Mint Root Borer Control with Diamide Insecticides

My 2024 research proposal

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Objective:

- To develop some efficacy data in support of cyantraniliprole’s registration on mint.

- There is a tolerance for cyantraniliprole on mint. Getting mint added to the master lable FMC submits to the EPA is our challenge.

- Cyantranilprole has 2 formulations.
- Exirel is applied as a foliar spray.
- Verimark is applied via chemigation.

Methods

- We've had a tough time finding "consistent populations" of mint root borer in mint fields.

- In mid-August 2024 we purchased 2790 larval 2nd & 3rd instar cabbage loopers from Benzon Research out of Carlisle, PA.
- The larvae were overnight shipped and arrived in good quality to WSU IAREC on 8/27/2024.
- The larvae were in Styrofoam cups that contained general caterpillar diet media.
- Each cup contained a minimum of 25 larvae.
- Plots were established in our IR-4 research block at 12 by 15 feet in size for 4 replicates per treatment for the 2 insecticide treatments (cyantraniliprole and chlorantraniliprole) and an untreated control.
- The larvae from 9 cups were distributed per plot on 8/28/2024 for a density of 225 caterpillars per plot.

Methods

- Following the pre-treatment sample on 9/4/2024, the insecticide treatments were applied.
- Chlorantraniliprole in the Coragen® formulation was applied at the equivalent of 7.5 fl oz per acre in a dilution equivalent to 20 gallons per acre.
- Cyantraniliprole in the Exirel formulation was applied at the equivalent of 13.5 fl oz per acre in the dilution of 20 gallons of water per acre.
- Both insecticides were sprayed with a CO2 powered spray boom apparatus.

Results

Table 1. The mean number of beet armyworms per sweep ± Std error net sample pre- and post-treatment with Coragen and Exirel on September 5, 2024.

	Pre-Treatment	Post-Treatment	
Treatment	9/4/24	9/5/24	9/9/24
MS= *df*=2	7.58[ns]	40.33[a]	21.33[a]
Error df=9	9.08	0.56	0.89
Untreated	5.50±1.19	5.50±0.65	4.00±1.63
Coragen	7.50±2.10	0**	0**
Exirel	8.00±1.00	0**	0**

a/ significant at $p<0.01$

**/ Highly significant treatment difference in the abundance of cabbage loopers between treated and untreated plots at $p<0.01$.

We have proved that both Coragen and Exirel can provide significant control of caterpillar pests on Washington mint.

Conclusion

- We have proved that both Coragen and Exirel can provide significant control of caterpillar pests on Washington mint.

Acknowledgements

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Integrated Management of Mites on Mint

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Methods: Objective 1.
Field test candidate acaricides for their efficacy against spider mite populations

- We established small research plots in our research peppermint plots. Plot size was 4 by 6 feet.
- A pretreatment sample was taken on August 1, following which the plots were treated at the maximum proposed label rate of each acaricide in the equivalent of 18.4 gallons of water per acre.
- Acaricides tested included Vigilant 4SC, Kanemite, Onanger Optek, Nealta, Magister, and the alternative acaricides Cinnerate, TetraCURB and Mighty Mint oil Treatments described in Table 1).
- Following the applications on August 1, 2023 samples were taken at 3 DAT (days after treatment) on August 4, 7 DAT on August 8, and 14 DAT on August 15.
- From these samples a total of 15 leaves per replicate were scanned under a microscope and from these counts the number of mites from these 15 leaves was totaled.

Acaracide Treatments 2023

#	Product	Active ingredient	Rate/acre
1	Control	n/a	n/a
2	Cinerate	Cinamaldehyde	64 oz
3	Kanemite 15 SC	Acequinocyl	31 oz
4	Magister	Fenazaquin	36 oz
5	Mighty Mint Oil	Peppermint oils	3 gal
6	Nealta	Cyflumetofen	13.7 oz
7	Onanger Optek	Hexythiozox	20 oz
8	TetraCurb	Essential oils	1 gal
9	Vigilant 4 SC	Bifenazate	24 oz

Table1. Acaricide treatment applied to peppermint on August 1, 2023.

