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

M. T. McGrath, S. R. Menasha and G. M. Fox
Dept of Plant Pathology & Plant-Microbe Biology
Cornell Univ, and Cornell Coop Ext, LIHREC,
3059 Sound Avenue, Riverhead, NY 11901

Powdery mildew resistant zucchini and yellow summer squash cultivar evaluation, 2008.

The objective of this study was to evaluate cultivars differing in powdery mildew resistance genes. The main goal was to determine whether cultivars with homozygous resistance, e.g. two copies of the powdery mildew resistance gene (PMRR), provide better suppression of powdery mildew than cultivars with heterozygous resistance (PMR). This was the case in cultivar evaluations conducted in 2007 but not in 2006. Most commercial resistant squash cultivars have PMR. Ability of the cultivars evaluated in 2008 to resist powdery mildew as well as their yields were determined relative to Spineless Beauty and Gentry, standard cultivars lacking powdery mildew resistance. This field experiment was conducted at the Long Island Horticultural Research and Extension Center in Riverhead on Haven loam soil. Fertilizer (N-P-K 10-10-10) at 500 lb/A was broadcast and incorporated on 5 May. Black plastic mulch and drip tape were laid on 6 May. Seeds were sown on 25 May in the greenhouse. Seedlings were transplanted into beds covered with black plastic mulch on 12 Jun. Water was provided as needed via drip irrigation lines located beneath the mulch. Additional fertilizer (N-P-K 46-0-0) at 30 lb/A was injected through the drip irrigation system on 2 and 17 Jul. Weeds were controlled between the rows of black plastic mulch by seeding white clover for a living mulch on 13 May after roto-tilling to prepare a seed bed and manage weeds that had already germinated. During the season, weeds were managed by mowing, hand weeding, and applying Select 2E (8 oz/A) with 1% COC on 8 Aug. Cucumber beetles were managed with Admire 2F applied after transplanting as a soil drench around transplants (0.0007 fl oz/plant) on 21 Jun and Asana XL (9.6 oz/A) applied to foliage on 13 Jun, 30 Jul, and 14 Aug. No fungicides were applied to control powdery mildew. The following fungicides were applied preventively for downy mildew (*Pseudoperonospora cubensis*) and Phytophthora blight (*Phytophthora capsici*): Curzate 60 DF (3.2 oz/A) on 30 Jul and Ranman 400 SC (2.75 fl oz/A) on 19 Jul and 14, 23, and 30 Aug. Plots were three adjacent rows each with five plants spaced 24 in. apart. Rows were spaced 68 in. apart. A single plant of Multipik summer squash, a susceptible 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 of the susceptible cultivars were examined for powdery mildew on 7 Jul. Assessments were done on 15, 22 and 29 Jul, and on 8 and 15 Aug. Initially 20-50 older leaves were examined in each plot, with the quantity adjusted based on the incidence of symptomatic leaves. Mid-aged and young leaves were also assessed on 15 Aug when powdery mildew had progressed to these age groups. Powdery mildew colonies (spots) 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%. 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 curve (AUDPC) to obtain a measure of severity over the entire assessment period (15 Jul – 15 Aug). Powdery mildew control was calculated for upper and lower leaf surfaces using AUDPC values relative to the AUDPC value for the susceptible cultivars. Powdery mildew severity was also assessed on stems and leaf petioles. Squash fruit were harvested and weighed on 20, 23, 26 and 31 Jul; and on 2, 7 and 18 Aug. Fruit were separated into marketable and unmarketable grades based on length, then weighed. There were no unmarketable fruit with blemishes due to disease or insect feeding. Fruit characteristics were also evaluated and overall appearance was rated on a scale of 1 to 9 with 1= poor and 9 = best. Average monthly high and low temperatures (^{o}F) were 80/63 in Jun, 84/67 in Jul, and 79/63 in Aug. Rainfall (in.) was 3.88, 3.67, and 3.76 for these months, respectively.

