

# Comparison of Powdery Mildew Resistant Pumpkin Varieties and Experimental Lines

## Report on 2005 Research Project

Margaret Tuttle McGrath, Associate Professor, Dept. of Plant Pathology, Cornell University  
Jane Davey, Research Support Specialist, Dept. of Plant Pathology, Cornell University  
Cornell University, LIHREC, 3059 Sound Avenue, Riverhead, NY  
Contact information. E-mail: mtm3@cornell.edu

### Summary:

Before selecting powdery mildew resistant (PMR) varieties, growers need information on their performance, especially when grown under local conditions, in terms of powdery mildew reaction, fruit yield and quality, and susceptibility to other diseases. Some pumpkin varieties with resistance to powdery mildew are more susceptible to another important disease, bacterial wilt. Additional evaluations are needed to determine the extent of this problem, and, hopefully, to identify commercial varieties and experimental lines that have similar wilt-susceptibility as non-mildew-resistant varieties. Unfortunately, cucumber beetles were not observed until 11-14 days later than in previous experiments and bacterial wilt was substantially less severe even in the gourd Turk's Turban, a highly beetle-attractive and wilt-susceptible plant which was grown through out the field to ensure beetles and the pathogen were present.

Valuable information, however, was obtained on powdery mildew suppression and yield of PMR varieties and experimental lines of pumpkin, and growers were provided opportunities to examine the fruit of these after harvest. Pumpkins were evaluated within an integrated program with fungicides applied on an extended spray interval. Among the pumpkins evaluated, compared to varieties lacking known genes for resistance, best season-long suppression of powdery mildew on both upper and lower leaf surfaces, quantified as AUDPC, was obtained with two experimental varieties from the Cornell Plant Breeding program, XP6899 (Outstanding Seed), Magician (Harris Moran Seed) and Gold Bullion (Rupps Seed); however, none of the other entries had significantly more severe powdery mildew with the exceptions of 20 Karat Gold and Touch of Autumn. Percent control of powdery mildew was 0% for 20 Karat Gold, 42% for Touch of Autumn, and for the others ranged from 84% for Bumpkin to 100% for an experimental line from the Cornell Plant Breeding program. The pumpkin varieties produced fruit of a large range in size, color, and other horticultural characteristics. Size of fruit produced by the entries with powdery mildew resistance ranged from an average weight of 0.6 lb for Bumpkin to 11.2 lb for RPX 764. Thus there is now a good selection of PMR varieties for growers to choose from. Long Island growers have stated that evaluations of disease resistant varieties are an important research activity.

### Background and Justification:

Pumpkin varieties with resistance to powdery mildew (PMR) provide growers with a valuable new tool for managing this important disease that occurs every year throughout New York, as well as elsewhere in the US. Management practices must be implemented to avoid a reduction in yield. Application of fungicides is presently the principal practice for managing powdery mildew in pumpkin. Now that resistance has developed to the QoI (aka strobilurin, FRAC group 11) fungicides in New York, as well as elsewhere in the US, managing powdery mildew with

fungicides will be more challenging and also more expensive as growers will need to use additional fungicides. Thus the demand for PMR varieties is likely to increase.

Before selecting powdery mildew resistant varieties, growers need information on their performance, especially when grown under local conditions, in terms of powdery mildew reaction as well as fruit yield and quality. LI growers have described this disease as an important problem that is getting worse and resistant variety evaluations as an important need. PMR varieties evaluated previously exhibited a range in level of resistance that partly reflected whether the variety had resistance from one or both parents.

