



NSW DEPARTMENT OF
PRIMARY INDUSTRIES



Root and Crown Diseases of Wheat and Barley

in Northern NSW

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EFS
Eastern Farming
Systems Project

Getting the most from this brochure

This brochure will help you identify the major root and crown diseases of wheat and barley in northern NSW. For each disease, the symptoms in **bold type** are the distinguishing symptoms; if you have the disease, you will always see these symptoms. Current best management practices are given for each disease.

Remember, accurate diagnosis is the first step in disease management. A number of other problems (e.g. frost and herbicide injury) can produce symptoms that may resemble those described in this brochure.

Further, the symptoms you see in your paddock can sometimes vary from those described in this brochure. We encourage you to use this brochure in the paddock as part of a group with your local agronomist and seek further diagnosis from the authors if unsure.

Crown Rot

(Cause - The fungus *Fusarium pseudograminearum*)

ONSET AND DISTRIBUTION

- ▶ Usually not obvious until after heading, when whiteheads appear.
- ▶ Individual plants or patches; sometimes first seen in wheel tracks.
- ▶ Whiteheads develop with the onset of water stress, usually after flowering.
- ▶ Durum wheat is highly susceptible.
- ▶ The extent and development of Crown Rot is influenced by the interaction between soil and plant water potential, soil N and inoculum loading.
- ▶ Yield loss can occur even without the formation of whiteheads.

SYMPTOMS

- ▶ **Tiller bases always brown**, often extending up 2–4 nodes.
- ▶ Some tillers on diseased plants may not be affected.
- ▶ Whitehead formation is most severe in seasons with a wet start and dry finish.
- ▶ Plants difficult to pull up, often breaking off near ground level.
- ▶ Cottony fungal growth may be found inside tillers.
- ▶ Pinkish fungal growth may form on lower nodes especially during moist weather.
- ▶ Pinched grain at harvest.

MANAGEMENT

- ▶ Reduce levels of the fungus in your paddocks by rotating with crops such as field pea, faba bean, canola, mustard, chickpea, mungbean, sunflower or sorghum. This will work only if you control grass weeds in these break crops – particularly barley grass and phalaris. Note that break crops with denser canopies increase the breakdown of infected cereal residue.

Sowing break crops on wide or skip rows will reduce the breakdown of cereal residue in the inter-row area.

- ▶ Reduce moisture stress in your wheat or barley crop through fallow management, avoiding excessively high sowing rates, matching nitrogen fertiliser inputs to available soil water, and controlling in-crop weeds.
- ▶ The Crown Rot fungus is stubble-borne so in a no-till system inoculum becomes concentrated in the previous winter's



Brown discoloration of stem bases; normal plant on right. (Lester Burgess)



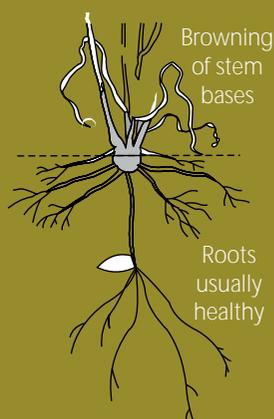
Pink/red discoloration of stem bases. (Kevin Moore)



Cross-section of a affected tillers showing white fungal growth. (Lester Burgess)

cereal rows. Use of precision guidance to establish new wheat or barley crops in between previous cereal rows reduces infection. Note that this relies on the previous cereal rows remaining as intact as possible, because any fragmentation (e.g. cultivation, mulching, grazing) redistributes inoculum to the inter-row area.

- ▶ Ensure adequate nutrition, especially with zinc.
- ▶ Sow bread wheat varieties with partial resistance to Crown Rot. Note that all current barley varieties are very susceptible and will encourage considerable build-up of inoculum. However, barley rarely suffers significant yield loss from Crown Rot largely because its earlier maturity limits the impact of moisture stress interactions with infection, which result in the production of whiteheads.
- ▶ Burning stubble does not guarantee freedom from Crown Rot. Burning removes only above-ground inoculum; the Crown Rot fungus still survives in crown tissue below ground. Hence burning is not a 'quick fix' for high inoculum levels. There is also no heat kill of inoculum in the soil.



