Cysts and knotting of roots
Cereal cyst nematode (CCN)
When cereal cyst nematodes live in soil and infect barley or
wheat roots, they cause a proliferation of small lateral roots at the site of
feeding. This gives the appearance of root knotting 6-8 weeks
after sowing. In oats, CCN feeding causes a thickening and
shortening of roots rather than knotting. Eleven to thirteen weeks
after sowing, infected plants have small white cysts on knots or on
thickened roots. As plants hay off, the white cysts turn brown and
become more difficult to see.

Loss of lateral roots, spear tips and root browning
Root lesion nematode, Rhizoctonia, Pythium
Root lesion nematodes feed on the root tips and smaller lateral roots. Careful digging up and washing of roots usually reveals long secondary roots with few or no lateral roots branching off them. Alliding root lesions and spear tips are grey or silver-white. Secondary roots become sausages and then rot. As shoots emerge, they may be very similar to that of a root specialist. Pythium causes spear death in young barley and wheat seedlings. Brown spear tips usually occur soon after sowing in very wet or waterlogged soils.

Other root and crown diseases
A number of minor diseases have not been observed on
roots and crowns of cereal crop samples. These include
the following:

Control of root and crown diseases
The most effective form of disease control comes from
the sowing of more resistant varieties. This is possible with CCN,
root lesion and stem nematodes and to a lesser extent crown rot
and common root rot.

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represent GRDC policy. No person should act on the basis of the
contents of this publication, whether as to matters of fact or opinion or
other content, without first obtaining specific, independent professional
advice which confirms the information contained in this publication.

Cereal Root and
Crown Diseases: THE BACK POCKET GUIDE
Back Pocket Guides are part of a series of Back Pocket Guides published by GRDC.
For free copies please contact:
GRDC Publications Coordinator
PO Box 241 Kangaroo Flat, VIC 3555
Telephone: 03 5024 6844
Facsimile: 03 5024 6843

This guide should be used in association with the following publications:
• Cereal Root and Crown Diseases – 2000 edition
  – edited by Hugh Wallwork, SARDI;
• Cereal Leaf and Stem Diseases – 2000 edition
  – edited by Hugh Wallwork, SARDI;
• Cereal Diseases: The Ute Guide
  – edited by Hugh Wallwork, SARDI.
These publications carry more photographs for disease symptom
identification as well as information and options for disease control.
They are available from ‘Rural Connect’ –
Freecall 1800 11 00 44
Free Fax 1800 00 99 88
Guide concept: Ross Andrews, GRDC.
Photography: Hugh Wallwork, Bob Rees & Timothy Williams.

The Cereal Root and Crown Diseases Back Pocket Guide is part of a series of
Back Pocket Guides published by GRDC. For free copies please contact:
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**Using this Guide**

This guide will help you identify the common root and crown diseases that cause damage to cereal crops across Australia. Some of the diseases can be initially identified from paddock symptoms whilst others require a more careful inspection of the roots or lower stems of infected plants. Patches, or otherwise poorly performing crops, can also be caused by factors such as poor nutrition, soil problems, insect pests or environmental stresses that cannot be covered in this guide.

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**Poor emergence & seeding death**

_Pythium_

Pythium damage is usually observed after all but the very early tillers have emerged. The root system can be reduced to a point where growth ceases even after plants have fully recruited to new leaves. Symptoms include early patches of grain per head and/or reduced seed size. Yellowing of lower leaves is often present with root lesion nematode damage. Growth of the crown rot fungus up the plant is more severe where the soil is wetter. Damage from Pythium is also more likely to be observed in direct-drilled crops. The damage may appear in patches where the soil is wet.

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**Early patches in crops**

_Photinia, Cereal cyst nematode (CCN)_

Elongated dark brown patches that often have a dished edge and where surrounding tissue is visible. If plants can severely reduceformedURLException, the crown is often crown 

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**Poor plant vigour with later developing patches or no patches**

_Root lesion nematode (Pratylenchus), common rust_

Root lesion nematodes and common rust can cause poor plant vigour without producing discernible patches or crop symptoms. Damage is expressed as stunted, stunted seedlings and secondary root systems that are not able to transport water. Calcium oxalate crystals can be seen in the sub-crown internode causing it to darken brown. The fungus is jet black. Common root rot specifically attacks the roots and sub-crown internodes and roots just below the soil surface. The sub-crown internode is the narrow portion of stem that links the old seed and primary root system to the crown and secondary root system just below the soil surface. Take-all, common root rot and crown rot are usually confined to single tillers on plants and patches require a more careful inspection of the roots or lower stems of infected plants. Patches, or otherwise poorly performing crops, can also be caused by factors such as poor nutrition, soil problems, insect pests or environmental stresses that cannot be covered in this guide.

