Great Lakes Fruit, Vegetable & Farm Market Expo
DeVos Place Convention Center
Grand Rapids,k MI
December 9-11, 2003

Celery

Wednesday afternoon 2:00 pm

Where: Gallery Overlook Room C (upper level)

Summary: Disease control is emphasized in this session. Consumer issues of food safety and quality round out the topics for this session.

Recertification credits: 1 (CommCore, Private, 1A)

CCA Credits: IPM(0.5) CM(0.5)

Moderator: Ron Eding, Hamilton

2:00 p.m. Celery Cultivar Development for Fusarium Resistance and Horticultural Quality

- Rebecca Grumet, Michigan State University

2:20 p.m. Disease Prediction and New Fungicides

- Ryan Bounds, Michigan State University

2:40 p.m. Fitting Cover Crops into Celery Production System for Integrated Management

- Mathieu Ngouajio, Michigan State University

3:00 p.m. Food Safety/Quality Assurance for Celery

- Doug Sanders, NC State University

3:20 p.m. Celery Research Inc. Annual Meeting

Celery Breeding and Variety Trials for Disease Resistance

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Departments of Plant Pathology and Horticulture, Michigan State University

Fusarium yellows (causal agent: *Fusarium oxysporum* f.sp. *apii*, race 2) is a major limiting factor in celery production in Michigan and nationally. This disease cannot be controlled with chemicals or cultural practices and so it is essential to have high quality, Fusarium-resistant cultivars. The Michigan State University celery breeding program used a combination of somaclonal variation and recurrent selection to develop high yielding, highly fusarium-resistant celery breeding lines. These lines also exhibited desirable horticultural characteristics, with the exception of short petioles. A crossing program was then initiated to increase height and to combine sources of resistance between the somaclonal materials and commercially available Fusarium-resistance which is derived from celeriac.

Hybrid families were produced between MSU somaclone lines and the commercial cultivar 'Greenbay' ('XP166). The hybrid progeny showed a high level of resistance and significantly greater height than the somaclone derived parents. This past summer, 2003, replicated trials were performed with selected F3 progeny families that showed good disease resistance, yield, height and horticultural qualities in single plot trials in 2002. The replicated trial also included several commercial cultivars for comparison: Greenbay, XP-266, XP-85, Picador, Dutchess, Fuerte, and Sabroso, Peto 285, and three SVS trial lines.

Disease conditions in the field were very severe. The susceptible control, 'FL683' received a mean disease rating of 4.1 (rated on a scale of 1-5, where 1=no disease and 5=dead). None of the 'FL683' plants were marketable. Overall, the selected F3 families showed a high level of resistance: six of the families had excellent disease ratings of 1.0 - 1.2; two had somewhat higher ratings of 1.5 and 1.8. Three of the commercial cultivars performed very well: Picador, Fuerte, and Sabroso, with ratings of 1.1 - 1.3. Other lines, however, did not perform as well in this field: Greenbay (1.5), XP266 (1.6), XP85 (1.6), Dutchess (2.7) and Peto 285 (2.4). It is not known whether there is a decline in the resistance or increase in virulence of the fungus in this very severe location.

Mean yields of the F3 somaclone families ranged from 19.5 - 26.4 lbs/10 plants. This compares very favorably with commercial cultivars that gave yields ranging from 15.0 - 21.7. Individual values were: Greenbay (21.7), XP-266 (21.4), XP-85 (19.5), Picador (20.7), Dutchess (15.0), Fuerte (16.3), and Sabroso (21.4), Peto 285 (17.2). There was a general trend of decreased yield accompanying increased disease ratings, suggesting that lower yields were more likely a reflection of disease occurrence rather than yield potential.

For four somaclone families height was good (less than one plant of ten had petioles with first node less than 9" from the base, ratings of 0 - 0.8 short stalks/10 stalks); two families had higher ratings (1.8 - 4.8). In most cases, the commercial cultivars were tall (ratings of 0 - 1.3) but in a few cases, where disease incidence was higher, the cultivars had height ratings of 6.0, 8.0, and 5.5, indicating the stunting effect of the disease.

Finally, all entries were also tested for response to inoculation with late blight (causal agent: *Septoraia appicola*) in a non-Fusarium infested field. Disease ratings for all cultivars and breeding lines were high.

