PUMPKIN (*Cucurbita pepo* 'Appalachian')
Powdery mildew; *Podosphaera xanthii* (formerly named *Sphaerotheca fuliginea*)

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Evaluation of fungicide programs for managing powdery mildew of pumpkin, 2002.

A field experiment was conducted at the Long Island Horticultural Research and Extension Center in Riverhead, NY, on Haven loam soil. Fertilizer (N-P-K 15-15-15) at 666 lb/A was broadcast and incorporated on 8 Jun. Pumpkin seed were planted on 20 Jun at approximately 24-in. plant spacing within rows and 68-in. row spacing. The herbicides Curbit EC (2 pt/treated A) and Command 3ME (1.3 pt/treated A) plus the insecticide Admire 2F (16 fl oz/ treated A) for cucumber beetles were applied in a 10-inch band over the planted rows on 20 Jun; these were incorporated by irrigating. During the season, weeds were controlled by cultivation and hand weeding. Asana XL (9.6 oz/A) was applied on 11 Jul and Sevin XLR (2 pt/A) on 1 Aug for additional control of cucumber beetles. To manage Phytophthora fruit and crown rot (*Phytophthora capsici*), Ridomil Gold EC (1 pt/A) was broadcast over the entire field then incorporated on 8 Jun and Acrobat 50WP (6.4 oz/A) was applied on 11 Jul, 1 Aug, 17 Aug, and 20 Sep. Additionally, soil drainage was improved by subsoiling on 25 Jul between rows before vines grew over. Plots were thinned to about 18 plants in three 15-ft rows. There was 10 ft between plots. A randomized complete block design with four replications was used. Average monthly high and low temperatures (F) were 78/60 in Jun, 85/67 in Jul, 84/67 in Aug, 76/61 in Sep, and 63/50 in Oct. Rainfall (in.) was 4.73, 1.2, 3.09, 5.92, and 4.92 for these months, respectively. The field was overhead irrigated (approx. 1.0 in.) on 20 Jul, 2 and 10 Aug, and 4 and 11 Sep when soil was dry due to inadequate rainfall. All treatments were initiated after the IPM threshold of one leaf with powdery mildew symptoms of 50 old leaves examined was reached in all 36 plots. This threshold was shown previously to be as effective as using a preventive schedule (Plant Dis. 80:910-916). Treatments were started on 15 Aug. Fungicides were applied weekly with a tractor-mounted boom sprayer equipped with D5-45 hollow cone nozzles spaced 17 in. apart that delivered 100 gal/A at 150 psi. Upper and lower surfaces of 5 to 50 leaves in each plot were examined weekly for powdery mildew beginning on 1 Aug when fruit were starting to enlarge. Initially, 50 older leaves were examined in each plot. The examined leaves were selected from the oldest third of the foliage based on leaf appearance and position in the canopy. As disease progressed, the number of leaves examined was adjusted based on the incidence of affected leaves in a plot. Mid-aged and young leaves were also examined beginning on 23 Aug. Only young leaves were examined on 17 Sep. 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 on 5, 12, and 17 Sep. Fruit quality was evaluated in terms of handle (peduncle) condition for mature fruit without rot on 1 Oct. Handles were considered good if they were green, solid, and not rotting. Mature fruit were counted. Weight was not assessed. Isolates were collected on 8 Oct from plots treated with Quadris alone. Their sensitivity to QoI fungicides was assessed using a leaf disk bioassay (Plant Dis. 80:633-639).

