

EVALUATION OF FUNGICIDE PROGRAMS FOR MANAGING POWDERY MILDEW OF MUSKMELON, 1999: The objectives of this study were to examine fungicide resistance management programs for DMI (demethylation inhibiting) fungicides and to evaluate two strobilurin fungicides, Quadris and Sovran. The resistance management programs examined focused on the fungicide components; non-chemical control measures were not included. Bayleton, which is a first generation DMI fungicide, was used because strains of the pathogen resistant to this fungicide are already known to occur. Nova, a newer DMI fungicide, was also used. Two strategies were tested alone and combined: 1) mixture with a multi-site fungicide (Bravo) and 2) alternation with a systemic fungicide with a different mode of action (Quadris). An experiment was conducted at the Long Island Horticultural Research and Extension Center in Riverhead, NY, in a field with Haven loam and Riverhead sandy loam soil. Fertilizer (1000 lb/A of 10-10-10) was broadcast and incorporated on 27 May. To manage *Phytophthora* fruit and crown rot, Ridomil Gold EC (1 pt/A) was broadcast over the entire field then incorporated on 28 May. On 15-18 Jun, 21-day-old seedlings were transplanted into black plastic mulch at 36-in. plant spacing and 68-in. row spacing. Plants were watered using drip irrigation as needed based on irrometer readings. Weeds between rows were controlled by applying Dual 8E (1 pt/treated A) on 2 Jun, applying Gramoxone Extra (1.6 pt/treated A) on 30 Jun, and hand-weeding. Cucumber beetles were managed by applying Sevin XLR (1 qt/A) on 23 Jun, 3 Jul, and 25 Jul. Average monthly high and low temperatures (F) were 83/62 in Jun, 89/69 in Jul, 83/66 in Aug, and 77/61 in Sep. Rainfall (in.) was 0.8, 3.67, 8.18, and 5.31 for these months, respectively. To establish a low level of resistance, squash were transplanted into three rows in the experimental field on 4 Jun and inoculated on 7 Jul with a 99:1 ratio of a Bayleton-sensitive strain and a Bayleton-resistant strain. Fungicides were applied weekly from 30 Jul to 1 Sep with a tractor-mounted boom sprayer equipped with D3-45 hollow cone nozzles spaced 11 in. apart that delivered 100 gpa at 200 psi. A randomized complete block design with four replications was used. Plots contained 24 plants in three rows. Upper and lower (under) surfaces of 10-50 leaves in each plot were examined weekly for powdery mildew beginning on 20 Jul. Powdery mildew colonies were counted; severity was assessed when colonies could not be counted accurately because they had coalesced and/or were too numerous. Average severity for the entire canopy was calculated from the individual leaf assessments. Defoliation was assessed weekly from 24 Aug to 14 Sep. Sensitivity to DMI fungicides of the powdery mildew population in some plots was assessed using a seedling bioassay (F&N Tests 53:227-228) conducted in the field on 3 and 16 Aug and a leaf disk bioassay (Plant Dis. 80: 633-639) conducted in the laboratory with individual isolates collected from the field before treatment on 30 Jul and 25 Aug. Isolates were defined as highly sensitive to DMI fungicides (unable to grow on leaf disks treated with 2 ppm a.i. Nova), moderately sensitive (able to tolerate 2 ppm a.i. Nova), and moderately insensitive (able to tolerate 20 ppm a.i. Nova). Based on previous results, moderately insensitive isolates are resistant to Bayleton.

Powdery mildew was first observed on 20 Jul in 9.5% of the plots. Symptoms were observed throughout the experiment on 29 Jul; fungicide treatments were started the next day. Bayleton resistance was at a higher frequency in plots before the first application (20%) than in the spreader rows at the time of inoculation (about 1%). The high frequency of moderately sensitive strains (69%) indicated a substantial influx of inoculum from outside sources. Both strategies for managing DMI resistance were effective. After 5 applications, Bayleton-resistant strains were most common in the Bayleton alone treatment (80%), less common in the Bravo + Bayleton treatment (50%) and the Quadris alternated with Bayleton treatment (33%), and least common in the Quadris alternated with Bravo + Bayleton treatment (0%). Bayleton-resistant strains were more common in the Bravo + Nova alt. Quadris treatment (50%) than in the Quadris alt. Bravo + Nova treatment (0%). Highly DMI-sensitive strains were only found in plots treated with either Quadris or Sovran alone. They were 20% of the pathogen population in these plots. Significant differences among treatments were detected beginning on 9 Aug, which was 3 days after the second application. Powdery mildew severity on upper surfaces of nontreated plants (5.9%) was significantly greater than all treatments (0.0-0.5%) except Bayleton (2.8%) on 9 Aug. Although resistance was high, Bayleton did provide some control: mildew was significantly less severe on Bayleton-treated than nontreated plants on all other assessment dates. Bravo alone controlled powdery mildew effectively on upper but not lower leaf surfaces, thereby confirming previous results with pumpkins and further documenting the limitations of contact fungicides for resistance management. Bravo + Bayleton was similar in effectiveness to Bravo used alone for controlling powdery mildew on upper leaf surfaces and the combination was similar to Bayleton alone on lower surfaces. Quadris applied weekly was as effective as Quadris applied in alternation with Bravo + Nova. These 2 treatments were more effective than Quadris applied in

alternation with Bravo + Bayleton for powdery mildew on lower leaf surfaces. Efficacy was not affected by the choice of Quadris or Bravo + Nova for the first application in the alternation. Applying Bravo alone for the last 2 applications did not result in significantly more defoliation in Sep due to reduced powdery mildew control. Sovran applied weekly was not significantly more effective than Quadris. However, it was more effective when these fungicides were applied in alternation with Bravo + Bayleton.

