Powdery Mildew Resistant Winter Squash Cultivar Evaluation, New York 2006

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Cultivars with resistance are a valuable tool for managing powdery mildew, a very common disease that can reduce yield (fruit quantity and/or size) and market quality (flavor, color, storability, etc). There are a handful of winter squash cultivars that recently became available on the commercial market advertised as having resistance to powdery mildew. These cultivars include hybrid and open-pollinated lines of butternut, acorn and specialty squashes. In pumpkin, previous experiments have demonstrated that the level of resistance among powdery mildew resistant cultivars is highly variable. The goal of this study was to evaluate four solid green acorn-type winter squash cultivars, two striped acorn-types, and a delicata-type squash with powdery mildew resistance for their ability to resist this disease as well as their yielding ability relative to Table Ace, a standard cultivar lacking powdery mildew resistance that is commonly grown.

Materials and Methods:

A field experiment was conducted at the Long Island Horticultural Research and Extension Center in Riverhead on Haven loam soil. All squash seed were planted on 18 May in the greenhouse and were transplanted into black plastic mulch on 13 Jun. During the season weeds were controlled with one application of Select 2EC 8 fl oz on 31 Jul, hand weeding, and mowing between the rows of black plastic mulch. Water was provided as needed through drip irrigation lines placed beneath the mulch. No fungicides were applied specifically for powdery mildew; however, copper fungicides applied for control of bacterial leaf spot (*Xanthomonas campestris* p.v. *cucurbitae*) would have also provided some suppression of powdery mildew on upper leaf surfaces. Champ (2 lb/A) was applied on 29 Jul; Cuprofix Disperss (2.5 lb/A) was applied on 12 Jul, and 5, 13, and 23 Aug; and Kocide 2000 (1.5 lb/A) was applied on 31 Aug. The following fungicides were applied preventively for downy mildew (*Pseudoperonospora cubensis*) and Phytophthora blight (*Phytophthora capsici*): Acrobat 50 WP (6.4 oz/A) on 12 Jul, Previcur Flex 66F (1.2 pt/A) on 29 Jul, Ranman (2.75 fl oz/A) on 23 Aug, and Tanos (8 oz/A) on 31 Aug. Neither disease developed before the end of this experiment.

Plots were one 14-ft row each with a plant spacing of 24-in. One summer squash plant of a susceptible cultivar (Multipik) was planted as a border between each plot. A randomized complete block design with four replications was used.

Upper and lower surfaces of leaves were assessed for powdery mildew beginning on 27 Jul when fruit were starting to enlarge. Ten old leaves were selected on 27 Jul and on 8 Aug in each plot based on leaf appearance and position in the canopy. On 15 Aug 10 mid-aged leaves were assessed. Powdery mildew colonies (spots) were counted; severity was assessed 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%. Average severity for the entire canopy was calculated from the individual leaf assessments. These canopy severity values were used to calculate area under disease progress (AUDPC) to obtain a measure of severity over the entire assessment period. Powdery mildew control was calculated for upper and lower leaf surfaces using AUDPC values relative to the average AUDPC value for Table Ace.

Winter squash fruit were harvested, weighed, and measured on 11 Sep. Two representative fruit per plot were selected for measuring fruit width, fruit length, and cavity width and for assessing sugar content, which was done with a hand-held refractometer. Fruit characteristics

were also evaluated and overall appearance was rated on a scale of 1 to 9; 1= poor, 5 = marginal, 7 = acceptable, and 9 = good.

Results and Discussion:

All squash cultivars tested with claims for resistance to powdery mildew exhibited at least 50% control relative to Table Ace based on AUDPC values. The most effective cultivar was Royal Ace PM. Autumn Delight and Table Star also provided more than 90% control of powdery mildew on the lower leaf surface. These three produce dark green to dark black/green acorn-type fruit. Table Star has a yellow star where the stem joins the fruit and tended to be rather stout with a pointed base. Flesh was medium orange in color with small to medium seeds. Fruit were rated 8 on a 1 to 9 scale for overall appearance. Royal Ace PM produced short, stout fruit with a pointed base and a wide top. Fruit were very uniform in size, shape, and color. Flesh was light orange with medium sized seeds, rated 8.5. Autumn Delight fruit had a smooth, round base and light orange flesh with small seeds. Overall appearance was 8.25. Table Ace fruit were rated 6. Fruit tended to be uniform in size and shape but not color, have a pointed base, and very light orange flesh.