Disease Prediction and New Fungicides for Celery

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INTRODUCTION

Research trials were conducted at the MSU Muck Soils Research Farm and grower cooperator's farms to identify effective disease management programs for celery. Late blight (caused by *Septoria apiicola*), Early blight (caused by *Cercospora apii*), and Crater rot (caused by *Rhizoctonia solani*) may cause extensive damage on celery stalks and result in a reduction of marketable yield. The objectives of this research were to 1) test disease predictive systems for timing sprays, 2) evaluate new fungicides and biofungicides, and 3) identify effective fungicide programs for controlling foliar blights and crater rot.

I. DISEASE PREDICTIVE SYSTEMS FOR MANAGING FOLIAR BLIGHTS

Disease predictors use easily obtained weather information to time sprays and may be useful in reducing costly fungicide applications to celery. To examine the effectiveness of such systems, sprays were applied weekly or when prompted by disease predictors. Buffer rows, adjacent to the rows receiving fungicide sprays, were inoculated with *Septoria apiicola* spores on July 9 and 16. Sprays were applied according to the Septoria predictor when 12 consecutive hours of leaf wetness occurred with a minimum reapplication interval of seven days. The Cercospora predictor treatments were sprayed when specific temperature and humidity requirements were met and no sprays were applied in the past seven days. Tom-Cast treatments were sprayed according to Disease Severity Value (DSV) accumulation, which is based on the duration of leaf wetness and the temperature during the wetness periods. Daily DSVs range from 0 to 4, representing conditions unfavorable to highly favorable for disease development. DSVs accumulate until a threshold value is reached (10, 15, or 20 DSVs in this study), a spray is applied, and the DSV total returns to zero.

Late blight symptoms appeared in inoculated buffer rows on July 24. By August 11, all untreated plants were infected and disease progressed rapidly until harvest. Ten plants from each treatment row were hand-harvested, trimmed to 14 in. length, and weighed on August 26. Trimmed plants were evaluated for disease, stripped of diseased petioles, and weighed again. Excellent disease control (no disease on petioles) was achieved when sprays were applied every seven days (12 sprays) or according to the Septoria predictor (10 sprays) (Figure 1). The Cercospora predictor, Tom-Cast 10 DSV or Tom-Cast 15 DSV using Quadris 2.08F alternated with Bravo Ultrex 82.5WDG treatments also limited petiole blight. Sprays applied according to the Tom-Cast 15 DSV program using Bravo Ultrex 82.5 alone or the Tom-Cast 20 DSV programs resulted in poor disease control that did not differ from the untreated.

The yield loss due to the removal (stripping) of diseased petioles was expressed as a percentage of the total yield (Figure 2). Weekly (12 sprays) treatments or those applied according to the Septoria (10 sprays), Cercospora (7 sprays), or Tom-Cast 10 DSV (8 sprays) predictors using Bravo Ultrex 82.5 alone or in alternation with Quadris 2.08F resulted in little or no yield loss. In addition, Quadris 2.08F alternated with Bravo Ultrex 82.5WDG applied according to Tom-Cast 15 DSV (5 sprays) was effective in limiting yield loss and did not differ from spray programs that prevented yield loss. In general, spray programs using Quadris 2.08F alternated with Bravo Ultrex 82.5WDG appeared to be more effective in controlling disease and reducing yield loss when compared to programs using Bravo Ultrex 82.5WDG alone. Studies will be conducted next season to verify these results.

