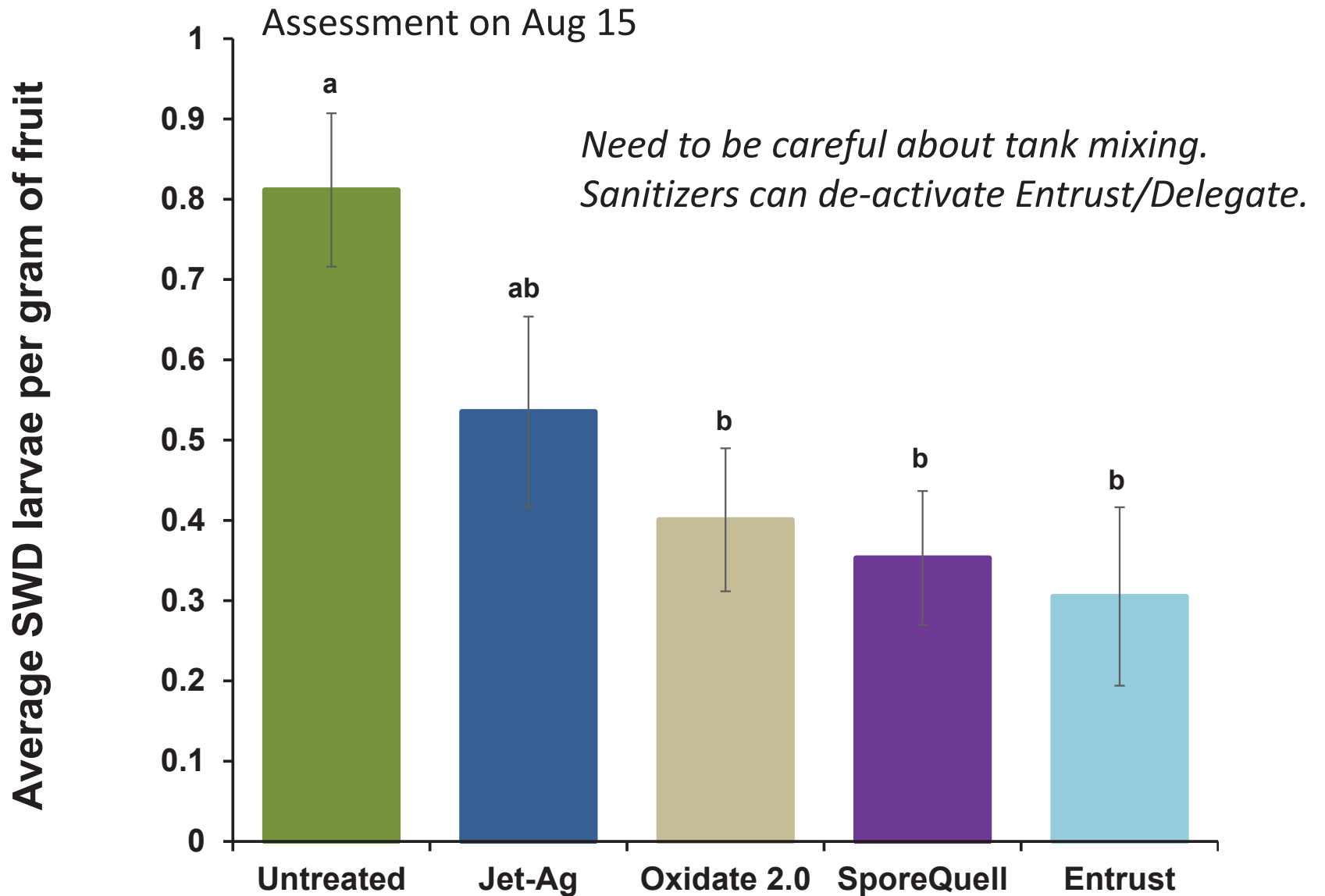
SporeQuell

Entrust 6 oz



Applied using an airblast sprayer in 50 GPA

Can fruit sanitizers help reduce SWD infestation?



