

Efficacy of fungicides for managing powdery mildew in pumpkin, 2012.

The primary objective of this study was to evaluate the efficacy of several fungicides with single-site mode of action for the control of cucurbit powdery mildew. Both new and currently registered products were tested in an area where in previous years strains of the pathogen were detected with resistance to FRAC code 1, 7, and 11 fungicides and moderate resistance to FRAC code 3 fungicides. An experiment was conducted in a field with Haven loam soil at the Long Island Horticultural Research and Extension Center in Riverhead, NY. The field was plowed on 2 May and tilled on 30 May. Seeds were planted at approximately 24-in. plant spacing within rows with a vacuum seeder on 19 Jun. The seeder applied fertilizer in two bands about 2 in. away from the seed. Controlled release fertilizer (N-P-K, 15-5-15) was used at 675 lb/A (101 lb/A N). The herbicides Strategy (3 pt/A), Curbit EC 1 pt/A, and Sandea (0.5 oz/A) were applied over the entire plot area on 22 Jun, which was followed by irrigation to activate. During the season, weeds were controlled by cultivating and hand weeding as needed. Cucumber beetles were managed by applying the insecticide Admire Pro (2.8 fl oz/1000 ft) in a narrow band over the planted rows immediately after the herbicide application on 22 Jun and Asana XL (9.6 fl oz/A) on 31 Jul. The following fungicides were applied preventively for downy mildew (*Pseudoperonospora cubensis*) and/or Phytophthora blight (*Phytophthora capsici*): ProPhyt (2 qts/A) on 18 Jul; Curzate 60 DF (5 oz/A) on 31 Jul and 8 Aug; Presidio (4 fl oz/A) on 31 Jul, 23 Aug, and 7 Sep; Ranman 400 SC (2.75 fl oz/A) on 31 Jul; and Revus (8 oz/A) on 8 Aug, 14 Aug, 31 Aug and 14 Sep. A fungicide application could not be made before a 2.5 in. rain event on 28 Jul because of sprayer malfunction. Rain also fell on 20 and 24 Jul. Symptoms of Phytophthora blight were first observed on 30 Jul. Affected plants were removed, then several oomycete fungicides were applied together on 31 Jul before resuming a 7-day schedule alternating among individual products. Four plots were lost because of blight. Downy mildew was not seen. Plots were three 15-ft rows spaced 68 in. apart. The plots were 20 ft apart in the row initially until plants began to vine. Vines were moved as needed to maintain plot separation. A randomized complete block design with four replications was used. Treatments were applied five times on a 7- or 14-day schedule beginning on 2 Aug using a tractor-mounted boom sprayer equipped with twinjet (TJ60-11004VS) nozzles spaced 17 in. apart that delivered 68 gal/A at 65 psi and 2.3 mph. Plots were inspected for powdery mildew symptoms on upper and lower leaf surfaces weekly beginning on 30 Jul. Initially the examined leaves were selected from the oldest third of the foliage based on leaf physiological appearance and position in the canopy. Additional powdery mildew assessments were made on 7, 14, 21 and 28 Aug and 6 Sep. Mid-aged and young leaves were also assessed beginning on 7 Aug. At least nine leaves were examined in each plot on each assessment date. Powdery mildew colonies were counted; severity was assessed by visual estimation of percent leaf area affected when colonies could not be counted accurately because they had coalesced and/or were too numerous. Colony counts were converted to severity values using the conversion factor of 30 colonies/leaf = 1% severity. Average severity for the entire canopy was calculated from the individual leaf assessments. Area Under Disease Progress Curve (AUDPC) values were calculated from 14 Aug through 6 Sep. Defoliation was assessed on 17 Sep and 15 Oct. Fruit quality was evaluated in terms of handle (peduncle) condition for mature fruit without rot on 17 Sep and 15 Oct. Handles were considered good if they were green, solid, and not rotting. Average monthly high and low temperatures (°F) were 78/61 in Jun, 85/68 in Jul, 83/67 in Aug, 75/60 in Sep, and 66/52 in Oct. Rainfall (inches) was 5.44, 4.35, 3.24, 3.75, and 2.17 for these months, respectively.