I. DISEASE PREDICTIVE SYSTEMS FOR MANAGING FOLIAR BLIGHTS (cont'd.)

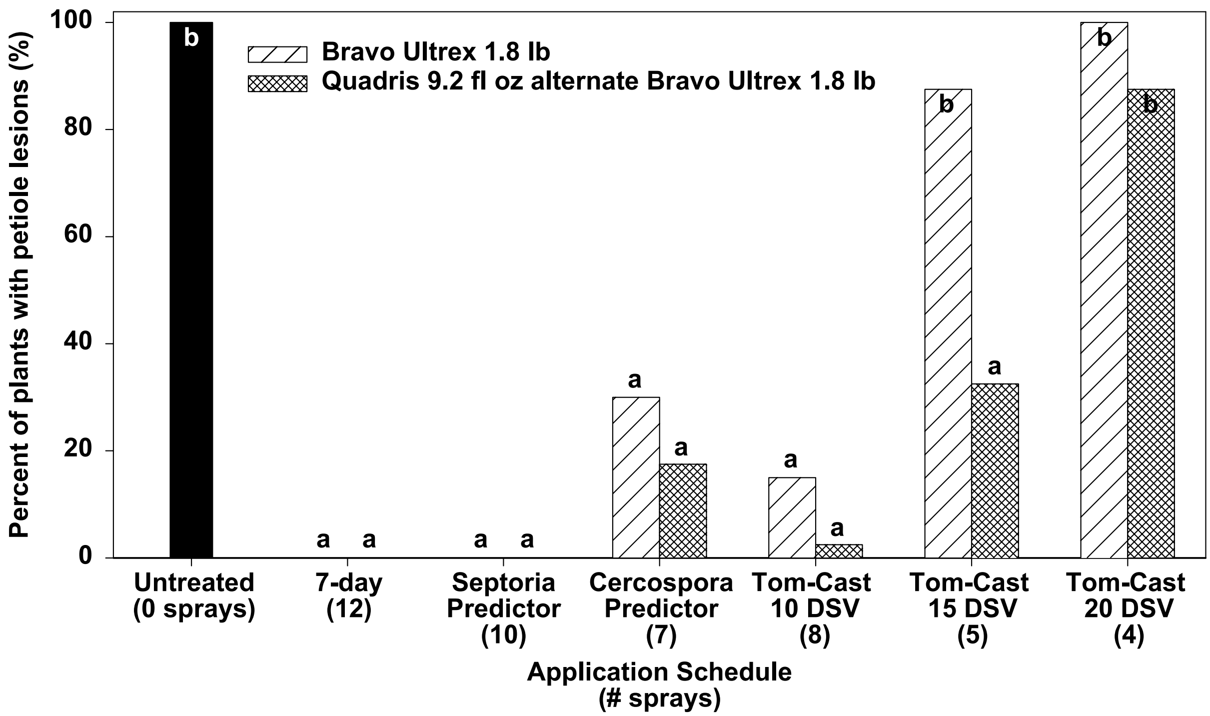

Figure 1. Incidence of petiole blight after plants were hand-harvested and trimmed to fresh market specifications, 2003.

