SQUASH, WINTER (*Cucurbita pepo*)
Powdery mildew; *Podosphaera xanthii*

M. T. McGrath[1], S. R. Menasha[2] and L.K. Hunsberger[1]
Dept of Plant Pathology & Plant-Microbe Biology
Cornell Univ[1], and Cornell Coop Ext[2], LIHREC,
3059 Sound Avenue, Riverhead, NY 11901

Powdery mildew-resistant acorn-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 16 Jun. Seedlings were transplanted by hand into beds covered with black plastic mulch on 21 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 16 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 four adjacent rows each with three plants spaced 24 in. apart. Rows were spaced 68 in. apart. One plant of Multipik, a powdery mildew-susceptible summer squash cultivar, was 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 the individual leaf assessments. Area under disease progress curve (AUDPC) was calculated based on the six weekly disease severity ratings. Yield assessments were done on 12 Sep. Average monthly high and low temperatures (°F) were 79/61 in Jun, 87/68 in Jul, and 82/66 in Aug. Rainfall (inches) 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 on 21 Jul in all except one treated plot of a resistant cultivar. The proportion of older leaves examined with symptoms was 46% in both experiments then. Incidence at that time was unusually high for the region. It was only 3% on 20 Jul 2010 in a similar experiment with these same cultivars. Powdery mildew incidence therefore was substantially above the action threshold of 2% on 20 Jul when the powdery mildew fungicide program was started for assessing integrated management. Sweet REBA, the cultivar evaluated with homozygous resistance (e.g. two copies of the major powdery mildew resistance gene; PMRR), was less severely affected by powdery mildew than Tay Belle PM, which has heterozygous resistance (PMR). Severity was significantly different based on AUDPC values and also many severity assessments. Powdery mildew severity on Sweet REBA and the susceptible cultivar Table Ace differed significantly for almost all assessments. Thus homozygous resistance was effective when powdery mildew resistance was tested as a sole management program and as a component of an integrated management program that included weekly applications of a targeted fungicide for powdery mildew (Quintec, Pristine, and Procure). Powdery mildew severity on Tay Belle PM and Table Ace never differed significantly. Thus heterozygous resistance was ineffective as a sole management practice as well as when fungicides were also applied. However, effectiveness of the fungicide program may have been compromised by its initiation after recommended using the established action threshold. Based on AUDPC values, Sweet REBA provided 74% and 91% control on upper and lower leaf surfaces, respectively, as the sole management practice and 85% and 53% increased control when treated with targeted fungicides compared to the similarly treated Table Ace. Yield of Sweet REBA did not differ significantly from Table Ace (data not shown). In conclusion, cultivars with homozygous resistance are needed to effectively control powdery mildew in acorn squash. Control can be improved by using an integrated program. Applying fungicides to a resistant cultivar will also minimize selection pressure for pathogen strains adapted to either resistance genes or targeted fungicides.

Fungicide treatment	Powdery mildew severity (%)[z]					
	Upper leaf surface			Lower leaf surface		
Cultivar (resistance)[y]	10-Aug	17-Aug[x]	AUDPC	10-Aug	17-Aug	AUDPC
Non-fungicide treated						
Table Ace (S)……	0.2	7.4 ab	134.9 a	6.2 ab	35.0 a	480.6 a
Tay Belle PM (PMR)……	0.0	13.2 a	171.9 a	10.6 a	40.1 a	578.4 a
Sweet REBA (PMRR)…….	0.0	1.5 b	20.7 b	0.8 b	7.5 b	125.6 b
P-value (treatment)	0.2441	0.0135	0.0002	0.0299	0.0008	0.0012
Fungicide treated						
Table Ace (S)……	5.4 a	24.3	217.2 a	30.6 a	49.5 a	522.0 a
Tay Belle PM (PMR)……	3.5 ab	34.4	213.9 a	18.6 a	48.4 a	422.6 a
Sweet REBA (PMRR)…….	0.0 b	12.6	56.7 b	0.0 b	9.7 b	46.7 b
P-value (treatment)	0.0089	0.1189	0.0020	0.0025	0.0168	0.0006

[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] PMRR = homozygous resistance; PMR = heterozygous resistance; S=susceptible.

[x] Numbers for each fungicide treatment in each column with a letter in common are not significantly different from each other (Tukey's HSD, P=0.05).