CoRoN Enhancement of Pumpkin Fungicides: Effects on Foliar Diseases

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Kent Cushman, Mississippi State University

Interpretative Summary

The effect of fungicides and foliar fertilizers on pumpkin diseases and yield was evaluated in a field test of small, ornamental pumpkins. Sprays of azoxystrobin and chlorothalonil reduced the severity of downy mildew, the incidence of Microdochium blight, and plant loss to disease. Chlorothalonil also reduced the severity of powdery mildew. Foliar nitrogen (CoRoN) appeared to reduce downy mildew severity late in the season. Combining foliar nitrogen with foliar phosphorous and potassium appeared to increase powdery mildew severity. Yields were significantly increased with sprays of azoxystrobin, chlorothalonil, aluminum tris, or foliar phosphite 0-28-26.

Introduction

The purpose of this study was to evaluate the effects of CoRoN, a controlled-release foliar nitrogen source, on the efficacy of fungicides used to control pumpkin diseases and on pumpkin yield and fruit quality. Similar tests were conducted with other cooperators at two sites in Mississippi, Crystal Springs and Verona. Only the results of the Tennessee study are reported here.

Materials and Methods

The test was conducted at the University of Tennessee=’s West Tennessee Experiment Station. Six foliar spray treatments, with and without CoRoN, were evaluated: Quadris 2.08F (azoxystrobin) at 15.4 fl oz/A alternated with chlorothalonil at 2 pint/A, Equus 720 (chlorothalonil) at 2 pint/A, Aliette WDG (aluminum tris) at 3 lb/A, Armicarb 100 (potassium bicarbonate) at 4 lb/A, foliar phosphite 0-28-26 (phosphorus acid and soluble potassium) at 3 pint/A, and a water control. CoRoN (28 % total N) was applied at 1 pint/A (9 August), 1 quart/A (16 August), or 2 quart/A (remaining sprays). All sprays were applied at 20 psi with a CO₂ sprayer equipped with a hand-held horizontal boom and 1 to 3 flat fan nozzles (nozzle number increased as plant size increased). Sprays were applied six times: August 9, 16, 23, and 29 and September 6 and 13.

A randomized complete block design with four replications was used. Experimental units consisted of a single row of ten Lil= Goblin pumpkins (Harris Seeds) seeded 2 ft. apart. This variety has a compact vine, no resistance to powdery mildew, and produces small 1-2 lb.
ornamental pumpkins about 4 inches in diameter. The test was planted by hand on 19 July. Plots not receiving CoRoN were sidedressed with 32 lb N/A on 14 August. Plants were rated for disease incidence and/or severity on four occasions: August 23, September 5-6, 14-16, and 27-28. Disease severity ratings were on a 0 - 5 scale where 0 = no disease and 1 = 1%, 2 = 10%, 3 = 30%, 4 = 60%, and 5 = 100% of leaf area with disease lesions. Intermediate scale points (e.g., 1.5, 2.5, 3.5...) were used where appropriate. Ratings were changed to percentage data using the formula \( \% \text{leaf area} = 1.5625 - 5.625x + 5.0625x^2 \), where \( x \) = the severity rating. For analysis of variance, arcsin transformed percentages were used. ANOVA results in tables report these analyses; percentages are the disease ratings before transformation.

Multiple locations and multiple observations at each location were used to gather data on the severity of downy mildew. Four locations were used per one-row plot, two on the south side of the row and two on the north side of the row (rows ran nearly straight east-west). At each location, the severity of downy mildew in the upper leaf canopy and lower leaf canopy were recorded. Powdery mildew disease severity was based on only two observations per plot, one on the north side and one on the south side. Disease incidence data for Microdochium blight and yellow vine are the percentages of plants severely affected with these diseases based on the original number of plants per row.

**Results and Discussion**

No foliar diseases were observed on August 23. One dead plant and seven plants showing signs of decline due to yellow vine were noted. The test received several heavy rainfalls August 27 - September 4 (total rainfall: 3.38 in.). By September 5, most plants showed some signs of infection with downy mildew, and an occasional plant was infected with powdery mildew. Microdochium blight was causing the decline of many plants and yellow vine was becoming more common. Both Quadris 2.08F and Equus 720 significantly reduced the incidence of Microdochium blight (Table 1) and downy mildew severity (Table 2) compared to the control and all other treatments. Yellow vine incidence and powdery mildew severity were unaffected by treatment. CoRoN had no apparent effect on fungicide efficacy.

By September 14, severe leaf loss due to downy mildew was apparent in all plots (Table 3), and powdery mildew was becoming more common in plots receiving Equus 720. Significant interactions between CoRoN use and other treatments were noted. These were most apparent with downy mildew for the water control and with powdery mildew for foliar phosphite (Table 4). Foliage loss due to downy mildew was so severe by September 28 that further disease severity ratings were not possible. Plant losses, mainly due to Microdochium blight plus some yellow vine, were noted. Quadris 2.08F and Equus 720 significantly reduced these losses (Table 5). CoRoN had no apparent effect on plant survival.