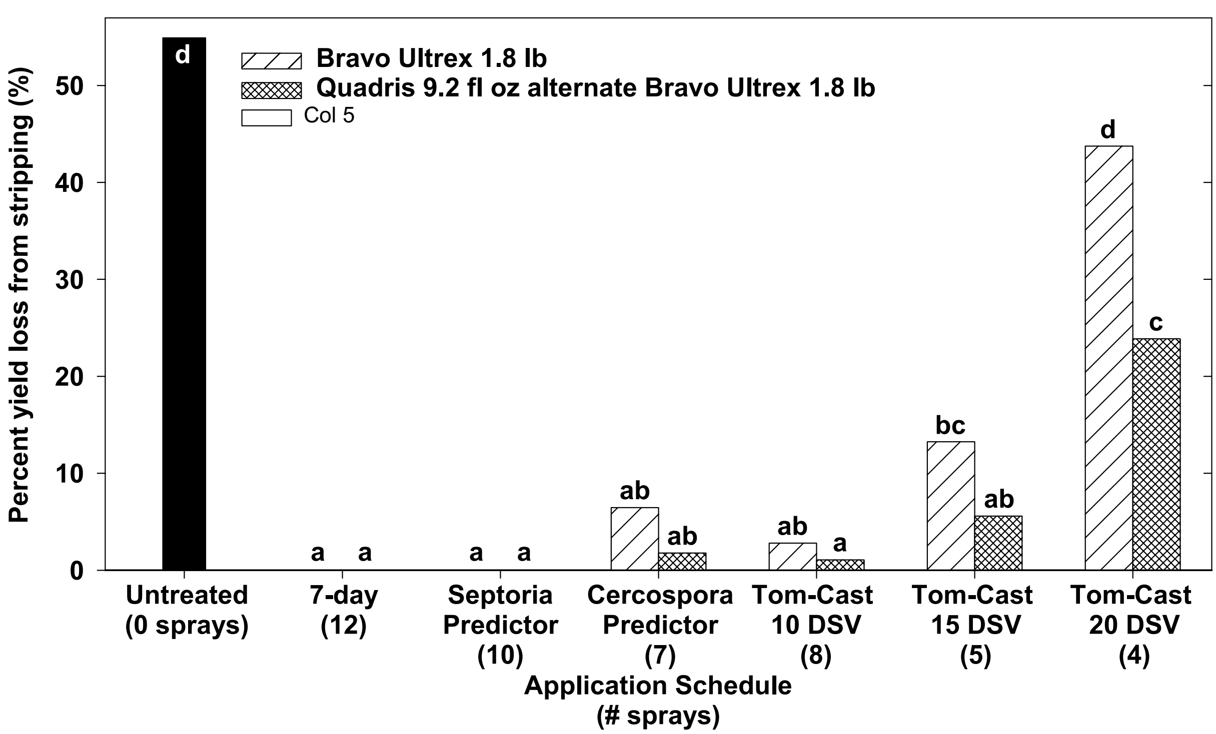

Figure 2. Percentage of total yield lost when infected petioles were removed from stalks, 2003.

I. NEW PRODUCT TESTING FOR CONTROL OF LATE BLIGHT

New fungicides and biofungicides were tested to determine their level of activity against Late blight. Ten weekly sprays were applied from July 3 through September 5. Disease symptoms appeared in inoculated buffer rows on August 15. At harvest, petioles of untreated plants were severely diseased which resulted in extensive trimming and low yield. Applications of Quadris 2.08F alternated with Tilt 3.6EC, Bravo Ultrex 82.5WDG applied alone or applied in alternation with Pristine 38WG or Quadris 2.08F were highly effective in controlling disease and resulted in no disease symptoms on petioles. Plants treated with EXP 702010 8.33EC or 710-145f 0.14% w/v were severely diseased.

Table 1. Evaluation of fungicides and biopesticides for managing late blight, 2003.

Treatment and rate/A	Currently registered	Petiole blight: Incidence (%)[z]	Petiole blight: Severity[y]	Stripped yield (lb)[x]
Untreated	--	100.0 b[w]	47.5 b	13.2 b
Cabrio 20WG 1 lb *alternate* Bravo Ultrex 82.5WDG 1.8 lb	no yes	0.0 a	0.0 a	30.8 a
Pristine 38WG 0.66 lb *alternate* Bravo Ultrex 82.5WDG 1.8 lb	no yes	0.0 a	0.0 a	38.4 a
Quadris 2.08F 14.9 fl oz *alternate* Bravo Ultrex 82.5WDG 1.8 lb	yes yes	0.0 a	0.0 a	32.3 a
Quadris 2.08F 14.9 fl oz *alternate* Tilt 3.6EC 4 fl oz	yes yes	0.0 a	0.0 a	35.6 a
Bravo Ultrex 82.5WDG 1.8 lb	yes	0.0 a	0.0 a	33.1 a
Serenade 10WP 6 lb *alternate* Bravo Ultrex 82.5WDG 1.8 lb	yes yes	0.0 a	0.0 a	33.5 a
Messenger 3WDG 0.6 lb *alternate* Bravo Ultrex 82.5WDG 1.8 lb	yes yes	15.0 a	10.0 a	31.4 a
Endura 70WG 0.7 lb	no	0.0 a	0.0 a	33.8 a
EXP 702010 8.33EC 0.8 pt	no	100.0 b	52.5 b	15.4 b
EXP 702010 8.33EC 1.6 pt	no	100.0 b	47.5 b	12.4 b
710-145f 0.14% w/v 5.7 pt	no	100.0 b	52.5 b	9.3 b

[z] Percentage of trimmed plants with one or more petiole lesions
[y] Severity of petiole blight assessed as the percentage of petiole area with disease symptoms.
[x] Ten plants were hand-harvested, trimmed to 14 in. length, and stripped of diseased petioles prior to weighing.
[w] Means within a column followed by the same letter are not significantly different according to Tukey's Studentized Range Test (P=0.05).

II. FUNGICIDE PROGRAMS FOR CONTROL OF EARLY BLIGHT

This study was conducted to examine Early blight control provided by two rates and different alternations of Quadris 2.08F in spray programs with other standard fungicides. Eight weekly sprays were applied from July 23 through September 10. Disease symptoms appeared in several localized areas throughout the field on August 12. All fungicide treatments significantly reduced disease and yield loss when compared to the untreated. Treatments of Bravo Ultrex 82.5WDG applied alone or in alternation with Quadris 2.08F (15.4 fl oz/A) were highly effective in controlling early blight and resulted in no petiole blight or yield reduction. The three-way alternation program of Quadris 2.08F (9.2 fl oz/A), Bravo Ultrex 82.5, and Tilt 3.6EC was the least effective of the fungicide treatments in limiting petiole blight and reducing yield loss; however, it did not differ when compared to treatments that prevented petiole disease. The treatments did not have a significant effect on total yield, indicating the fungicides did not adversely affect plant growth.

