Celery

**Wednesday afternoon 2:00 pm**

Where: Grand Gallery (main level) Room D

**MI Recertification credits:** 2 (1B, COMM CORE, PRIV CORE)

**CCA Credits:** PM(2.0)

**Moderator:** Ben Werling, Extension Educator, MSU Extension, Hart, MI

**2:00 pm** Updates on Disease Research and Management for California Celery
- Steve Koike, Monterey Co. UC Cooperative Extension, Salinas, CA

**2:45 pm** Insect Management in Celery
- Zsofia Szendrei, Entomology Dept., MSU

**3:10 pm** Celery Anthracnose Biology and Research
- Lina Rodriguez-Salamanca, Plant, Soil and Microbial Sciences Dept., MSU

**3:40 pm** Celery Herbicide Update
- Bernard Zandstra, Horticulture Dept., MSU

**4:00 pm** Session Ends

Annual meeting of Michigan Celery Research Inc. will be held at the conclusion of the Celery session.
Updates on Disease Research and Management for California Celery

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California celery production: The great majority of California celery is located in counties adjacent to the Pacific Ocean, from Ventura County in the south stretching up to Santa Cruz and San Benito counties in the north. Ventura and Monterey counties together produce the majority of the California crop. All commercial celery in California is planted in the field as transplants that are produced in greenhouse trays. Transplants increase the uniformity of the celery crop and decrease the time needed to grow the crop in the field. Transplanted celery is typically placed in double rows on 36- to 40-inch beds; plants are spaced 9 inches apart and the plant rows are 14 inches apart. Clays, clay loams, and loams with good drainage and high water holding capacity have historically been used to grow celery. With the introduction of drip irrigation, however, celery production is now common on lighter texture soils because uniform soil moisture can be maintained with such systems. Celery transplants are established with sprinklers and later irrigations may be applied with sprinkler, furrow, or drip systems. However, the overwhelming trend is for the use of drip applied water. Celery takes up large amounts of nutrients. About 200-250 lbs of nitrogen, 40-45 lbs of phosphorus, and 350-450 lbs of potassium per acre are removed from the field in the harvested portion.

Celery IPM: For conventionally grown celery, weed pests are managed with several herbicides that can be applied prior to or after transplanting. Such products include prometryn, S-metolachlor, bensulide, trifluralin, linuron, sethoxydim, clethodim. The most important insect pests are worms, aphids and leafminers. Pests requiring attention will vary depending on the geographical region and time of year. Presently, insect pests are primarily managed by the application of insecticides; insect-resistant cultivars are not yet available for California growers. Main above-ground diseases on celery include bacterial leaf spot (Pseudomonas syringae pv. apii), crater rot (Rhizoctonia solani), pink rot (Sclerotinia sclerotiorum), late blight (Septoria apiicola). Fusarium yellows (F. oxysporum f. sp. apiii) is the main below-ground disease. Aster yellows (caused by a phytoplasma) and a few virus diseases are occasionally seen. Nematodes are not an issue for celery grown in California.

Recent plant pathology research:

1. Bacterial leaf spot (Pseudomonas syringae pv. apii): In California, various Apiaceae crops are affected by a bacterial leaf spot disease (Figure 1). Bacterial leaf spot of celery was characterized in 1989-90. Bacterial leaf spot of cilantro (coriander) was documented in 1991. Bacterial leaf spot of parsley was not seen or documented until 2002. Most recently, a bacterial blight disease of fennel was discovered in 2010. Initially, each of these diseases was considered to be caused by distinct bacterial pathogens, or pathovars. However, in-depth molecular analysis of the parsley pathogen revealed that these crop diseases may be caused by more than one pathovar and that such bacterial pathogens have broader host ranges within the Apiaceae crop group. Such information is important because of the intensive crop rotation practiced in Monterey County’s Salinas Valley, in which celery, cilantro, parsley, and fennel may all be planted in rotation with each other.
2. *Apium virus Y* (ApVY) of celery in California: ApVY was only recently reported in California. Disease symptoms are variable and depend on the celery cultivar (Figure 2). In general, older leaves show yellow or brown line patterns, yellow blotches, brown lesions, and in some cases have distorted and twisted leaflets. Younger leaves may show a faint mosaic or mottling. Celery petioles could exhibit dark brown, sunken, elongated lesions. However, for some cultivars, the celery plants having symptomatic leaves will not have any petiole symptoms. Overall plant growth does not appear to be affected. Vectored by aphids, this virus has been also found in the field on cilantro and parsley. Production of a seed crop from known infected celery plants demonstrated that while the seed coat tested positive for ApVY, the embryo and resulting celery seedling never tested positive. Extensive surveys indicated that the weed poison hemlock (*Conium maculatum*) was commonly infected in regions where diseased celery occurred, suggesting that poison hemlock was the primary reservoir of the virus.
Figure 2. Leaf and petiole symptoms of California celery infected with Apium Virus Y.