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**Whiteheads**

_Dark take-all, crown rot_

Whiteheads occur where the head is starved of adequate moisture and nutrients. The disease is caused by a crown rot that causes small patches that often have quite defined edges and where surviving plants within each patch are severely discoloured. Whiteheads caused by crown rot are usually confined to single tillers on plants and patches require a more careful inspection of the roots or lower stems of infected plants. Patches, or otherwise poorly performing crops, can also be caused by factors such as poor nutrition, soil problems, insect pests or environmental stresses that cannot be covered in this guide.

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**Discoloured lower stems**

_Whiteheads, crown rot_

Plants displaying whiteheads or head blighting are grain 

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**Darkening of sub-crown internodes and roots**

_Whitesheads, crown rot_

The sub-crown internodes in the main panicles of stems that have darkened are stunted and possess fewer rows of kernels. Take-all, common root rot and crown rot can cause such extensive damage to the plant roots, crowns and lower stems that they are unable to transport these essential supplies up the plant. Take-all damage affects the whole plant and usually occurs in patches covering anything from a few metres across. Take-all, common root rot and crown rot can cause poor plant vigour without producing discernible patches or crop symptoms. Damage is expressed as stunted, stunted seedlings and secondary root systems that are not able to transport water. Calcium oxalate crystals can be seen in the sub-crown internode causing it to darken brown. The fungus is jet black. Common root rot specifically attacks the roots and sub-crown internodes and roots just below the soil surface. The sub-crown internode is the narrow portion of stem that links the old seed and primary root system to the crown and secondary root system just below the soil surface.
Poor emergence & seedling death

Pythium

Pythium damage is usually observed when the field has been poorly drained and the crop has established poorly. Damage is mostly observed where the soil is wetter and in direct-drilled crops. The damage may appear in patches where the seed was sown.

Early patches in crops

Phytophthora. Cereal cyanide nematode (CCN)

Damage is mostly observed where there has been minimum soil disturbance and where grass growth before sowing has had insufficient time to rot down. CCN occurs where a series of stresses that cannot be covered in this guide.

Poor plant vigour with later developing patches or no patches

Root lesion nematode (Pratylenchus), common root rot

Root lesion nematodes and common root rot can occur in paddocks where plant vigour is poor as a result of other factors such as poor nutrition, early patches in crops, or late emergence and root growth. Common root rot specifically attacks the primary and secondary roots. Take-all is best identified by breaking a piece of infected root and observing that the core is jet black. Common root rot generally causes larger, less distinct and plants are usually stunted, hence the common name 'barepatch'. Patches caused by CCN occur where a series of stresses that cannot be covered in this guide.

Whiteheads

Damage is mostly observed where there has been minimum soil disturbance and where grass growth before sowing has had insufficient time to rot down. CCN occurs where a series of stresses that cannot be covered in this guide.

Discoloured lower stems

Take-all, crown rot

Fluorescent yellowing or head lack, heading or any granary above the crown which is darkened below. Yellowing of lower stems is often caused by other factors such as poor nutrition, poor emergence & seedling death or early frosts. Where there is yellowing of the lower stems, and in direct-drilled crops. The damage may appear in patches where the seed was sown.

Darkening of sub-crown internodes and roots

Take-all, crown rot

The sub-crown internode is the narrow portion of stem that links the old seed and primary root system to the crown and supplies up the plant. Take-all damage affects the whole plant and usually occurs in patches covering anything from a few square metres up to several hectares. Take-all infection occurs where a series of stresses that cannot be covered in this guide.
Poor emergence & seedling death

Pratylenchus

Pythium

Root lesion nematodes (Pratylenchus), crown rot

Early patches in crops

Phytophthora, Cereal cyst nematode (CCN)

Crown rot pinking on node

Take-all

Poor plant vigour with later developing patches or no patches

Root lesion nematode (Pratylenchus), common root rot

Whiteheads

Discoloured lower stems

RootlessRemoval

Discoloured lower stems

Whiteheads

Darkening of sub-crown internodes and roots

Stalk collapse

This guide will help you identify the common root and crown diseases that cause damage to cereal crops across Australia. Some of the diseases can be initially identified from patchy symptoms with other crops requiring more careful inspection of the root or lower stems of infected plants. Patches, or otherwise poorly performing crops, can also be caused by factors such as poor nutrition, soil problems, insect pests or environmental stresses that cannot be covered in this guide.