Common Root Rot

(Cause - The fungus *Bipolaris sorokiniana*)

ONSET AND DISTRIBUTION

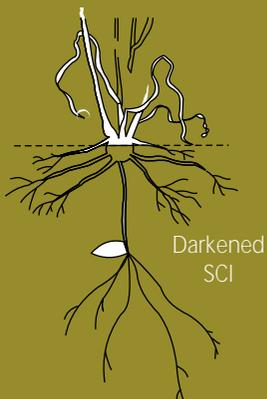
- ▶ Can occur from tillering onwards but most obvious after flowering.
- ▶ No distinct paddock symptoms, although the crop may lack vigour.
- ▶ Severe infections can lead to stunting of plants.
- ▶ Appears more prevalent in paddocks that are N deficient.
- ▶ When N is not limiting, yield loss occurs through a reduction in tillering due to poor N use efficiency.
- ▶ Affected plants are usually scattered through the crop.
- ▶ Widespread through the grain belt; often found in association with Crown Rot.

SYMPTOMS

- ▶ **Dark brown to black discolouration of whole or part of the SCI.**
- ▶ Tiller bases and surrounding leaf sheafs may be brown.
- ▶ Severely affected plants are stunted and have fewer tillers.
- ▶ Pinched grain at harvest.

MANAGEMENT

- ▶ Reduce levels of the fungus in your paddocks by rotating with crops such as field pea, faba bean, canola, mustard, mungbean, sorghum or sunflower. Tree crops or pasture must be grass-free. Grow partly resistant wheat or barley varieties.



- ▶ If moisture permits, reduce sowing depth to limit the length of the SCI.
- ▶ Ensure adequate nutrition especially of phosphorus which reduces severity.
- ▶ Burning does not decrease spore levels in the soil.



Plants from an affected crop (right) are stunted and have fewer tillers. Plants from a normal crop (left). (Kevin Moore)



The darkened SCI is a distinctive symptom of Common Root Rot. (Kevin Moore)



Common Root Rot causes darkening of the SCI and browning of the roots; healthy plant on right. (Kevin Moore)

Root Lesion Nematode (RLN)

(Cause - *The nematodes Pratylenchus thornei* and *Pratylenchus neglectus*)

ONSET AND DISTRIBUTION

- ▶ Can occur from tillering onwards.
- ▶ Uneven patches or waviness across the paddock.
- ▶ Affects wheat, chickpea, soyabeans, mungbeans and black gram.
- ▶ Barley, sunflower, sorghum, canola and mustard are less affected.
- ▶ Crops such as field pea, faba bean, lupin, lentil, rye, triticale, durum wheat and oats make good break crops.

SYMPTOMS

- ▶ Diagnosis is difficult and can be confirmed only by a laboratory test.
- ▶ Severely affected plants are yellow and stunted, with decreased tillering.
- ▶ Plants may wilt later in the season.
- ▶ Root systems are stunted, with reduced branching.
- ▶ Indistinct dark brown areas on roots, especially side branches.

MANAGEMENT

- ▶ First reduce RLN numbers by growing resistant crops.
- ▶ Resistant crops reduce nematode reproduction but do not eliminate the problem, as nematodes can survive in the soil for many years.
- ▶ Grow tolerant wheat cultivars, because these yield well in spite of being hosts to RLN.
- ▶ Avoid sowing wheat late, as these crops tend to be more severely affected than earlier-sown crops.
- ▶ Nematodes are spread by surface water, vehicles and farm machinery; adopt hygiene measures to prevent introducing RLN to your farm.
- ▶ Some crops may be resistant to one species but susceptible to others (e.g. canola is susceptible to *P. neglectus* but moderately resistant to *P. thornei*).
- ▶ Where mixed populations of species occur, use of crops resistant to only one species may allow the other species to increase.

