SQUASH (*Cucurbita moschata* 'Waltham Butternut')
Powdery mildew; *Sphaerotheca fuliginea*

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EVALUATION OF A BIOCONTROL AGENT AND BIOCOMPATIBLE FUNGICIDES FOR MANAGING POWDERY MILDEW OF WINTER SQUASH, 1994: A hyperparasitic fungus, *Ampelomyces quisqualis* (AQ-10), a fatty acid material (M-Pede), and a mineral oil (JMS Stylet-Oil) were compared in an experiment conducted on Haven loam soil at the Long Island Horticultural Research Laboratory in Riverhead, NY. AQ-10 and M-Pede were applied alone or in combination with Nova, a systemic mildicide, to determine whether including a systemic fungicide would improve control, especially on the lower leaf surface. Nova was selected because resistance to benomyl and to triadimefon had been detected in 1991-1993. On 23 May 1000 lb/A of 10-10-10 fertilizer was broadcast and incorporated. Winter squash were seeded on 15 Jun at 24-in. within row plant spacing and 68-in. between row spacing. Plots were thinned by hand to obtain 48 plants in three 35-ft rows. Plants were sidedressed with ammonium nitrate at a rate of 30 lb N/A on 21 Jul. Weeds were controlled by applying Command 4EC at 8 oz/treated A in a 12-in. band over the row on 15 Jun before planting, mechanically cultivating and hand-weeding. Cucumber beetles and aphids were managed by applying the following insecticides: Asana (9.6 oz/A) on 7 Jul, Sevin 80S (1.5 lb/A) on 22 Jul, and Lannate (1 lb/A) on 29 Jul. To suppress downy mildew, Aliette 80 WP (5 lb/A) plus potassium carbonate (3 lb/A) were applied on 19 Aug and Ridomil 2E (1 pt/A) was applied on 25 Aug. Average monthly high and low temperatures (F) and total rainfall (in.) were 84, 60, and 0.19 in Jun; 88, 67, and 0.7 in Jul; and 81.5, 60.5, and 7.26 in Aug, respectively. The field was irrigated (1.0 in.) 8 times on 28 Jun; 2, 7, 13, 19-20, and 26-27 Jul; 1, and 11-12 Sep. Treatments were started after symptoms were found on older leaves. AQ-10 was applied with 0.03% Nu-film-P wetting agent. Compatibility of AQ-10 with Nova was determined by mixing these materials, spraying them on water agar, then examining spores after germination. Treatments were made during late afternoon or early evening, to provide favorable conditions for the antagonistic fungus, using a tractor-mounted boom sprayer equipped with ALBUZ lilac ceramic hollow cone nozzles that delivered 74 gal/A at about 250 psi. High gallonage and high pressure were used to obtain good coverage. A randomized complete block design with 4 replications was used. Upper and lower leaf surfaces in each plot were examined routinely for powdery mildew. Initially, 50 of the older leaves were selected. Young and mid-aged leaves were also examined beginning on 17 Aug. Colonies were counted or severity (percent leaf area covered by mildew) was assessed. Average severity for the entire canopy was calculated from the individual leaf assessments. Area under disease progress curve (AUDPC) was calculated for severity from 27 Jul through 23 Aug. Severity data were transformed by natural log transformation where necessary to obtain constant variance before subjection to analysis of variance. Impact of treatments on yield was not examined because the plants died prematurely due to downy mildew.

Powdery mildew was found on 26 Jul, when the average size of the largest fruit was 1.8 in. long and the canopy had closed. Treatments were started 3 days later. Leaves senesced prematurely because of downy mildew. This disease developed rapidly, in part because of rainy weather, and was not controlled with the selective systemic fungicides applied in mid-Aug. Only the Bravo + Nova treatment provided some control of downy mildew. However, differences in powdery mildew suppression were detected among treatments. AQ-10 performed extremely well. The E10 WDG formulation was more effective than the E9 WP formulation. E10 WDG was more effective than the fungicides Bravo + Nova for suppressing powdery mildew on lower leaf surfaces based on data from 23 Aug and AUDPC values; however, these differences were only significant for the AQ-10 + Nova treatment. Applying Nova with AQ-10 did result in significantly better powdery mildew suppression on lower leaf surfaces than using AQ-10 alone based on AUDPC values. The proportion of spores of *A. quisqualis* that germinated was not affected by Nova. AQ-10 was applied with JMS Stylet-Oil as an enhancement agent to improve spreading, sticking and spore viability; but this did not improve control significantly. Neither M-Pede nor JMS Stylet-Oil applied alone provided adequate suppression of powdery mildew on either leaf surface. AUDPC values for these treatments were not significantly different from those for the nontreated control.

	Powdery mildew severity (% leaf coverage)					
	upper leaf surface [1]			lower leaf surface [1]		
Treatment and rate/A (application time) [2]	10 Aug	23 Aug	AUDPC	10 Aug	23 Aug	AUDPC
Control (No Fungicide)	.13	1.62 b [3]	5.6 d	.12 b	6.7 ef	43.6 de
Bravo 825 2.7 lb (1-3) + Nova 50DF 4 oz (1,3)	.01	.08 a	.1 ab	.04 a	3.2 cde	20.5 cde
M-Pede 2% (1-3)	.08	.54 a	2.1 cd	.13 b	8.0 f	52.6 e
M-Pede 2% (1-3) + Nova 50DF 4 oz (1,3)	.01	.13 a	.1 a	.02 a	.9 ab	3.3 ab
AQ-10 E9 WP 0.5 lb (1-3)	.08	.81 ab	1.8 bcd	.12 b	3.8 def	22.4 cde
AQ-10 E10 WDG 1 oz (1-3)	.02	.08 a	.3 abc	.01 a	1.1 abc	7.3 bc
AQ-10 E10 WDG 1 oz (1-3) + Nova 50DF 4 oz (1,3)	.02	.04 a	.1 abc	.05 ab	.3 a	1.3 a
AQ-10 E10 WDG 1 oz (1-3) + JMS Stylet-Oil 0.75% (1-3) ..	.01	.10 a	.2 abc	.04 ab	1.2 abc	6.5 abc
JMS Stylet-Oil 0.75% (1-3)	.03	.44 a	1.6 bcd	.05 ab	2.4 bcd	12.8 bcd
P-value	.2329	.0242	.0266	.0380	.0001	.0001

1 Exact colony counts were made when possible and severity was estimated using the conversion factor of 30 colonies/leaf = 1%.
2 Application times were: 1=29 Jul, 2=8 Aug, and 3=16 Aug. This experiment was terminated early due to development of downy mildew.
3 Numbers in a column with a letter in common are not significantly different according to Fisher's Protected LSD (P=0.05).