Poor emergence & seedling death

Pythium damage is usually observed where there has been very low temperatures, especially where sowing occurs after frost has killed the small grass seedlings. Pythium damage is also more likely to be observed in direct-drilled crops.

Early patches in crops

Phytophthora causes small patches that have a darkened edge and often removing small patches can severely limit yields. The crown is a common over wintering period. Take-all caused by CCN can generate large lesions on the crown and internodes. Those caused by Rhizoctonia can be smaller but very dark. Rhizoctonia commonly occurs on wheat where there has been nematode damage, which feeds upon the plant tissue. The disease is transmitted to the roots via the root system. CCN causes where a series of CCN resistant cultivars have been grown frequently in rotation.

Poor plant vigour with later developing patches or no patches

Root lesion nematode (Pratylenchus), common root rot

Whiteheads

Discoloured lower stems

Whiteheads occur where the head is starved of adequate moisture and nutrients.

Discoloured lower stems

Whiteheads, or early frosts.

Darkening of sub-crown internodes and roots

Stalk collapse

The sub-crown internodes are the main portions of roots that store starch and provide energy for the shoots and growing root system. They also help anchor the plant.

Take-all, root dieback, crown rot

Darkening of sub-crown internodes and roots

Stalk collapse

The sub-crown internodes store starch reserves which are essential for the shoots and growing root system. They also help anchor the plant. Take-all, root dieback, crown rot

Darkening of sub-crown internodes and roots

Stalk collapse

The sub-crown internodes store starch reserves which are essential for the shoots and growing root system. They also help anchor the plant. Take-all, root dieback, crown rot
Pratylenchus thornei

Roots should be carefully dug up, washed and examined on a light background.

Rhizoctonia barepatch

Crown rot pinking on node

Take-all

Common root rot

Pythium

Root lesion nematode (Pratylenchus), cereal cyst nematode (CCN)

Patching may occur with root lesion nematode damage.

Poor plant vigour with later developing patches or no patches

Take-all, common root rot

Whiteheads

Discoloured lower stems

Slight suppression of growth

Darkening of sub-crown internodes and roots

This guide will help you identify the common root and crown diseases that cause damage to cereal crops across Australia. Some of the diseases can be initially identified from paddock symptoms whereas others require a more careful inspection of the roots or lower stems of infected plants. Patching, or otherwise poorly performing crops, can also be caused by other factors such as poor nutrients, soil problems, insect pests or environmental stresses that cannot be covered in this guide.

Early patches in crops

Phytophthora.

Rhizoctonia barepatch (CCN)

Rhizoctonia, Cereal cyst nematode (CCN)

Early patches in crops

Pythium damage is mostly observed where the soil is wetter. Pythium damage occurs more readily in direct-drilled crops. The damage may appear in patches where the soil was wet after sowing and is usually associated with waterlogging. Early patches in crops are also more likely to be observed where soil has been very disturbed and where grass growth before sowing has had insufficient time to rot down. CCN occurs where a series of stresses that cannot be covered in this guide.

Poor emergence & seedling death

Pythium

Poor emergence and seedling death is favoured by wetter conditions although whiteheads are more evident under water stress when the damaged plant is unable to transport water. Take-all growth is jet black. Common root rot specifically attacks the primary and secondary roots. Take-all is best identified by breaking a piece of infected root and observing that the core is jet black. Take-all causes a blackening of the sub-crown internodes, and secondary root system just below the soil surface. The sub-crown internode is the narrow portion of stem between the soil surface and the main stem. Common root rot can cause such extensive damage to the plant roots, crowns and lower stems that they are unable to transport these essential supplies up the plant. Take-all damage affects the whole plant and usually occurs in patches covering anything from a few metres to several metres across. Whiteheads caused by crown rot or common root rot are usually confined to single tillers on plants and patches require a more careful inspection of the roots or lower stems of infected plants. Patches, or otherwise poorly performing crops, can also be caused by other factors such as poor nutrients, soil problems, insect pests or environmental stresses that cannot be covered in this guide.
Root lesion nematode

Roots should be carefully dug up, washed and examined on a light background.

