

### **Powdery mildew-resistant butternut-type winter squash cultivar evaluation, 2009.**

The goal of this study was to determine whether hybrids with homozygous resistance, e.g. two copies of the powdery mildew resistance gene (PMRR), provide better suppression of powdery mildew than hybrids with heterozygous resistance (PMR). PMRR experimental hybrids were obtained from two plant breeders. This field experiment was conducted at the Long Island Horticultural Research and Extension Center in Riverhead on Haven loam soil. The field was plowed on 30 Apr and conventionally tilled on 14 May and 1 Jun. A blend of 19-10-12 controlled release fertilizer (containing 65% of N as ESN, a controlled release formulation) plus muriate of potash (0-0-60) at 100 lb/A was spread on 10 Jun and incorporated by disking. Black plastic mulch and drip tape were laid on 15 Jun. Seeds were sown on 29 May in the greenhouse. Seedlings were transplanted into the plastic-covered beds on 16 Jun. Water was provided as needed through drip irrigation lines located beneath the mulch. Weeds were controlled between plastic mulch strips by applying Strategy (3 pt/A) and Sandea (0.5 oz/A) on 17 Jun with a shielded herbicide sprayer and by hand weeding. Cucumber beetles were managed with Admire 2F (0.0007 fl oz/plant) applied after transplanting as a soil drench around transplants on 29 Jun and with Asana XL (9.6 oz/A) applied to foliage on 24 Jun and 1 Jul. No fungicides were applied to control powdery mildew. Ridomil Gold EC 1 pt/A + SprayHandler 8 fl oz/A were applied to soil on 8 Jun and incorporated by disking for Phytophthora blight (*Phytophthora capsici*). The following foliar fungicides were applied preventively for downy mildew (*Pseudoperonospora cubensis*) and Phytophthora blight: ProPhyt (4 pt/A) on 24 Jun; Forum 4.16SC (6 oz/A) on 27 Jul, 8 Aug, 27 Aug, 13 Sep, and 24 Sep; and Ranman 400SC (2.75 fl oz/A) on 17 Jul, 1 Aug, 16 Aug, 4 Sep, 18 Sep, 1 Oct. Plots were three adjacent rows each with three plants spaced 24 in. apart. Rows were spaced 68 in. apart. Within each of the three rows between each plot a plant of Gentry summer squash, a susceptible cultivar, was planted 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 10 to 30 leaves in each plot were assessed for powdery mildew on 15, 22, and 31 Jul; 5 and 14 Aug; and on 1 Sep. Initially the examined leaves were selected from the oldest third of the foliage based on leaf appearance and position in the canopy. As disease progressed mid-aged and young leaves also were examined. 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. Squash fruit were harvested and weighed on 8 Oct. Three 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 using fruit samples that were frozen and then thawed. Fruit characteristics were also evaluated and overall appearance was rated on a scale of 1 to 5 with 1 = poor and 5 = best. Average monthly high and low temperatures (°F) were 73/58 in Jun, 80/64 in Jul, 83/68 in Aug, and 74/58 in Sep. Rainfall (in.) was 6.43, 4.82, 2.01, and 2.39 for these months, respectively.

Powdery mildew symptoms were first seen on 22 Jul (36 days after transplanting) in 19 of the 44 plots. Symptoms were found in only one of the 12 plots planted to a PMRR hybrid. Powdery mildew was not consistently less severe for PMRR hybrids compared to PMR hybrids on subsequent assessment dates (not all data included in table). However, Bugle (PMRR) had the lowest average severity for most assessments. Severity remained low through 14 Aug rating, then increased to high levels by 1 Sep. The susceptible hybrid was the most severely affected hybrid on 31 Jul, but not on 1 Sep, which could have been due to death of the most severely affected leaves before 1 Sep. Lack of significant differences among hybrids in severity on 1 Sep may be partly due to the large degree of variation among plots. Severity was at a moderate level for the resistant hybrids on 1 Sep (exceeding 10% on upper leaf surfaces for most hybrids and 24% on lower surfaces for all). This may reflect a change in the pathogen such it is able to overcome host resistance or reduced suppression as plants reach maturity. The last assessment was 95 days after seeding. Unfortunately severity was not assessed during the last two weeks in Aug. Severity was not assessed after mid-Aug in a similar experiment conducted in 2008 (PDMR 3:V122). Fruit of JWS 61108 had the numerically highest sugar content; it was only significantly greater than Quantum and AF 7514. Honey Nut and JWS 61107 were bred to produce personal-sized fruit, which are especially popular for CSA boxes. Honey Nut produced the smallest fruit and the greatest number of fruit per plant. Quantum produced the greatest estimated weight of fruit per plant while Honey Nut and Waltham produced the least.

