Managing the Uncertainties in Growing and Marketing Fruits and Vegetables

Education Session Abstracts
December 10 - 12, 2002

MICHIGAN STATE UNIVERSITY EXTENSION

Compiled by:
Roger C. Brook, Running Water Publishing, LLC
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Development of Fusarium-resistant Celery Cultivars

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Fusarium yellows (causal agent: *Fusarium oxysporum* f.sp. *apii* race 2) is a limiting factor in celery production in Michigan and nationally. This disease cannot be controlled with chemicals or cultural practices and so it is imperative to have high quality, resistant cultivars. The Michigan State University celery breeding program has 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 initiated in 2000 to increase height and determine whether the MSU 'FL683'-derived somaclone lines have a different source of resistance than the celeriac-derived resistance present in current commercial cultivars.

Hybrid families were produced between three MSU somaclone lines and the commercial cultivar, 'Greenbay' ('XP166'). The hybrid progeny all showed a high level of resistance and significantly greater height than the somaclone-derived parents. This past summer, 2002, trials were performed with F3 progeny families produced from 36 F2 individuals selected for disease resistance, yield, height, and horticultural qualities. The F2 selections represented four initial hybrid combinations and 10 F2 families. The F3 families were tested individually in single plots, and in bulks in a replicated trial (see Figure 1).

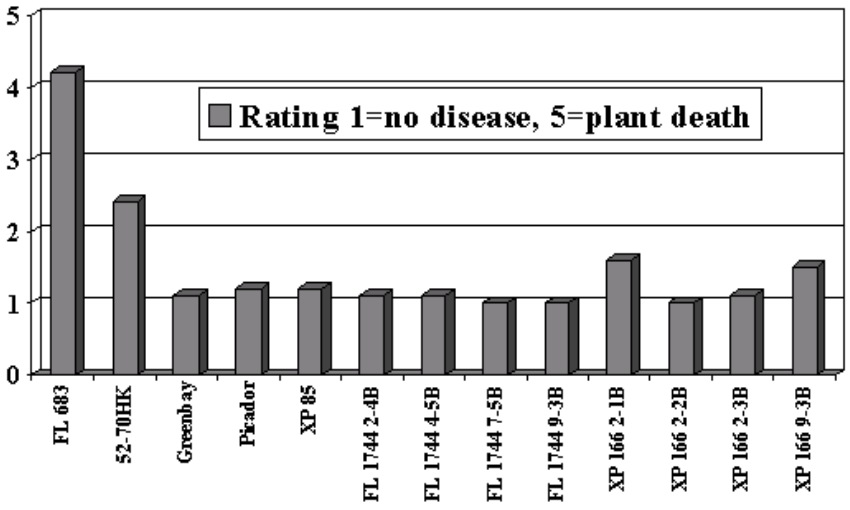

Figure 1. Fusarium disease rating of commercial and somaclonal lines transplanted in a heavily infested site, Hudsonville, 2002.

Once again, disease conditions in the test field were severe,. The susceptible control, 'FL683'

received a mean disease rating of 4.2 (rated on a scale of 1-5, where 1=no disease and 5=dead plant); none of the 'FL683' plants were marketable. On average the F3 progeny showed a high level of resistance, however, there was variability among the F3 families, as would be expected, if there is segregation for the disease resistance trait. Average ratings for the families ranged from 1.0 – 1.8 with an overall average of 1.2. The averages for the ten lines ranged from 1.0 – 1.5. The bulks ranged from 1.0 – 1.6 with a mean of 1.2. With the exception of two bulks, all of the others scored 1.0 or 1.1. These values compare favorably with the commercial cultivars, XP85, XP166, XP266 and Picador which gave values of 1.2, 1.1, 2.4, and 1.2, respectively. Surprisingly, XP266 did not perform well this year, the reason is not known. Yield of the F3 families measured as weight (lbs)/10 plants ranged from 12.5 – 23.4, with an overall mean of 17.0. Weights of the commercial cultivars were 18.8, 19.2, 12.6, and 17.0, respectively. The families were less variable for height than at the F2 stage, indicating success in selecting for this trait. Although not as tall as some of the commercial varieties, six of ten families had acceptable heights, greater than 9" to the first node.

F2 bulks corresponding to 6 of the F3 lines were tested in row trials on two grower-cooperators' farms. F2 materials were used, as F3 seed were not available in time for the commercial plantings. Data were available from one farm. Plants in the row trial showed excellent disease resistance (all had ratings of 1.0). Yields (weight/10 plants) were slightly lower than the XP266 check variety, and the plants were more variable in size and height. This variability is consistent with an early generation (F2) bulk and should diminish as selection proceeds.

Selected individuals were dug from the F3 trial field and are currently in cold storage to induce flowering to allow for F4 seed production this winter.

A New Program for Disease Management

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One of the trials conducted in 2002 emphasized a comparison between commonly used fungicides and new products for use on celery. The ability of the treatments to limit Septoria blight was evaluated by assessing the amount and severity of infection and the marketable yield.

Trial 1. Testing new products for control of Septoria blight of celery.

