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

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Comparison of powdery mildew resistant pumpkin and winter squash under reduced-fungicide program, 2004.

A field experiment was conducted at the Long Island Horticultural Research and Extension Center in Riverhead, NY, on Haven loam soil. Fertilizer (N-P-K 10-10-10) at 1000 lb/A was broadcast and incorporated on 25 May. A nested statistical design was used with cultivar nested in crop and five replications. Plots were single rows of 8 plants at 30-in. spacing. A plant of the gourd Turk's Turban was planted between each plot. This gourd was shown previously to be very susceptible to wilt due at least partly to it being highly attractive to cucumber beetles, which vector the bacteria that cause wilt. Each row contained a replication. Rows were spaced at least 11.3 ft apart. Transplants were seeded in the greenhouse on 25 May. On 8-9 Jun, seedlings were transplanted with 20-20-20 starter fertilizer into black plastic mulch. Plants were watered using drip irrigation as needed based on irrometer readings. Weeds between rows were controlled by applying Strategy (3 pt/A) before transplanting, mechanically cultivating and hand-weeding. Downy mildew was managed by applying Phostrol (4 pt/A) on 2 Aug; Phostrol (5 pt/A) on 11 Aug, 20 Aug, 26 Aug, and 4 Sep; Flouronil (2 lb/A) on 11 and 26 Aug; and Curzate (3.2 oz/A) on 14 Aug and 4 Sep. Average monthly high and low temperatures (F) were 77/59 in Jun, 82/65 in Jul, 82/66 in Aug, 78/60 in Sep, and 64/49 in Oct. Rainfall (in.) was 0.88, 3.33, 3.94, 6.97, and 2.04 for these months, respectively. The entire field received a reduced-fungicide program for powdery mildew, with applications made about every 14 days: Nova 40W (4-5 oz/A) + Bravo Weather Stik (2.5-3 pt/A) on 23 Jul and 20 Aug, and Quintec (4 oz/A) + Bravo Weather Stik (2.5 pt/A) or Flouronil (2 lb/A) on 8 and 26 Aug. Fungicides were applied because an integrated program is recommended for slowing selection of pathogen strains able to overcome powdery mildew resistance (PMR) or able to resist the action of the fungicides, and also because with some PMR varieties control of powdery mildew has been improved by applying fungicides on a 14-day schedule. Another goal of the experiment was to determine whether heightened bacterial wilt susceptibility found previously in 2 PMR pumpkin cultivars was associated with PMR and came from crosses to incorporate PMR into *C. pepo*; therefore, in addition to PMR pumpkins and squashes from a diversity of plant breeders, 3 entries were the *Cucurbita moschata* line with PMR and 2 segregating populations derived from the *C. moschata* line. Segregating population #1 is the first cross of the *C. moschata* line with *C. pepo* (*C. moschata-C. pepo*). Segregating population #2 is the first backcross (*C. pepo-C. moschata*). Plants were examined routinely for cucumber beetles and symptoms of wilt. Upper and lower surfaces of 5 to 25 leaves in each plot were examined for powdery mildew on 27 Jul, 3 Aug, and 25 Aug. Initially, 25 older leaves were examined in each plot. The examined leaves were selected from the oldest third of the foliage based on leaf appearance and position in the canopy. As disease progressed, the number of leaves examined was adjusted based on the incidence of affected leaves in a plot. Mid-aged and young leaves were also examined on 25 Aug. Powdery mildew colonies were counted; severity was assessed when colonies could not be counted accurately because they had coalesced and/or were too numerous. Average severity for the entire canopy was calculated from the individual leaf assessments. A square root transformation was used when needed prior to analysis to achieve homogeneity of variance. Mature pumpkin fruit were harvested from 4 replications and weighed on 13, 15, 20, and 24 Sep. Squash fruit were harvested on 1 Oct.