PMR pumpkin varieties also need to be evaluated in terms of susceptibility to bacterial wilt. Through a previous project, one of the first commercially-available PMR pumpkin varieties, Merlin, was found to be substantially more susceptible to bacterial wilt than powdery mildew susceptible pumpkin varieties. For example, 89% of Merlin plants developed severe wilt by 25 Aug 1999 versus only 3% of Harvest Moon plants. PMR pumpkin variety Magic Lantern was also found to be more susceptible under high disease pressure. As a result of this work, New York growers have been told that if they choose to grow these PMR varieties they will need to manage cucumber beetles, which vector the bacterial wilt pathogen, more aggressively than with non-PMR varieties. Insecticides are the primary tool for managing cucumber beetles. Thus growers are switching disease problems and pesticides, rather than solving the problem and reducing need for pesticide.

New PMR varieties and experimentals are being developed, some of which are anticipated to be not more susceptible to bacterial wilt than varieties that do not have resistance to powdery mildew. Based on results from a small experiment conducted in 2003, wilt susceptibility appears to not be linked to PMR. Three closely-related pumpkin varieties were compared that differ in their reaction to powdery mildew. Incidence of wilt in Magic Lantern, which has resistance from 1 parent, was similar to wilt incidence in Sorcerer, a closely-related variety without resistance to powdery mildew, and was similar to wilt incidence in closely-related Magician, which has resistance to powdery mildew from both of its parents. If wilt susceptibility was linked to mildew resistance, then Sorcerer would be least susceptible and Magician would be most susceptible. Additionally, in a previous PMR pumpkin evaluation study, wilt was observed in Merlin and Magic Lantern, but not in any of the Cornell University experimental lines. The PMR gene in the varieties developed by Harris Moran as well as other commercial seed companies is from the Cornell Plant Breeding Program.

Additional evaluations are needed to identify PMR varieties and experimentals that are not more susceptible to bacterial wilt than non-mildew-resistant varieties. Evaluating wilt susceptibility cannot be done by the plant breeders developing these PMR varieties because bacterial wilt is not a problem in areas where some of this work is being done.

### **Objectives:**

1. Determine attractiveness to cucumber beetles and susceptibility to wilt of PMR pumpkin varieties and experimental lines.
2. Compare suppression of powdery mildew achieved with the PMR pumpkin varieties and experimentals within an integrated management program.
3. Evaluate yield.

## **Procedures:**

1. An experiment was conducted using methods developed for previous experiments on bacterial wilt susceptibility. Plants were started in the greenhouse, then transplanted to the field into black plastic mulch with drip irrigation on 8-10 June while at the first-leaf stage, which was two weeks after seeding. There were 8 plants per plot and 4 replications per treatment arranged in a randomized block experimental design. Insecticides were not applied. The gourd Turk's Turban was planted between plots and at both ends of each row to ensure that cucumber beetles were present and evenly distributed in the field. This variety was previously shown to be very attractive to cucumber beetles and very susceptible to wilt. Plots were examined weekly for cucumber beetles while plants were young and also for symptoms of bacterial wilt. Beetles were counted and wilt assessed.

Commercial varieties and experimental lines of pumpkins from breeding programs in New York, New Hampshire, Rupp Seeds, Meyer Seed International, and Harris Moran Seeds were evaluated. These pumpkins included Merlin and the 3 varieties evaluated in 2003: Magic Lantern, Sorcerer, and Magician. *Cucurbita martinii*, which is the original source of PMR in squash and pumpkin, was included as well to further address the question of whether susceptibility to wilt is connected to PMR. These varieties were all compared to two pumpkin varieties without known genes for resistance, Howden and Sorcerer.

2. Control of powdery mildew with PMR pumpkin varieties and experimental lines was examined within an integrated management program that also included fungicides for powdery mildew applied on a reduced-spray schedule. This kind of a program is recommended on PMR varieties for managing selection of new pathogen strains able to overcome powdery mildew resistance or able to resist the action of the fungicides. The entire experiment was treated with fungicides on a 14 day interval beginning after detecting powdery mildew in the susceptible varieties. The reduced-fungicide program consisted of Bravo Ultrex 82.5WG (2.7 lb/A) + Nova 50W (5 oz/A) applied on 21 Jul and 20 Aug and Bravo Ultrex 82.5WG (2.7 lb/A) + Quintec 2.08SC (4 fl oz/A) applied on 5 Aug with a tractor-pulled boom sprayer that delivered 65 gal/A at 290 psi. This program worked well for PMR varieties in previous experiments. Powdery mildew severity was assessed routinely for each entry beginning on 2 Aug. Average severity for the entire canopy was calculated from individual leaf assessments. Area under Disease Progress Curve (AUDPC) was calculated for severity from 2 Aug through 17 Aug to obtain an assessment of control of powdery mildew over time.

