Great Lakes Fruit, Vegetable & Farm Market EXPO
Michigan Greenhouse Growers EXPO

December 10-12, 2019

DeVos Place Convention Center, Grand Rapids, MI

Celery

Moderator: Mark Cnossen, Cnossen Farms, Wayland, MI

2:00 pm Postharvest Management of Celery
- Trevor Suslow, Produce Marketing Association

3:00 pm Carrot Weevil Biology and Control (OH 2B, 0.5 hrs)
- Elizabeth Long, Purdue University

3:30 pm Celery Pathology Update (OH 2B, 0.5 hrs)
- Mary Hausbeck, Michigan State University

3:00 pm Suitability of Oilseed Radish Varieties and Other Cover Crops as Hosts for Plant Parasitic Nematodes**)**
- Marisol Quintanilla-Tornel, Michigan State University

Annual Meeting of Michigan Celery Research Inc. will be held at the conclusion of the Celery session.

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MONITORING CARROT WEEVILS USING WOODEN BOIVIN TRAPS

ENT-83
Agriculture and Natural Resources
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The carrot weevil, *Listronotus oregonensis*, is a major pest of parsley, celery and carrots in the Great Lakes region of the United States and Canada. Adult carrot weevils are small (0.2-0.6 centimeters long), mottled-brown beetles with a distinctive snout that is typical of weevils (Figure 1). These weevils rarely fly; thus, they colonize fields primarily by walking from overwintering sites and will feign death when disturbed.

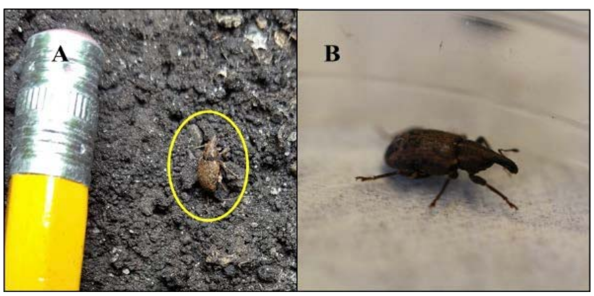

Figure 1. Adult carrot weevils. *Photo by Elizabeth Long.*

Figure 2. A parsley field damaged by carrot weevil larvae (left). A parsley plant killed by carrot weevil larvae (right). *Photo by Elizabeth Long.*

Adult carrot weevils feed on the foliage of plants in the carrot family, including parsley. The female lays eggs in the petiole or crown of the plant when it reaches the four-leaf stage, while the larvae cause the most severe damage by feeding and tunneling through the roots (Figure 2). Tunneling often leads to plant death, and in some cases, up to 100 percent loss has been reported in parsley. Monitoring carrot weevil populations is especially challenging because the adults are well camouflaged, the eggs remain hidden within the plant, and currently, no synthetic lures exist to attract and trap the adults.

Monitoring Adult Carrot Weevils

Scouting for egg-laying scars is one method used for monitoring carrot weevils (Torres and Hoy, 2002). One hundred and fifty plants are inspected for egg-laying scars in an X-shaped pattern across the field. If 1 percent of plants have egg-laying scars, action is recommended. However, this scouting technique is time-consuming and requires previous knowledge of what egg-laying scars look like on the host plant.

Another option for monitoring carrot weevil populations is to use a wooden Boivin trap baited with a single carrot. This trap is roughly a foot long and is hollowed out in the center with “teeth” along the edge (Figure 3). The channel in the center of the trap houses the carrot bait and the “teeth” provide a tight space for the weevils to hide as they feed on the carrot. The action threshold for Boivin traps is 1.5 weevils per trap (Boivin and Brodeur, 1992).