Plants were examined routinely for cucumber beetles and symptoms of wilt. While cucumber beetles were present from 28 Jun, and many Turk's Turban plants died due to wilt, symptoms remained at too low a level in the pumpkins and squashes for meaningful comparison. Among the pumpkins evaluated, best season-long suppression of powdery mildew on both upper and lower leaf surfaces, quantified as AUDPC, was obtained with both of the Cornell University lines evaluated (NY01-609 and NY01-605A), an experimental from Harris Moran Seed Company (HMX 2689), and Harris Moran's Magician. Severity of powdery mildew was also low on the *C. moschata* line and the 2 segregating populations. Other PMR entries with significantly less powdery mildew on lower leaf surfaces than both Sorcerer and Howden, the susceptible varieties included for comparison, were Touch of Autumn, both lines from Brent Loy at the University of NH (NH1755A and NH1771A), Gold Bouillon, 3 experimentals from Rupp Seed (03RPX763, 03RPX764, and RPX 03515), Merlin, and Hobbit. Magic Lantern, Rupp experimental RPX 03516, and an experimental from Meyer Seed International (MSX6009) did not have significantly less severe powdery mildew than Sorcerer and Howden. Fruit weight varied significantly among the pumpkins evaluated. Listed in order by average fruit size were Touch of Autumn (largest fruit was 3.8 lb), NY01-605A (7.1 lb), NH1771A (14.4 lb), Hobbit (12.5 lb), NH1755A (13.8 lb), Merlin (16.6 lb), NY01-609 (19.0 lb), Magician (16.5 lb), RPX 03515 (18.6 lb), Sorcerer (23.8 lb), Magic Lantern (19.6 lb), Gold Bouillon (26.2 lb), HMX 2689 (21.1 lb), RPX 03516 (27.3 lb), MSX6009 (30.6 lb), 03RPX763 (23.4 lb), 03RPX764 (25.4 lb), and Howden (28.3 lb). Number of fruit produced per plant also varied significantly. Fruit of Rupp experimental 03RPX764 was the most popular among growers and others who selected their top 3, MSX6009 was second, and Sorcerer was third. Other pumpkins receiving high ratings were Howden, Magic Lantern, Magician, and HMX 2689. Both PMR acorn-type winter squashes, Cornell University line NY98-768-7L and Royal Acorn PM, were significantly less severely affected than Table Ace on lower leaf surfaces. Fruit weight did not vary significantly among these squashes, averaging 1.5 lb. Royal Acorn PM produced significantly more fruit than the others.

