Comparison of Propiconazole Rates for Control of Fungal Brown Spot of Wild Rice

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ABSTRACT

Wild rice (Zizia palustris 'K-2') was inoculated with conidial suspensions of Bipolaris oryzae. Propiconazole was applied at 124, 186, and 247 g a.i./ha at boot and heading and 247 and 308 g a.i./ha at boot only. Plants treated with 124 g a.i./ha twice or 308 g a.i./ha once did not have significant (P = 0.05) yield increases or decreased disease severity when compared with the nontreated control. Plants treated with either 186 or 247 g a.i./ha at boot and heading had average significant yield increases of 54 and 87%, respectively. Only one application of propiconazole at 247 g a.i./ha resulted in a significant yield increase of 61% above the control. With the exception of the treatments at 124 and 308 g a.i./ha (phytotoxic), propiconazole reduced leaf infection by 80, 89, and 80% on the flag, F-1, and F-2 topmost leaves, respectively, when compared with the control.

Wild rice (Zizia palustris L.) is grown commercially on 11,129 ha in Minnesota and California (11). Fungal brown spot (FBS) of wild rice caused by Bipolaris oryzae (Breda de Haan) Shoem. (=Cochliobolus miyabeanus (Ito & Kuribayashi) Drechs. ex Dastur) is destructive in cultivated paddies in Minnesota (1,5) but not in California. Yield reductions associated with FBS have been quantified (6,7). Significant disease control can be achieved by the use of mancozeb (6), chlorothalonil, and/or iprodione (7,8). It has been demonstrated that B. oryzae can become tolerant to high concentrations of mancozeb in the laboratory (4). However, mancozeb is currently the only registered fungicide for FBS control on cultivated wild rice in Minnesota.

In 1985, 1986, and 1987, the efficacy of propiconazole at various rates in controlling FBS was studied at the University of Minnesota North Central Experiment Station in Grand Rapids. Propiconazole, a systemic fungicide having ergosterol-biosynthesis inhibiting properties (2), has demonstrated efficacy against many representative species in the Ascomycetes, Deuteromycetes, and Basidiomycetes (10). This is the first report of the effects of propiconazole at various rates on yield and control of FBS on cultivated wild rice.

MATERIALS AND METHODS
Wild rice seed, cultivar K-2, obtained from a commercial grower was stored in water at 2°C for 6 mo and then sown during the first week of May in 1985, 1986, and 1987. Experimental paddies were fertilized with 33.7 kg N/ha applied as urea and incorporated using a Roto-tiller. The seed was sown by hand-broadcasting at 11.25 kg/ha in 1.5 × 2.1 m plots. A second fertilization urea at 3.4 kg N/ha was made during the boot stage of plant development. Plots were sprayed with diazinon at 1.12 kg/ha 30 days after planting to control leaf miner (Eribolus longulus Loew) and with malathion at 1.12 kg/ha at early milk stage of grain development to control rice worm (Apamea apamiformis Guenee) (9).

Experimental design. A randomized complete block design with six replicates was used. Plant density in each plot was adjusted to 23 plants/m². Most plants produced approximately three tillers. Grain was hand-harvested from a 1.2 × 1.8 m area when the plants were at the 50% darkened grain (ripe) stage of plant development.

Inoculation. Isolates of B. oryzae were collected from lesions on cultivated wild rice plants in Minnesota, maintained on Dico potato-dextrose agar (PDA) slants at 24°C, and cycled through wild rice plants in the greenhouse to ensure pathogenicity. Cultures were resolicited from lesions on the infected plants and were single-spored. They were then maintained on PDA at 4°C in the dark. A grain culture medium consisting of oat, wheat, and rye (1:1:1) seed was placed in galvanized trays (30 × 20 × 10 cm) lined with aluminum foil and soaked for 12 hr in distilled water. After decanting the water, the trays were covered with aluminum foil and autoclaved at 121°C for 2 hr. Mycelial plugs from several isolates of B. oryzae were added and the medium was incubated at 24°C for 3 wk.
The effect of various rates of propiconazole on the yield and disease severity of wild rice cultivar K-2 infected with fungal brown spot caused by *Bipolaris oryzae* in 1985, 1986, and 1987

<table>
<thead>
<tr>
<th>Fungicide rate (g a.i./ha)</th>
<th>Growth stage at application</th>
<th>Yield (kg/ha)</th>
<th>Percent disease severity</th>
<th>Average percent disease severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>124</td>
<td>Boot and heading</td>
<td>319 a</td>
<td>330 a</td>
<td>339 a</td>
</tr>
<tr>
<td>186</td>
<td>Boot and heading</td>
<td>315 a</td>
<td>503 b</td>
<td>454 b</td>
</tr>
<tr>
<td>247</td>
<td>Boot and heading</td>
<td>508 c</td>
<td>617 c</td>
<td>690 c</td>
</tr>
<tr>
<td>247</td>
<td>Boot</td>
<td>407 b</td>
<td>493 b</td>
<td>491 b</td>
</tr>
<tr>
<td>308</td>
<td>Boot</td>
<td>332 a</td>
<td>344 a</td>
<td>304 a</td>
</tr>
<tr>
<td>Control</td>
<td></td>
<td>359 a</td>
<td>299 a</td>
<td>324 a</td>
</tr>
</tbody>
</table>

*Means in each column followed by the same letter are not significantly different at *P* = 0.05 according to Duncan's multiple range test.

RESULTS AND DISCUSSION

Each year, propiconazole at 124 g a.i./ha had no significant (*P* = 0.05) effect on yield (Table 1). Also, the severity of FBS on the flag, F-1, and F-2 topmost leaves was greater than in other fungicide treatments.

In 1986 and 1987, propiconazole application of 186 g a.i./ha at both boot and heading stages of development resulted in increased yields (*P* = 0.05) of 68 and 40%, respectively, when compared with the control (Table 1). In 1985, a combination of poor seed germination (20%), requiring selected transplanting, and storm and bird damage may have contributed to yields that were generally lower in the fungicide treatments at 186 and 247 g a.i./ha.

When applied at 247 g a.i./ha during the 3 yr, propiconazole significantly increased yields (Table 1). Plants treated at both boot and heading produced significantly higher yields than other treatments. Yield increases of 42, 106, and 113% over the control occurred in 1985, 1986, and 1987, respectively. The average FBS over the 3-yr period on the flag, F-1, and F-2 topmost leaves were 1, 3, and 4%, respectively, when compared with an average 6, 30, and 63% for the control (Table 1). Plants receiving a single propiconazole application of 247 g a.i./ha during boot produced an average yield significantly greater than the control (average of 59%) in 1986 and 1987. Disease severity ratings on the flag, F-1, and F-2 topmost leaves averaged 1, 3, and 15%, respectively, for the 3-yr period (Table 1).

A single application of propiconazole at 308 g a.i./ha at boot did not significantly affect yield (Table 1).

Phytotoxicity characterized by tissue death at the site of fungicide application occurred 5 days after application at the 124 g a.i./ha rate. However, the fungicide did inhibit pathogen development, as shown by lower FBS, when compared with both the control and the rates of 186 and 247 (at boot only) g a.i./ha over the 3-yr period (Table 1).

In summary, consistent significant control of FBS on cultivated wild rice throughout the season under controlled epidemic conditions was achieved by the application of propiconazole at 247 g a.i./ha at boot alone and/or at both boot and heading.

LITERATURE CITED