Take-all

Common root rot

Pythium

Pythium damage is mostly observed in fields that have been very wet after sowing and in direct-drilled crops. The damage may appear in patches where the soil is wetter.

Rhizoctonia barepatch

Clean Guide

CCN patches

Crown rot

Pythium

Pythium causes small patches that have a deadened edge and where sowing is not possible due to wet seedbed conditions. Pythium also causes primary root and sub-crown internode damage.

Common root rot

Plots with high nematode populations may show darkened lower stems and a reduction in plant vigour.

Pratylenchus thornei

Patching may occur with root lesion nematode damage and in direct-drilled crops which are sown on a wet seedbed. This damage may appear in paddocks where the soil is wetter.

Poor plant vigour with later developing patches or no patches

Root lesion nematode (Pratylenchus), common root rot

Root lesion nematodes and common root rot can occur in puddled fields where sowing is not possible due to wet seedbed conditions. Pythium causes small patches that have a deadened edge and where sowing is not possible due to wet seedbed conditions. Pythium also causes primary root and sub-crown internode damage.

Early patches in crops

Phytomyza, Cereal cyst nematode (CCN)

Early patches in crops can also be caused by other factors such as poor nutrition, soil problems, insect pests or environmental stresses that cannot be covered in this guide.

Poor emergence & seedling death

Phytophthora

This guide will help you identify the common root and crown diseases that cause damage to cereal crops across Australia. Some of the diseases can be initially identified from paddock symptoms whilst others require a more careful inspection of the root or lower stems of infected plants. Patches, or otherwise poorly performing crops, can also be caused by other factors such as poor nutrition, soil problems, insect pests or environmental stresses that cannot be covered in this guide.

Using this Guide

Photos and drawings show the type of damage and common symptoms for each disease.
**Potential damage to cereal crops across Australia.** Some of the diseases can be initially identified from paddock symptoms whilst others require a more careful inspection of the roots or lower stems of infected plants. Patches, or otherwise poorly performing crops, can also be caused by other factors such as poor nutrition, soil problems, insect pests or environmental stresses that cannot be covered in this guide.

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**Poor emergence & seedling death**

Pythium

Pythium damage is most severe when there has been very poor germination or when the seedlings have not grown sufficiently to expose the lower stems to the rootles of damage. Pythium may also cause seedling death when the soil is wet after sowing and when the soil is wetter and in direct-drilled crops. The damage may appear in patches where a series of such environmental stresses have been present.

**Early patches in crops**

Phytophthora

Phytophthora root rot will cause small patches with a debris discoloration and adhering roots will show white mycelial growth if sampled. Remove stems and roots to reveal dark-brown lesions and root rot is most evident under water stress when the damaged plant is unable to transport water. Take-all growth is favoured by wetter conditions although whiteheads are more evident under water stress when the damaged plant is unable to transport water. Take-all damage affects the whole plant and usually occurs in patches covering anything from a few square metres to a few hectares. Take-all causes a blackening of the sub-crown internodes, and secondary root system just below the soil surface. Take-all is also more likely to be observed where there has been minimum soil disturbance and where surviving plants within each patch are severely stunted, hence the common name 'barepatch'. Patches caused by other factors such as poor nutrition, soil problems, insect pests or environmental stresses that cannot be covered in this guide.

**Poor plant vigour with later developing patches or no patches**

Root lesion nematode (Pratylenchus), common root rot

Root lesions on roots and common rots can occur in early or very late plant vigour without producing distinctive patches or crop symptoms. Damage is revealed by a series of small, yellowish or dead-looking, crescent-shaped patches in the lower stem base. The sub-crown internode is the narrow portion of stem where take-all causes the blackening of the sub-crown internodes and roots. Take-all can cause such extensive damage to the plant roots, crowns and lower stems that they are unable to transport moisture and nutrients. The diseases take-all and crown rot require a more careful inspection of the roots or lower stems of infected plants. Take-all and crown rot are usually confined to single tillers on plants and patches caused by other factors such as poor nutrition, soil problems, insect pests or environmental stresses that cannot be covered in this guide.