PAA products effect on yeast in vitro

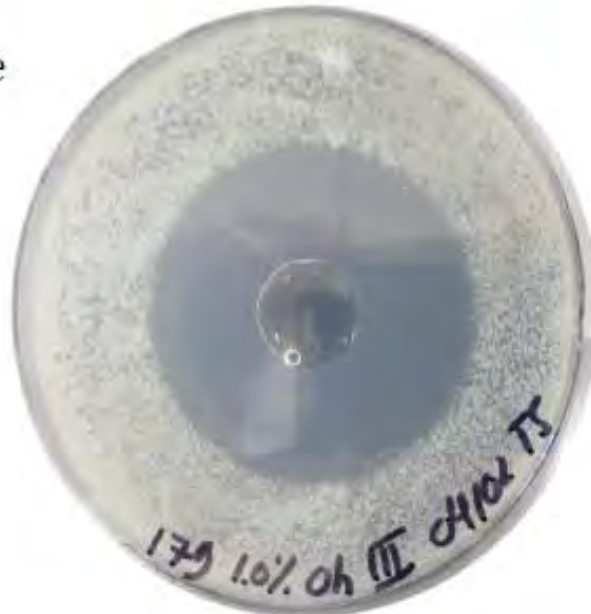
Control



Half-dose
(0.5%)



Full-dose
(1%)



One and a half dose
(1.5%)