References:


Insect Pest Management in Celery

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Michigan is one of the top three states in the U.S. for celery production with a $22.4 million crop value in 2012. Among other challenges, aphids and caterpillars have been cited as top concerns among celery growers within the state. Despite its lengthy production history in the U.S. there is little information in the published literature regarding the insect community of Michigan celery. In order to identify and evaluate the pest and natural enemy populations within celery fields, we surveyed the seasonal abundance of insect in commercial farms.

APHID MANAGEMENT

Spirea aphids (Aphis spiraecola) pose an annual challenge to Michigan’s celery growers. Aphid infestations can be spotty, making scouting difficult. Once present, numbers can increase rapidly and lead to significant problems. Their feeding is focused on the newer growth, causing curled foliage that can stunt the plant. Also, aphids vector viruses and, if present at harvest, can lead to the rejection of a load for processing. Aphid control is difficult, especially since they situate themselves on the underside of the leaves and deep down in the heart of the plant where it’s difficult to get good insecticide coverage. Nevertheless, current control practices rely heavily on insecticides, making it important to evaluate products for their efficacy in the field.

In 2013, we set up a foliar insecticide trial on a commercial celery farm in southwest Michigan. Seven treatments including an untreated control were tested for aphid management; all of the products in this trial are currently registered for use on celery. The study site was selected due to the presence of high aphid numbers. Celery plants at the time of the trial were about 5-6 weeks away from being harvested. Treatments were replicated four times in a randomized complete block design. Plots were 20 feet long and three rows wide.

Treatments were applied on 13 August 2013 using a single-nozzle hand-held boom (30 gallons/acre and 30 psi). Movento 240 SC (5 fl oz/A) was tested with five different brands of penetrating surfactants: Dyne-Amic, Silwet L77, Syl-Tac, HyperActive, and SuperSpread90. Two other treatments were an untreated control and a Movento 240 SC (5 fl oz/A) without surfactant.

For both trials, we made visual aphid evaluations on all the plants in the middle row of the plot. We counted the total number of plants as well as noted the rating of aphid damage on each plant. Plants were rated based on the number of aphids present; 0 = no aphids, 1 = aphids were present once, but they are all dead, 2 = more aphids, and 3= fully developed colonies. Plants from each plot were evaluated 3, 8, and 13, days post-application. Plant ratings were transformed sqrt (x+0.1) prior to statistical analysis. Analysis of variance was used for data analysis and ad-hoc Tukey means separation was used to compare treatment means (P < 0.05).

Movento with any of the penetrating surfactants performed significantly better than the untreated control or Movento without surfactant (Fig. 2). Movento without a penetrating surfactant performed the same as the untreated control.
Among the surfactant treatments, Movento with Dyne-Amic and Syl-Tac significantly lowered aphid numbers compared to Movento+HyperActive, but these two treatments were not significantly different from the other surfactants (Figure 1).

In this trial, we learnt that it’s essential to apply Movento with a penetrating surfactant, and certain types of penetrating surfactant can improve the activity of Movento.

Bars with the same letters are not statistically significantly different from each other.

