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

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Evaluation of powdery mildew resistant cultivars of acorn squash, 2020.

An experiment with acorn squash was conducted at the Long Island Horticultural Research and Extension Center (LIHREC) in Riverhead, NY, in a field with Haven loam soil. The objective of this experiment was to evaluate three new powdery mildew resistant cultivars (Starry Night, Sugar Bush, and Tiptop) for powdery mildew resistance, yield, and fruit quality compared to a susceptible cultivar (Table Ace) and one of the first resistant cultivars commercialized (Autumn Delight). The field was mold-board plowed on 6 Apr. For management of Phytophthora blight (caused by *Phytophthora capsici*), a mustard biofumigant cover crop (cv. Rojo Caliente) was seeded at 10 lb/A by drilling on 7 Apr after applying urea fertilizer (46-0-0) at 80 lb/A N on 6 Apr. On 12 Jun the mustard was flail chopped, immediately incorporated by disking, and followed by a cultipacker to seal the soil surface; the field could not be irrigated to initiate biofumigation as usually done. Controlled-release fertilizer (N-P-K, 19-10-9) at 525 lb/A (101 lb/A N) was broadcast over the bed area and incorporated on 22 Jun. Beds were formed with drip tape and covered with black plastic mulch also on 23 Jun. A waterwheel transplanter was used to make planting holes in the beds and apply starter fertilizer. Seed was sown in trays in a greenhouse on 4 Jun. Seedlings were transplanted by hand into the holes on 25 Jun. Plants that died were replaced on 29 Jun, 7 Jul and 13 Jul. Plots were three 10-ft rows spaced 68 in. apart with 12 plants per plot at 2-ft spacing. To separate plots and provide a source of inoculum, there were two powdery mildew-susceptible summer squash plants (cv. Slick Pik) between plots. Weeds were managed between the mulched beds by applying the herbicides Strategy 3 pt/A, Sandea 0.5 oz/A, and Curbit EC 1 pt/A prior to transplanting on 23 Jun using a tractor mounted sprayer. During the season, weeds were managed by cultivating and hand weeding as needed. The following fungicides were applied throughout the season to manage Phytophthora blight: Orondis Ultra 7 fl oz/A on 9 Jul, 19 and 31 Aug, Omega 1 pt/A on 15 Jul and 10 Sep, Presidio 4 fl oz/A on 22 Jul and 25 Aug, Revus 8 fl oz/A on 29 Jul, and Ranman 2.75 fl oz/A on 5 and 12 Aug. In this area, the primary source of initial inoculum of *Podosphaera xanthii* is considered to be long-distance wind-dispersed spores from affected plants. There were two adjacent experiments. Plants in one experiment were treated with the following fungicides using a tractor-drawn boom sprayer (50 GPA and 125 PSI) to evaluate the resistant cultivars as part of an integrated management program: Procure 8 fl oz/A on 5, 19 and 31 Aug, and Vivando 15 fl oz/A on 12 Aug, 25 Aug and 10 Sep. The other experiment was not sprayed with fungicides for powdery mildew. A randomized complete block design with four replications was used for both experiments. Untreated plots were inspected for powdery mildew symptoms on upper and lower leaf surfaces on 22 and 29 Jul; 3, 11, 18 and 25 Aug; and 1, 8, 15, and 22 Sep. Treated plots were inspected on 22 and 29 Jul; 3, 10, 17 and 24 Aug; and 1, 8, 15, 22 and 29 Sep. For the first four assessments in both experiments, 27 to 30 older leaves were rated in each plot starting with plots of the susceptible cultivar. Since no symptoms were found in these plots at the first three assessments, plots of the resistant cultivars were not examined on those dates. For the remaining assessments, an equal number of young, mid-aged, and old leaves (selected based on leaf physiological appearance and position in the canopy) were rated for a total of 15 to 21 leaves in each plot. Powdery mildew colonies were counted; severity was assessed by visual estimation of percent leaf area affected when colonies could not be counted accurately because they had coalesced and/or were too numerous. 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) values were calculated from 11 Aug through 8 Sep for untreated plots, and 3 Aug through 22 Sep for treated plots. Sixteen mature fruit were harvested from each fungicide-treated plot on 6 Oct and weighed. Flesh samples were taken from two representative fruit from each plot, frozen, then thawed to obtain juice to analyze for sugar content using a refractometer to obtain a Brix reading. Fruit remaining in each plot were counted. Fruit appearance, taste, texture, and marketability were rated by 16 staff members and gardeners on a 1 (poor) to 5 (excellent) scale as interpreted by the rater. Data for each experiment were analyzed separately with one-way ANOVA and Tukey's HSD to separate means using JMP statistical software. Average monthly high and low temperatures (°F) were 86.3/69.6 in Jul, 84.3/68.2 in Aug and 75.7/60.9 in Sep. Rainfall (in.) was 3.80, 3.33, and 2.70 for these months, respectively.