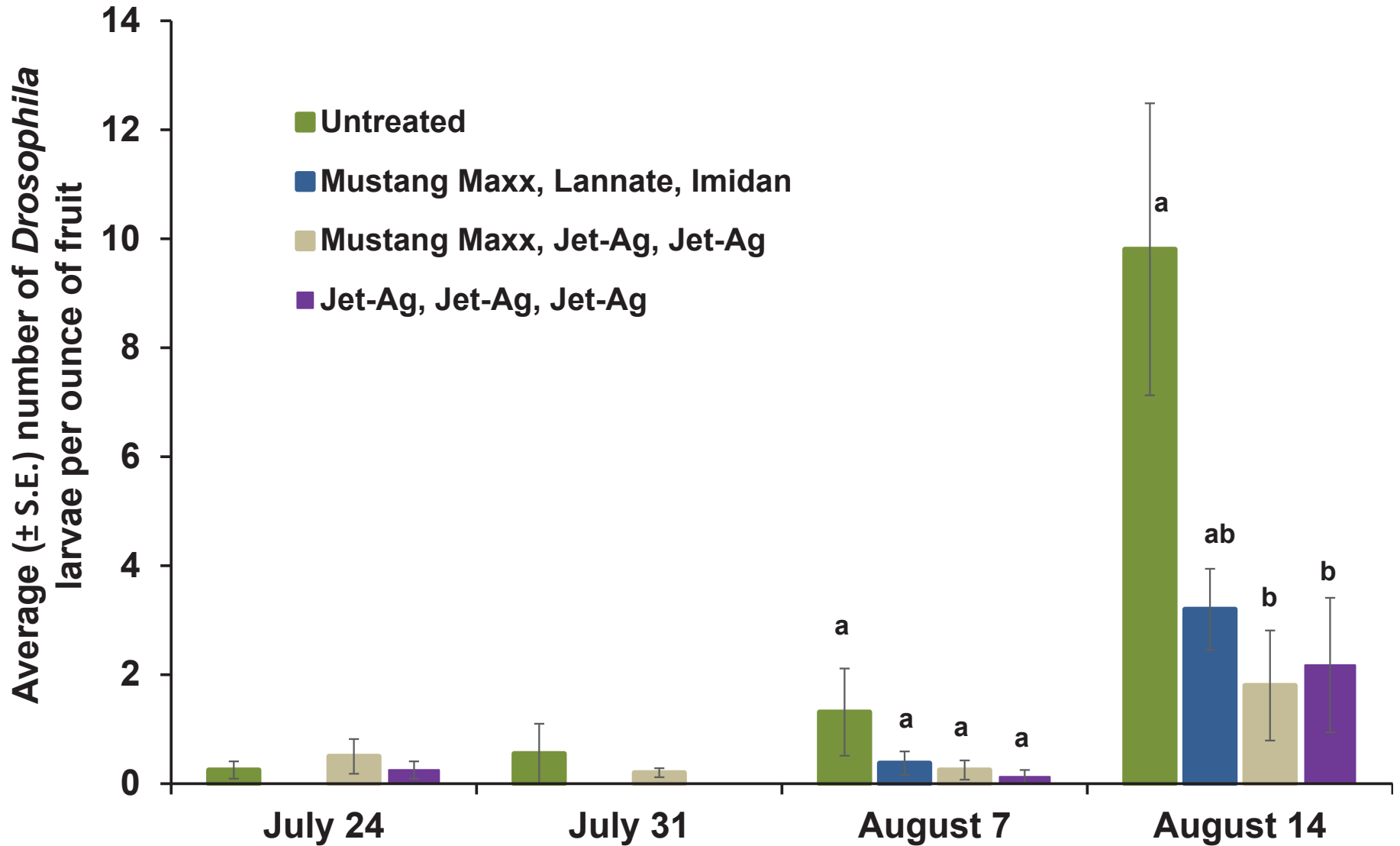


Hamby lab (UMD)

Example pictures for growth inhibition - Strain 179 JetAg- Agar was inoculated at the same day

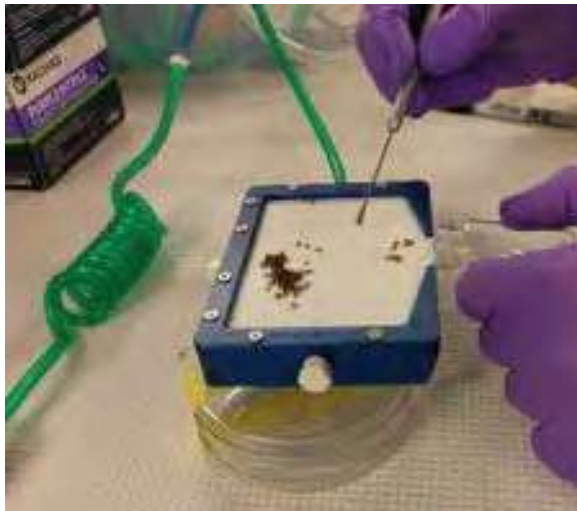
Effect of PAA+HP on SWD infestation

Small plot trials in MI Blueberry



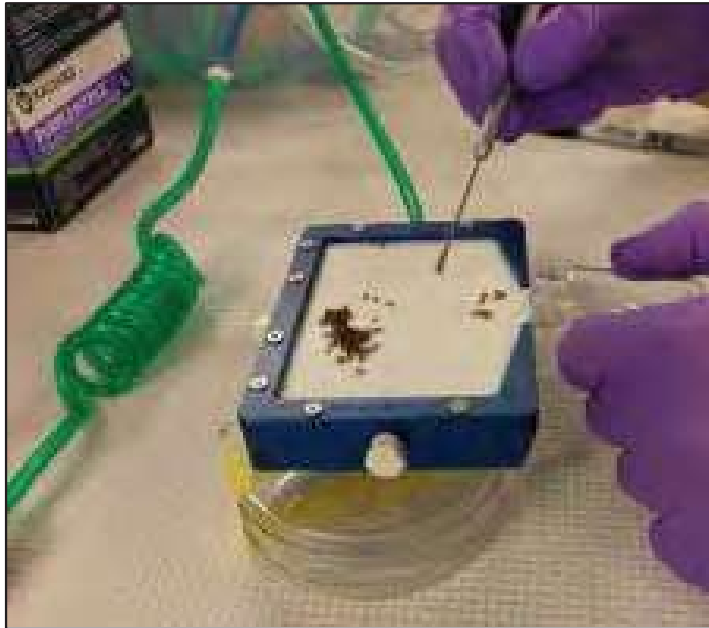
Insecticide susceptibility bioassays

- New Scintillation vial resistance bioassays.
- Discriminating does for higher throughput
- LC90x8



