Evaluation of Cucumber Varieties Resistant to Downy Mildew

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Downy mildew has been a major problem in Long Island cucurbit crops, especially cucumbers, since a new pathogen strain appeared in the US around 2004. It has occurred every year on LI since, sometimes starting as early as mid-July. Impact has been great especially for organic producers because they do not use synthetic fungicides and their customers want a continuous supply of cucumbers into the fall, which they have not been able to do because downy mildew has been killing their plants. Cost of fungicides needed to manage downy mildew conventionally is a major constraint because cucumbers are not a high value item. The downy mildew fungus exists as pathotypes varying in ability to infect the various cucurbit types. Cucumber is susceptible to all pathotypes and thus is the first crop affected in an area. Premature death of leaf tissue results in reduced fruit quality and quantity. Loss can be quite extensive in cucumber as fruit production declines substantially in severely affected plants, much of the fruit produced is misshapen, and plants die prematurely. Before 2004, downy mildew was very effectively managed in cucumber because most varieties marketed for commercial production had high level of resistance to pathogen strain present then. This resistance provides limited suppression of the new strain.

There are now cucumber varieties resistant to downy mildew worthy of consideration for production on LI. The goal of an experiment conducted in 2017 was to obtain information about how these varieties perform in terms of disease resistance as well as fruit quality and yield in order to provide growers information they need to decide if any of the resistant varieties are suitable for their operation.

Procedures:
The experiment was conducted with field-grown cucumber at the Long Island Horticultural Research and Extension Center (LIHREC) in Riverhead, NY, in a field with Haven loam soil. The field was plowed on 11 Apr and prepared for planting on 9 Jun. Controlled release fertilizer (N-P-K, 15-5-15) was broadcast and incorporated into the soil at 675 lb/A (101 lb/A N). Beds were formed, a single line of drip tape was laid over the top, and beds were covered with black plastic mulch in one pass. Holes were punctured through the plastic at 2 ft spacing on 25 Jul. Admire Pro insecticide was applied to the open holes at 10.5 fl oz/A on 26 Jul using a backpack sprayer. Strategy 3 pt/A, Sandea 0.5 oz/A and Roundup PowerMax 22 oz/A were applied prior to transplanting for weed control on 26 Jul using a tractor-mounted sprayer. Cucumbers were seeded in the greenhouse on 5 Jul, and transplanted into the field on 27 Jul. During the season, weeds were controlled by cultivating and hand weeding as needed.

The primary source of initial inoculum in this area is considered to be long-distance wind-dispersed spores from affected plants. Plots consisted of one 18-ft row spaced 68 in. apart containing 9 plants. The 6-ft area between plots was not planted. A completely randomized
A design with four replications was used. Plots were inspected for downy mildew symptoms on 11 and 28 Aug, and 6 and 14 Sep. At each assessment, disease severity was estimated for the entire plot canopy as well as 9 randomly selected symptomatic leaves in each plot. Area Under Disease Progress Curve (AUDPC) values were calculated from 11 Aug through 14 Sep. Yield and fruit quality assessments were taken on 6, 15, and 21 Sep. All fruit was sorted by marketability and weighed per plot.

**Results:**
Natural inoculum was depended on for this experiment. A late planting date was used because some years downy mildew has not been seen on Long Island until September. Symptoms were observed in this experiment on Aug 10, just two weeks after transplanting, in all plots. Disease pressure was very high and symptoms developed quickly, which resulted in severely limited yield in most varieties in the experiment. Most of the varieties produced less than one marketable fruit per plant throughout the season (see table). Only Citadel, Bristol, and DMR 401 had significantly lower disease severity ratings across all measurements compared to the susceptible variety Straight Eight (see table). Data in table sorted by AUDPC values. These three varieties were also the highest yielding, both in marketable and total fruit. In terms of both yield and disease resistance, DMR 401 was far and away the most successful variety in this experiment. It produced more than twice the fruit of the next highest yielding variety in both marketable and total fruit. AUDPC for the entire canopy was significantly negatively correlated with marketable fruit per plant.