Figure 1. Acaricide Spray Trial- 2023
Mites per 15 leaves scanned

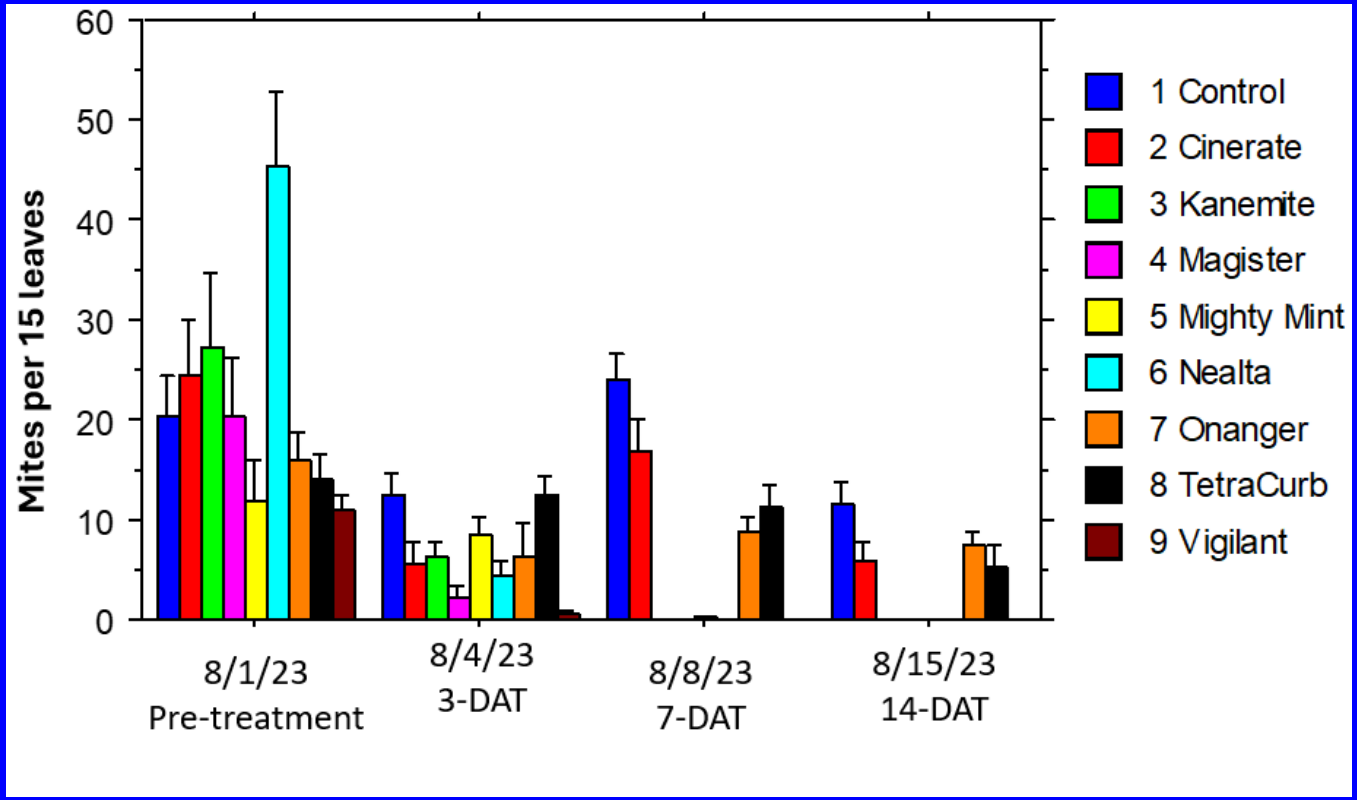
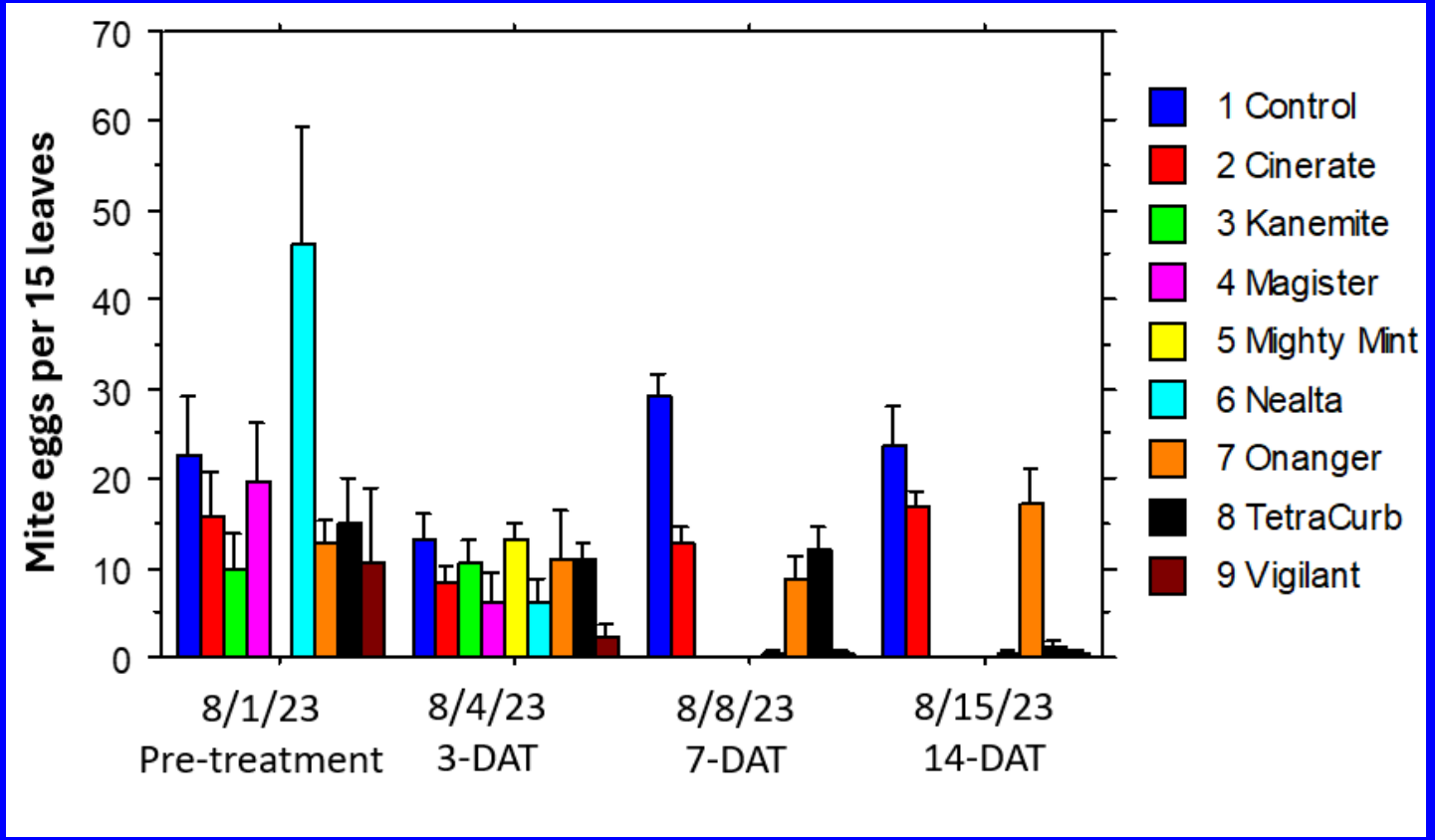