Powdery mildew was first observed in this experiment on 30 Jul. Most treatments were individual products evaluated alone. This is neither a labeled nor recommended use pattern for growers. Such evaluations, however, identify appropriate rates for new products and monitor efficacy of registered fungicides at risk for resistance development in order to develop management recommendations for growers. Among currently registered fungicides, Pristine (FRAC Code 7 and 11) applied at its highest label rate was ineffective. Powdery mildew severity on leaves treated with Pristine was significantly less than on non-treated pumpkins only on 21 Aug and only for the upper leaf surface (1.7 and 10%, respectively). In previous years at this location, pathogen isolates resistant to both components of this fungicide have been detected, and the fungicide has exhibited variable performance in previous evaluations. Powdery mildew also was not effectively controlled by Fontelis (FRAC 7), a chemically-related fungicide registered in 2012. This fungicide did suppress powdery mildew through 21 Aug on both leaf surfaces and 28 Aug on upper surfaces. Procure (FRAC 3) applied at its highest label rate was effective through 28 Aug on both leaf surfaces. In contrast with Pristine and Fontelis, Procure was effective based on AUDPC values. Similar control was achieved with Mettle, a new FRAC 3 fungicide not registered yet for use on cucurbits. There were no significant differences between these fungicides or between the two rates of Mettle tested. Quintec (FRAC 13) was highly effective through the last assessment on 6 Sep when the other registered fungicides were no longer effective. IKF-309, an experimental fungicide, was numerically, but not significantly, more effective applied five times on a 7-day than three times on a 14-day schedule. The later treatment was not effective compared to the non-treated control. The higher rate of IKF-309 was numerically, but not significantly, more effective than the lower rate based on most assessments. Similar control was obtained applying IKF-309 alone or in alternation with Rally. There was a trend toward more effective control with the combination on lower leaf surfaces, where powdery mildew is more challenging to control, but the opposite on upper surfaces. Very good to excellent control was achieved with the two programs with multiple fungicides applied in alternation. The program with new fungicides (Torino and Luna Sensation) was numerically but not significantly better, providing 99% and 99% control on upper and lower leaf surfaces, respectively, based on AUDPC values, compared to 82% and 89% control, respectively, achieved with the program with current fungicides. Plants receiving these programs had noticeably less defoliation on 17 Sep than other treatments; however, there was no separation among means despite the low *P* value. No significant differences were detected among treatments in fruit quality.

Treatment and rate/A (application dates) ^y	Powdery mildew severity (%) ^z						Defolli- ation (%)
	Upper leaf surface			Lower leaf surface			
	28 Aug	6 Sep	AUDPC ^x	28 Aug	6 Sep	AUDPC ^x	
Non-treated control.....	27.3 ab	57.3 a	589.3 a	76.1 a	80.9 a	1401 a	95.0 a
Pristine 38 WG 18.5 fl oz (1-5).....	12.8 bcd	41.3 ab	234.1 abc	50.1 abc	84.2 a	847 abc	95.0 a
Procure 480 SC 8 fl oz (1-5).....	2.3 cd	20.0 ab	94.1 bcd	29.5 cde	69.0 a	601 bc	92.5 a
Quintec 2.08 SC 6 fl oz (1-5).....	0.5 cd	0.9 b	24.5 cd	1.1 de	1.5 c	63 e	78.3 a
Fontelis SC 1 pt (1-5).....	9.4 cd	44.9 ab	292.4 abc	58.2 abc	73.3 a	944 abc	93.8 a
Mettle 125 ME 6 fl oz (1-5).....	2.8 cd	14.8 b	68.9 bcd	24.8 cde	66.7 a	510 cd	93.8 a
Mettle 125 ME 8 fl oz (1-5).....	1.4 cd	11.9 b	119.9 abcd	38.1 bcd	57.4 ab	611 bc	88.8 a
IKF-309 4 fl oz (1, 3, 5).....	16.7 abc	33.0 ab	311.5 ab	72.5 ab	75.2 a	1209 ab	95.0 a
IKF-309 5 fl oz (1, 3, 5).....	30.4 a	21.2 ab	404.8 ab	56.7 abc	70.9 a	1004 abc	96.6 a
IKF-309 4 fl oz (1-5).....	2.8 cd	12.3 b	90.3 bcd	58.5 abc	70.5 a	942 abc	92.5 a
IKF-309 5 fl oz (1-5).....	3.8 cd	5.3 b	84.2 bcd	45.6 abc	71.9 a	834 abc	92.5 a
IKF-309 4 fl oz (1, 3, 5) alt. Rally 40W 5 oz (2, 4).....	0.3 cd	34.6 ab	166.3 abcd	25.1 cde	78.7 a	575 bcd	94.0 a
Quintec 6 fl oz (1,3,5); Procure 8 fl oz (2); Pristine 18.5 oz (4).....	0.2 d	20.7 ab	71.0 bcd	1.0 e	19.4 bc	154 de	62.5 a
Torino 0.85SC 3.4 fl oz (1, 4); Quintec 2.08 SC 6 fl oz (2, 5) ; Luna Sensation 5 fl oz (3) + Bravo Ultrex 1.8 lb (1-5)...	0.0 d	1.1 b	5.5 d	0.3 e	2.2 c	15 e	67.3 a
<i>P-value (treatment)</i>	<0.0001	0.0004	<0.0001	<0.0001	<0.0001	<0.0001	0.0142

^z Numbers in each column followed by the same letter are not significantly different from each other (Tukey's HSD, $P=0.05$). Defoliation means did not separate.

^y Rate of formulated product/A. Application dates were 1=2 Aug, 2=8 Aug, 3=14 Aug, 4=22 Aug, and 5=29 Aug.

^x AUDPC values were square root transformed before analysis. Table contains de-transformed values.