SQUASH, WINTER (*Cucurbita moschata*)
Powdery mildew; *Podosphaera xanthii* (formerly *Sphaerotheca fuliginea*)

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Efficacy of genetic control and chemical control for managing powdery mildew in butternut-type winter squash, 2003.

The objectives of this study were to compare a new cultivar of butternut squash that has homozygous resistance for powdery mildew (Bugle) to a susceptible standard cultivar (Waltham) and to determine if there is a benefit to augmenting powdery mildew control by applying fungicides to the resistant cultivar. Bugle seed was obtained from the Cornell Plant Breeding program and Waltham from Hollar Seeds. In addition to a nontreated control, each cultivar received a grower standard fungicide program, Flint 50WDG (2 oz/A) plus Bravo Ultrex 82.5 WDG (2.7 lb/A) applied in alternation with Procure 50WS (6 oz/A) + Microthiol Disperss 80W (sulfur) (4 lb/A) on a 7-day schedule, and a reduced fungicide program (standard program applied on a 14-day schedule). The field experiment was conducted at the Long Island Horticultural Research and Extension Center in Riverhead, NY, on Haven loam soil. Fertilizer (666 lb/A of 15-15-15) was broadcast and incorporated on 4 Jun. Seeding was done in the greenhouse on 29 May. Waltham was reseeded on 10 Jun due to poor germination. Seedlings were transplanted with starter fertilizer (15-30-15) at 24-in. plant spacing and 68-in. row spacing into beds covered with black plastic mulch and equipped with drip irrigation on 24 Jun. Upper and lower (under) surfaces of 5 to 50 leaves in each plot were examined approximately weekly for powdery mildew. Symptoms were first observed on the susceptible cultivar on 29 Jul and in most plots of the resistant cultivar on 14 Aug. Fungicide applications were started within two days of detection. Applications were made weekly (31 Jul; 7, 14, 20, and 26 Aug; and 6 and 17 Sep) with a tractor-mounted boom sprayer equipped with D5-25 hollow cone nozzles spaced 17 in. apart that delivered 110 gpa at 100 psi. The last two applications were delayed by rainy weather. Microthiol Disperss was applied alone the last week. A seedling fungicide sensitivity bioassay was conducted on 31 Aug. Summer squash seedlings were dipped in Flint (50 ppm), Nova (20 ppm), or a combination of both, then allowed to dry overnight before setting in the field for a day with non-treated seedlings. Defoliation was assessed 4 times beginning on 29 Aug. Representative samples of 6 ripe fruit were harvested from each plot and weighed on 29 Sep and 8 Oct; remaining fruit were counted. Percentage of sucrose was determined using a hand-held refractometer for two fruit per plot.

On the susceptible cultivar Waltham, powdery mildew was controlled more effectively with a standard fungicide program (7-day spray interval) than with a reduced fungicide program (14-day interval). Both fungicide programs were equally effective at reducing defoliation. Severity was similar on Waltham that received seven fungicide applications as on the non-fungicide-treated powdery mildew resistant (PMR) cultivar Bugle. Defoliation, however, was significantly lower for Bugle on 4 and 15 Sep indicating that genetic control might have been more effective than chemical control. Powdery mildew causes leaves to senesce prematurely. Efficacy of chemical control was likely compromised by fungicide resistance. The fungicide sensitivity bioassay revealed that resistance to QoI fungicides was very common (estimated frequency of 100%) and most of the pathogen population (54%) also was moderately insensitive to DMI fungicides. Control of powdery mildew on Bugle was not improved significantly by applying fungicides. A reduced fungicide program, however, could function to delay selection of a new pathogenic race able to overcome this resistance. Applying fungicides to control powdery mildew did not affect yield significantly for either cultivar. Fungicide treatment did not affect size, quantity, or sucrose content of fruit produced. Bugle produced significantly smaller fruit than Waltham (1.8 vs 2.9 lb) but more fruit/plant (7.7 vs 5.6); consequently, total fruit weight did not vary significantly between them (13.7 versus 16.2 lb mature fruit/p lant). The greater cost of seed of Bugle, $48.50/lb versus $15.15/lb for Waltham, is offset by the additional fungicide applications needed to affectively control powdery mildew in Waltham. It will cost about $16 more to grow an acre of Waltham sprayed seven times than an acre of Bugle sprayed thrice.

	Powdery mildew severity (%coverage) [z]				Defolia-	Mature fruit		
	Upper leaf surface		Lower leaf surface		tion (%)	Weight	Quantity	Sucrose
Cultivar, Treatment [y]	26 Aug	AUDPC	26 Aug	AUDPC	15 Sep	(lb/fruit)	(No./plant)	(% Brix)
Bugle, standard fungicide program……	0.06b [x]	28b	0.3d	51c	20c	2.0b	7.6b	8.9
Bugle, reduced fungicide program……..	0.05b	17b	0.8cd	68c	24c	1.6b	7.5bc	8.7
Bugle, no fungicide…….....	0.21b	14b	0.9cd	177c	16c	1.8b	8.0c	9.0
Waltham, standard fungicide program….	0.05b	11b	3.0c	220c	46b	2.7a	5.2a	9.0
Waltham, reduced fungicide program…..	0.51b	23b	13.5b	500b	53b	3.0a	5.9a	9.1
Waltham, no fungicide…….....	2.89a	240a	29.7a	1168a	88a	2.8a	4.9a	8.9
P-value	0.0278	0.0001	0.0001	0.0001	0.0001	0.0005	0.0001	0.5973
Source of Variation for 2-factor ANOVA								
Cultivar	0.0387	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.3586
Treatment	0.0401	0.0001	0.0004	0.0001	0.0089	0.9392	0.5276	0.9050
Cultivar X Treatment interaction	0.1585	0.0001	0.0026	0.0001	0.0011	0.2892	0.0830	0.2936

[z] Exact colony counts were made when possible and severity was estimated using the conversion factor of 10 colonies/leaf = 1%.

[y] Fungicide treatment was Flint (2 oz/A) plus Bravo (2.7 lb/A) applied in alternation with Procure (6 oz/A) plus Microthiol Disperss (sulfur)(4 lb/A) then Microthiol Disperss applied alone on the last date. Application dates were: 1=31 Jul, 2=7 Aug, 3=14 Aug, 4=20 Aug, 5=26 Aug, 6=6 Sep, and 7=17 Sep. The last two applications were delayed by rainy weather. Standard program (7-day) for Waltham was Flint + Bravo (week 1,3,5) and Procure + Microthiol Disperss (2,4,6), and for Bugle it was Flint + Bravo (week 3,5) and Procure + Microthiol Disperss (4,6). Reduced program (14-day) for Waltham was Flint + Bravo (week 1,5) and Procure + Microthiol Disperss (3), and for Bugle it was Flint + Bravo (week 3) and Procure + Microthiol Disperss (5). All received Microthiol Disperss on 17 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).