Celery

Where: Grand Gallery (main level) Room D
MI Recertification credits: 1 (1B, COMM CORE, PRIV CORE)
OH Recertification credits: 1 (presentations as marked)
CCA Credits: PM(1.0)
Moderator: Mark Cnossen, Cnossen Farms, Wayland, MI

2:00 pm	Update on the East Coast Celery Market and Industry • Ron Gleason, Hillside Gardens, Bradford, Ontario, Canada
3:00 pm	Celery Pathology Update (OH: 2B, 0.5 hr) • Mary Hausbeck, Plant, Soils and Microbial Sciences Dept., MSU
3:30 pm	Celery Weed Control Update (OH: 2C, 0.5 hr) • 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.

Celery Pathology Update

Mary K. Hausbeck (517-355-4534), K. E. Goldenhar, and B. R. Harlan
Michigan State University, Department of Plant, Soil and Microbial Sciences

Michigan is ranked second in the country for celery production. In 2016, this crop was produced on 1,900 acres and valued at $17.5 million. Pathogens can infect celery during all aspects of production; as seedlings in flats in the greenhouse through harvest in the field. The most serious greenhouse disease is Pythium root rot, which can result in stunted plants and reduced yields (Figure 1A-B). Diseases that have been a problem in celery field production in Michigan include early blight, late blight, bacterial leaf spot, anthracnose and Fusarium yellows. (Figure 1B-F).

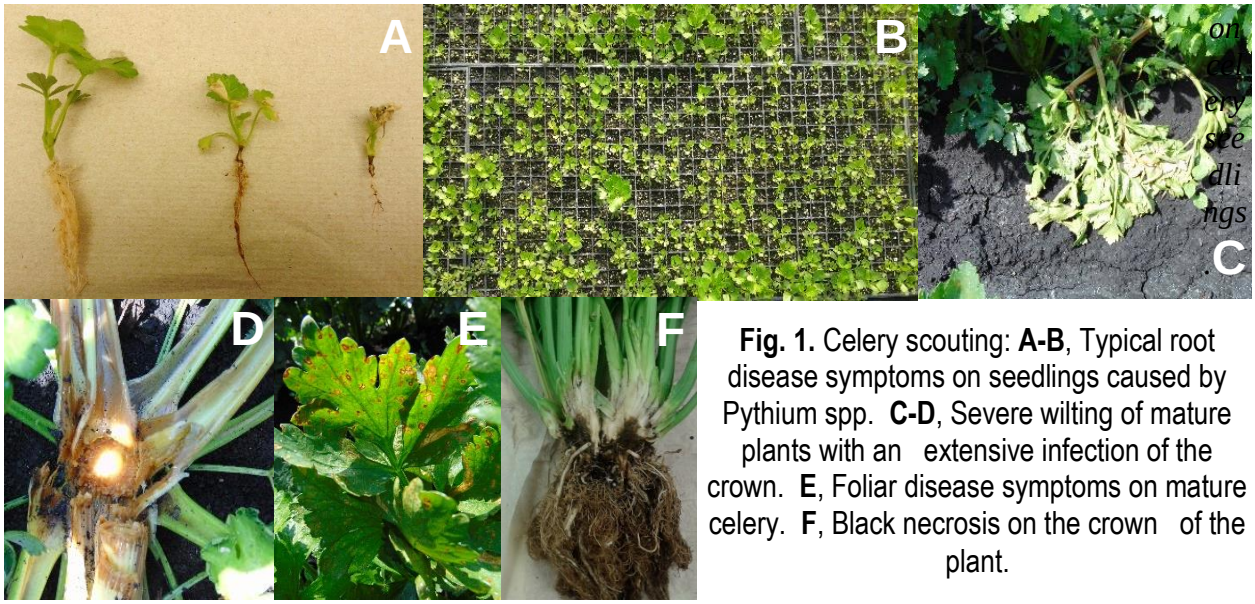

Fig. 1. Celery scouting: **A-B**, Typical root disease symptoms on seedlings caused by Pythium spp. **C-D**, Severe wilting of mature plants with an extensive infection of the crown. **E**, Foliar disease symptoms on mature celery. **F**, Black necrosis on the crown of the plant.