The center eight plants in each plot were harvested 2 - 3 October. All treatments except
Armicarb 100 significantly increased pumpkin yield (Table 6) compared to the water control. Yields with Quadris 2.08F were significantly greater than those of all other treatments, both in terms of the number of pumpkins harvested and total weight of marketable fruit. Applications of CoRoN did not significantly affect yield, and there were no significant interactions between CoRoN use and the other spray treatments. A notable ($P = 0.10$) decrease in marketable fruit with use of CoRoN was observed, however. The numbers of unmarketable pumpkins due to rot (mean = 7%) or misshaped fruit (mean = 1%) were unaffected by treatment.

Table 1. Effects of CoRoN and fungicide treatment on the incidence of yellow vine and Microdochium blight on Lil= Goblin pumpkin, September 5 - 6, 2001, Jackson, TN.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Yellow vine</th>
<th>Microdochium blight</th>
</tr>
</thead>
<tbody>
<tr>
<td>without CoRoN</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>with CoRoN</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Quadris 2.08F</td>
<td>9</td>
<td>0</td>
</tr>
<tr>
<td>Equus 720</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Aliette 80WDG</td>
<td>4</td>
<td>21</td>
</tr>
<tr>
<td>Armicarb 1–</td>
<td>9</td>
<td>15</td>
</tr>
<tr>
<td>Foliar phosphite 0-28-26</td>
<td>6</td>
<td>14</td>
</tr>
<tr>
<td>water</td>
<td>14</td>
<td>14</td>
</tr>
</tbody>
</table>

ANOVA results

<table>
<thead>
<tr>
<th>Source</th>
<th>F Value</th>
<th>(Prob. &gt;F)</th>
<th>F Value</th>
<th>(Prob &gt;F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>fungicide</td>
<td>0.99</td>
<td>0.44</td>
<td>5.78</td>
<td>0.0006</td>
</tr>
<tr>
<td>CoRoN</td>
<td>0.99</td>
<td>0.33</td>
<td>1.29</td>
<td>0.26</td>
</tr>
<tr>
<td>Fungicide x CoRoN</td>
<td>0.60</td>
<td>0.70</td>
<td>0.23</td>
<td>0.94</td>
</tr>
</tbody>
</table>
*Values are the means of four replications. Means followed by a different letter are significantly different (P = 0.05).

Table 2. Effects of CoRoN and fungicide treatment on the severity of downy mildew and powdery mildew on Lil= Goblin pumpkin, September 5 - 6, 2001, Jackson, TN.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Downy mildew</th>
<th>Powdery mildew</th>
</tr>
</thead>
<tbody>
<tr>
<td>without CoRoN</td>
<td>18</td>
<td>0.6</td>
</tr>
<tr>
<td>With CoRoN</td>
<td>20</td>
<td>0.6</td>
</tr>
<tr>
<td>Quadris 2.08F</td>
<td>6 c*</td>
<td>0.0</td>
</tr>
<tr>
<td>Equus 720</td>
<td>7 c</td>
<td>0.7</td>
</tr>
<tr>
<td>Aliette 80WDG</td>
<td>23 ab</td>
<td>1.4</td>
</tr>
<tr>
<td>Armicarb 100</td>
<td>25 ab</td>
<td>0.3</td>
</tr>
<tr>
<td>Foliar phosphite 028-26</td>
<td>17 b</td>
<td>0.9</td>
</tr>
<tr>
<td>Water</td>
<td>36 a</td>
<td>0.3</td>
</tr>
</tbody>
</table>

ANOVA results

<table>
<thead>
<tr>
<th>Source</th>
<th>F Value</th>
<th>(Prob &gt;F)</th>
<th>F Value</th>
<th>(Prob &gt;F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>fungicide</td>
<td>11.09</td>
<td>0.0001</td>
<td>2.04</td>
<td>0.10</td>
</tr>
<tr>
<td>CoRoN</td>
<td>0.61</td>
<td>0.44</td>
<td>0.25</td>
<td>0.62</td>
</tr>
<tr>
<td>Fungicide x CoRoN</td>
<td>1.04</td>
<td>0.41</td>
<td>0.66</td>
<td>0.66</td>
</tr>
<tr>
<td>Rep</td>
<td>9.35</td>
<td>0.0001</td>
<td>2.27</td>
<td>0.10</td>
</tr>
</tbody>
</table>
Values are the means of four replications. Means followed by a different letter are significantly different (P = 0.05).