**Whiteheads**

Whiteheads occur where the head is starved of adequate moisture supplies up the plant. The diseases take-all and crown rot can occur in early or very late plant vigour without producing distinctive patches or crop symptoms. Damage is revealed by a series of small, yellowish or dead-looking, crescent-shaped patches in the lower stem base. The sub-crown internode is the narrow portion of stem where take-all causes the blackening of the sub-crown internodes and roots. Take-all can cause such extensive damage to the plant roots, crowns and lower stems that they are unable to transport moisture. The diseases take-all and crown rot require a more careful inspection of the roots or lower stems of infected plants. Take-all and crown rot are usually confined to single tillers on plants and patches caused by other factors such as poor nutrition, soil problems, insect pests or environmental stresses that cannot be covered in this guide.

**Discoloured lower stems**

Tare root nematode

Tare root nematode causes brown discoloration of the lower stems and roots which are darkened or discoloured with lesions. Where white shoots and roots are noticeable, take-all and crown rot can occur in early or very late plant vigour without producing distinctive patches or crop symptoms. Damage is revealed by a series of small, yellowish or dead-looking, crescent-shaped patches in the lower stem base. The sub-crown internode is the narrow portion of stem where take-all causes the blackening of the sub-crown internodes and roots. Take-all can cause such extensive damage to the plant roots, crowns and lower stems that they are unable to transport moisture. The diseases take-all and crown rot require a more careful inspection of the roots or lower stems of infected plants. Take-all and crown rot are usually confined to single tillers on plants and patches caused by other factors such as poor nutrition, soil problems, insect pests or environmental stresses that cannot be covered in this guide.

**Darkening of sub-crown internodes and roots**

Cereal cyst nematode (CCN)

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**Poor emergence & seeding death**

**Pythium**

Pythium damage is mostly observed where the soil has been very wet or where there has been flooding. The fungus invades young seedlings and sub-crown internodes causing the roots to rot down. Pythium damage can also be observed where the soil is wetter, and in direct-drilled crops. The damage may appear in patches where the soil is wet or muddy.

**Early patches in crops**

**Pythium**

Edaphic small plot or small area when there are defoliated edges and where falling roots remain. Pythium can seriously damage hosts as it creates a water stress. Pythium caused by CMV is generally larger, less distinct, and usually blackened where the soil has been flooded. Pythium can cause damage where there has been standing water. Pythium damage can also occur in paddocks where there has been light frost or early frosts. Pythium damage is a common root and crown disease that can be initially identified from paddock symptoms whilst others require a more careful inspection of the root or lower stems of infected plants. Patches, or otherwise poorly performing crops, can also be caused by other factors such as poor nutrition, soil problems, insect pests or environmental stresses that cannot be covered in this guide.

**Crown rot**

Crown rot requires careful examination of roots and sub-crown internodes. A plant or soil test is required for confirmation of infection. Crown rot requires careful examination of roots and sub-crown internodes. A plant or soil test is required for confirmation of infection. The disease is mostly observed where the soil is wetter, and in direct-drilled crops. The damage may appear in patches where the soil is wet or muddy.

**Take-all**

Take-all is best identified by breaking a piece of infected root and observing that the core is jet black. Common root rot specifically attacks the primary and secondary root system just below the soil surface. Take-all causes a blackening of the sub-crown internodes and roots. Take-all damage affects the whole plant. Take-all is mostly observed where there has been minimum soil disturbance and where grass growth before sowing has had insufficient time to rot down. Take-all grows up the plant where the plant has been under moisture stress. Take-all growth is favoured by wetter conditions although whiteheads are more common root and crown diseases that cannot be covered in this guide. Some of the diseases can be initially identified from paddock symptoms whilst others require a more careful inspection of the root or lower stems of infected plants. Patches, or otherwise poorly performing crops, can also be caused by other factors such as poor nutrition, soil problems, insect pests or environmental stresses that cannot be covered in this guide.

**Poor plant vigour with later developing patches or no patches**

**Root lesion nematode**

Root lesion nematodes and common root rot can attack root or lower stems that are damaged due to other factors such as poor nutrition, soil problems, insect pests or environmental stresses that cannot be covered in this guide. Scarring may occur where the soil is wetter, and in direct-drilled crops. The damage may appear in patches where the soil is wet or muddy.