**Discussion:**
Under the severe disease pressure of this experiment, good downy mildew suppression was exhibited by DMR 401 (75% control), Bristol (50%), and Citadel (49%). DMR 401 produced substantially more marketable fruit than the other varieties whose yield and fruit quality were severely impacted by downy mildew. It was developed by Cornell plant breeder Michael Mazourek and is sold at http://commonwealthseeds.com/. Citadel is a pickle type suitable for fresh market production. Bristol is a new Seminis brand variety reported to have improved resistance. SV3462CS (37% control), SV4719CS (36%), Diamondback (33%) and Marketmore 76 (23%) exhibited moderate downy mildew suppression. DMR 401, Bristol, and NY264, another Cornell variety sold by Commonwealth Seeds, performed well in evaluations conducted at the University of Massachusetts in 2016 and 2017. Citadel exhibited very good resistance while Peacemaker exhibited excellent resistance in an evaluation conducted at North Carolina State University in 2016.

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Downy mildew severity and yield for cucumber varieties and experimental hybrids bred to be resistant.

<table>
<thead>
<tr>
<th>Variety</th>
<th>28 Aug</th>
<th>6 Sep</th>
<th>14 Sep</th>
<th>AUDPC</th>
<th>14 Sep</th>
<th>AUDPC</th>
<th>Marketable</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Straight Eight</td>
<td>27 a</td>
<td>63 a</td>
<td>65 a</td>
<td>1255 a</td>
<td>76 a</td>
<td>1454 a</td>
<td>0.00 e</td>
<td>0.01 e</td>
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<tr>
<td>Speedway</td>
<td>25 ab</td>
<td>47 ab</td>
<td>56 ab</td>
<td>1038 ab</td>
<td>65 ab</td>
<td>1299 ab</td>
<td>0.00 e</td>
<td>0.71 cd</td>
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<tr>
<td>Marketmore 76</td>
<td>24 ab</td>
<td>44 b</td>
<td>53 abc</td>
<td>970 bc</td>
<td>66 ab</td>
<td>1254 abc</td>
<td>0.03 de</td>
<td>0.26 de</td>
</tr>
<tr>
<td>Diamondback</td>
<td>23 ab</td>
<td>38 bc</td>
<td>49 abc</td>
<td>845 bcd</td>
<td>61 abc</td>
<td>1080 bc</td>
<td>0.33 c</td>
<td>0.94 bcd</td>
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<tr>
<td>SV4719CS</td>
<td>17 bc</td>
<td>39 bc</td>
<td>56 ab</td>
<td>806 bcd</td>
<td>66 ab</td>
<td>1033 cd</td>
<td>0.25 cd</td>
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<td>SV3462CS</td>
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<td>34 bcd</td>
<td>51 abc</td>
<td>788 cd</td>
<td>65 ab</td>
<td>1018 cd</td>
<td>0.26 cd</td>
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<td>17 bc</td>
<td>22 de</td>
<td>36 c</td>
<td>643 d</td>
<td>42 cd</td>
<td>823 d</td>
<td>1.01 b</td>
<td>2.09 b</td>
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<tr>
<td>Bristol</td>
<td>12 c</td>
<td>28 cd</td>
<td>42 bc</td>
<td>633 d</td>
<td>50 bcd</td>
<td>802 d</td>
<td>0.39 bc</td>
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<td>DMR 401</td>
<td>13 c</td>
<td>8 e</td>
<td>17 d</td>
<td>319 e</td>
<td>31 d</td>
<td>539 e</td>
<td>2.79 a</td>
<td>5.10 a</td>
</tr>
</tbody>
</table>

$P$-value (variety) $<0.0001$ $<0.0001$ $<0.0001$ $<0.0001$ $<0.0001$ $<0.0001$ $<0.0001$ $<0.0001$

$z$ Numbers in each column with a letter in common are not significantly different from each other (Tukey’s HSD, $P=0.05$).

$y$ When data were not distributed normally, values were square root transformed before analysis. Table contains de-transformed values.
9/15 fruit from 9 plants

Bristol

Citadel

SV4719CS

Diamondback

SV3462CS

DMR 401

Marketmore 76

Speedway

Straight Eight