Powdery mildew severity (% leaf coverage)

Treatment and rate/A (application dates) <sup>2</sup>	upper leaf surface <sup>1</sup>			lower leaf surface <sup>1</sup>			Defoliation (%)	
	17 Aug	24 Aug	AUDPC	17 Aug	24 Aug	AUDPC	24 Aug	14 Sep
Control (No Fungicide).....	61.5 a <sup>3</sup>	78.1 a	832 a	66.5 a	84.4 a	878 a	84 a	100 a
Bayleton 50DF 4 oz (1-5) .....	18.6 b	24.3 b	282 b	26.5 b	45.7 b	434 b	50 b	100 a
Bravo Ultrex 2.7 lb (1-5).....	0.5 cd	7.9 c	40 cd	50.1 a	61.1 ab	647 ab	50 b	99 a
Bravo + Bayleton (1-5) .....	3.0 c	1.8 cd	51 c	25.7 b	39.8 b	373 b	32 c	80 ab
Quadris F 11 fl oz (1-2), 15.4 oz (3-6) .....	0.6 cd	1.1 cd	15 c-e	0.3 c	0.4 d	10 de	2 d	34 d
Quadris 11 fl oz (1), 15.4 oz (3,5), Bayleton (2,4,6) .....	0.07 cd	2.2 cd	31 c-e	0.6 c	4.7 cd	48 c-e	4 d	70 bc
Quadris 11 fl oz (1), 15.4 oz (3,5), Bravo + Bayleton (2,4,6).....	0.00 d	2.7 cd	16 c-e	0.7 c	16.7 c	104 c	4 d	69 bc
Quadris 11 fl oz (1), 15.4 oz (3,5), Bravo + Nova 40WP 2.5 oz (2,4,6).....	0.00 d	0.0 d	0.2 e	0.0 c	3.1 d	13 de	2 d	57 b-d
Bravo + Nova (1,3,5), Quadris 11 fl oz (2), 15.4 oz (4,6) .....	0.02 cd	0.0 d	1.6 de	1.0 c	4.2 cd	57 cd	8 d	46 cd
Quadris 11 fl oz (1), 15.4 oz (3), Bravo + Nova (2,4), Bravo (5,6) .....	0.02 cd	0.0 d	0.5 de	0.0 c	1.1 d	6 de	1 d	40 d
Sovran 50WG 3.2 oz (1-6).....	0.00 cd	0.0 d	2.3 c-e	0.0 c	0.1 d	1 e	6 d	50 cd
Sovran (1,3,5), Bravo + Bayleton (2,4,6) .....	0.00 cd	0.0 d	0.7 de	0.1 c	1.8 d	9 de	1 d	54 b-d
<i>P</i> -value	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

<sup>1</sup> Exact colony counts were made when possible and severity was estimated using the conversion factor of 10 colonies/leaf = 1%. A square root transformation was used to stabilize variance.

<sup>2</sup> Formulation and rate are listed with the first mention of each material. Application dates: 1=30 Jul, 2=6 Aug, 3=13 Aug, 4=19 Aug, 5=25 Aug, and 6=1 Sep. Applications on 19 and 25 Aug were 1 day early due to rain forecast for scheduled application day.

<sup>3</sup> Means in a column with a letter in common are not significantly different according to Fisher's Protected LSD ( $P = 0.05$ ).

Sensitivity of isolates to DMI fungicides (%)

	Highly Sensitive	Moderately Sensitive	Moderately Insensitive
Before treatment	11	69	20
After 5 applications:			
Nontreated	0	86	14
Bayleton 4 oz/A (7-day)	0	20	80
Bravo Ultrex 2.7 lb/A (7-day)	0	100	0
Bayleton 4 oz/A + Bravo Ultrex-2.7 lb/A (7-day)	0	50	50
Quadris F 12 fl.oz/A (7-day)	17	83	0
Sovran 50 WG 0.1 lb ai/A (7-day)	25	63	12
Quadris (14-day); Bayleton (alternate 14-day schedule)	0	67	33
Quadris (14-day); Bayleton + Bravo Ultrex (alternate 14-day)	0	33	67
Sovran (14-day); Bayleton + Bravo Ultrex (alternate 14-day)	0	83	17
Quadris (14-day); Nova + Bravo Ultrex (alternate 14-day)	0	100	0
Nova + Bravo Ultrex (14-day); Quadris (alternate 14-day)	0	50	50