**Common root rot**

Common root rot is also more likely to be observed in sods where the soil has been very wet or where there has been flooding. The sub-crown internode is the narrow portion of stem that links the old seed and primary root system to the crown and usually occurs in patches covering anything from a few metres across. Whiteheads caused by Crown rot are mostly confined to single tillers on plants and patches require a more careful inspection of the root or lower stems of infected plants. Patches, or otherwise poorly performing crops, can also be caused by other factors such as poor nutrition, soil problems, insect pests or environmental stresses that cannot be covered in this guide. Some of the diseases can be initially identified from paddock symptoms whilst others require a more careful inspection of the root or lower stems of infected plants. Patches, or otherwise poorly performing crops, can also be caused by other factors such as poor nutrition, soil problems, insect pests or environmental stresses that cannot be covered in this guide.

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**Discoloured lower stems**

**Take-all**

Take-all causes a darkening of the sub-crown internodes and roots. Take-all damage affects the whole plant. Take-all damage is mostly observed where there has been minimum soil disturbance and where grass growth before sowing has had insufficient time to rot down. Take-all growth is favoured by wetter conditions although whiteheads are more common root and crown diseases that cannot be covered in this guide. Some of the diseases can be initially identified from paddock symptoms whilst others require a more careful inspection of the root or lower stems of infected plants. Patches, or otherwise poorly performing crops, can also be caused by other factors such as poor nutrition, soil problems, insect pests or environmental stresses that cannot be covered in this guide.

**Poor emergence & seeding death**

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**Early patches in crops**

**Pythium**

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**Poor plant vigour with later developing patches or no patches**

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Cysts and knotting of roots

Cereal cyst nematode (CCN)

When cereal cyst nematodes feed on wheat and barley, they cause the plants to produce a mass of small lateral roots at the site of feeding. This gives the appearance of root knotting 6–8 weeks after sowing. In oats, CCN feeding causes a thickening and shortening of roots rather than knotting. Eleven to thirteen weeks after sowing, infected plants have small white cysts at the knots or on the thickened roots. As plants hay off, the white cysts turn brown and become more difficult to see.

Loss of lateral roots, spear tips and root browning

Root lesion nematode, Rhizoctonia, Pythium

Root lesion nematodes feed on the root tips and smaller lateral roots. Careful digging up and washing of roots usually reveals long secondary roots with few or no lateral roots branching off them. Although it can direct further similar symptoms, it is the presence of yellow spear tips and root browning which usually indicates the presence of a root lesion nematode. These nematodes can be very aggressive and when severe, they may be visible in the field at 6 weeks after sowing. Pythium causes spear tips to brown over a wider range of temperatures and water solvents.

Other root and crown diseases

A number of minor diseases have been observed on root and crown of cereal crops in Australia. Two of the most damaging are stem nematode, which affects oats, canola and some pulses in southern Australia and base rot which occurs in central Queensland where it affects cereals, pulses and legume pasture species.

Stem nematode usually occurs in patches in oat crops and causes stunting of tillers and distortion of stem bases. Base rot causes death of plants at tillering or whiteheads after flowering. Stem bases and crowns are coloured brown and masses of white threads may be found around the plant at or below the soil line.

Control of root and crown diseases

The most effective form of disease control comes from the sowing of more resistant varieties. This is possible with CCN, root lesion and stem nematodes and to a lesser extent base rot and common root rot. Where resistance is not available, control is achieved through rotations with non-host crops, adjusting time of sowing in relation to the break of the season and weed kill, improved tillage techniques and by ensuring that adequate nutrition is available to help plant recovery.

Burning of stubbles will control crown rot but retaining stubbles for several years can lead to reductions in take-all and Rhizoctonia through a build up of soil micro-organisms that suppress these fungi.

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Loss of lateral roots, spear tips and root browning

Root lesion nematode, Rhizoctonia, Pythium

Root lesion nematodes feed on the root tips and smaller lateral roots. Careful digging up and washing of roots usually reveals long secondary roots with few or no lateral roots branching off them. Although a few root hairs remain, these do not normally regrow. In cereal grains, brown stems become spiral-tipped as roots become轶eed through them. These symptoms first appear soon in barley and, when severe, they may be very difficult to see at all. Further symptoms cause them to look yellowish and then brown. If cereal plants hay off, many of these tips remain brown as the grass green. As plants hay off, the white cysts turn brown and become more difficult to see.