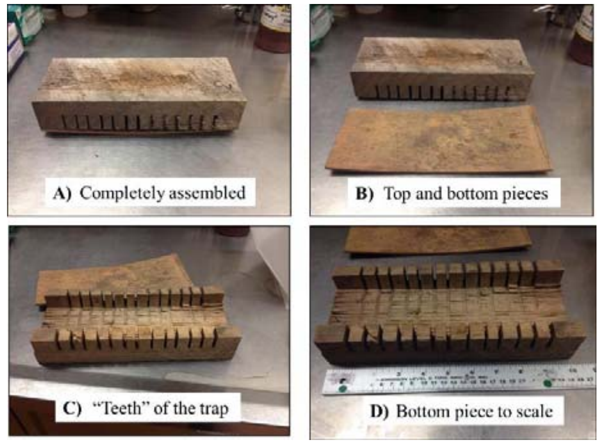

Figure 3. An assembled wooden Boivin trap (A), the top and bottom pieces of the trap (B), visible teeth of the trap (C), and the bottom of trap to scale (D). *Photo by Suzanne Blatt.*

How to Use Wooden Boivin Traps

Place wooden Boivin traps along the edge of fields where the focal crop will be planted. The key is to place traps early, before the crop emerges. The tooth-side of the trap should be placed down on the soil to make it easy for carrot weevils to enter. Secure the bottom and top of the trap together by placing a rubber band over each end. Check traps every three to four days to look for weevils and replace the carrot. As the carrot rots, it will become less effective as bait.

Hundreds of weevils can be collected in these traps early in the season before the crop emerges (Figure 4). However, as the season progresses, the carrot bait may be outcompeted by the surrounding crop, such that significantly fewer adults are attracted. More importantly, use of these traps early in the season still provides an early warning of carrot weevil activity when the crop is young and most vulnerable.

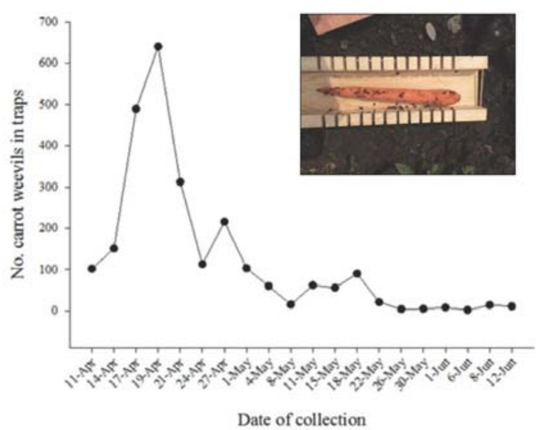

Figure 4. Number of adult carrot weevils collected from wooden Boivin traps from April 11 to June 12, 2017.

Tips for Using Wooden Boivin Traps

1. When checking a trap, first carefully turn it over and inspect the outside bottom while it is still closed. Then, remove the plywood bottom and check all sides for adult weevils. Finally, inspect the inside by running a stick or small paintbrush through the teeth to expose any weevils that may be hiding.
2. Bring a jar or Ziploc bag to collect weevils, and dispose of your catch by placing the sealed container in the freezer and then the trash.
3. Mark the trap with a flag for easy location.

How to Make Wooden Boivin Traps

Materials:

- 8 feet of 4 x 4-inch post (pine or cedar)
- A single 4 x 8 piece of ½-inch exterior plywood
- 10-inch table saw blade width 1/8 inch or larger
- Protective eye wear

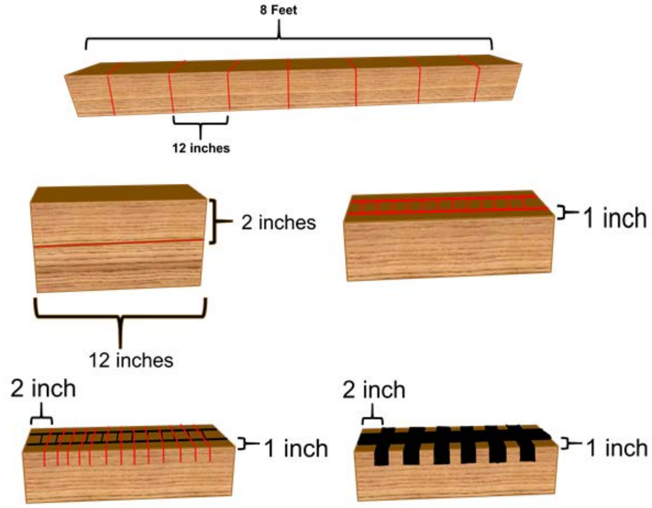

Figure 5. Construction of a wooden Boivin trap. Red lines symbolize cuts; black lines symbolize previous cuts and gouges. **(Top)** Post with cuts at every 12 inches. **(Middle left)** 12-inch piece of post with single longitudinal cut. **(Middle right)** Cuts necessary to make the bait channel. **(Bottom Left)** Cuts necessary to make teeth. **(Bottom right)** Finished base with canal and teeth gouged out. Schematics not drawn to scale.