Greenhouse Transplant Disease Control

Root rot diseases, such as *Pythium* and *Rhizoctonia*, can be an annual problem for celery transplant producers. *Pythium* can "nibble" the feeding roots of plants, resulting in stunted growth. *Pythium* also causes severe symptoms, such as crown rot, that can result in plant death. Saturated, overwatered growing media favors the *Pythium* pathogen. *Pythium* can persist in the greenhouse and 'hibernate' on dirty plant containers, benches, hoses, and greenhouse walkways, ready to become activated by the right crop and weather conditions. Use a pressure washer with soap and water when cleaning walkways, benches, etc. Follow with a disinfestant to remove any remaining pathogens. Scouting is an important first step in controlling root rots. If *Pythium* has a significant head start, the root system of some plants will be too rotted and the fungicides will not be able to rescue them. *Rhizoctonia* is most likely to spread via contaminated soil, flats, or pots, so sanitation is an important method of limiting the disease. This pathogen can thrive in wet/dry or warm/cool conditions and in severe cases it can destroy the root system of an infected plant. Minimizing stress on the crop by promoting good growth makes the plant less vulnerable to attack by a root rot.

Fungicides can be an effective method of controlling root rots on transplants. When treating for root rot pathogens, it is important that the product is applied to the root zone of the plant. Biocontrol products can be helpful in controlling some root rot diseases, however, they are more effective when

applied prior to disease development. See the below table (Table 1) for a complete list of products that can be applied to celery transplants in the greenhouse. Preliminary studies have shown that the biopesticide product Actinovate to have some efficacy against Pythium rot. In other greenhouse studies, some Pythium control was observed using products such as Aliette WDG, Alude, Heritage WDG, and Reason 500SC.

Table 1. Fungicides Labeled for Use on Celery Transplants in the Greenhouse

Trade Name	Active Ingredient	Pathogens on Label*	FRAC
Aftershock SC -or- Evito 480SC -or- Tepera	Fluoxastrobin	C, P, R, S	11
Aliette WDG -or- Linebacker WDG	Aluminum tris	P	33
Cannonball WG -or- Emblem	Fludioxonil	R, S	12
Fontelis SC	Penthiopyrad	C, R, S	7
Gem 500SC	Trifloxystrobin	C, R, S	11
Heritage WG	Azoxystrobin	C, F, P, R, S	11
Luna Privilege	Fluopyram	S	7
Luna Sensation	Fluopyram/Trifloxystrobin	C, R, S	7/11
Reason 500SC	Fenamidone	P	11
Switch 62.5WDG	Fludioxonil/Cyprodinil	S	9/12
Copper Fungicides Labeled for Use on Celery Transplants in the Greenhouse			
Badge SC, X2	Copper oxychloride/Hydroxide	B, P	M01
C-O-C-S WDG	Copper oxychloride/Basic copper	B, P	M01
Cueva Fungicide	Copper octanoate	B, C, S	M01
Cuprofix/Ultra/FL	Basic copper sulfate	B, C, S	M01
Kentan DF -or- Kocide 3000 -or- Nu-Cop -or- Previsto -or- KOP-5 -or- MasterCop	Copper hydroxide	B, C, S	M01
Nordox 75WG	Copper oxide	B, C, S	M01
Biopesticides Labeled for Use on Celery Transplants in the Greenhouse			
Alude Fungicide -or- Confine Extra -or- Fungi-Phite -or- KPhite -or- ProPhyt -or- Phiticide -or- Reveille	Phosphorus acid/ Potassium phosphite	P	33
Actinovate AG	*Streptomyces lydicus*	F, R, P	--
Cease Biofungicide -or- Serenade Soil	*Bacillus subtilis*	F, R, P	44
Double Nickel 55	*Bacillus amyloliquefaciens*	B, C, F, P, R	44
OSO 5%SC	Polyoxin D Zinc Salt	R	19
Regalia Biofungicide	Extract of *R. sachalinensis*	B, C, S	P5
RootShield G/WP	*Trichoderma harzianum*	P, R, F	BM 02
RootShield Plus G/WP	*T. harzianmum/T. virens*	P, R, F	BM 02
Tenet WP	*T. asperellum/T. gamsii*	F, P, R	BM 02

*B=Bacterial diseases, C=Cercospora blight, F=Fusarium root and crown rot, P=Pythium root rot, R=Rhizoctonia root and crown rot, S=Septoria blight.