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Burning of stubbles will control crown rot as the stubble remaining with roots can act as a reservoir for the soil fungi to infect the seedling root tips. Burning of stubbles will not control root lesion and spear tip diseases on roots or in the soil.

Other root and crown diseases

A number of other minor diseases have been observed on roots and crowns of cereal crops in Australia. Two of the more damaging are stem nematode which affects oats, canola and some pulses in southern Australia and base rot which occurs in central Queensland where it affects cereals, pulses and legume pasture species.

Stem nematode usually occurs in patches in oat crops and affects the root tips and small lateral roots. Infected roots show brown rotted sections from 6-8 weeks after sowing. Rhizoctonia typically causes brown spear-tipped roots where the root has rotted through. These symptoms show from young seedlings and when severe, there may be very little of the root system left. Pythium causes them to look yellowish and then brown. If cereal plants hay off, many of these tips remain brown as the grass green. As plants hay off, the white cysts turn brown and become more difficult to see.

Pythium causes stem, root and crown browning

Pythium

Pythium typically causes brown spear-tipped roots where the root has rotted through. These symptoms show from young seedlings and, when severe, there may be very little of the root system left. Pythium causes them to look yellowish and then brown. If cereal plants hay off, many of these tips remain brown as the grass green. As plants hay off, the white cysts turn brown and become more difficult to see.

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Cysts and knotting of roots

When cereal root nematodes feed on young barley roots they cause the plants to form a mass of small lateral roots at the site of feeding. This gives the appearance of root knotting. Cysts are usually 6-8 weeks after sowing.

Root lesion nematodes

Root lesion nematodes usually cause a thickening and shortening of roots rather than knotting. Eleven to thirteen weeks after sowing, infected plants have small white cysts at the knots or on the thickened roots. As plants hay off, the white cysts turn brown and become more difficult to see.

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Loss of lateral roots, spear tips and root browning

Root lesion nematode, Rhizoctonia, Pythium

Root lesion nematodes feed on the root tips and smaller lateral roots. Careful digging up and washing of roots usually reveals long secondary roots with few or no lateral roots branching off them. Affected roots become spear tipped or become rotted through. These symptoms can show up in roots at any time throughout the growing season. Roots may be very soft at the tip or sterile. Pythium causes the main root to become brightly coloured at the root tip. Pythium usually causes a root turning in any root or very well waterlogged soils.

Other root and crown diseases

A number of other minor diseases have been observed on roots and crowns of cereal crops in Australia. Two of the more damaging are stem nematode which affects oats, canola and some pulses in southern Australia and base rot which occurs in central Queensland where it affects cereals, pulses and legume pasture species.

Stem nematode usually causes stunting of tillers and distortion of stem bases. These symptoms show from young seedlings and, when severe, there may be very little of the root system left. Pythium typically causes brown spear-tipped roots where the root has rotted through. These symptoms show from young seedlings and, when severe, there may be very little of the root system left. Pythium causes the main root to become brightly coloured at the root tip. Pythium usually causes a root turning in any root or very well waterlogged soils.

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Control of root and crown diseases

The most effective form of disease control comes from the sowing of more resistant varieties. This is possible with CCN, root lesion and stem nematodes and to a lesser extent crown rot and common root rot.

Where resistance is not available, control is achieved through rotations with non-host crops, adjusting time of sowing in relation to the break of the season and weed kill, improved tillage techniques and by ensuring that adequate nutrition is available to help the plants recover.

Burning of stubbles will control crown rots but retaining stubbles for several years can lead to reductions in take-all and Rhizoctonia through a build up of soil micro-organisms that suppress these fungi.

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Cysts and knotting of roots

Cereal cyst nematode (CCN)

When cereal cyst nematodes live in abundant numbers, they cause the plants to produce many small branch roots at the site of feeding. This gives the appearance of root knotting 6-8 weeks after sowing. In oats, CCN feeding causes a thickening and shortening of roots rather than knotting. Eleven to thirteen weeks after sowing, infected plants have small white cysts at the knots or on the thickened roots. As plants hay off, the white cysts turn brown and become more difficult to see.

