PUMPKIN (*Cucurbita pepo* 'Sorcerer')
Powdery mildew; *Podosphaera xanthii*

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Evaluation of a biopesticide (MOI-106) and Rally for managing powdery mildew on pumpkin, 2008.

The experiment was conducted in a field with Haven loam soil at the Long Island Horticultural Research and Extension Center. The field was plowed on 10 May and tilled on 11 Jun. Fertilizer (N-P-K 10-10-10) at 500 lb/A was broadcast and incorporated on 18 Jun. Seeds were planted at approximately 24-in. plant spacing within rows with a vacuum seeder on 21 Jun. The seeder applied fertilizer at 50 lb/A N in a band about 2 in. away from the seed. The herbicides Strategy (3 pt/A) and Sandea (0.5 oz/A) were applied over the plots on 22 Jun followed by overhead irrigation (0.5 in) to activate them. During the season, weeds were controlled by cultivating, rototilling between plots, and hand weeding as needed. Red clover at 10 lb/A was planted with a grain drill to establish driveways on 12 Jul. Cucumber beetles were managed by applying the insecticide Admire 2 F (20 fl oz/A) on 22 Jun in a narrow band over the planted rows immediately after applying herbicide and applying Asana XL (9.6 fl oz/A) to foliage on 31 Jul, 14 Aug, and 21 Aug. To manage damping-off, Ridomil Gold EC (1 pt/A) was broadcast over the field and incorporated mechanically on 10 Jun. SprayHandler (0.5 pt/A) was applied with Ridomil. The following fungicides were applied to foliage preventively for downy mildew (*Pseudoperonospora cubensis*) and Phytophthora blight (*Phytophthora capsici*): Ranman 400 SC (2.75 fl oz/A) on 20 Jul, 14 Aug, 21 Aug, 30 Aug, and 21 Sep; Forum 4.16SC (6 oz/A) on 5 Aug, 12 Sep, and 24 Sep; and Curzate 60 DF (3.2 oz/A) on 31 Jul. Kocide 3000 (1-1.25 lb/A) was applied for bacterial leaf spot on 5 Aug and 12 Sep. Plots were three 15-ft rows spaced 68 in apart. The plots were 18 ft apart. A randomized complete block design with four replications was used. Applications of the products tested were made weekly from 30 Jul to 11 Sep using a tractor-mounted boom sprayer equipped with D5-25 hollow cone nozzles spaced 17 in. apart that delivered 96 gal/A at 100 psi. Plots were inspected weekly for powdery mildew symptoms on 1, 8, 12, 18, and 26 Aug; 2 Sep and 13 Sep. Initially upper and lower leaf surfaces of 50 older leaves were examined per plot. Leaves to be examined were selected from the oldest third of the foliage based on leaf physiological appearance and position in the canopy. As disease progressed, the number of leaves examined was adjusted based on incidence of symptomatic leaves in each plot. Mid-aged leaves were also assessed beginning on 18 Aug and young leaves on 26 Aug. Five leaves of each age group were rated starting on 2 Sep. Mid-aged to young leaves were examined on 13 Sep, as most old leaves had senesced by then. Powdery mildew colonies were counted; severity was assessed by visual estimation of percent leaf area infected 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. A square root transformation was used when needed prior to analysis to achieve homogeneity of variance. Canopy condition including defoliation was assessed on 29 Aug and 12 Sep. Fruit quality was evaluated in terms of handle (peduncle) condition for mature fruit without rot on 25 Sep and 10 Oct. Handles were considered good if they were green, solid, and not rotting. Fungicide sensitivity of pathogen strains in the experiment was examined by conducting in-field seedling bioassays and by testing isolates in the laboratory on treated leaf disks. For the bioassay, pumpkin seedlings were produced in a growth chamber and then greenhouse. They were treated with various rates of different fungicides applied with a CO_2-pressurized backpack sprayer. The day after treatment the seedlings were placed in the field for at least 4 hours, then moved to a greenhouse for about 10 days until mildew developed. Severity of powdery mildew on leaves of treated seedlings was compared to non-treated ones to estimate the proportion of the pathogen population able to tolerate each fungicide rate tested. The bioassay was conducted on 18 Jul in a nearby experiment where powdery mildew had already started to develop to determine resistance frequency at LIHREC before fungicide treatments for powdery mildew were started. The assay was conducted on 13 Aug in a nontreated section of the field beyond where the experiment being reported was conducted. Isolates were collected on 18 Aug from nontreated plots. Their sensitivity to fungicides was assessed using a leaf disk bioassay (Plant Dis. 80:633-639). Average monthly high and low temperatures (^oF) were 80/63 in Jun, 84/67 in Jul, 79/63 in Aug, 75/61 in Sep, and 63/47 in Oct. Rainfall (in.) was 3.88, 3.67, 3.76, 8.34, and 3.18 for these months, respectively.

Powdery mildew was at a low level at the first assessment on 1 Aug, which was 2 days after treatments were started. Symptoms were found in 6 of 12 plots on 23 of the 600 older leaves examined. On 26 Aug the biopesticide MOI-106 was providing 62% control on upper leaf surfaces and 11% control on lower leaf surfaces. Degree of control was 51% on upper leaf surfaces based on AUDPC values. Limited control on lower leaf surfaces is not surprising considering MOI-106 does not have systemic activity. Rally provided a very high level of control: 98 and 89% control on upper and lower leaf surfaces, respectively, based on AUDPC values. Therefore the level of insensitivity to DMI fungicides in this pathogen population did not affect control. None of the 5 isolates collected on 18 Aug from nontreated plots tolerated 80 ppm in the leaf disk assay. Based on the bioassay conducted on 13 Aug, 20% of the pathogen population tolerated this concentration. Dose in the spray tank was 156 ppm. There were no significant difference among treatments in total number of fruit or percent rotten fruit. Proportion of marketable fruit with good handles was greatest for Rally-treated pumpkins, reflecting the impact of powdery mildew control on vine health and thus time when vines die resulting in pumpkin handles becoming brown, shriveled, and soft.

	Powdery mildew severity (%)							
	Upper leaf surface			Lower leaf surface			Good handles (%)	
Treatment and rate [y]	26-Aug	2-Sep	AUDPC	26-Aug	2-Sep	AUDPC	8-Oct	23-Oct
Rally 40WSP 5 oz/A	0.3 c	0.7 b	4.8 c	1.4 c	5.2 b	29.7 b	90.6 b	68.1 b
MOI-106 1%	3.7 b	23.1 ab	109.0 b	10.5 b	42.5 a	232.0 a	56.8 a	24.8 a
Nontreated	9.7 a	42.5 a	221.7 a	11.7 a	50.3 a	268.4 a	50.8 a	18.8 a
P-value (treatment)	0.0005	0.0241	0.0038	0.0058	0.0162	0.0038	<.0001	0.0004

[z] Exact colony counts were made when possible and severity was estimated using the conversion factor of 30 colonies/leaf = 1%. Data were transformed from percentages by a square root transformation when needed to obtain normality of variance before analysis of variance was performed. The table has de-transformed means.

[y] Treatments were started after finding symptoms on older leaves. Application dates were on 30 Jul; 5, 13, 19, and 27 Aug; 5 Sep, and 11 Sep.

[x] Means followed by the same letter are not statistically different from each other (Fisher's Protected LSD, P=0.05).