II. FUNGICIDE PROGRAMS FOR CONTROL OF EARLY BLIGHT (cont'd.)

Table 2. Evaluation of registered fungicides for managing early blight, 2003.

Treatment and rate/A (application sequence)*	Petiole blight		Yield	
	Incidence (%)	Severity (%)	Total (lb)	Loss (%)
Untreated	77.5 b**	11.8 b	21.7	18.7 b
Bravo Ultrex 82.5WDG 1.8 lb (1-8)	0.0 a	0.0 a	21.1	0.0 a
Quadris 2.08F 9.2 fl oz (1,3,5,7) Bravo Ultrex 82.5WDG 1.8 lb (2,4,6,8)	5.0 a	0.3 a	21.5	0.2 a
Quadris 2.08F 15.4 fl oz (1,3,5,7) Bravo Ultrex 82.5WDG 1.8 lb (2,4,6,8)	0.0 a	0.0 a	19.9	0.0 a
Quadris 2.08F 9.2 fl oz (1,4,7) Bravo Ultrex 82.5WDG 1.8 lb (2,5,8) Tilt 3.6EC 4 fl oz (3,6)	25.0 a	1.0 a	21.8	1.9 a
Quadris 2.08F 15.4 fl oz (1,4,7) Bravo Ultrex 82.5WDG 1.8 lb (2,5,8) Tilt 3.6EC 4 fl oz (3,6)	7.5 a	0.6 a	22.0	0.7 a
Bravo Ultrex 82.5WDG 1.8 lb (1-3,7) Quadris 2.08F 9.2 fl oz (4-6,8)	15.0 a	0.3 a	20.7	0.7 a
Bravo Ultrex 82.5WDG 1.8 lb (1-3,7) Quadris 2.08F 15.4 fl oz (4-6,8)	7.5 a	0.6 a	22.0	0.5 a

* Kocide 53.8DF 1.5 lb/A was added to each fungicide treatment to limit bacterial blight.
** Means within a column followed by the same letter or no letter are not significantly different according to Tukey's Studentized Range Test (P=0.05).

III. FUNGICIDE PROGRAMS FOR CONTROL OF CRATER ROT

The goal of this study was to test standard and unregistered fungicides for controlling crater rot. Nine weekly sprays were applied from June 3 through July 29. Disease pressure was low when compared to previous seasons, which had warmer and more humid weather during July. Over 45% of untreated plants had petiole lesions while all fungicide treatments limited disease to $\leq$ 22.1%. Only the alternation of Quadris 2.08F and Bravo Ultrex 82.5WDG significantly limited the incidence of crater rot when compared to the untreated. Treatments of Quadris 2.08F, Topsin M 70WP, or Scholar 50WP alternated with Bravo Ultrex 82.5WDG were effective in limiting yield loss when compared to the untreated.

Table 3. Evaluation of standard fungicides and unregistered fungicides for managing crater rot, 2003.

Treatment and rate/A (application sequence)*	Crater rot incidence (%)	Yield	
		Total (lb)	Loss (%)
Untreated	46.3 b**	44.6	6.7 c
Bravo Ultrex 82.5WDG 1.8 lb	17.9 ab	48.7	2.7 bc
Quadris 2.08F 9.2 fl oz *alternate* Bravo Ultrex 82.5WDG 1.8 lb	1.0 a	50.4	0.1 a
Tilt 3.6EC 4 fl oz *alternate* Bravo Ultrex 82.5WDG 1.8 lb	22.1 ab	49.2	2.3 bc
Topsin M 70WP 0.5 lb (Not registered) *alternate* Bravo Ultrex 82.5WDG 1.8 lb	19.6 ab	46.8	1.7 ab
Scholar 50WP 0.44 lb (Not registered) *alternate* Bravo Ultrex 82.5WDG 1.8 lb	16.1 ab	46.2	1.8 ab

* Kocide 53.8DF 1.5 lb/A was added to each fungicide treatment to limit bacterial blight.
** Means within a column followed by the same letter or no letter are not significantly different according to Tukey's Studentized Range Test (P=0.05).