Figure 2. Acaricide Spray Trial- 2023
Mite eggs per 15 leaves scanned



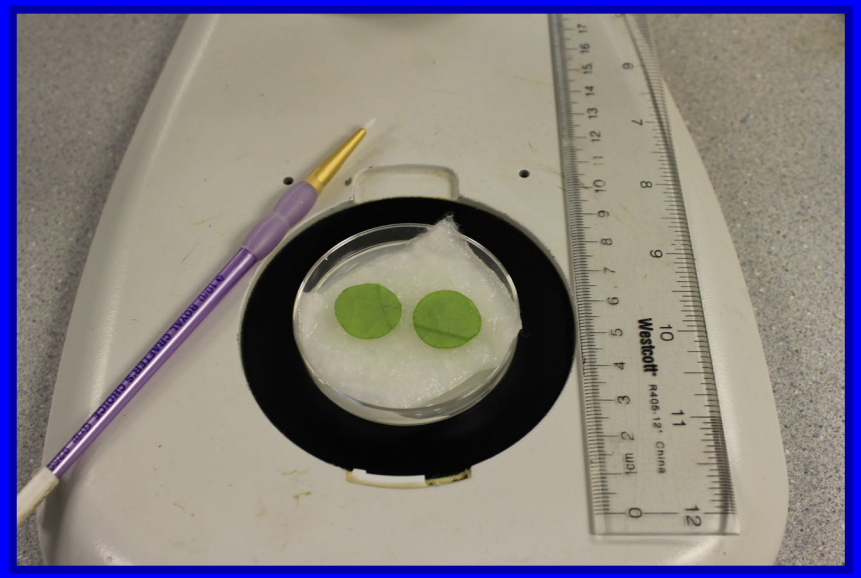
Objective 2. Conduct trials with candidate alternative acaricides.
In 2023 we focused on Mighty Mint Oil, Cinnerate, Tetracurb.

