The risk of soil-borne diseases

Key Points

- Soil-borne diseases may have a large impact on cereal yields and reduce crop quality.
- Most of the causal pathogens survive in host residues in or on the soil and usually remain there as long as susceptible host residues remain.
- Take-all and sharp eyespot are the most common root and stem-base diseases in NZ. Although occurring in barley, they are more significant in wheat, particularly autumn sown wheat.
- Crop rotation is an important means of reducing pathogen inoculum.

Introduction

Stem base and root diseases of cereals include *Fusarium* diseases such as crown rot, root rot and snow mould, as well as take-all, sharp eyespot, and eyespot. The effects of these diseases include:

- decreased yield, through reducing grain number and weight,
- lowered grain quality for food and feed, and
- lowered quality of seed for sowing through reduced germination, emergence, and vigour.

Most of the causal pathogens survive in crop residues in or on the soil, and usually persist only as long as susceptible residues remain. Residue management, cultivation method, cropping sequence and herbicides can affect the quantity and duration of crop and grass weed residues. Some of the pathogens have a wider host range than cereals, e.g. the take-all fungus can survive on, and cause disease from, twitch. The *Fusarium* species have a wide host range amongst cereals and grasses, as well as some broadleaf weeds.

Most growers have experienced occasional major crop losses from diseases such as take-all or crown rot, and frequently report smaller but unquantified losses. This update reports a summary of the likely risk factors for soil-borne diseases following a three-year survey.

Take-all

More details on the take-all disease are available in Arable Update Cereals No.86. Wheat crops are at far greater risk than barley of take-all infection (Table 1). If a wheat or barley crop must be sown in a high-risk situation, barley is the lower-risk crop. Autumn-sown wheat crops are at greater risk than spring crops due to: the fungus being more active in warmer soil conditions; the longer period of slow crop growth when disease develops; and residues having less break-down time before sowing. Delayed sowing of cereals is therefore a key factor in reducing take-all risk.

Highest take-all risk occurs following wheat. Crops sown after other cereals or grasses are at higher risk than those sown after non-Gramineae crops. The risk increases with increasing intensity of cereal (especially wheat) cropping. Take-all decline (due to a build-up of natural biological control) has been reported overseas after continuous wheat for at least three years, but we found the highest take-all incidence where wheat had been grown continuously for at least four years.

Grass weeds, especially twitch, can harbour the take-all fungus. Application of glyphosate can exacerbate the problem and sufficient time must be given after application to allow the twitch, and the fungus, to die off completely. The presence of twitch in non-Gramineae crops can reduce the ability of such crops to reduce inoculum in the soil.

The presence of infected crop or weed residues is an important risk factor (the take-all pathogen does not survive freely in the soil). Residue management and cultivation methods that hasten the break down of such residues reduce inoculum levels and, therefore, reduce the risk of take-all.

In the UK, early spring N applications were shown to be beneficial. No correlation was found between take-all incidence and soil pH, lime application, or fertiliser type in the New Zealand crops examined. However, overseas studies suggest that:

1. take-all is most severe in soils that are alkaline to neutral in pH,
2. excessive liming encourages take-all (especially if soil-pH is elevated above 6.0),
3. application of N as ammonia may suppress take-all while nitrates favour the disease.

Further work will be needed to determine if these are risk factors in New Zealand. None of the crops in our survey were grown in neutral to alkaline soil (the highest was in a soil with pH 6.4) so these factors may not be an issue in New Zealand.

Rainfall patterns during the growing season can influence take-all severity. Wet conditions in winter and early spring are most conducive to the development of disease on roots and crowns. Dry soil conditions (especially with warm, dry winds) during grain fill will exacerbate the ‘white head’ symptoms and poor grain fill because infection of roots and crowns will reduce the efficiency of water transport from the soil. Irrigation after flowering will improve grain-fill in infected plants.

Sharp Eyespot
Autumn wheat is at greater risk of sharp eyespot than spring wheat or barley. Early autumn sown (April to May) wheat crops are at higher risk of sharp eyespot than later sown crops. Autumn wheat crops in South Canterbury tend to have higher levels of sharp eyespot than those from other regions (possibly in part because they tend to be earlier sown), but levels can be high in all regions where autumn wheat is sown.

Sites where a cereal or grass (especially wheat) was the previous crop tend to be at greater risk of sharp eyespot than where another crop was grown. High sharp eyespot incidence can, however, occur irrespective of crop history.

Some wheat cultivars may be more susceptible than others, but there is no information currently available on relative susceptibility amongst wheat cultivars. Crops sown with untreated seed may be at a slightly higher risk of sharp eyespot than crops sown with fungicide-treated seed.

Crown Rot
Wheat crops are at greater risk of crown rot than barley crops. The disease is relatively rare under current management practices, but can be severe. Risk of crown rot may be slightly higher at sites where cereals or grasses were grown the previous season.

Overseas studies suggest that the risk of crown rot is greatest under conservation tillage practices. Overseas studies have shown that cultivars differ in their susceptibility to crown rot. There were insufficient infected crops in our surveys to postulate on cultivar differences in New Zealand.

Sowing untreated seed increases the risk of crown rot. This will be particularly important where high levels of *Fusarium* are present on the seed. Seed treatment may also delay infection from soil-borne inoculum.

Root Rot
Wheat crops are at greatest risk of root rot. The risk is very low for spring barley. Crops in Mid and South Canterbury tend to have higher levels, but further data are needed to confirm the trend.

Risk of root rot infection increases slightly with increasing frequency of cereal or grass cropping, although there is not a strong correlation with previous crop history. There is some evidence that autumn wheat cultivars differ in their susceptibility to root rot, although information on relative susceptibility is not available at present.

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Table 1: Take-all incidence in New Zealand wheat and barley crops, and in the different regions, in the 2001/2002 season.

<table>
<thead>
<tr>
<th>Region</th>
<th>No. of crops</th>
<th>Crops infected (%)</th>
<th>Mean tillers infected (%)</th>
<th>Mean tillers infected in infected crops (%)</th>
<th>Crops with ≥10% tillers infected (%)</th>
<th>Crops with ≥20% tillers infected (%)</th>
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<tr>
<td>Autumn wheat</td>
<td>55</td>
<td>40</td>
<td>9.5</td>
<td>23.6</td>
<td>25</td>
<td>20</td>
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<td>Spring wheat</td>
<td>21</td>
<td>38</td>
<td>5.4</td>
<td>14.1</td>
<td>14</td>
<td>10</td>
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<td>Spring barley</td>
<td>27</td>
<td>33</td>
<td>3.9</td>
<td>11.7</td>
<td>11</td>
<td>7</td>
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<tr>
<td>Winter barley</td>
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<td>13</td>
<td>0.3</td>
<td>2.3</td>
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<td>Triticale</td>
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<td>50</td>
<td>1.1</td>
<td>2.3</td>
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<tr>
<td>North Island</td>
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<td>50</td>
<td>2.3</td>
<td>4.6</td>
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<td>0</td>
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<tr>
<td>North Canterbury</td>
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<td>36</td>
<td>4.0</td>
<td>12.1</td>
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<td>9</td>
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<tr>
<td>Mid Canterbury</td>
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<td>27</td>
<td>5.1</td>
<td>19.0</td>
<td>17</td>
<td>10</td>
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<tr>
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<td>58</td>
<td>12.7</td>
<td>21.8</td>
<td>33</td>
<td>25</td>
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<tr>
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<td>70</td>
<td>22.0</td>
<td>31.4</td>
<td>50</td>
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