Directions:

1. Set the table saw so the saw is all the way up.
2. Using the table saw, cut each 8-foot post into 12-inch pieces (Figure 5).
3. Cut each piece of post in half to get 4 x 2 x 12-inch pieces.
4. Set the table saw so it is between ¼ and ½ inch.
5. To make the center channel of the trap, cut 1 inch in from the long sides of the trap, then make cuts close together down the length so the middle can be removed.
6. To make the “teeth” cut 2 inches in from each short side. Working interior to these cuts, create the “teeth” by making a cut every ½ to ¾ of an inch.
7. Once the “teeth” have been created use a chisel to remove the cut wood, revealing the channel and the teeth.
8. Repeat steps 3 through 5 on every 4 x 2 x 12-inch piece of post.
9. Cut the 4 x 8-foot piece of plywood into 4 x 12-inch plates.
10. Secure the plywood plate to the trap, covering the channel, by placing a rubber band at each end.

This process should yield 16 traps. Always wear proper personal protective equipment.

Roger Rennekamp, Associate Dean and Director, Ohio State University Extension

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Celery Pathology Update

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Fusarium Yellows. Michigan is ranked second in the U.S. for celery production with 1600 acres valued at $12.7 million. Celery is grown on muck soils for either the fresh market or as a contracted crop for processing as soup or V8 juice. Recently, growers have noticed a 'melting-down' and plant death of the cultivar CR-1 which makes up the majority of the acreage grown in the state. Growers attribute this problem to physiological cracking of the celery base with subsequent invasion by secondary organisms. Plant death and poor quality has also been detected in the packing sheds. Preliminary results from field samples collected from producers across the state indicated that *Fusarium* spp. are associated with these disease symptoms. Fusarium yellows is caused by the soilborne pathogen *Fusarium oxysporum* f. sp. *apii* (FOA) resulting in plant stunting, chlorosis, and vascular discoloration leading to rapid wilting and death (Figure 1A,B). Celery cultivars previously developed through MSU research efforts that were tolerant/resistant to Fusarium yellows had made this a forgotten pathogen, and it is currently unknown whether the recent outbreak is the result of a *Fusarium*-initiated disease. *Fusarium solani*, responsible for "red root" of celery, has also been detected from diseased celery samples. Historically, neither fungicides nor cultural strategies have offered significant crop protection from Fusarium diseases.

2019 Sampling. Fungal isolates (216) were sampled from diseased celery collected in Michigan. Isolates were grown in culture and examined for identifying characteristics of *F. oxysporum* such as colony color, micro- and macroconidia morphology, and examined for the presence or absence of chlamydospores using both visual and microscopic observation techniques. Isolates (100) have been preliminarily identified as *Fusarium* spp. based on the presence of *Fusarium* macroconidia in culture on water agar (Figure 1C). Isolates have been placed into long-term storage and will be confirmed to species and race with molecular techniques.

Field Trials: Fusarium. Three field trials were established testing Miravis Prime (active ingredients pydiflumetofen/fludioxonil [FRAC code 7/12]), Omega (fluazinam [29]), Quadris (azoxystrobin [11]), and Quadris Top (azoxystrobin/difenoconazole [11/3]) for control of root rots on celery 'CR-1.'