Treatment and rate/A, applied at 7-day intervals	Currently registered	Active ingredient	Foliar infection* (%) 10/1	Yield per 10 plants (lb)
Untreated inoculated	~	~	7 d**	6.1 c
Untreated natural infection	~	~	6.8 cd	28 ab
Cabrio 20WG 1.0 lb alternated Bravo Ultrex 82.5WDG 1.8 lb	no yes	pyraclostrobin chlorothalonil	1 a	29 a
BAS 516 38WG 10.5 oz	no	pyraclostrobin + BAS 510	1.3 a	27 ab
Quadris 2.08SC 9.2 fl oz alternated Bravo Ultrex 82.5WDG 1.8 lb	yes yes	azoxystrobin chlorothalonil	1 a	27 ab
Quadris 2.08SC 15.0 fl oz alternated Bravo Ultrex 82.5WDG 1.8 lb	yes yes	azoxystrobin chlorothalonil	1 a	26 ab
Quadris 2.08SC 9.2 fl oz alternated Tilt 3.6EC 4.0 fl oz	yes yes	azoxystrobin propiconazole	3 b	28 ab
Quadris 2.08SC 15.0 fl oz alternated Tilt 3.6EC 4.0 fl oz	yes yes	azoxystrobin propiconazole	2 ab	27 ab
Bravo Ultrex 82.5WDG 1.8 lb	yes	chlorothalonil	1 a	26 ab
Serenade 10WP 6.0 lb	yes	*Bacillus subtilis*	5.8 c	24 ab
Messenger 3WDG 9.0 oz	yes	harpin protein	6 cd	24 b
Equus DF 82.5DF 1.8 lb	yes	chlorothalonil	1.5 a	28 ab
Kocide 2000 54WG 1.5 lb	yes	copper hydroxide	6.5 cd	24 ab
Actigard 50WG 1.0 oz	no	acibenzolar-S-methyl	5.5 c	24 ab

* Based on a rating of 1 to 10 where 1=0% to trace of disease; 10=complete defoliation & death.

** Column means with a letter in common are not significantly different (Student-Newman-Keuls; *P*=0.05).

When plants were left untreated, they became severely diseased. Many of the products tested provided excellent disease control, and included Equus DF, or BAS 516 38WG, or Bravo Ultrex 82.5WDG alone or alternated with Quadris 2.08SC or Cabrio 20WG. Good control was also achieved with Quadris 2.08SC alternated with Tilt 3.6EC. When Quadris was used in alternation with Bravo, it appeared that the lower Quadris rate (9.2 fl oz) was as effective as the higher rate (15.0 fl oz).

The higher rate of Quadris did not negatively affect yield. The Serenade 10WP, Messenger 3WDG, Kocide 2000 54WG, and Actigard 50WG products did not provide adequate disease control. To avoid the development of resistance, fungicides should be alternated within each growing season.

Disease forecasting uses weather (temperature, leaf wetness, rainfall, and relative humidity) to determine whether disease is likely to develop. When the environment is favorable, the forecaster alerts the grower that a fungicide spray is needed. Disease forecasters can help time sprays so they are applied when they are most needed. Disease forecasters have been used successfully in vegetable crops, including tomatoes and asparagus. Recent research suggests that carrot blights can also be managed using disease forecasting. In a celery trial conducted during the 2002 growing season, three disease forecasters were compared with each other and to commonly used calendar-based spray programs.

Trial 2. Using forecasters to control Septoria blight of celery.

Treatment and rate/A, application schedule	No. of appl.	Foliar infection* (%) 10/1	Yield per 10 plants (lb)
Untreated inoculated	-	7 c	6.5 b
Untreated natural infection	-	5.5 b	22.9 a
Quadris 2.08SC 9.2 fl oz alternated Bravo Ultrex 82.5WDG 1.8 lb, 7 day	12	1.3 a	23.1 a
Bravo Ultrex 82.5WDG 1.8 lb, 7 day	12	1.3 a	26 a
Quadris 2.08SC 9.2 fl oz alternated Bravo Ultrex 82.5WDG 1.8 lb, Septoria predictor	9	1.3 a	26.1 a
Bravo Ultrex 82.5WDG 1.8 lb, Septoria predictor	9	1 a	22.3 a
Quadris 2.08SC 9.2 fl oz alternated Bravo Ultrex 82.5WDG 1.8 lb, Cercospora predictor	6	1.8 a	26.5 a
Bravo Ultrex 82.5WDG 1.8 lb, Cercospora predictor	6	1.8 a	23.7 a
Quadris 2.08SC 9.2 fl oz alternated Bravo Ultrex 82.5WDG 1.8 lb, Tom-Cast 15 DSV	5	1.8 a	25.4 a
Bravo Ultrex 82.5WDG 1.8 lb, Tom-Cast 15 DSV	5	1.3 a	24.6 a

*Based on a rating of 1 to 10 where 1=0% to trace of disease to 10=complete defoliation and death.
**Column means with a letter in common are not significantly different (Student-Newman-Keuls; *P*=0.05).

When plants were left untreated, they became severely diseased. Spraying the plants every 7 days with either Bravo Ultrex 82.5WDG alone or Bravo Ultrex 82.5WDG alternated with Quadris 2.08SC provided excellent disease control and resulted in 12 applications. Using the Septoria disease predictor reduced the number of sprays needed to 9 without compromising disease control or yield. When fungicides were timed with the Cercospora (6 sprays) or Tom-Cast (5 sprays) disease predictor, the number of fungicide sprays needed dropped even further. Using Bravo Ultrex 82.5WDG alone was comparable to using an alternating program of Bravo Ultrex 82.5WDG and Quadris 2.08SC.

Further work is needed to determine whether forecasting systems can hold up under severe disease pressure, especially when lesions occur early in the season.

This research was supported in part by the GREEEN project (www.greeen.msu.edu), "Using Resistance and Reduced Risk Fungicides to Manage Fusarium Yellows and Foliar Diseases in Michigan Celery;" Celery Research, Inc.; and the USDA CSREES Risk Avoidance and Mitigation Program project, "A Strategy to Advance IPM for Celery Growers in Michigan, California and Florida."