Oat Crown Rust vs. Biodiversity

Crown rust of oats is a plague that has been around as long as oats have been raised in the Midwest. It's often invisible, but crown rust sometimes devastates the crop, as in 1996 in northeast Iowa. PFI is partnering with ISU and with farmers and scientists in Minnesota to try a different approach to this disease.

For the better part of a century, plant breeding has developed varieties resistant to strains of crown rust of oat (Puccinia coronata). But crown rust is a sneaky fungus. It keeps evolving, bypassing the resistance bred into the crop. Scientists would respond by breeding in a new resistance gene from wild oat and its relatives. And rust would then develop "virulence" to that new gene as well. Now breeders are running out of resistance genes in the wild. Is this the end of the road for oats on Midwest farms? Let's hope not! Oat is too useful as a nurse crop for forages, a clean-up crop for nutrients and weeds, and a high-fiber feed for baby pigs.

Back in the 1950s, lowa scientists like Dr. Artie Browning tried a different approach to managing oat rust. They created varieties that were biodiverse. In this "multiline" approach, some oat plants in the field were resistant to one strain of rust, and other plants were resistant to other strains. The crop could compensate for losses to any particular strain of rust that might be prevalent in a given year, much as wild plant populations do in natural systems. In addition, the oat diversity reduced the pressure on the rust to develop new infective strains. The multiline approach definitely worked.

However, it took more time and resources to develop oat varieties that were a mix of different genetics.

Small grains breeding has even fewer resources today than half a century ago when multilines were popular. But if producers knew how to combine different commercially available oat varieties, they might be able to create their own biodiverse, multivariety seeding. The key piece of information would be how to combine those commercial varieties.

And to do that, we have to know what strains of rust each variety is resistant to. The project is generating just this information by inoculating oat varieties with different rust strains and by comparing the performance of a varietal mixture to that of its components. The work, with producers in lowa and Minnesota, began in 2006 and will continue through 2008.

| Compared to Average of Varieties. Blend Variety Blen | | | | | | | |
|---|---------------------|------|------------------------|-------|---------|--|--|
| State | Farm | Year | Yield | Avg | Benefit | | |
| | | 2 | —— bushels per acre —— | | | | |
| IA | Natvig | 2006 | 61.0 | 58.3 | 2.6 | | |
| IA. | Lansing | 2006 | 95.7 | 92.1 | 3.6 | | |
| IA | Wilson | 2006 | 125.0 | 112.8 | 12.2 | | |
| IA | Ames | 2006 | 111.2 | 111.5 | -0.3 | | |
| MN | Yokiel | 2006 | 71.3 | 66.5 | 4.7 | | |
| MN | Tews | 2006 | 99.7 | 86.7 | 12.9 | | |
| MN | Fernholz | 2006 | 98.1 | 88.1 | 10.0 | | |
| MN | U of M | 2006 | 102.3 | 93.4 | 8.8 | | |
| IA | Natvig | 2007 | 69.5 | 66.4 | 3.1 | | |
| IA | Grice‡ | 2007 | 67.5 | 67.7 | -0.2 | | |
| IA | Wilson [§] | 2007 | | 116.6 | | | |
| IA | Ames | 2007 | 111.2 | 111.5 | -0.3 | | |
| MN | Yokiel | 2007 | 70.0 | 61.6 | 8.5 | | |
| MN | Tews | 2007 | 106.7 | 105.3 | 1.4 | | |
| MN | Fernholz | 2007 | 79.4 | 79.9 | -0.5 | | |
| MN | U of M | 2007 | 82.8 | 81.4 | 1.4 | | |
| Average: | | | 90.1 | 85.5 | 4.5 | | |

[‡] High in-field variability: [§] Blend yield not available.



Oat variety differences are visible at heading-out time.

What have we learned so far?

- Although infestation levels were low, the variety blend really did reduce rust infestations in 2006; 2007 data are not competely analyzed.
- Although the difference was not statistically significant, the variety blend out-yielded the average of the separate varieties in 2006 on seven out of eight farms and in 2007 on four of seven farms (Table 15). That could be both from less rust and because variety mixes simply use resources ore efficiently.

- Table 16 provides combinations of oat varieties that are "complementary," meaning that together they provide greater resistance to crown rust than either variety separately. In other words, complementarity is relative to the solo performance of the varieties that make it. A good variety blend should combine three things: 1) complementary varieties; 2) varieties whose individual rust resistance is good (CR in the table); and 3) varieties whose yield ptential is good.
- Three-variety combinations will give more diversity than two-variety combos, hence more of the protection that diversity provides. But three also makes it more difficult to maximize some of the other attributes, such as finding three very high yielding varieties or three varieties that all mature at about the same time. In terms of disease resistance, there is probably also diminishing returns to adding more varieties.

The high yielding oat varieties Baker, and Woodburn do not appear in Table 16 because they did not prove to be complementary with other varieties. Also not appearing are blends whose complementarity was not as strong and/or whose individual varieties are not high yielding. If you really like a variety that doesn't appear, PFI can likely provide you with information about the varieties that it combines with best.

| resist ance to crown rust. Very Highly Complementary Combinations Avg Blaze Kame Spurs Avg Yld ¹ 145 143 148 145 CR ¹ 1.8 2.0 1.9 1.9 Plaze Esker Avg 148 CR 1.8 2.0 1.9 Yld 145 150 148 CR 1.8 2.0 1.9 Yld 145 148 147 CR 1.8 1.9 1.9 Yld 145 148 147 CR 1.8 1.9 1.9 Yld 145 148 147 CR 1.8 1.9 1.9 Yld 145 140 143 CR 1.8 1.4 1.6 Highly Complementary Combinations Highl 142 127 Yld 145 143 144 CR <td< th=""><th colspan="9">Table 16. Oat variety combinations for</th></td<> | Table 16. Oat variety combinations for | | | | | | | | |
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| †Oat yield in bushels per acre. | - | | | 2.0 | 2.1 | | | | |
| [‡] CR is crown rust resistance; smaller = better. | [†] Oat yield in bushels per acre. | | | | | | | | |
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