Symptoms of powdery mildew were found on the powdery-mildew-susceptible cultivars on 7 Jul at a low level (on 19 of 400 older leaves examined). Symptoms were found in all plots on 15 Jul except one plot of Zucchini #8517. Among the zucchini cultivars, powdery mildew on lower leaf surfaces was suppressed best by Zucchini #8517, a PMRR experimental cultivar developed by Outstanding Seeds. Degree of suppression based on AUDPC values was 75% and 81% on upper and lower leaf surfaces, respectively. Performance varied among the PMR cultivars reflecting differences in modifying genes. A zucchini cultivar considered to have a medium level of resistance to powdery mildew, Envy, provided only 33% and 31% suppression on upper and lower leaf surfaces, respectively, which was the lowest degree of suppression relative to Spineless Beauty, the susceptible check cultivar. Payroll, which has more resistance, provided 46% and 43% suppression on the two leaf surfaces, respectively. Amatista, a grey zucchini type with a higher level of resistance, suppressed powdery mildew by 64% and 50%, respectively. Zucchini #8517 and Amatista were both significantly better than Envy for most assessments. The yellow squash susceptible cultivar, Gentry, did not become as severely affected by powdery mildew as Spineless Beauty. The two resistant squash cultivars evaluated, Success PM and Sunglo, are PMRR. They suppressed powdery mildew equally well: 68% suppression on upper leaf surfaces and 70% and 85% suppression on lower leaf surfaces, respectively. Better control of powdery mildew was obtained with resistant summer squash varieties in 2008 than in 2007. Zucchini #8517 out-yielded the other zucchini cultivars. Success PM did not yield as well as the susceptible cultivar, as in previous years; however, in 2008 it was not because Success PM, an OP cultivar, began producing fruit later than the other cultivars. There were marketable fruit in all plots at the first harvest. Fruit quality was very good for all cultivars. Lowest overall appearance rating was 7.5 for Success PM.

Cultivar (resistance)	Powdery mildew severity (%) [z]										Marketable fruit			
	Upper leaf surface				Lower leaf surface						Number/ plant		Weight/ plant (lb)	
	7-Aug		AUDPC		29-Jul		7-Aug		AUDPC					
Zucchini #8517 (PMRR)	9.0	cd [y]	93.4	de	0.01	d	6.6	d	109.8	c	7.3	a	5.9	a
Amatista (PMR)	10.2	cd	138.5	cd	0.62	cd	32.0	cd	285.2	b	3.3	c	0.9	c
Payroll (PMR)	29.1	b	206.5	bc	1.11	cd	41.7	bc	326.3	b	5.7	b	3.4	b
Envy (PMR)	28.7	b	256.2	b	5.62	b	61.4	ab	398.0	b	5.8	b	3.7	b
Spineless Beauty (Susceptible)	54.1	a	380.1	a	13.71	a	75.6	a	575.6	a	4.9	b	3.0	b
Sunglo (PMRR)	5.9	cd	34.2	e	0.22	d	13.1	d	46.0	c				
Success PM (PMRR)	2.1	d	34.5	e	0.04	d	7.9	d	96.4	c	7.3		3.1	
Gentry (Susceptible)	17.0	bc	108.0	de	3.72	bc	53.6	ab c	316.8	b	9.3		4.3	
P-value (treatment)	< .0001		< .0001		< .0001		< .0001		< .0001		0.0005		<.0001	

[z] Exact colony counts were made when possible and severity was estimated using the conversion factor of 30 colonies/leaf = 1%. Data were transformed from percentages by a square root transformation when needed to obtain normality of variance before analysis of variance was performed. The table has de-transformed means.

[y] Numbers in each column with a letter in common are not significantly different according to Fisher's Protected LSD (*P* = 0.05). Yield was analyzed for the two squash types separately. Sunglo was excluded because it is a crookneck type while the other two are straightneck types. Probability <t from the t-test comparing them was 0.0408 and 0.0143 for number and weight of fruit, respectively.