SQUASH, WINTER (*Cucurbita moschata* 'Waltham')
Powdery mildew; *Podosphaera xanthii*

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Experimental fungicides compared to fungicides registered for managing powdery mildew of winter squash, 2004.

The objective of this experiment was to compare two experimental fungicides of high priority for the IR-4 program to current and future grower standard fungicide programs. The current standard fungicide program consisted of a DMI fungicide (Procure50WS) tank-mixed with a protectant fungicide (sulfur formulated as Microthiol Disperss 80W) and applied in alternation with a QoI fungicide (Flint 50WDG) plus sulfur. These fungicides were federally registered for this use in the US at the time of the study. Control with this program was anticipated to be compromised by strobilurin resistance based on results from 2003. Therefore a future program was also included with Quintec 2.08SC substituted for Flint 50WDG. At the time, Quintec 2.08SC had a federal label for other crops and was granted a 24c registration in NY. Squash was grown on black plastic mulch with a clover living mulch between the rows of plastic. Fertilizer (N-P-K 10-10-10) at 1000 lb/A was broadcast and incorporated on 7 May. Black plastic mulch and drip irrigation were laid on 12 May. Dutch white clover (11 lb/A) was drilled at 7-in. row spacing in the driveways between plots on 12 May and seed was hand-spun on 14 May over the approximately 32-inch-wide bare soil strips between the plastic strips after smoothing the soil with a rototiller. Weeds were managed by applying the herbicides Sandea (0.5 oz/A) on 4 Jun to the entire field and Round-up Ultra (1.5 qt/A) on 20 Jul between plots, mowing before transplanting, and hand-removal. Seeding was done in the greenhouse on 24 May. Seedlings were transplanted with starter fertilizer (20-20-20) at 24-in. plant spacing and 68-in. row spacing on 23 Jun. A randomized complete block design with four replications was used. Plots were 3 rows of 3 plants each with 12 ft between plots. To manage Phytophthora fruit and crown rot (*Phytophthora capsici*), the low end of the field with poor drainage was not planted, Ridomil Gold EC (1 pt/A) was broadcast over the entire field then incorporated on 7 May, and Phostrol (5 pt/A) was applied on 12 Aug, 25 Aug, 4 Sep, and 17 Sep. Downy mildew was managed by applying Ridomil Gold EC (0.25 pt/A) with Phostrol on 12 and 25 Aug, Curzate (3.2 oz/A) on 14 Aug, 4 Sep, and 12 Sep, and Acrobat 50WP (6.4 oz/A) on 20 Aug, 7 Sep and 14 Sep. These fungicides were selected because they were not expected to affect powdery mildew. Applications of Ridomil and Acrobat also may have been beneficial for managing *P. capsici*. The field was irrigated when irrometer readings indicated soil was dry due to inadequate rainfall. Average monthly high and low temperatures (^{o}F) were 77/59 in Jun, 82/65 in Jul, 82/66 in Aug, 78/60 in Sep, and 64/49 in Oct. Rainfall (in.) was 0.88, 3.33, 3.94, 6.97, and 2.04 for these months, respectively. All treatments were initiated after the IPM threshold of one leaf of 50 old leaves examined with powdery mildew symptoms was reached in most plots (Plant Dis. 80:910-916). Applications were made weekly (27 Jul; 4, 11, 18, 24, and 30 Aug; and 6 Sep) with a tractor-mounted boom sprayer equipped with D5-25 hollow cone nozzles spaced 17 in. apart that delivered 85 gpa at 100 psi. Upper and lower surfaces of 5 to 50 leaves in each plot were examined for powdery mildew on 26 Jul; 2, 10, 17, 23 and 30 Aug, and 15 Sep. 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 leaves also were examined beginning on 10 Aug. Young leaves also were examined on 15 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. A square root transformation was used when needed prior to analysis to achieve homogeneity of variance. Canopy condition was assessed on 1, 13, and 24 Sep. Ripe fruit were harvested from each plot and weighed on 13 Oct.

