

**AGRICULTURAL RESEARCH FOUNDATION**  
**FINAL REPORT**  
**Funding Cycle 2015-2017**

**Title:**

Investigation of Predator Mite in Carrot Grown for Seed to Control Two-Spotted Spider Mite

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**Summary:**

Two-spotted spider mites (TSSM) are a significant pest in hybrid carrot seed in central Oregon. Spider mite populations can increase dramatically during the time bees are present to pollinate the crop from late June until mid-August. During this time, no insecticide applications are made. Once bees are removed from the fields, a cleanup application to control insect pests often includes a combination of Orthene (acephate) and Comite (propargite). However, Comite is problematic due to the two weeks it takes for mites to die and the two week re-entry interval (REI) that prevents rouging crews from accessing the fields. If predator mites can be used effectively to control TSSM during crop pollination, elimination of the cleanup spray may be possible. A reduction in miticide applications would benefit the environment, worker safety, seed quality and grower profitability.

**Objectives:**

The objectives of this project were: 1) document whether predators can be successfully established in hybrid carrot grown for seed, 2) evaluate predator mite application timing to prevent crop injury from TSSM and 3) evaluate the integration of predator mites with the miticide Zeal (etoxazole).

**Procedures:**

Research was conducted in five commercial hybrid carrot seed fields, three near Madras and two near Culver, Oregon. Large, non-replicated plots the length of the field consisted of one to two sets of females not treated with Zeal and two sets of females treated with Zeal, as was the remainder of the field. Field configuration of male and female plants consists of four female rows separated by two male rows centered between blank rows separating the male and female rows.

Predator mites used in the study consisted of a blend of two species *Galendromus occidentalis* and *Neoseiulus fallacis* released at the rate of 1,250 mites/acre. These are the species and application rate commonly used on peppermint in the area. The timing for the release of

predators followed application of Warrior for lygus control by at least three weeks to minimize any detrimental effect of residual product on predator survival.

Pre-counts of TSSM were taken at each of the three locations in the morning of the day predator mites were released in the evening. Releasing predators in the evening was done to provide time for them to adapt to their new surrounding before exposure to the summer heat the following day. Mites are dispensed from a salt shaker-type container held over the outside female rows while walking and tapping the container lightly every 15 feet. For logistical reasons, predators were released a day apart at the five locations starting on June 30 and completed on July 6. Post-release counts of TSSM and predator mites were taken weekly for up to six weeks until the plants became “crispy” as they dried down prior to harvest.

Mite counts were taken by sampling a leaf from the middle of the plant and using a hand lens to count TSSM. Thirty plants were sampled per plot, with fifteen plants 30 feet apart accessed from each side of the four-row female plots. The maximum number of mites recorded per sample was 20. Observing predators by examining leaves with a hand lens was not successful in the preliminary study from 2014. As a result, predator mite counts were taken by shaking a leaf over an 8 ½ x 11 piece of black tag board and counting the number observed. To increase the chances of finding predators the area shaken was increased to the entire stem the leaf was attached to starting on July 27.

#### **Significant Accomplishments:**

Results across the five locations indicate that predators were able to survive in a Zeal-treated environment and were able to keep TSSM under reasonable control in combination with Zeal (Table 1). With application of predators delayed until after the field Warrior application, TSSM populations in the non-Zeal plots were initially too high for predator mites alone to bring down to acceptable levels. Predator mites were found at all five locations in Zeal-treated plots as well as the non-Zeal plots, with the exception of the non-Zeal plots at H & T (Table 2). In non-Zeal plots predator mites were able to bring the TSSM populations down over time but not below the treatment threshold level (Table 3).

#### **Benefits & Impacts:**

An earlier release of predator would be possible if an alternative to Warrior for lygus control more compatible to predator survival was found. This would open the door for additional research to determine if predators alone could provide adequate control of TSSM when released earlier in the spring while TSSM populations are low.

#### **Additional Funding Received During Project Term:**

No additional funding for this project was received.

#### **Future Funding Possibilities:**

If additional research is needed to move the use of predator mites into the mainstream of carrot seed production in central Oregon, the Agricultural Research Foundation and local industry funding would be potential sources of support.

Table 1. Average number across locations of predator mites and TSSM per leaf sampled from seed carrots in plots without Zeal applied and treated with Zeal near Madras and Culver, Oregon.

Sample Date	Mites/Leaf			
	Non-Zeal		Zeal Treated	
	Predators	TSSM	Predators	TSSM
Pre-Count	0.00	10.6	0.00	2.5
Week 1	0.06	10.4	0.01	1.3
Week 2	0.00	14.7	0.01	2.4
Week 3	0.03	16.4	0.02	4.7
Week 4	0.02	12.6	0.01	3.5
Week 5	0.03	13.4	0.02	3.4
Week 6	0.04	12.2	0.03	3.5

Table 2. Average number of predator mites per leaf or leaf and stem sampled from seed carrots at each location in plots without Zeal applied and treated with Zeal near Madras and Culver, Oregon.

Sample Date	Average Predator Mites per Location									
	Madras		Roff		Harris		Boyle		H & T	
	Non-Zeal	Zeal	Non-Zeal	Zeal	Non-Zeal	Zeal	Non-Zeal	Zeal	Non-Zeal	Zeal
Pre-Count	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Week 1	0.13	0.07	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Week 2	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00
Week 3	0.03	0.03	0.03	0.00	0.03	0.00	0.03	0.03	0.00	0.03
Week 4	0.00	0.00	0.03	0.00	0.03	0.00	0.03	0.00	0.00	0.07
Week 5	0.03	0.03	0.03	0.00	0.03	0.03	0.03	0.03	---	---
Week 6	0.03	0.03	0.07	0.03	0.03	0.03	0.03	0.03	---	---

Table 3. Average number of TSSM per leaf sampled from seed carrots at each location in plots without Zeal applied and treated with Zeal near Madras and Culver, Oregon.

Sample Date	Average TSSM per Location									
	Madras		Roff		Harris		Boyle		H & T	
	Non-Zeal	Zeal	Non-Zeal	Zeal	Non-Zeal	Zeal	Non-Zeal	Zeal	Non-Zeal	Zeal
Pre-Count	3.2	0.1	10.9	0.1	15.5	3.9	11.1	0.5	12.4	8.1
Week 1	8.9	0.1	16.2	2.2	17.5	3.3	1.0	0.8	8.2	0.2
Week 2	6.7	0.2	19.4	4.3	19.6	3.4	19.1	4.0	8.8	0.2
Week 3	12.5	0.6	16.1	4.5	15.4	5.4	18.4	5.2	19.6	7.8
Week 4	10.4	2.3	15.3	0.0	12.7	6.9	12.9	2.4	11.9	1.4
Week 5	17.4	3.7	11.3	1.2	11.6	5.7	13.3	3.0	---	---
Week 6	15.7	4.5	11.8	1.4	8.0	5.0	13.3	3.0	---	---