3. Pumpkin fruit were harvested and weighed on 20-21 Oct and the average fruit weight was calculated. Fruit quality was evaluated in terms of handle (peduncle) condition for mature fruit without rot. Handles were considered good if they were green or brown, solid, and not rotting.

During a Twilight meeting in early September growers had an opportunity to examine the fruit and rank their favorites. Fruit were left on display next to a roadway at LIHREC so that other growers could examine them at their convenience.

## **Results and Discussion:**

Plants were examined for cucumber beetles and symptoms of wilt beginning on 20 June. Beetles were first observed on 1 July. Symptoms of bacterial wilt were first observed on 19 July on Turk's Turban plants. Few symptoms developed on any plants in this experiment and remained at too low a level for meaningful comparison. Symptoms started to develop in this experiment much later than in previous, similar experiments conducted in 1999 and 2000. Bacterial wilt is expected to be less severe the later it begins to develop in a cucurbit crop because cucumber beetles are attracted to flowers more than leaves and symptoms tend to be more localized with entire runners less often affected. Transplanting was done at the same time in previous years, but

beetles were seen on 17 June 1999 and 20 June 2000 and symptoms of wilt were seen on 6 July 1999 and 3 July 2000.

Symptoms of powdery mildew were first observed on 20 July on the varieties that did not have resistance. Fruit were starting to enlarge at that time. The first fungicide application was made the next day.

Among the pumpkins evaluated, best season-long suppression of powdery mildew on both upper and lower leaf surfaces, quantified as AUDPC, was obtained with two experimental varieties from the Cornell Plant Breeding Program, XP6899 (Outstanding Seed), Magician (Harris Moran Seed) and Gold Bullion (Rupps Seed); however, none of the other entries had significantly more severe powdery mildew with the exceptions of 20 Karat Gold and Touch of Autumn (see Table 1). Percent control of powdery mildew was 0% for 20 Karat Gold, 42% for Touch of Autumn, and for the others ranged from 84% for Bumpkin to 100% for a Cornell experimental line (these values are based on the average AUDPC values for upper and lower leaf surfaces compared to the combined averages for the two susceptible varieties, Howden and Sorcerer).

Size of fruit produced by the entries with powdery mildew resistance ranged from an average weight of 0.6 lb for Bumpkin to 11.2 lb for RPX 764 (see Table 1 and Photographs).

### **Conclusions:**

Unfortunately it was not possible to evaluate varieties for wilt susceptibility because cucumber beetles appeared later than in previous experiments and bacterial wilt incidence and severity remained too low for assessment. However, valuable information was obtained on powdery mildew susceptibility and yield of pumpkins with powdery mildew resistance (PMR). Control for most entries ranged from 84% to 100% compared to standard susceptible varieties. The PMR pumpkins produced fruit of a good range in size (0.6-11.2 lb/fruit), color, and other horticultural characteristics. Thus there is now a good selection of PMR varieties for growers to choose from.