Powdery mildew remained substantially less severe in this experiment than in previous experiments conducted at this location with Waltham butternut squash due at least partly to the occurrence of downy mildew and perhaps also due to the fungicides used to manage it. Severity on non-treated plants, while higher than all other treatments, remained less than 1% on the upper surface of leaves, and on the lower surface it averaged only 6% on 30 Aug and 23% on 15 Sep. Treatments were started early in powdery mildew development, one day after symptoms were observed in 25 of 28 plots on only 66 of the 1400 older leaves examined. There were significant differences in powdery mildew severity among treatments on 10 Aug, when powdery mildew was more severe on squash receiving the current standard program than on squash receiving any other treatment (data not shown). Resistance to QoI fungicides was shown to be common on Long Island at the start of powdery mildew development through another project. There were no significant differences between the two grower standard programs. Both experimental fungicides applied at the higher rate were significantly more effective than the two grower standard programs based on AUDPC values. There were no significant differences between the experimental fungicides applied at the higher rate. Defoliation rated in Sep may have been partly due to downy mildew. There were no significant differences among treatments in average fruit weight, number of fruit, or total weight of fruit (data not shown).

	Powdery mildew severity (% leaf coverage) [z]						Defoliation (%)	
	Upper leaf surface			Lower leaf surface				
Treatments and rate/A (application time) [y]	30 Aug	15 Sep	AUDPC	30 Aug	15 Sep	AUDPC	1 Sep	13 Sep
NF-149 WG 1.8 oz (1-7)…….	0.0020 b [x]	0.004 a	1.6 d	0.0004 b	0.8 b	6.4 c	27.5 ab	21.3 ab
NF-149 WG 3.6 oz (1-7)…..……..	0.0036 b	0.000 a	5.0 cd	0.0306 b	0.0 b	2.0 c	12.5 bcd	31.3 a
V-10118 0.41EC 1.6 fl oz (1-7) ……..……	0.0005 b	0.010 a	20.3 bc	0.1056 b	1.3 b	26.9 bc	22.5 abc	32.5 a
V-10118 0.41EC 3.1 fl oz (1-7) ……..……	0.0000 b	0.002 a	4.1 cd	0.0524 b	0.5 b	7.0 c	10.3 cd	28.8 a
Procure 50WS 6 oz + Microthiol Disperss 80W (1,3,5), Quintec 2.08SC 4 fl oz + Microthiol Disperss 80W (2,4), Microthiol Disperss 80W (6,7) [w] …….	0.0001 b	0.289 a	36.0 ab	0.6906 b	13.6 a	125.5 ab	3.3 d	7.5 b
Procure 50WS 6 oz + Microthiol Disperss 80W (1,3,5), Flint 50WDG 2 oz + Microthiol Disperss 80W (2,4), Microthiol Disperss 80W (6,7) [w]…….....	0.0000 b	0.529 a	79.6 a	0.3795 b	12.7 a	115.7 ab	1.5 d	8.8 b
Non-treated ……..……..……	0.0310 a	0.099 a	19.5 bcd	6.0368 a	21.5 a	302.0 a	37.5 a	33.8 a
P value	0.0436	0.135	0.0012	0.0144	0.0014	0.0012	0.0024	0.0346

[z] Exact colony counts were made when possible and severity was estimated using the conversion factor of 10 colonies/leaf = 1%. AUDPC (area under disease progress curve) was calculated for severity from 26 Jul to 15 Sep.

[y] Application dates were: 1=27 Jul, 2=4 Aug, 3=11 Aug, 4=18 Aug, 5=24 Aug, 6=30 Aug, and 7=6 Sep.

[x] Numbers in each column with a letter in common or no letters are not significantly different according to Fisher's Protected LSD (*P* = 0.05).

[w] Microthiol Disperss 80W was always applied at 4 lb/A. The fungicide program with Flint 50WDG was considered the current grower standard while the program with Quintec 2.08SC is considered the future standard.