

### Evaluation of fungicide programs for managing powdery mildew of pumpkin, 2003.

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 seeds were planted on 27 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 rows on 30 Jun. During the season, weeds were controlled by cultivation and hand weeding. Asana XL (9.6 fl 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 25 Jun and Phostrol (2.5-5 pt/A) was applied on 26 Jul; 6, 13, 20, and 28 Aug, and 7 Sep. Additionally, soil drainage was improved by subsoiling on 25 Jul between rows before vines grew over. Plots averaged 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 76/59 in Jun, 82/66 in Jul, 83/69 in Aug, 75/61 in Sep, and 63/47 in Oct. Rainfall (in.) was 8.33, 2.81, 2.8, 5.9, and 5.05 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 of 50 old leaves examined with powdery mildew symptoms was reached in 35 of 36 plots. This threshold was shown previously to be as effective as using a preventive schedule (Plant Dis. 80:910-916). Starting on 7 Aug fungicides were applied weekly with a tractor-mounted boom sprayer equipped with D5-25 hollow cone nozzles spaced 17 in. apart that delivered 110 gal/A at 100 psi. Upper and lower surfaces of 5 to 50 leaves in each plot were examined weekly for powdery mildew beginning on 31 Jul 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 19 Aug. Only young leaves were examined on 22 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. Isolates were collected on 19 Aug and 25 Sep from nontreated plots and plots treated with Flint or Flint, Nova and Procure. Their sensitivity to QoI fungicides was assessed using a leaf disk bioassay (Plant Dis. 80:633-639). Defoliation was assessed on 15 and 22 Sep. Fruit quality was evaluated in terms of handle (peduncle) condition for mature fruit without rot on 30 Sep and 10 Oct. Handles were considered good if they were green, solid, and not rotting. Fruit were weighed for 4 treatments on 22 Oct.

Flint alternated with Microthiol Disperss (sulfur) reduced powdery mildew, but greater reductions were obtained with Flint plus sulfur alternated with Nova or Procure plus sulfur. Nova and Procure were equally effective in this program with Flint and sulfur. Control was not improved significantly by applying a DMI fungicide weekly (e.g. Flint plus sulfur plus Nova alternated with Procure plus sulfur). A13666, which contains the active ingredients in Quadris plus Bravo, alternated with Procure plus Bravo was not as effective as a similar program with Flint and sulfur, perhaps because sulfur is more effective than Bravo on lower surfaces (F&N Tests 57:V86). Pathogen strains resistant to QoI and/or DMI fungicides were common in the area by the end of Aug, therefore control for programs with these fungicides was only moderate on lower leaf surfaces when assessed on 8 Sep (19-52%) but good with Quintec (91%). A fungicide program consisting of Flint plus sulfur applied week 1, Procure plus sulfur applied week 2, then sulfur applied alone on subsequent weeks was not significantly less effective than a fungicide program with Flint or Procure included in all weekly sulfur applications (68% and 89% control on upper leaf surfaces on 8 Sep for these 2 programs, respectively, and 24% and 34% control on lower surfaces). A similar reduced-spray fungicide program with applications on 7 and 14 Aug only, controlled powdery mildew through 25 Aug as effectively as the full-season program, but by 8 Sep, powdery mildew was as severe on these plants as on the non-treated plants. As found in previous experiments, efficacy of powdery mildew control was related to leaf longevity and proportion of fruit with good solid handles. There were no significant differences in quantity of marketable fruit or average fruit weight for the treatments assessed, which were nontreated, Quintec, and two others. QoI-resistant strains were not more common in Flint-treated plots than in nontreated plots on 19 Aug, with an average of 22% of isolates resistant. In contrast, QoI resistance was detected in 33%, 64%, and 78% of the isolates collected on 25 Sep from nontreated plots, plots treated with Flint plus sulfur, and plots treated with Flint, Nova, Procure plus sulfur, respectively. On 19 Aug, 25% of isolates found to be moderately resistance to DMI fungicides were also resistant to QoI fungicides, while all of the isolates collected on 25 Sep that were moderately DMI resistant were also QoI resistant.

Treatments and rate/A (application time) <sup>y</sup>	Powdery mildew severity (% leaf coverage) <sup>z</sup>						Defolia- tion (%)	% Solid handles
	Upper leaf surface			Lower leaf surface				
	25 Aug	8 Sep	AUDPC	25 Aug	8 Sep	AUDPC	22 Sep	10 Oct
Nontreated control.....	12.0 a <sup>x</sup>	20.7 b	357 a	38.4 a	76.5 ab	1018 a	76 a	42 c
Flint 50WDG 2 oz (1,3,5) alternated with Microthiol Disperss 80W 4 lb (2,4,6) .....	2.6 b	13.0 bc	134 c	17.2 bc	77.3 a	768 b	55 b	50 bc
Flint 50WDG 2 oz + Microthiol Disperss 80W 4 lb (1,3,5) alternated with Nova 40WP 5 oz + Microthiol Disperss 80W 4 lb (2,4,6) .....	0.1 c	3.2 d	32 e	9.1 c	40.0 d	422 de	28 c	72 ab
Flint 50WDG 2 oz + Microthiol Disperss 80W 4 lb (1,3,5) alternated with Procure 50WS 6 oz + Microthiol Disperss 80W 4 lb (2,4,6) .....	0.4 c	2.4 d	26 e	6.8 c	50.6 cd	452 de	36 c	65 abc
Flint 50WDG 2 oz + Microthiol Disperss 80W 4 lb + Nova (1,3,5) alternated with Procure 50WS 6 oz + Microthiol Disperss 80W 4 lb (2,4,6) .....	0.6 bc	2.9 d	30 e	5.1 c	36.4 d	327 e	33 c	71 ab
Flint 50WDG 2 oz + Microthiol Disperss 80W 4 lb (1); Procure 50WS 6 oz + Microthiol Disperss 80W 4 lb (2); Microthiol Disperss 80W 4 lb (3-6) .....	0.4 c	6.7 cd	53 de	11.7 bc	58.5 c	565 cd	21 c	65 abc
Flint 50WDG 2 oz + Microthiol Disperss 80W 4 lb (1); Procure 50WS 6 oz + Microthiol Disperss 80W 4 lb (2) .....	0.8 bc	31.1 a	238 b	9.2 c	74.3 ab	645 bc	66 ab	52 bc
A13666 3 pt (1,3,5) alternated with Procure 50WS 6 oz + Bravo Ultrex 82.5 WDG 2.7 lb (2,4,6) .....	0.6 bc	11.4 c	101 cd	23.2 b	61.9 bc	742 bc	34 c	65 abc
Quintec 6 fl oz (1-6) .....	0.1 c	0.9 d	24 e	5.7 c	6.9 e	140 f	19 c	91 a
P value	0.0001	0.0001	0.0001	0.0002	0.0001	0.0001	0.0001	0.0456

<sup>z</sup> 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 6 Aug through 8 Sep.

<sup>y</sup> Rate of formulated product/A. Application times were: 1=7 Aug, 2=14 Aug, 3=20 Aug, 4=26 Aug, 5=6 Sep, and 6=17 Sep. The last two applications were delayed by rainy weather.

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