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

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Evaluation of fungicides for managing downy mildew of winter squash, 2006.

The objective of this study was to evaluate registered and experimental chemicals for the control of downy mildew in butternut squash. Downy mildew has become an important problem for cucurbit growers in the northeastern US because in recent years this disease has infected plants in the area much earlier in the season than was previously observed. A field experiment was conducted at the Long Island Horticultural Research and Extension Center on Haven loam soil. The field was tilled on 1 May and fertilizer (N-P-K 10-10-10) at 400 lb/A was broadcast and incorporated on 24 May. Three rows of black plastic mulch spaced 30 in. apart were laid on 30 May. 'Bugle' squash seeds, a variety with powdery mildew resistance, were planted on 13 Jun in the greenhouse and were transplanted in the field on 29 Jun. Due to poor germination of seed, three replications were transplanted and the fourth replication was hand-seeded (2 seeds/hole) into the plastic mulch. During the season, weeds were controlled with one application of Select 2 EC (8 fl oz/A) on 31 Jul, hand weeding, and mowing between the rows of black plastic mulch. The insecticide Asana XL EC (9.6 fl oz/A) was applied on 30 Jul and 5 Aug to control cucumber beetles. Water was provided as needed through drip irrigation lines placed beneath the mulch. Additional fertilizer (N-P-K 34-0-0) at 29.4 lb/A was injected through the drip irrigation system on 12 and 28 Jul; and 10 and 17 Aug. Cuprofix Disperss 36.9 DF (2.5 lb/A) was applied on 12 Jul for control of bacterial leaf spot (caused by *Xanthomonas campestris* p.v. *cucurbitae*). Plots were three 12-ft rows spaced 68-in apart. Each row consisted of 3 plants each spaced 24 in. apart; 10 ft was left unplanted between plots. A randomized complete block design with four replications was used. Average monthly high and low temperatures (^{o}F) were 77/62 in Jun, 84/69 in Jul, 82/67 in Aug, and 73/58 in Sep. Rainfall (in.) was 5.83, 3.79, 5.48, and 3.66 for these months, respectively. All treatments were started on 28 Jul and reapplied weekly on 4, 11, 18, and 30 Aug; 5 and 19 Sep with a tractor-mounted boom sprayer equipped with D5-25 hollow cone nozzles spaced 17 in. apart that delivered 85 gal/A at 100 psi. Downy mildew severity was assessed on upper and lower leaf surfaces on 18 Sep, 3 days after symptoms were first observed, and again on 27 Sep. Ten mid-aged leaves per plot were selected for both assessments based on leaf physiological appearance and position in the canopy. Downy 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. 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.

Downy mildew was first observed on 15 Sep on the lower surface of leaves in one plot. Only one replication was examined extensively and the disease was only found in the control plot. When the first disease assessment was done on 18 Sep, symptoms of downy mildew were not found on the upper leaf surface for any treatment. There were no significant differences in disease severity on the lower leaf surface on this date. When evaluated on 27 Sep, all treatments were controlling downy mildew to a similar degree based on severity on the upper leaf surface; however, all but Cabrio were controlling downy mildew based on severity on the lower leaf surface. Area under the disease progress curve (AUDPC) was calculated for severity from 18 to 27 Sep on the lower leaf surface. Based on AUDPC values, the fungicide program, consisting of several registered products combined, along with Revus 250 SC (mandipropamid) and the two treatments with the experimental Valent BioSciences fungicide (V-10161 alone and in combination with Bravo Ultrex 82.5 WG) provided the best level of downy mildew control. Ridomil Gold EC performed at a slightly lower level than these fungicides and Cabrio EG was ineffective. Efficacy of Cabrio EG was likely affected by resistance to quinone outside inhibitor (Q_oI) fungicides which has been documented elsewhere in the US; however, this was not confirmed. There has also been concern that strains of the pathogen with resistance to mefenoxam could occur and affect efficacy of Ridomil fungicides. No phytotoxicity was observed.

	Downy mildew severity (%)[z]					
	Upper leaf surface		Lower leaf surface			
Treatment and rate/A	27-Sep		18-Sep	27-Sep		AUDPC	
Fungicide program[y] …….....	0.2	b[x]	0.7	5.1	b	24.8	c
Revus 250 SC 8 fl oz ……..……..	0.1	b	0.4	6.6	b	32.9	c
V-10161 3 fl oz ……..……	0.4	b	1.2	7.1	b	33.2	c
V-10161 3 fl oz alt Bravo Ultrex 82.5 WG 1.5 lb	0.2	b	1.2	8.5	b	44.3	c
Ridomil Gold EC 2 pt ……..…….…...	0.1	b	3.9	6.8	b	66.3	bc
Cabrio EG 12 oz…….…...	1.0	b	7.6	30.0	a	177.3	ab
Nontreated (control) ……..…...	9.2	a	9.5	35.9	a	205.5	a
P-value	0.0006		0.3646	0.0004		0.0111	

[z] Exact colony counts were made when possible and severity was estimated using the conversion factor of 30 colonies/leaf = 1%. Severity data is for mid-aged leaves on both 18 and 27 Sep. AUDPC was calculated for the lower leaf surface only.

[y] The fungicide program consisted of two applications of Bravo Ultrex 82.5 WG (1.5 lb/A) alone followed by one application of Bravo Ultrex 82.5 WG (1.5 lb/A) + Previcur Flex 6F (1.2 pt/A) followed by one application of Bravo Ultrex 82.5 WG (1.5 lb/A) + Previcur Flex 6F (1.2 pt/A) + Curzate 60DF (3.2 oz/A) followed by two applications of Bravo Ultrex 82.5 WG (1.5 lb/A) + Curzate 60DF (3.2 oz/A).

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