The two cultivars producing striped acorns (white fruit with green speckling), Harlequin and Celebration performed at a slightly lower level than the solid green conventional acorn-types providing 51-76% control of powdery mildew. Harlequin fruit has green stripes, a pointed base, and round, flattened fruit. Flesh was golden yellow with small seeds, overall rated 8. Celebration fruit has yellow stripes and nice, uniform shape and coloring. Flesh was light golden orange and overall appearance was rated 8.

Bush Delicata, the only open-pollinated cultivar evaluated, provided good powdery mildew control statistically similar to that of Royal Ace PM, Autumn Delight, and Table Star. This heirloom-type delicata was named a 2002 All-America Selection (AAS), a seed-industry award. Bush Delicata produces oblong fruit with green stripes. Fruit varied slightly in length. Flesh was golden yellow and fruit has a long cavity with very small seeds, rated 8.

On 27 Jul, the first assessment date, powdery mildew was severe on Table Ace with average severity on old leaves of 54% on upper leaf surfaces and 86% on lower surfaces. Celebration with 15% and 31% severities, respectively, had an intermediate level of powdery mildew compared with the susceptible cultivar and the other resistant cultivars, which had severities of 0-3% and 0-4%. No symptoms were observed on Autumn Delight or Bush Delicata. Symptoms were observed on all cultivars on 8 Aug. Severities on upper and on lower leaf surfaces were 59% and 85%, respectively, for Table Ace, 27% and 40-52% for the striped acorns, and 4-19% and 10-29% for the other cultivars. (this data not shown in table)

Fruit production was affected by poor weed control; therefore, yield data in table 1 should not be considered an indication of yielding ability but rather should be considered relative yield values. The control cultivar Table Ace had the lowest marketable yield per plant and the least number of fruit plant. This likely reflects impact of powdery mildew, which was severe on this susceptible cultivar from the first assessment on 27 Jul. Harlequin produced the statistically highest number of fruit per plant as well as the highest weight of fruit per plant.

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Table 1. Yield and control of powdery mildew for squash cultivars compared on Long Island, NY, 2006. The first four entries are green acorn-type cultivars with resistance to powdery mildew listed in order of disease control. These are followed by two striped acorns, a delicata, then the conventional green acorn cultivar included for comparison.

		Marketable Fruit					Total	Powdery Mildew Control (%)	
Winter Squash Cultivar	Seed Source	Number/ plant	Weight/ plant (lb)	Fruit Length (in)	Cavity Width (in)	Fruit Wt (lb)	Number Fruit/ Plant	Upper Leaf Surface	Lower Leaf Surface
Royal Ace PM	HM	1.1 bc[z]	1.2 bcd	9.3 bc	6.4 a	1.12 b	1.3 bc	96 c	94 d
Autumn Delight	SI	1.3 b	1.6 ab	10 b	5.3 ab	1.23 a	1.4 b	93 c	92 cd
Table Star	RU	1.5 ab	1.4 abcd	7.5 c	6.2 a	0.93 c	1.5 ab	88 c	92 cd
Taybelle PM	SI	1.2 bc	1.6 abc	8.8 bc	5.4 ab	1.28 a	1.3 b	81 bc	81 cd
Harlequin	SI	1.9 a	1.8 a	8.3 bc	6.2 a	0.95 c	2 a	74 bc	69 bc
Celebration	RU	1.6 ab	1.5 abc	8 bc	6.2 a	0.94 c	1.6 ab	63 b	51 b
Bush Delicata	SI	1.2 bc	1 cd	12.9 a	3.9 c	0.87 c	1.2 bc	87 c	86 cd
Table Ace	SI	0.8 c	0.9 d	8.2 bc	4.6 bc	1.21 ab	0.8 c	0 a	0 a
P-value		0.0059	0.0412	0.0035	0.0041	0.0001	0.0053	0.0001	0.0001

[z] Numbers in each column followed by the same letter are not significantly different from each other according to Fisher's protected LSD (*P*=0.05).