This “Mighty Mint” oil killed nearly 100% of all the mite populations we tested including super mites from California strawberry fields in 2019 and 2020.

Cinnerate is a cinnamon aldehyde, emulsified with potassium oleate.

Tetracurb is a rosemary oil-based product. It is used mostly on soft-bodied insects.

Bioassay Methods



Response of acaricide susceptible spider mite populations to exposure to candidate alternative acaricides.

Susceptible population

Population	Product	% Mortality[a]	N	LC50	95% Cl	Slope ± SEM	X^2
Susceptible	Mighty Mint	85.0%	400	44.76	39-51	2.74±0.27	26.82
Susceptible	Cinnerate	12.5%	400	Did not calculate			
Susceptible	TetraCURB	92.5%	400	48.15	38-58	2.79±0.13	56.59

[a]Mortality at the labelled rate

Two of the 3 alternative acaricides performed well with both Mighty Mint Oil and TetraCURB providing 100% mortality of the treated mites at the rates recommended on the label for both of those alternative acaricides.

Given these positive results these alternative acaricides could play a substantial role in spider mite IPM.

Good spray coverage would be essential for good performance of these products in the field.

We just could not get Cinnerate to kill mites using our bioassay methods. Cinnerate was okay in our field trials.

Field populations

- Subsequently 3 populations of mites were collected from commercial mint fields and placed in colony in the laboratory.
- These populations were subsequently subjected to bioassay as detailed above.
- These results of these Bioassays are detailed on the next slide.

Response of field-collected and acaricide-susceptible spider mite populations to exposure to candidate alternative acaricides.

Table 3. Response of field-collected and acaricide-susceptible spider mite populations to exposure to candidate alternative acaricides.

Population	Product	% Mortality[a]	N	LC50	95%	Slope ± SEM	X^2	RR
Susceptible	Mighty Mint	87.0%	400	44.76	39-51	2.74±0.27	26.82	1.00
Granger	Mighty Mint	72.5%	200	62.69	43-88	2.17±0.36	21.68	1.40
Royal City	Mighty Mint	77.5%	200	48.45	21-78	1.85±0.33	36.10	1.08
Toppenish	Mighty Mint	100%	200	21.97	13-28	3.17±0.73	7.95	0.49
Susceptible	TetraCURB	90.0%	400	48.15	38-58	2.79±0.13	56.59	1.00
Granger	TetraCURB	95.0%	200	22.12	9-33	2.12±0.47	15.81	0.46
Royal City	TetraCURB	87.5%	200	28.46	15-40	2.08±0.40	25.53	0.64
Toppenish	TetraCURB	92.5%	200	15.89	5-25	1.84±0.44	17.24	0.36
Susceptible	Cinnerate	15.0%	400	Did not calculate				
Granger	Cinnerate	12.5%	200	Mortality < 50% at 200% label rate				
Royal City	Cinnerate	25.0%	200	Mortality < 50% at 200% label rate				
Toppenish	Cinnerate	10.0%	200	Mortality < 50% at 200% label rate				

[a]Mortality at the labelled rate

Resistance Ratios

- Resistance ratios (RRs) were calculated by dividing the LC50 of the candidate field population by the LC50 of the susceptible lab colony.
- As a general rule a population is considered susceptible if the RR is less than 10.
- Resistance is a concern when the RR ranges between 10 and 100.
- A population would be considered resistant if the RR exceeds 100.
- The resistance ratios detailed on the previous slide are inconsequential.
- Both Mighty Mint Oil and TetraCURB function as smotherants and with these types of acaricides resistance is typically not a concern.
- I have no idea why Cinnerate failed.

Alternative Acaricides

- Given these positive results in these bioassays and in addition to the efficacy of these products in the field trials detailed under Objective a, these alternative acaricides could play a substantial role in spider mite IPM.
- Good spray coverage would be essential for good performance of these products in the field.
- Incorporating these alternative plant essential oil-based acaricides into the spider mite IPM program would reduce overreliance on the effective conventional acaricides.
- These alternative products have no MRL issues in target export markets like the European Union.


Questions?