**Table 1: Powdery mildew severity, fruit weight, and handle condition of pumpkin varieties and experimental lines with variable powdery mildew resistance evaluated in 2005.**

Entry	Powdery mildew severity (% leaf coverage) <sup>z</sup>									Fruit weight (lbs)	Good handles (%)		
	Upper leaf surface			Lower leaf surface									
	9-Aug	17-Aug	AUDPC	9-Aug	17-Aug	AUDPC							
<i>C. moschata</i> line.....	0.0	0.0	d <sup>y</sup>	0.0	e	0.0	c	0.0	d	0.0	d	nd <sup>x</sup>	nd
Segregating Population #1.....	0.5	0.0	d	0.0	e	0.0	c	0.0	d	0.0	d	nd	nd
Segregating Population #2.....	0.1	0.0	d	3.7	cde	0.4	bc	0.1	cd	4.0	bcd	nd	nd
NY01-609 (PMRR) <sup>w</sup> .....	0.0	0.0	d	0.0	e	0.0	c	0.0	d	0.0	d	6.3	de 17
XP6899 (PMRR).....	1.0	0.0	d	0.0	e	0.0	c	0.0	d	0.0	d	6.6	de 8
Magician (PMRR).....	0.0	0.0	d	0.0	e	0.0	c	0.0	d	0.0	d	6.4	de 13
Gold Bullion (PMR).....	0.0	0.0	d	0.0	e	0.0	c	0.0	d	0.1	d	9.0	bc 16
NY01-605A (PMRR).....	0.0	0.0	d	0.4	e	0.0	c	0.0	d	0.0	d	2.6	h 33
RPX 763 (PMR).....	0.0	0.0	d	0.2	e	0.0	c	0.0	d	0.2	d	10.5	ab 13
NH1799 (PMR).....	0.0	0.0	d	0.3	e	0.0	c	0.0	cd	0.2	d	10.7	a 19
Gladiator (PMRR).....	0.0	0.0	d	0.3	e	0.0	c	0.0	d	0.3	cd	9.9	ab 10
XP6888 (PMRR).....	0.0	0.0	d	0.6	de	0.0	c	0.0	d	0.1	d	5.0	ef 14
Magic Lantern (PMR).....	0.0	0.1	bcd	1.0	cde	0.1	c	0.1	cd	1.1	cd	7.3	cd 13
Hobbit (PMR).....	0.0	0.0	d	0.1	e	0.2	bc	0.0	d	1.2	cd	4.5	fg 23
Merlin (PMR).....	0.0	0.1	cd	0.8	de	0.1	bc	0.2	cd	2.2	cd	7.6	cd 14
Bumpkin (PMR).....	0.2	0.0	d	1.5	cde	0.4	bc	0.0	d	3.3	bcd	0.6	i 83
RPX 764 (PMR).....	0.0	0.0	d	0.3	e	0.4	bc	0.0	d	3.8	bcd	11.2	a 10
NH1788 (PMRR).....	0.0	0.0	d	0.4	e	0.4	bc	0.0	d	3.8	bcd	2.9	gh 24
Touch of Autumn (PMR).....	0.0	0.0	d	21.1	ab	0.0	c	0.0	d	3.0	bcd	1.6	hi 36
20 Karat Gold (PMR).....	0.0	4.9	a	30.0	a	5.7	a	5.3	a	65.6	a	7.6	cd 9
Howden (PMS).....	0.1	1.3	bc	9.0	dbc	0.9	bc	1.3	bc	13.9	bc	10.0	ab 9
Sorcerer (PMS).....	0.3	1.6	b	10.3	abc	1.6	b	2.2	ab	23.9	ab	7.8	cd 9
Treatment <i>P</i> -value	0.0967	0.0002		0.0001		0.0023		0.0004		0.0006		0.0001	0.0001

<sup>z</sup> Exact colony counts were made when possible and severity was estimated using the conversion factor of 30 colonies/leaf = 1%. Severity data is for all leaves on 9 Aug and 17 Aug.

<sup>y</sup> Numbers in each column with a letter in common are not significantly different according to Fisher's Protected LSD (*P* = 0.05).

<sup>x</sup> nd = not determined.

<sup>w</sup> 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, XP entries are from Outstanding Seed Co, and 'RPX' entries are from Rupp Seeds.