Foliar Diseases of Celery

Early blight (caused by *Cercospora apii*) and late blight (caused by *Septoria apiicola*) can impact yield quality and quantity of celery in Michigan. The disease symptoms, including defoliation and stunting of the plants and petiole blighting, can result in severe yield losses for celery growers. *Cercospora* and *Septoria* may be seedborne fungi or overwinter in Michigan fields; therefore, resistant cultivars, fungicide programs, and disease-free seed are important for managing these diseases. Symptoms of Cercospora early blight include yellow to tan, circular-shaped lesions on the upper and lower surface of leaves and elongated lesions on petioles. Septoria late blight is the most common disease of celery in Michigan. Symptoms of Septoria late blight include yellow to brown, irregularly shaped lesions on the leaves and petioles. The reproductive structures of the fungus, small black pycnidia, are embedded in these lesions. Pycnidia can also be observed on infected petioles. When left uncontrolled, Septoria late blight can result in losses exceeding 70% especially, during wet conditions when disease incidence and severity are high.

Most foliar leaf blights can be controlled with registered fungicides. Fungicides should be used in rotation with one another and all can be tank-mixed with copper-based products for dual control of both fungal and bacterial diseases. Adequate fungicide coverage of the celery foliage and petioles is a challenge and we have observed that once the plants are large enough to form a thick canopy, coverage to the lower portions of the plants is limited.

Evaluating fungicides for control of foliar blights of celery. Michigan State University established a trial with a grower cooperator in Allegan County, MI near Wayland in a sandy soil previously planted to sorghum. Celery 'Dutchess' seeds were sown on 28 Jun with approximately 44,000 plants per acre. Spacing was 20 in. between rows and 8 in. between plants within a row. Fertilization, weed and insect control were managed by the grower cooperator and were to commercial standards. A completely randomized block design with four replicates was established. Each treatment replicate consisted of two rows that were 20 ft long with a 2-ft buffer zone between treatments within a row. Treatments were applied using a CO_2 backpack sprayer and a broadcast boom equipped with three XR8003 flat-fan nozzles calibrated at 50 psi and delivering 50 gal/A. Treatments were applied on 15, 25 Aug; 6, 15, 22, 29 Sep and 6 Oct. Plants in a 10-ft section of the middle row were evaluated 15 Aug, 13 and 26 Sep. Plants were harvested from the center 5 ft of the 2 rows of treatment plots on 27 Sep, trimmed following market specifications, rated and weighed on Sep 28.

Due to the lack of disease pressure in this year's research plot, it was not possible to evaluate the effectiveness of the treatments to control leaf or petiole blight. This lack of disease pressure did, however, allow for a more thorough evaluation of the relationship between the fungicide treatments and yield. No treatments resulted in a significant difference in yield compared to the untreated control. Celery plants treated with Pristine WG and Switch WG resulted in the lowest yield, which were statistically lower when compared to the plants treated with Bravo WeatherStik SC or Merivon SC. Phytotoxicity was not observed on any of the foliage in this experiment.

Table 2. Evaluation of fungicide treatments on celery yield.
(See next page)

Table 2. Evaluation of fungicide treatments on celery yield.

Treatment and rate/A, applied at 7 to 10-day intervals	Yield (lb/6 ft)
Untreated Control	34.1 ab*
Bravo WeatherStik SC 2 pts	35.8 a
Quadris SC 15.5 fl oz	32.4 ab
Pristine WG 14 oz	30.4 b
Switch WG 12.5 oz	30.5 b
Quadris Opti SC 3 pts	32.3 ab
Quilt Xcel SE 14 fl oz	31.9 ab
Merivon SC 8 fl oz	35.4 a
Luna Tranquility SC 16 fl oz	32.3 ab
Luna Sensation SC 7.6 fl oz	34.3 ab

*Column means with a letter in common or with no letter are not significantly different (LSD t test; P=0.05).