Symptoms were found in 1 of the 36 plots on 1 Aug (on 1 of 1800 older leaves examined), in 18 plots on 8 Aug (33 of 1800 leaves), and in all plots on 15 Aug (295 of 432 leaves). Powdery mildew incidence increased substantially between 8 and 15 Aug, thus incidence on 15 Aug differed from the IPM threshold more than desired. This suggests scouting in commercial fields should be done more frequently than every 7 days. Treatments were started on 15 Aug. Only 4 treatments, those that included Quadris, were applied on the first date due to applicator error. Not surprisingly, these treatments had the least powdery mildew on 23 and 26 Aug. The grower standard fungicide program is Quadris applied in alternation with Nova + Bravo. The two components of this program were evaluated separately to determine if control with either Quadris and Nova was below expectations suggesting occurrence of resistance. Quadris was effective initially, providing 80% control of powdery mildew on upper leaf surfaces and 89% control on lower surfaces on 26 Aug following two applications. But control dropped to 0% (severity not significantly different from nontreated) and 42%, respectively, 8 days later. Nova + Bravo was more effective, providing 87% and 65% control at that time even though the first application time of this treatment was missed. Quadris applied in alternation with Nova + Bravo provided 75% and 42% control. In sharp contrast, Quadris applied at 12 fl oz/A on a 14-day schedule was one of the most effective treatments in an experiment at this location in 1997, providing 93% and 66% control at the 25 Sep assessment (F&N Tests 53:227-228). Five of 9 isolates tested were resistant to QoI fungicides (able to grow well on disks treated with up to 100 ppm trifloxystrobin) and exhibited reduced sensitivity to DMI fungicides (able to grow well on disks treated with 50 or 100 ppm triadimefon). Resistance is qualitative to QoIs and quantitative to DMIs. It is not known whether this degree of insensitivity to DMIs is enough to affect efficacy of Nova. Two isolates were sensitive to both chemical classes. Interestingly, only two isolates exhibited a mixed response being sensitive to QoIs but tolerant to DMIs. The most effective treatments were Quadris alt. Procure + Bravo and Quadris alt. Nova + Microthiol Disperss (sulfur). These were significantly better than the grower standard for powdery mildew on lower leaf surfaces based on 3 and 9 Sep severities and also AUDPC values. Cabrio at 16 oz/A alt. Nova + Bravo was as effective as the grower standard even though the Cabrio treatments were started a week after the Quadris ones. TD 2345-01 suppressed powdery mildew only on upper leaf surfaces. The two treatments providing the best control of powdery mildew had the least defoliation on all assessment dates and the most fruit with good solid handles, an important measure of pumpkin fruit quality. Nova + Bravo was the third best treatment based on all of these parameters. There was a trend toward more fruit in plots with best control, but differences were not significant. Quadris alt. Nova + Bravo had significantly less defoliation than nontreated on 5 and 12 Sep, but not on 17 Sep.

Treatment and rate/A (application time)[x]	Powdery mildew severity (% leaf coverage) [w]						Defoliation (%)	% Solid handles
	Upper leaf surface			Lower leaf surface				
	26 Aug	3 Sep	AUDPC	26 Aug	3 Sep	AUDPC	17 Sep	1 Oct
Nontreated ……	28.1 a [x]	62.1 a	800 a	36.8 a	73.3 ab	1034 a	74 a	39 c
Quadris F 15.4 fl oz [w] (1-5) ……	5.7 cd	49.5 a	473 b	4.1 d	42.8 cd	528 c	70 a	56 bc
Nova 40WP 5 oz + Bravo Ultrex 82.5WG 2.7 lb (2-5) ……	19.3 ab	7.9 cd	212 de	17.7 bc	25.3 e	460 cd	19 c	78 ab
Quadris F 15.4 fl oz [w] (1,3,5) *alt.* Nova 40WP 5 oz + Bravo Ultrex 82.5WG 2.7 lb (2,4) ……	11.1 bcd	15.7 cd	214 de	11.1 cd	42.8 cd	575 c	49 ab	73 ab
Quadris F 15.4 fl oz [w] (1,3,5) *alt.* Nova 40WP 5 oz + Microthiol Disperss 80W 4 lb (2,4) ……	1.2 d	8.4 cd	105 e	5.7 cd	16.3 e	250 e	29 bc	66 ab
Quadris F 15.4 fl oz [w] (1,3,5) *alt.* Procure 50WS 6 oz + Bravo Ultrex 82.5WG 2.7 lb (2,4) ……	2.9 d	4.2 d	67 e	7.4 cd	28.8 de	341 de	20 c	78 a
Cabrio 20EG 12 oz (2,4) *alt.* Nova 40WP 5 oz + Bravo Ultrex 82.5WG 2.7 lb (3,5) ……	19.1 ab	14.0 cd	294 cd	33.2 a	58.8 bc	836 b	68 a	59 abc
Cabrio 20EG 16 oz (2,4) *alt.* Nova 40WP 5 oz + Bravo Ultrex 82.5WG 2.7 lb (3,5) ……	15.3 bc	21.2 bc	286 cd	17.0 bcd	44.7 cd	598 c	51 a	60 abc
TD 2345-01 90DG 2 lb (2-5) ……	10.8 bcd	32.9 b	374 bc	30.3 ab	87.1 a	1099 a	66 a	42 c
P-value	0.0012	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002	0.0082

[z] Exact colony counts were made when possible and severity was estimated using the conversion factor of 30 colonies/leaf = 1%. Area under the disease progress curve (AUDPC) was calculated for severity from 23 Aug through 9 Sep.

[y] Rate of formulated product/A. Application times were: 1=15 Aug, 2=21 Aug, 3=27-28 Aug, 4=6 Sep, and 5=13 Sep.

[x] Numbers in each column with a letter in common are not significantly different according to Fisher's Protected LSD (*P* = 0.05).

[w] Applied with NuFilm P (6 oz/A).