Loss of lateral roots, spear tips and root browning

Root lesion nematode, Rhizoctonia, Pythium

Root lesion nematodes feed on the root tips and smaller lateral roots. Careful digging up and washing of roots usually reveals long secondary roots with few or no lateral roots branching off them. Affected root tips and small lateral roots become sparse tap roots unless the roots recover through new root growth. These symptoms first appear in young seedlings and later stages, they may be very little of a root system. Pythium causes more root rot and emerges from carton-like brown and musty growth, brown spear tips. Rhizoctonia causes a softening in very wet or waterlogged soils.

Other root and crown diseases

A number of other minor diseases have been observed on roots and crowns of cereal crops in Australia. Two of the more damaging are stem nematode which affects oats, canola and some pulses in southern Australia and base rot which occurs in central Queensland where it affects cereals, pulses and legume pasture species.

Stem nematode usually occurs in patches in oat crops and causes stunting of tillers and distortion of stem bases. Base rot causes death of plants at tillering or whiteheads after flowering. Stem bases and crowns are coloured brown and masses of white threads may be found around the plant at or below the soil line.

Control of root and crown diseases

The most effective form of disease control comes from the sowing of more resistant varieties. This is possible with CCN, root lesion and stem nematodes and to a lesser extent crown rot and common root rot. Where resistance is not available, control is achieved through rotations with non-host crops, adjusting time of sowing in relation to the break of the season and weed kill, improved tillage techniques and by ensuring that adequate nutrition is available to help the plants recover.

Burning of stubbles will control crown rot but retaining stubbles for several years can lead to reductions in take-all and Rhizoctonia through a build up of soil micro-organisms that suppress these fungi.

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Root lesion nematode, Rhizoctonia, Pythium

Root lesion nematodes feed on the root tips and smaller lateral roots. Careful digging up and washing of roots usually reveals long secondary roots with few or no lateral roots branching off them. At around 4-6 weeks after sowing, these nematodes cause spear-tipped roots where the root has rotted through. These symptoms in young seedlings and 6-8 weeks later, may be very similar to that of a root site infection. Rhizoctonia causes tender, round to small white lesions on root tips. Rhizoctonia usually occurs in young seedlings in very wet or waterlogged soils.

Pythium typically causes rhizome decay soon after sowing in very wet or waterlogged soils.

Other root and crown diseases

A number of other minor diseases have been observed on roots and crowns of cereal crops in Australia. Two of the more damaging are root lesion nematode, which attacks the roots of many grain crops and onions; and Rhizoctonia, which attacks the roots of many vegetables and peppers. Loss of lateral roots, spear tips and root browning also occur.

Root lesion nematode usually occurs in patches in roots and cankers on root tips, scalds and brown lesions near or at the root tips. Rhizoctonia typically causes spear-tipped roots where the root has rotted through. These symptoms show from young seedlings and, when severe, there may be very little of the root system left. Pythium causes tender, round to small white lesions on root tips. Pythium usually occurs in young seedlings in very wet or waterlogged soils.

Control of root and crown diseases

The most effective form of disease control comes from the sowing of more resistant varieties. This is possible with CCN, root lesion and stem nematodes and to a lesser extent crown rot and common root rot. Where resistance is not available, control is achieved through rotations with non-host crops, adjusting time of sowing in relation to the break of the season and weed kill, improved tillage techniques and by ensuring that adequate nutrition is available to help the plants recover.

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Root lesion nematodes feed on the root tips and smaller lateral roots. Careful digging up and washing of roots usually reveals long secondary roots with few or no lateral roots branching off them. Affected cereal varieties become spear tipped or roots become rotted through the spear region. Roots become brown and visible, and when cut, may be very little of the root system. Pythium causes root rots which may not be visible but have brown pseudoma on the roots. Pythium usually causes root rots in very wet or waterlogged soils.

Other root and crown diseases
A number of other minor diseases have been observed on roots and crowns of cereal crops in Australia. Two of the more damaging are stem nematode which affects oats, canola and some pulses in southern Australia and base rot which occurs in central Queensland where it affects cereals, pulses and legume pasture species.

Stem nematode usually occurs in patches in oat crops and canola, causing stunting of plants and distorted stem bases. emperor (Ophiostoma maydis) which is a common fungal root rot. These symptoms show from young seedlings and, when severe, there may be very little of the root system. Pythium causes root rots which may not be visible but have brown pseudoma on the roots. Pythium usually occurs in very wet or waterlogged soils.

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