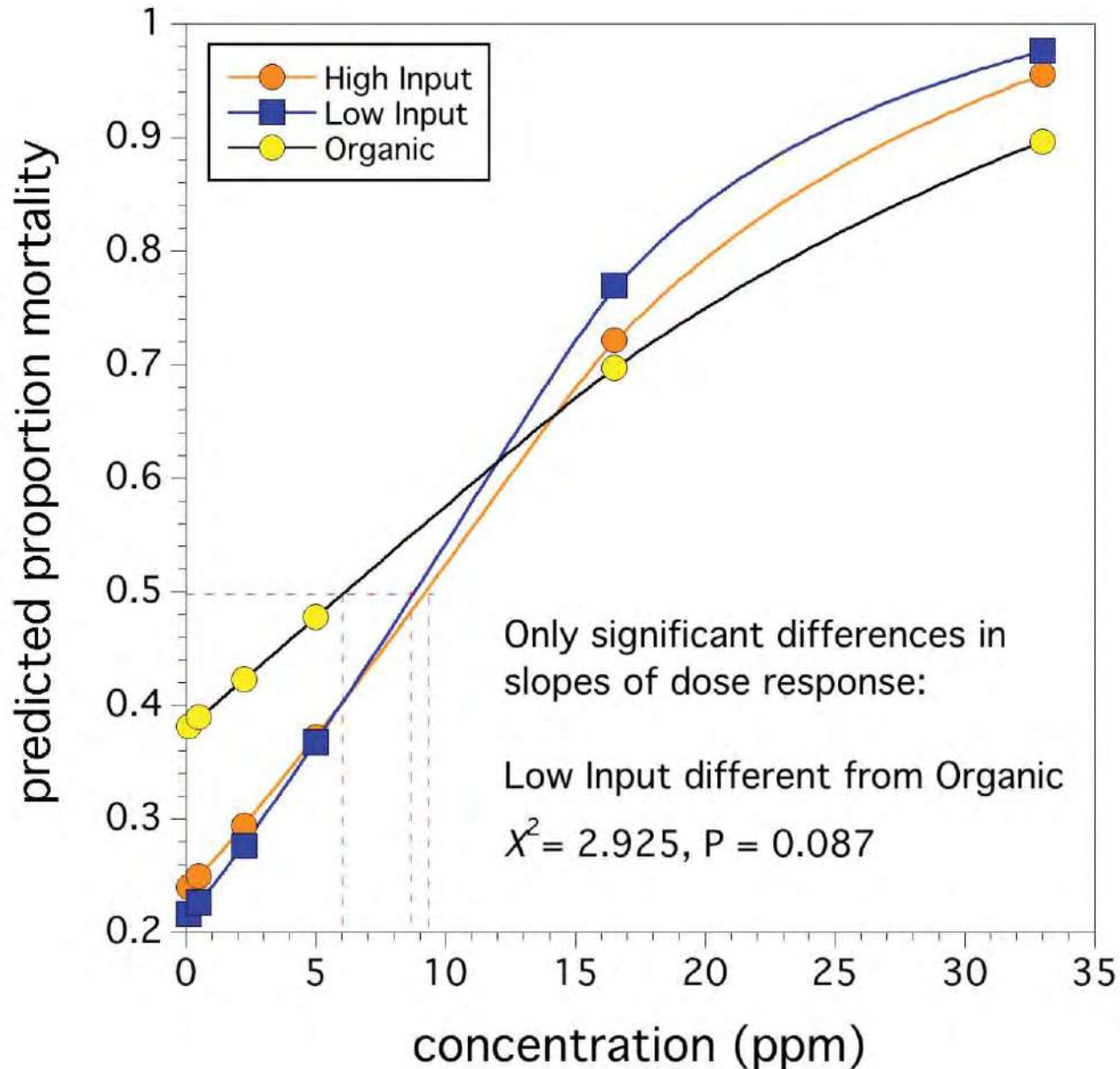
Insecticide susceptibility bioassays

1. Prepare solutions with different amounts of insecticide
2. Add small amount to inside of vial
3. Coat inside of glass vial
4. Let residues dry overnight
5. Expose 5 male, 5 female SWD
6. Assess after 6 hours