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Celery Weed Control 2017

Bernard Zandstra
Michigan State University
EXPO, Grand Rapids, MI
December 6, 2017

Herbicides labeled for celery in Michigan 2016

Dual Magnum 7.62 EC

When: Before or after transplanting
Rate: 2 pt (1.9 lb ai)
PHI: 62 days
Weeds: Annual grasses, nutsedge, pigweeds, nightshades
Label: 24c indemn. **(www.farmassist.com)**
MOA: VLCFA synthesis inhibitor 15(K3)

Caparol 4L

When: After transplant, 4-6 weeks later
Rate: 1-2 qt (1-2 lb ai); 2 qt max per year
Weeds: Broadleaves and grasses
Label: Section 3; 1 or 2 applications
Resistant common purslane
MOA: PS II inhibitor 5(C1)
Current status: under review at EPA

Lorox 50 DF

When: After transplanting up to 8 inches
Rate: 1.5-2 lb (0.75 - 1 lb ai)
Weeds: Broadleaves and grasses
Label: Section 3
MOA: PS II inhibitor 7 (C2)
Current status: under review at EPA

Chateau 51 WDG

When: Before transplant or 3-7 days after transplant
Rate: 3 oz (0.096 lb ai)
Weeds: broadleaves and grasses
MOA: PPO inhibitor 14 (E)

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Poast 1.5 E and Select Max 0.97 E

Post grass control

MOA: ACCase inhibitor 1(A)

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New Herbicide for Celery

Zidua 85 WDG (pyroxasulfone)

When: Pre or Post transplant

Rate: 2.5 – 5.0 oz (0.133 – 0.267 lb ai)

Weeds: Annual grasses, common ragweed, marsh yellowcress, Virginia pepperweed

Pria: 10/17/18

Label: maybe 2019

MOA: VLCFA synthesis inhibitor 15 (K3)

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New Herbicide Labels for Celery

Prowl H_2O - Pre or Post TP

Project complete at IR-4

Label: 2020?

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New Herbicide Labels for Celery

Fusilade DX 2E

Post Grasses

Pria: 10/7/18

Label for 2019?

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Celery Response to Herbicides

	Treatment and Rate	Celery 7/25	Celery 8/24	Kg/Plot 10/6
1.	Caparol 2 x 2	1.3	1	40
2.	Prowl H2O 1.9 POT Caparol 2 PO1	1.7	1	39
3.	Dual Mag 1.9 POT Chateau 0.096 POT Caparol 2 PO1	2.7	1.7	37
4.	Zidua 0.133 POT Caparol 2 PO1	2.7	2	35

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Celery Response to Herbicide

	Treatment and Rate	Celery 7/25	Celery 8/24	Kg/Plot 10/6
5.	Zidua 0.215 POT Caparol 2 PO1	1	1	41
6.	Dual Mag 1.9 POT BIR 0.033 POT	7.3	6	20*
7.	Dual Mag 1.9 POT BIR 0.033 PO1 Caparol 1 PO1	1.3	6.7	20*

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Celery Response to Herbicide

	Treatment and Rate	Celery 7/25	Celery 8/24	Kg/Plot 10/6
8.	Zidua 0.133 POT Chateau 0.096 POT	1.3	1.7	41
9.	Untreated POT Caparol 2 PO1	1.3	2	33*

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COPU Control with Zidua

	Treatment and Rate	COPU 7/25	COPU 8/17	COPU 8/24
1.	Zidua 0.133 POT Caparol 2 PO1	10	7	5.7
2.	Zidua 0.215 POT Caparol 2 PO1	10	7.7	8.3
3.	Zidua 0.096 POT Chateau 0.096 POT	10	8.7	9.7
4.	Zidua 0.215 POT Chateau 0.096 POT	10	9.7	9.3

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COPU Control with Caparol

	Treatment and Rate	7/25	8/17	8/24
1.	Caparol 2 X 2	8.7	2.7	5.3
2.	Untreated POT Caparol 2 PO1	1	1.7	1

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Conclusions

1. Zidua was safe PRT and POT on celery at 0.133 lb ai; 2x rate causd some stuntng
2. Caparol did not provide good COPU control
3. Prowl H_2O, Chateau, and Zidua controlled COPU
4. BIR stunted celery; it is not safe enough for use on celery

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Thank You. Questions?

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