

Powdery mildew-resistant butternut-type winter squash cultivar evaluation, 2011.

The goals of this experiment, which is part of a multi-year cultivar evaluation project, were 1) to continue to monitor adaptation in the pathogen that has been reducing the effectiveness of powdery mildew resistance, 2) to determine whether cultivars with homozygous resistance (two copies of the major powdery mildew resistance gene; PMRR) are better protected against powdery mildew than cultivars with heterozygous resistance (PMR), 3) to investigate the contribution of resistance to an integrated management program, and 4) to evaluate yield and fruit quality. Two experiments were conducted in adjacent fields at the Long Island Horticultural Research and Extension Center in Riverhead on Haven loam soil. Controlled release fertilizer (N-P-K, 19-10-9) at 525 lb/A (100 lb/A of nitrogen) was broadcast and incorporated on 31 May. Beds were formed with drip tape and covered with black plastic mulch on 1 Jun. Seeds were sown on 31 May in the greenhouse. A waterwheel transplanter was used to make planting holes in the beds and apply starter fertilizer plus insecticide on 7 Jun. Seedlings were transplanted by hand into beds covered with black plastic mulch on 15 Jun. During the season, water was provided as needed via drip irrigation lines. Weeds were managed by mowing and hand weeding. Cucumber beetles were managed with Admire Pro (7.5 – 10 fl oz/treated A) applied with the transplanter on 7 Jun and Asana XL (9.6 fl oz/A) applied to foliage on 2 Jul. The two experiments were conducted in separate treatment areas, one receiving a standard commercial powdery mildew fungicide program, and one that did not. The following products were applied to manage cucurbit powdery mildew: Quintec (6 fl oz/A) on 28 Jul, 18 Aug and 3 Sep; Procure 50WS (8 oz/A) on 20 Jul and 26 Aug; Pristine (18.5 oz/A) on 4 Aug; and Actinovate (8 oz/A) on 4 Aug. The following fungicides were applied preventively for downy mildew (*Pseudoperonospora cubensis*) and Phytophthora blight (*Phytophthora capsici*): ProPhyt (4 pt/A) on 6 Aug; Ranman 400 SC (2.75 fl oz/A) on 18 Aug and 2 Sep; and Curzate (3.2 oz/A) on 26 Aug. All fungicide applications were made with a tractor-sprayer equipped with D4 nozzles at 17-in spacing that delivered and 60 gpa operated at 250-275 psi. Plots were three adjacent rows each with four plants spaced 24 in. apart. Rows were spaced 68 in. apart. Two plants of Multipik, a powdery mildew-susceptible summer squash cultivar, were planted between each plot in each row to separate plots and provide a source of inoculum. A randomized complete block design with four replications was used. Upper and lower leaf surfaces were assessed for powdery mildew on 14, 21, and 26 Jul, and on 3, 10 and 17 Aug. Powdery mildew colonies were counted; severity was estimated when colonies had coalesced or were too numerous to count. Colony counts were converted to severity values using the conversion factor of 30 colonies/leaf = 1% severity. Average severity for the entire canopy was calculated from individual leaf assessments. Area under disease progress curve (AUDPC) was calculated based on the six weekly disease severity ratings. Yield was assessed on 16 Sep. Average monthly high and low temperatures (°F) were 79/61 in Jun, 87/68 in Jul, and 82/66 in Aug. Rainfall (in.) was 6.1, 2.35, and 10.61 for these months, respectively. There was a hurricane (28 Aug) and several atypical intensive rain events during the 2011 growing season on Long Island.

Symptoms of powdery mildew were observed at a low level on 14 Jul: 3% of older leaves examined had symptoms with most of these in a plot of the susceptible cultivar. Symptoms were found on 21 Jul in most plots. The proportion of older leaves examined that day and found to have symptoms was 22% and 11% in the non-treated and fungicide-treated experiments, respectively. Powdery mildew incidence therefore was above the action threshold of 2% on 20 Jul when the powdery mildew fungicide program was started for assessing integrated management. Incidence at that time was unusually high compared to previous experiments. Symptoms were first observed on 4 Aug in a similar experiment conducted at the same time in 2010. Powdery mildew was as effectively suppressed with Metro, which has heterozygous resistance (PMR), as with Geneva, the cultivar evaluated with homozygous resistance (two copies of the major powdery mildew resistance gene; PMRR). These cultivars did not differ significantly when evaluated as the sole management practice or as a component of an integrated management program. Resistant cultivars as the sole management practice provided 71-78% and 76-77% control on upper and lower leaf surfaces, respectively, based on AUDPC values, and when treated with targeted fungicides for powdery mildew they increased control by another 60-78% based on severity on 18 Aug compared to the similarly treated susceptible cultivar Waltham. In contrast, in a similar experiment conducted in 2010 evaluating non-fungicide resistant cultivars, Geneva as well as 4 other PMRR and 3 PMR cultivars exhibited no suppression of powdery mildew. Bugle (PMRR) was the only cultivar in the 2010 experiment that was significantly less severely affected by powdery mildew than the susceptible cultivar Waltham. The resistant cultivars tested in 2009 also did not successfully suppress powdery mildew, whereas effective control was achieved in the 2008 experiment conducted at LIHREC. Results suggest performance of powdery mildew resistant genotypes is variable each year.

Fungicide treatment	Powdery mildew severity (%) ^z					
	Upper leaf surface			Lower leaf surface		
Cultivar (resistance) ^y	10-Aug	17-Aug	AUDPC ^x	10-Aug	17-Aug	AUDPC ^w
Non-fungicide treated						
Waltham (S).....	2.7	24.8	147.6 a	14.5 a	32.9 a	338.3 a
Metro (PMR).....	0.1	6.8	32.2 b	6.9 ab	7.4 b	76.2 b
Geneva (PMRR).....	0.9	9.9	43.2 b	5.1 b	12.8 b	82.6 b
<i>P-value (treatment)</i>	0.2239	0.1956	0.0021	0.0446	0.0127	0.0006
Fungicide treated						
Waltham (S).....	0.0	16.9 a	67.5 a	14.6	46.6 a	288.9 a
Metro (PMR).....	0.0	1.6 b	8.6 ab	3.7	12.9 b	80.8 b
Geneva (PMRR).....	0.0	0.3 b	1.3 b	6.1	13.3 b	94.4 ab
<i>P-value (treatment)</i>	0.4219	0.0209	0.0271	0.1289	0.0089	0.0360

^z Exact colony counts were made when possible and severity was estimated using the conversion factor of 30 colonies/leaf = 1% severity. Area Under Disease Progress Curve (AUDPC) was calculated from 14 Jul through 17 Aug.

^y PMR = heterozygous resistance. PMRR = homozygous resistance; S=susceptible.

^x Numbers for each fungicide treatment in each column with a letter in common are not significantly different according to Tukey's HSD (*P* = 0.05).

^w Data for the non-fungicide treated, lower leaf surface AUDPC values were square root-transformed to obtain normality of variance prior to analysis of variance. De-transformed means are presented.