Breeding for septoria resistance in wheat

A A. Rosielle

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Breeding for septoria resistance in wheat


The fungal disease Septoria occurs in most wheat crops in Western Australia but usually at too low a level to affect yield seriously. However, in some circumstances heavy losses can be sustained. This article describes Department of Agriculture's plant breeding work aimed at reducing losses from Septoria by developing resistant varieties.

The disease

Two Septoria diseases of wheat occur in Western Australia. Septoria tritici Rob, ap. Desm., commonly known as speckled leaf blotch, is usually more prevalent in the coastal area from Mount Barker to Esperance. Septoria nodorum (Berk.) Berk., commonly known as glume blotch, is worst in the West Midlands area and northern coastal region.

The symptoms and life cycles of the two diseases are similar. The authors have described them in detail in 1980. Both diseases cause irregular dead spots on leaves and leaf sheaths, but Septoria nodorum also occurs on stems and glumes. A heavy infection can destroy much of the green tissue on the plant. Both diseases depend on rain-splash dispersal of spores.

The diseases are more severe in high rainfall districts, on early sown crops or in years of high rainfall. Resistance is the best method of control. However, the quality of resistance available to the two diseases differs greatly.

Resistance to Septoria tritici

There are many sources of resistance to S. tritici, particularly among varieties from South America. Many of these varieties have undesirable characteristics, such as tallness, lateness, susceptibility to shattering and lodging, red grain and the like. However, resistance appears to be relatively simply inherited and therefore can easily be selected and transferred into an Australian background by backcrossing.

We have worked extensively with three sources of resistance from South America and have backcrossed these resistances into the wheat varieties Gamenya and Tincurrin. The backcrossing procedure adopted is shown in Table 1. Final selections from this programme are being yield tested at three sites. We anticipate that these lines will need at least four years additional yield and quality testing before any are released to Western Australian farmers.

Other sources of resistance are being evaluated in the programme to provide insurance against the possible breakdown of resistance due to the development of new races of S. tritici.

Certain Australian wheats already have valuable resistance to S. tritici. For example, the variety Egret, which performs well in southern high rainfall areas, has moderate resistance. The variety Oxley, which is related to Egret, is slightly more susceptible but is better than varieties like Gamenya, Madden, Tincurrin, and Halberd which are highly susceptible.

Resistance to Septoria nodorum

No strong resistance to Septoria nodorum has been found in wheat. Resistance appears to be under the control of a complex of genes. Varieties nevertheless differ in their reaction to the disease. Varieties such as Gamenya, Egret, Madden, and Halberd are highly susceptible and suffer yield reductions when disease is severe. Other varieties such as Darkan, Jacup, and Bokal are less susceptible and lose less yield.

Better resistance has been found in some overseas varieties. Most of these are poorly adapted, in various...
Testing and backcrossing will be repeated for several cycles by which time the lines should be suitable for field assessment for resistance, and yield and grain quality testing.

Certain lines, particularly winter wheats, show moderate to high resistance as seedlings in glasshouse tests. These lines are particularly difficult to evaluate in the field because they are extremely late maturing. Therefore we are attempting to introduce their resistance into local wheats by backcrossing in the glasshouse.

Seedlings from crosses are tested in the glasshouse by spraying a spore suspension onto plants. Resistant plants are backcrossed to a recurrent Australian parent and a new population of plants is produced for testing.

One technique which takes into account the effect of *S. nodorum* on seed weight is mechanical mass selection. Progeny from crosses are propagated in bulk in the field under conditions of severe infection. Tall plants are discarded by mowing, and after harvest shrivelled grains (less than 2.8 mm wide) are discarded by sieving. Then seed is passed over a gravity table to remove grain with low density. Bulk propagation and selection is repeated for three to four years to increase the frequency of resistant plants in the population.

Then single plant selections are made within these bulked lines and ultimately, selections are tested for yield.

It is difficult to assess the resistance of varieties or selections from crosses to *S. nodorum* in the field because time to maturity has a big impact on the extent to which symptoms develop. Early maturing varieties get more infection than later maturing varieties because their flag leaf and ear have emerged earlier and been exposed longer in conditions more favourable to the disease. Compared to adjoining rows of later maturity they appear susceptible.

We have found that seed weight is affected when severe *Septoria nodorum* occurs, and that highly susceptible varieties suffer big seed weight losses.

For similar reasons short varieties are more susceptible than tall varieties... they retain moisture and dew longer, thus increasing their chances of becoming infected. Because of these problems and because a resistant variety ultimately must be able to produce plump, well filled grain, we have placed strong selection emphasis on seed weight in the presence of *S. nodorum* infection.

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Testing and backcrossing will be repeated for several cycles by which time the lines should be suitable for field assessment for resistance, and yield and grain quality testing.

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Table 1. System used for backcrossing *Septoria tritici* resistance into Gamenya wheat

<table>
<thead>
<tr>
<th>Year</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975</td>
<td>Gamenya × Iassul (IAS-20)</td>
</tr>
<tr>
<td>1976</td>
<td>F₂, single plants field tested for resistance. Gamenya-like resistant plants crossed to Gamenya.</td>
</tr>
<tr>
<td>1977</td>
<td>First backcross F₂, single plants field tested for resistance. Gamenya-like resistant plants backcrossed to Gamenya.</td>
</tr>
<tr>
<td>1980</td>
<td>Bulk lines yield and quality tested. Rows grown from single plant selection. Rows which were agronomically uniform, resistant, and from lines with satisfactory yield and quality were harvested.</td>
</tr>
<tr>
<td>1981</td>
<td>Bulk lines from 1980 rows tested for yield, quality, and resistance.</td>
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<tr>
<td>1982-1985</td>
<td>Additional yield, quality, and resistance tests of selected lines to be conducted, also seed multiplication.</td>
</tr>
</tbody>
</table>