Powdery mildew was first observed on 3 Aug in one plot of a susceptible cultivar; no symptoms were seen the previous 2 weeks. In the experiment with plants not treated with fungicides for powdery mildew, all resistant cultivars were significantly less severely affected by powdery mildew than the susceptible cultivar at most assessments. A significant difference among resistant cultivars was only detected with one assessment. The fungicide program provided excellent control of powdery mildew on upper leaf surfaces. Control was considered only good on lower surfaces because starting with the 8 Sep assessment, average severity on lower leaf surfaces was at least 11% for all cultivars (8 and 15 Sep data not shown). Control of powdery mildew is likely the reason defoliation was substantially less in the fungicide-treated plots. Maintaining leaves until acorn squash fruit are mature is important for fruit flavor and minimizing sunscald. There was indication of better control achieved using both management practices (fungicides applied to resistant cultivar) based on fungicide-treated resistant cultivars having numerically less severe powdery mildew than the fungicide-treated susceptible cultivar for most assessments. There were no significant differences among cultivars in average fruit weight (1.6 – 1.8 lb/fruit), number marketable fruit per plant (data not shown) or total number fruit. Fruit of Starry Night had significantly higher sugar content than all other cultivars except Sugar Bush, while Autumn Delight had the lowest Brix values. Average quality ratings for the cultivars (data not analyzed) were: Table Ace (3.6 for external appearance, 3.8 for internal appearance, 3.9 for taste, 3.3 for texture, and 73% would buy), Autumn Delight (3, 3.7, 3.3, 3.5, 40%), Starry Night (3.6, 3.7, 4.3, 4.1, 80%), Tiptop (4.3, 4.3, 2.6, 3, 47%), and Sugar Bush (4.7, 3.9, 3.1, 3.4, 53%). This report includes work that is supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, Hatch under NYC-153409.

Table 1. Results from experiment not treated with fungicides for powdery mildew.

Cultivar (reaction to powdery mildew)	Powdery mildew severity (%)*							% Defoliation*	
	Upper leaf surface			Lower leaf surface					
	1 Sep	8 Sep	AUDPC	25 Aug	1 Sep	8 Sep	AUDPC	15 Sep**	22 Sep
Table Ace (susceptible)	20 a	65 a	409 a	7 a	40 a	89 a	640 a	94 a	100
Autumn Delight (resistant)	10 ab	33 b	209 b	2 b	12 bc	45 b	258 b	65 ab	94
Tiptop (resistant)	14 ab	36 b	257 b	4 ab	22 b	56 b	372 b	69 ab	92
Starry Night (resistant)	11 ab	34 b	219 b	4 ab	19 bc	56 b	361 b	32 b	74
Sugar Bush (resistant)	9 b	31 b	199 b	2 b	8 c	49 b	242 b	74 a	97
P-value (cultivar)	0.0356	0.0007	0.0023	0.0027	<0.0001	0.0003	<0.0001	0.0056	0.2530

* Numbers in each column with a letter in common or no letter are not significantly different from each other (Tukey's HSD, P=0.05).

** Values were square root transformed before analysis because raw data were not distributed normally. Table contains de-transformed values.

Table 2. Results from experiment treated weekly with fungicides for powdery mildew.

Cultivar (reaction to powdery mildew)	Powdery mildew severity (%)*					Defoliation (%)*		Yield*	
	Upper leaf surface		Lower leaf surface						
	1 Sep	AUDPC	1 Sep**	22 Sep	AUDPC	22 Sep	29 Sep	Brix	Total fruit/ plant
Table Ace (susceptible)	1.90	41	5.3	28 a	632	53	48	10.4 bc	5.4
Autumn Delight (resistant)	0.03	5	0.5	15 bc	306	40	36	9.5 c	6.7
Starry Night (resistant)	1.23	19	2.2	25 ab	422	26	33	15.9 a	6.1
Tiptop (resistant)	1.81	14	2.0	17 abc	485	50	56	11.5 bc	5.9
Sugar Bush (resistant)	0.77	12	0.7	11 c	238	41	49	13.7 ab	7.2
P-value (cultivar)	0.6002	0.2625	0.0769	0.0014	0.108	0.1867	0.1872	0.0007	0.0762

* Numbers in each column with a letter in common or no letter are not significantly different from each other (Tukey's HSD, P=0.05).

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