Other means of interest:

**upper leaf canopy**  **lower leaf canopy**

Downy mildew severity: 23 % 15%

**south side of row**  **north side of row**

Downy mildew severity: 16 % 22%

(rows ran nearly straight east-west)

Table 3. Effects of CoRoN and fungicide treatment on the severity of downy mildew and powdery mildew on Lil= Goblin pumpkin, September 14 -16, 2001, Jackson, TN.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Downy mildew</th>
<th>Powdery mildew</th>
</tr>
</thead>
<tbody>
<tr>
<td>without CoRoN</td>
<td>60</td>
<td>3</td>
</tr>
<tr>
<td>with CoRoN</td>
<td>59</td>
<td>3</td>
</tr>
<tr>
<td>Quadris 2.08F</td>
<td>64 ab*</td>
<td>4 b</td>
</tr>
<tr>
<td>Equus 720</td>
<td>59 abc</td>
<td>8 a</td>
</tr>
<tr>
<td>Aliette 80WDG</td>
<td>58 bc</td>
<td>2 b</td>
</tr>
<tr>
<td>Armicarb 100</td>
<td>54 c</td>
<td>1 b</td>
</tr>
<tr>
<td>Foliar phosphite 0-28-26</td>
<td>55 c</td>
<td>2 b</td>
</tr>
<tr>
<td>water</td>
<td>666 a</td>
<td>1 b</td>
</tr>
</tbody>
</table>

ANOVA results

<table>
<thead>
<tr>
<th>Source</th>
<th>F Value</th>
<th>(Prob &gt;F)</th>
<th>F Value</th>
<th>(Prob &gt;F)</th>
</tr>
</thead>
</table>
Table 4. Effects of fungicide treatments with (+) and without (-) CoRoN on the severity of downy mildew and powdery mildew on Lil= Goblin pumpkin, September 14 - 16, 2001, Jackson, TN.

<table>
<thead>
<tr>
<th>Treatment #</th>
<th>Downy mildew</th>
<th>Powdery mildew</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quadris 2.08f +</td>
<td>61 bc*</td>
<td>2 bcde</td>
</tr>
<tr>
<td>Quadris 2.08F -</td>
<td>66 ab</td>
<td>5 bcd</td>
</tr>
<tr>
<td>Equus 720 +</td>
<td>58 bcd</td>
<td>10 a</td>
</tr>
<tr>
<td>Equus 720 -</td>
<td>61 bc</td>
<td>5 ab</td>
</tr>
</tbody>
</table>

*Values are the means of four replications. Means followed by a different letter are significantly different (P = 0.05).

Other means of interest:

**upper leaf canopy lower leaf canopy**

Downy mildew severity: 80 % 39%

**south side of row north side of row**

Downy mildew severity: 58 % 61%

Powdery mildew severity: 1 % 4%

(rows ran nearly straight east-west)
<table>
<thead>
<tr>
<th>Treatment</th>
<th>Plant loss (% of plants dead or dying)</th>
</tr>
</thead>
<tbody>
<tr>
<td>without CoRoN</td>
<td>37</td>
</tr>
<tr>
<td>with CoRoN</td>
<td>42</td>
</tr>
<tr>
<td>Quadris 2.08F</td>
<td>28 b*</td>
</tr>
<tr>
<td>Quuss 720</td>
<td>25 b</td>
</tr>
</tbody>
</table>

*Values are the means of four replications. Means followed by a different letter are significantly different (P = 0.05).

Table 5. Effects of CoRoN and fungicide treatment on total losses of Lil= Goblin pumpkin plants, September 27-28, 2001, Jackson, TN.
<table>
<thead>
<tr>
<th></th>
<th>Number fruit/acre</th>
<th>Number lbs/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without CoRoN</td>
<td>6945</td>
<td>7274</td>
</tr>
<tr>
<td>With CoRoN</td>
<td>5856</td>
<td>6098</td>
</tr>
<tr>
<td>Quadris 2.08F</td>
<td>8531 a</td>
<td>9594 a</td>
</tr>
<tr>
<td>Equus 720</td>
<td>7115 b</td>
<td>7970 b</td>
</tr>
<tr>
<td>Aliette 80WDG</td>
<td>6788 b</td>
<td>6758 b</td>
</tr>
<tr>
<td>Armicarb 100</td>
<td>3993 c</td>
<td>3794 c</td>
</tr>
</tbody>
</table>

*Values are the means of four replications. Means followed by a different letter are significantly different (P = 0.05).

Table 6. Effects of CoRoN and fungicide treatment on the yield of Lil= Goblin pumpkin, Fall, 2001, Jackson, TN.
Foliar phosphite 0-28-26 | 7006 | b | 7180 | b  
water | 4973 | c | 4821 | c

ANOVA results

<table>
<thead>
<tr>
<th>Source</th>
<th>F Value</th>
<th>(Prob &gt;F)</th>
<th>F Value</th>
<th>(Prob &gt;F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>fungicide</td>
<td>5.90</td>
<td>0.002</td>
<td>7.50</td>
<td>0.0006</td>
</tr>
<tr>
<td>CoRoN</td>
<td>3.92</td>
<td>0.06</td>
<td>3.51</td>
<td>0.08</td>
</tr>
<tr>
<td>Fungicide x CoRoN</td>
<td>0.241</td>
<td>0.94</td>
<td>0.20</td>
<td>0.96</td>
</tr>
<tr>
<td>Rep</td>
<td>5.54</td>
<td>0.007</td>
<td>6.78</td>
<td>0.003</td>
</tr>
</tbody>
</table>

*Values are the means of four replications

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This research represents one season's data and does not constitute recommendations. After sufficient data is collected over the appropriate number of seasons, final recommendations will be made through research and extension publications.