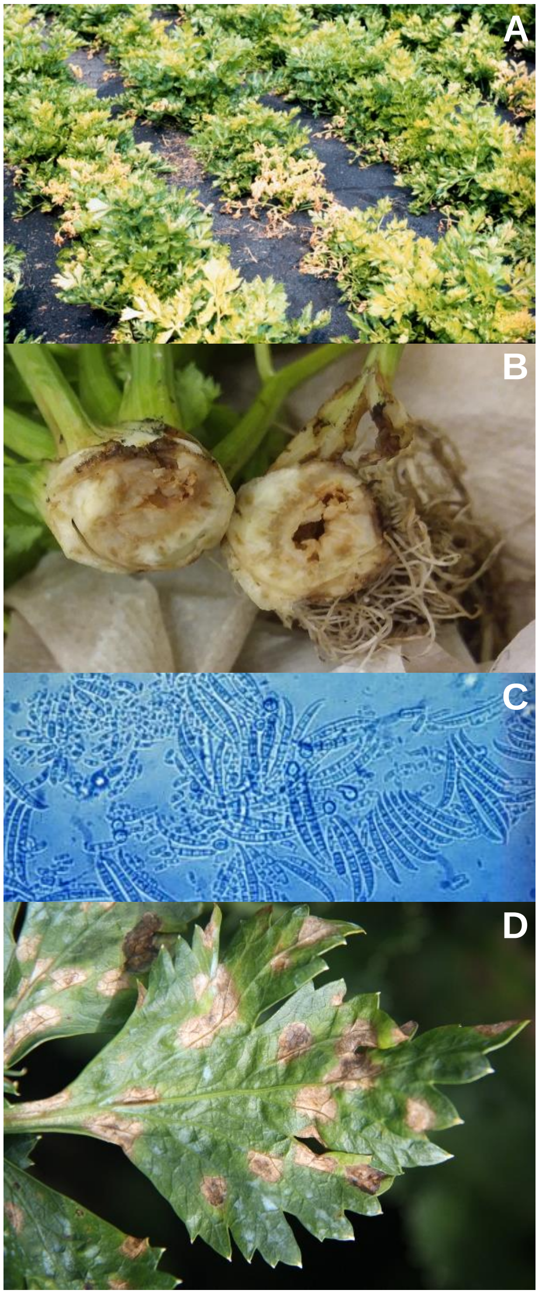

Figure 1. (A) Celery showing disease symptoms in the field. **(B)** Diseased celery sampled in 2018. **(C)** *Fusarium* macroconidia. **(D)** Celery infected with Cercospora early blight.

A 3-treatment trial did not have significant differences; Omega produced the fewest stunted and wilted plants and Quadris produced the fewest dead plants.

A 5-treatment trial (trial A) had significant differences among stunted plants on 24 Jun and 23 Aug, where Quadris Top and Omega SC, respectively, produced the fewest stunted plants. Quadris produced significantly fewer dead plants on 24 Jun compared to Omega. Quadris Top and Miravis Prime produced significantly fewer dead plants than Quadris on 12 Jul. Although not significant, Omega produced the lowest number of wilted plants on 23 Aug.

One 5-treatment trial (trial B) did not have significant differences among treatments; however, Quadris Top produced the fewest stunted and wilted plants, and treatments of Omega resulted in the fewest dead plants.

Field Trial: Early Blight. A 7-treatment trial was established to compare programs of fungicides with an untreated for control of early blight (caused by the fungus *Cercospora apii*) (Figure 1D). Products tested included Bravo WeatherStik (chlorothalonil [05]), Quadris (azoxystrobin [11]), Flint Extra (trifloxystrobin [11]), Merivon Xemium (fluxapyroxad/pyraclostrobin [7/11]), Luna Sensation (fluopyram/trifloxystrobin [7/11]), Miravis Prime (pydiflumetofen/fludioxonil [7/12]). On 18 October, the untreated control plants had 54.5% plants with petiole lesions, and the severity of stem and leaf infection was 5.3 and 4.8, respectively (0=healthy, 10= completely diseased). All treatments effectively decreased disease compared to untreated control plants. Infected plants with petiole lesions were limited ≤20.7%. The severity of disease infecting stems and leaves of fungicide-treated plants was ≤1.3 and ≤1.0, respectively.

FRAC codes: The alphanumeric codes in the brackets [] are the FRAC codes. They are assigned by the Fungicide Resistance Action Committee and are based on the mode of action of the active ingredient(s). Always check product labels and follow instructions. Rotate among FRAC codes when applying fungicides.

Acknowledgments. This research was supported by funding from Project GREEEN, Celery Research Inc., and by a Michigan Specialty Crop Block Grant administered by Celery Research Inc.

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