Insecticide susceptibility bioassays

Malathion



Potential Biological control

Ganaspis brasiliensis

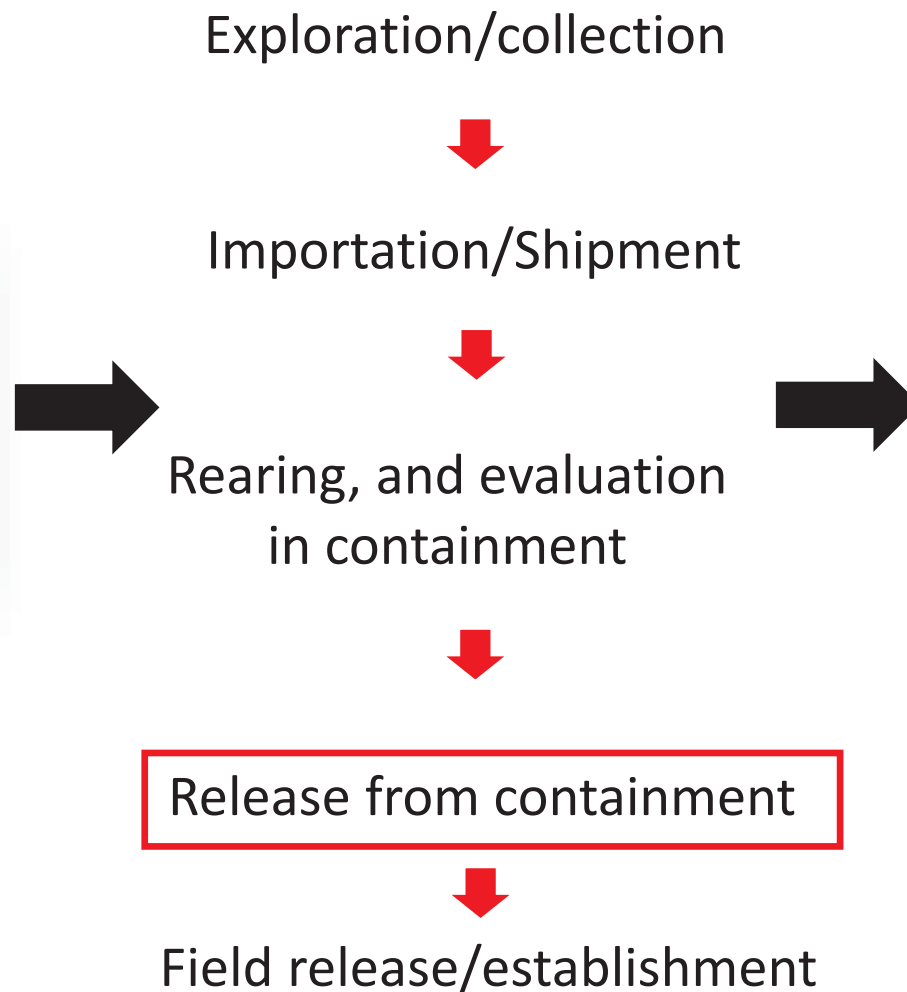
76% Parasitism rate in
native range



Where are we with biological control?



Photo Credit: Kent Daane





Acknowledgments



Wild Blueberry Commission OF MAINE



United States Department of Agriculture
National Institute of Food and Agriculture

- **Grower Cooperators.**
- Collaborators.
- Summer Technicians.

USDA Specialty Crop Block Grant (SCRI)
USDA SCRI Grant *Award number 2015-51181-24252*

Questions?