| Variety or experimental<br>(resistance) <sup>y</sup> | Powdery mildew severity (%) <sup>z</sup> |                |        |                    |        |   | Yield            |                       |    |                |    |        |     |
|--|--|----------------|--------|--------------------|--------|---|------------------|-----------------------|----|----------------|----|--------|-----|
|  | Upper leaf surface                       |                |        | Lower leaf surface |        |   | Number<br>/plant | Weight/<br>fruit (lb) |    | Sucrose<br>(%) |    |        |     |
|  | 31-Jul                                   | 1-Sep          |        | 31-Jul             | 1-Sep  |   |                  |                       |    |                |    |        |     |
| Bugle (PMRR) .....                                   | 0.0017                                   | b <sup>x</sup> | 3.2    | b                  | 0.0050 | b | 23.9             | 2.53                  | bc | 1.44           | ab | 11.97  | ab  |
| Betternut 401 (PMR) .....                            | 0.0017                                   | b              | 28.9   | a                  | 0.0433 | b | 39.1             | 2.53                  | bc | 1.41           | ab | 11.39  | abc |
| JWS 61107 (PMRR) .....                               | 0.0017                                   | b              | 15.2   | ab                 | 0.0100 | b | 31.6             | 3.11                  | b  | 1.08           | b  | 12.74  | ab  |
| Metro (PMR) .....                                    | 0.0342                                   | ab             | 20.9   | ab                 | 0.0200 | b | 25.9             | 2.19                  | bc | 1.46           | b  | 11.83  | abc |
| AF 7514 (PMR) .....                                  | 0.0250                                   | ab             | 9.5    | ab                 | 0.1492 | b | 26.5             | 1.94                  | bc | 2.83           | ab | 7.37   | c   |
| Quantum (PMR) .....                                  | 0.0000                                   | b              | 12.7   | ab                 | 0.0367 | b | 35.4             | 2.75                  | bc | 3.83           | a  | 8.63   | bc  |
| JWS 61108 (PMR) .....                                | 0.0500                                   | ab             | 12.4   | ab                 | 0.1508 | b | 24.5             | 2.89                  | bc | 1.76           | ab | 13.38  | a   |
| WSXP1037 (PMRR) .....                                | 0.0033                                   | b              | 15.3   | ab                 | 0.0817 | b | 37.8             | 2.47                  | bc | 1.84           | ab | 9.93   | abc |
| HMX 7732 (PMR) .....                                 | 0.0008                                   | b              | 19.0   | ab                 | 0.0692 | b | 30.6             | 2.56                  | bc | 2.03           | ab | 11.90  | ab  |
| Honey Nut (PMR) .....                                | 0.0008                                   | b              | 19.1   | ab                 | 0.0617 | b | 46.3             | 4.86                  | a  | 0.58           | b  | 11.07  | abc |
| Waltham (susceptible) .....                          | 0.2750                                   | a              | 13.0   | ab                 | 3.1183 | a | 31.5             | 1.39                  | c  | 1.92           | ab | 9.61   | abc |
| <i>P</i> -value (treatment)                          | 0.0385                                   |                | 0.0504 |                    | 0.0194 |   | 0.6135           | <.0001                |    | 0.0048         |    | 0.0017 |     |

<sup>z</sup>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. Only older leaves were assessed on 31 Jul.

<sup>y</sup>PMR = heterozygous resistance. PMRR = homozygous resistance.

<sup>x</sup>Numbers in each column with a letter in common are not significantly different according to Tukey's HSD ( $P = 0.05$ ) with the exception of the second data column.