Cucurbit crop and entry [y]	Powdery mildew severity (% leaf coverage) [z]						Fruit/ plant	Fruit wt (lb)
	Upper leaf surface			Lower leaf surface				
	3 Aug	25 Aug	AUDPC	3 Aug	25 Aug	AUDPC		
Pumpkin								
C. moschata line …….	0.000 f [x]	0.011 d	0.4 i	0.009 g	4.3 de	48.1 hi	--	--
Segregating population#2 ….	0.006 f	0.071 cd	1.0 ghi	0.211 efg	1.9 e	30.9 i	--	--
Segregating population#1 ….	0.072 ef	0.250 bcd	4.3 fghi	0.085 g	8.3 de	98.0 efghi	--	--
NY01-605A (PMRR)……	0.067 ef	0.049 cd	2.2 ghi	0.084 g	4.7 de	55.2 ghi	5.0 a	3.3 fg
NY01-609 (PMRR)……..	0.000 f	0.049 cd	0.5 hi	0.034 g	13.3 cd	147.7 efgh	3.0 bc	9.8 de
NH1771A (PMR) ……..……	0.217 def	0.396 bcd	11.5 defghi	2.736 ab	11.0 de	203.6 cdef	1.8 cd	9.1 e
NH1755A (PMR) ……..…	0.147 def	0.579 bcd	10.7 defghi	0.174 efg	7.1 de	86.0 fghi	2.7 bcd	4.3 fg
Gladiator (PMRR) ……	0.228 def	0.053 cd	5.8 efghi	0.125 fg	7.5 de	87.0 fghi	2.5 bcd	12.6 bc
Magician (PMRR) ……..….	0.127 def	0.256 bcd	5.7 efghi	0.120 fg	16.1 bcd	179.5 cdefg	2.4 bcd	11.1 cde
MSX6009 (PMRR) …….	2.259 abc	0.839 abcd	58.0 b	3.873 ab	29.0 abc	392.2 abc	2.2 bcd	13.3 abc
03RPX763 (PMR) ……	0.527 cdef	0.436 bcd	17.4 bcdefg	1.560 bcdef	12.2 cd	173.9 defgh	2.5 bcd	13.7 ab
03RPX764 (PMR) ……	0.861 bcde	0.099 cd	24.9 bcdef	2.025 bcd	12.9 cd	176.9 defgh	1.9 cd	15.2 a
RPX 03515 (PMR) ……..	0.545 cdef	0.047 cd	12.4 defghi	2.849 ab	13.0 cd	204.3 cdef	1.9 bcd	11.4 bcde
RPX 03516 (PMR) ……..	0.416 def	1.119 abc	31.3 bcde	2.554 ab	14.8 bcd	260.7 bcde	3.1 bc	13.0 abc
Touch of Autumn (PMR) ……	0.468 def	0.009 d	11.0 defghi	0.329 cdefg	6.3 de	80.8 fghi	5.3 a	2.0 g
Gold Bouillon (PMR) ……..	2.515 bc	0.094 cd	50.9 bc	2.211 bc	10.6 de	155.5 defgh	2.5 bcd	12.0 bcd
Merlin (PMR) ……..……	0.460 def	0.291 bcd	11.3 defghi	0.264 defg	16.6 bcd	188.8 cdefg	1.5 d	9.6 de
Hobbit (PMR) ……..……	0.482 def	0.225 bcd	12.3 defghi	1.711 bcde	15.0 bcd	207.5 cdef	3.2 c	5.7 f
Magic Lantern (PMR) …….	0.494 def	0.225 bcd	15.8 cdefgh	1.745 bcde	29.4 abc	350.4 abcd	2.3 bcd	11.8 bcd
Sorcerer (PMS) ……	1.138 abcd	1.399 ab	39.6 bcd	5.910 a	34.3 ab	475.7 ab	2.4 bcd	11.7 bcd
Howden (PMS) ……	3.334 a	2.876 a	137.2 a	4.293 ab	45.5 a	616.7 a	1.5 d	15.3 a
P-value	0.0002	0.0187	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Winter Squash (acorn type)								
Sweet REBA (PMRR) …….	0.381	0 b	5.6	0.083 b	3.4 b	23.9 b	4.906 b	1.472
Royal Acorn PM (PMRR) …….	0.962	0.147 ab	12.8	0.220 b	7.3 b	53.9 b	6.925 a	1.467
Table Ace (PMS) ……	1.442	0.582 a	23.0	3.154 a	32.3 a	402 a	3.850 b	1.623
P-value	0.60	0.0405	0.70	0.0395	0.0009	0.0024	0.0107	0.1386
ANOVA analyses (*P*-values)								
Crop	0.2090	0.4170	0.7291	0.0001	0.1900	0.1167	0.0001	0.0001
Crop (entry)	0.0092	0.0597	0.0008	0.3708	0.0003	0.0001	0.0001	0.0001
Replication	0.0059	0.7870	0.0737	0.2825	0.1660	0.2562	0.0050	0.6304

[z] Exact colony counts were made when possible and severity was estimated using the conversion factor of 30 colonies/leaf = 1%. Area under the disease progress curve (AUDPC) was calculated for severity from 27 Jul through 25 Aug.

[y] PMS indicates susceptible to powdery mildew, PMR indicates entry has resistance from one parent, and PMRR indicates entry has resistance from both parents. 'NY' entries are from Molly Jahn, Cornell University, 'NH' entries are from Brent Loy, University of NH, 'HMX' entries are from Harris Moran Seed Co., 'MSX' entries are from Meyer Seed International, and 'RPX' entries are from Rupp Seeds.

[x] For entry within a crop, numbers in a column with a letter in common are not significantly different according to Fisher's Protected LSD ($P = 0.05$).