Figure 1. Insecticide trial in celery with Movento 240 SC and five penetrating surfactants. All of the surfactants were applied with 5 fl oz/A Movento. Aphids were rated per plant, on the following scale: 0 = no aphids; 1 = plant had aphids, but they all died; 2 = one/few live aphids; and 3 = fully developed healthy aphid colonies. One foliar application was made on 8/13/13, and all plants in the middle row of the plot were checked for aphids 3, 8, and 13 days later.
In the 2013 growing season we also investigated the distribution and abundance of insects in and around commercial celery fields in three different counties in southwest Michigan. In general, more insects were captured in the margins and field edges than other sampling locations. Aphids and thrips were the most numerous pests by far, with leafhoppers coming in third in abundance. Spiders, lady beetles, ground beetles, and parasitic wasps were the most abundant natural enemies found in our traps.
Celery Anthracnose Biology and Research

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Several diseases, including early blight (Cercospora apii), late blight (Septoria apicola) and aster yellows, can impact yield quality and quantity of celery in Michigan. In September of 2010, an outbreak of celery anthracnose was documented in Allegan, Barry, Kent, Ottawa and Van Buren Counties. Symptoms were also observed in the 2011 and 2012 growing seasons. The symptoms observed included curled leaves, sporadic leaf margin discoloration, twisted petioles and oval lesions on petioles (Figure 1.)

Occasionally, tissue proliferation occurred on the lesions and resulted in adventitious roots and galls. Symptoms can occur during the different growth stages of celery in the greenhouse (Figure 2) and in the field (Figure 2). The causal agent of these symptoms was identified as Colletotrichum acutatum s.l., a pathogen capable of infecting multiple horticultural crops, including vegetables such as tomato, pepper, bean and spinach; and fruits, including strawberry, apple, peach and blueberry. This pathogen is known to overwinter in the soil, plant debris and is associated with several families of weeds.
Isolates of *C. acutatum* s.l. were collected during 2010, 2011 and 2012, in Allegan, Barry, Kent, Newaygo, Ottawa and Van Buren Counties. A total of 81 isolates were included in experiments to test differences in isolate aggressiveness. All isolates caused anthracnose symptoms. The most prevalent symptoms were lesions on the petioles and leaf curling. Leaf margin discoloration was observed frequently on the new growth, while tissue proliferation in the lesion was infrequent. Differences in aggressiveness among isolates of the pathogen were found. Several isolates produced significantly more lesions on the petioles that others, while other isolates failed to cause lesions on the petioles, and leaf curling was the prevalent symptom observed. No differences were found when comparing collection by year or county.

Research in the Hausbeck lab observed symptom development in the entire range of temperatures tested (from 59 to 86°F) with more severe symptoms observed at higher temperatures (≥77°F). Similarly, symptom development occurred at low leaf wetness duration (≤12 hours), but symptoms were more severe when inoculated plants were incubated for more than 12 hours of leaf wetness.

Fungicide trials conducted in 2011 and 2012 with preventive fungicide applications and artificial inoculation with *C. acutatum* determined fungicides in the strobilurin FRAC (Fungicide Resistance Action Committee) group 11 show efficacy at limiting celery anthracnose under moderate and severe disease conditions. Protectant fungicides in FRAC code M5 (for example, Bravo products) provided some control but were not able to prevent yield losses. Under moderate celery anthracnose severity, DMI (demethylation inhibitors) fungicides in the FRAC group 3 provided some control. Fungicides in the FRAC group 11 (strobilurins) are categorized as at high risk of resistance developing in the pathogen.
Therefore, in order to diminish resistance build up and keep these efficacious products in the grower’s toolbox, these fungicides should be alternated or mixed with protectant fungicides.

Greenhouse and field cultural practices should include appropriate sanitation and avoidance of the pathogen. Transplant trays and flats need to be treated appropriately with commercial disinfestants if reused. The disease can be carried on infected celery transplants from the greenhouse to the field. Therefore, is recommended to scout plants in the greenhouse and when symptoms are detected, eradication can prevent introducing the pathogen in the field. Irrigation in the greenhouse is key to minimize moisture that contributes to infection and symptom development. Irrigate early in the day to allow time for celery leaves to dry out. Inoculum sources should be further investigated in order to determine if celery seed can carry *C. acutatum*.

**For additional fungicide field trial information visit:**
http://www.glexpo.com/summaries/2011summaries/webCelery.pdf) and
http://www.glexpo.com/summaries/2012summaries/celery.pdf)

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