SQUASH (*Cucurbita moschata* 'Waltham Butternut')
Downy mildew; *Pseudoperonospora cubensis*

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Evaluation of fungicides for managing downy mildew in winter squash, 2007.

Two new fungicides expected to be registered in 2008, Revus and Presidio, were tested as components of fungicide programs. These new fungicides were compared to a currently recommended fungicide program: Tanos + ethylene bis dithiocarbamate (EBDC) fungicide alternated with Previcur Flex + EBDC fungicide. Butternut squash was direct-seeded on 11 Jul. A late planting date was used to increase the likelihood that downy mildew would develop during the experiment. Inoculum often has arrived late in the summer growing season in this area, especially before 2004 when the current dominant pathogen strain was not known. Weeds were controlled by applying Strategy (2 pt/A) over the seeded rows on 11 Jul, and by cultivating and hand weeding as needed. Cucumber beetles were managed with insecticides, applying Admire 2 F (20 fl oz/A) over the planted rows with Strategy on 11 Jul and Asana XL (9.6 fl oz/A) as a foliar treatment on 17 Aug. Powdery mildew was managed by applying Quintec (6 oz/A) on 4, 13, and 23 Sep and Procure 480SC (8 fl oz/A) on 27 Aug and 23 Sep. Plots consisted of three 15-ft rows spaced 68 in apart. The plots were 15 ft apart in the row. A randomized complete block design with four replications was used. Fungicides were applied weekly for 10 weeks beginning on 9 Aug, before symptoms were seen, using a tractor-mounted boom sprayer equipped with D5-25 hollow cone nozzles spaced 17 in. apart that delivered 86 gal/A at 100 psi. Downy mildew severity was assessed weekly beginning on 28 Sep by rating percent plot area with symptomatic leaf tissue and by rating defoliation as the disease progressed. Severity was also rated on 12 leaves. Average monthly high and low temperatures (^{o}F) were 82/66 in Jul, 82/65 in Aug, 77/60 in Sep, and 70/56 in Oct. Rainfall (in.) was 3.63, 2.60, 1.51, and 1.84 for these months, respectively. Overhead irrigation was used as needed to supplement rainfall.

Symptoms of downy mildew were first seen at this research facility on 14 Aug on cucumber in a nearby planting of a Cucurbitaceae differential set. Symptoms were not found in this experiment until mid-Sep. Non-treated plants quickly became severely affected. Downy mildew severity on these plants was 79% on 28 Sep and defoliation was 90% on 15 Oct. Downy mildew development was favored by the long, heavy dew periods common during late summer to fall where this experiment was conducted. All of the fungicide programs provided a similar, high level of control. Control ranged from 82% to 86% on 28 Sep and 56% to 65% on 18 Oct based on average downy mildew severity on leaves. Two of the four programs with Revus included Quadris Opti and/or Ridomil Gold Bravo. The mobile, single-site mode of action components of these products (azoxystrobin and mefenoxam) may not have contributed to control based on results from an adjacent experiment in which neither Cabrio 20 EG (another FRAC Code 11 fungicide) nor Ridomil Gold EC controlled downy mildew in cucumber, and resistance was detected (PDMR 2:V149). If azoxystrobin and mefenoxam were ineffective, then downy mildew was managed effectively by applying a mobile fungicide (Revus) every 14 days with a protectant fungicide (Manex or Bravo) applied every 7 days. Control was not improved by alternating Previcur Flex with Revus, thus applying a mobile fungicide every week; however, alternating among different mobile fungicides (with different FRAC codes) applied on a 7-day interval is recommended to reduce the chance of resistance developing to the mobile fungicides, all of which are considered to be at risk. There were no significant differences between the two rates of Presidio. Revus 2.09, Presidio 4SC, and Tanos 50DF were equally effective in 7-day fungicide programs consisting of these products applied in alternation with Previcur Flex 6F and with Manex F applied weekly.

	Downy mildew severity (%) [z]			Defoliation (%) [z]	
Treatment and rate/A [y]	28-Sep	8-Oct	18-Oct	15-Oct	18-Oct
Non-treated control ……	78.8 a [x]	92.5 a	96.3 a	90.0 a	96.3 a
Revus 2.09 8 fl oz + Manex F 1.6 qt alt Quadris Opti 3.2 pt ……	11.9 b	23.8 b	33.8 b	43.8 b	44.4 b
Revus 2.09 8 fl oz + Manex F 1.6 qt alt Previcur Flex 6F 0.6 pt + Manex F 1.6 qt ……..	10.6 b	16.9 b	38.8 b	38.8 b	43.8 b
Revus Opti 3.67 3 pt alt Previcur Flex 6F 0.6 pt + Manex F 1.6 qt …….	11.3 b	23.8 b	42.5 b	33.8 b	40.6 b
Ridomil Gold Bravo 2.5 pt + Revus 2.09 8 fl oz alt Quadris Opti 3.2 pt …….	14.4 b	16.9 b	42.5 b	31.3 b	36.3 b
Presidio 4SC 3 oz + Manex F 1.6 qt alt Previcur Flex 6F 0.6 pt + Manex F 1.6 qt ……..	14.4 b	16.3 b	37.5 b	31.3 b	36.3 b
Presidio 4SC 4 oz + Manex F 1.6 qt alt Previcur Flex 6F 0.6 pt + Manex F 1.6 qt ……..	10.6 b	13.1 b	42.5 b	30.0 b	33.8 b
Tanos 50DF 8 oz + Manex F 1.6 qt alt Previcur Flex 6F 0.6 pt + Manex F 1.6 qt ……..	12.5 b	13.1 b	41.3 b	28.8 b	32.5 b
P-value (trt)	< .0001	< .0001	0.0036	0.0001	0.0009

[z] Severity was assessed for 12 individual living leaves as percent leaf tissue with symptoms of downy mildew. Proportion of leaves in a plot that had died was estimated as a measure of defoliation.

[y] Rate of formulated product/A. Treatments were started before disease detection in the area. Application dates were 9 Aug, 16 Aug, 25 Aug, 31 Aug, 7 Sep, 14 Sep, 21 Sep, 26 Sep, 5 Oct, and 15 Oct.

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