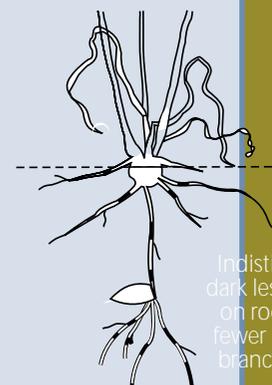
At right: Roots affected by RLN, showing reduced branching and darkened sections of the main roots.
(John Thompson)



Trial wheat plots showing stunting caused by RLN (centre), compared with tolerant varieties each side.
(John Thompson)



RLN (stained red) in a wheat root, as seen under the microscope. RLN is a small (0.5 – 1.0 mm long) worm-like animal that feeds and resides inside the young roots of many crops. It survives in soil between crops.
(John Thompson)



Indistinct dark lesions on roots; fewer side branches

Take-all

(Cause - The fungus *Gaeumannomyces graminis* var. *tritici*)

ONSET AND DISTRIBUTION

- ▶ Can occur from emergence onwards, but most obvious after flowering.
- ▶ More common in no-till crops.
- ▶ Usually in poorly defined patches.
- ▶ Generally more severe on wheat than on barley.

SYMPTOMS

- ▶ **Roots always black.**
- ▶ **All tillers on diseased plants are affected.**
- ▶ **All heads on diseased plants become whiteheads.**
- ▶ The SCI, crown and tiller bases can also be black, especially in a wet spring.
- ▶ Stunted yellow plants with reduced tillers.
- ▶ Plants easily pulled up, roots usually rotted.
- ▶ Whitehead development worse after hot dry conditions.
- ▶ Weeds often invade Take-all patches.
- ▶ Pinched grain at harvest.

MANAGEMENT

- ▶ Reduce levels of the Take-all fungus in your paddocks by rotating with crops such as field pea, faba bean, canola, mustard, chickpea, oats, mungbean, sunflower or sorghum to provide one year free of grass hosts.
- ▶ Break crops or pasture must be free of grass weeds.



Black roots are a distinguishing feature of Take-all; normal plant on the left. (Kevin Moore)

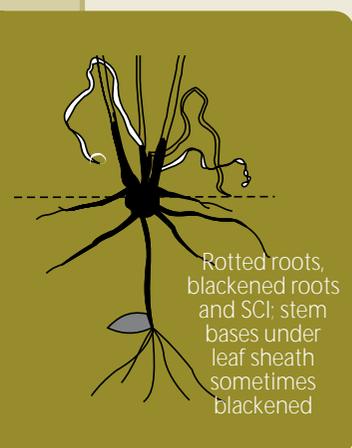


Blackening of the crown and lower stems, also a symptom of Take-all. (Gordon Murray)

- ▶ 'Winter clean' pasture in late winter before cropping to remove grasses by spraying with grass-selective herbicide.
- ▶ Use adequate fertiliser, especially phosphorus and nitrogen.
- ▶ Seed treatment with the fungicide triaiafol can provide suppression.



Whiteheads in a crop affected by Take-all. (Percy Wong)



Fusarium Head Blight (FHB)

(Cause – the fungus *Fusarium graminearum*)

ONSET AND DISTRIBUTION

- ▶ Causes a head infection rather than root or crown disease.
- ▶ Seen after flowering when prolonged wet weather occurs during heading and grain fill.
- ▶ Overhead irrigation can favour infection.
- ▶ Durum wheats are all highly susceptible.
- ▶ Inclusion of maize in the rotation favours the build-up of inoculum.
- ▶ Spores produced on maize, wheat, barley, sorghum, oats, triticale or grass weeds are windblown into heads.
- ▶ *Fusarium pseudograminearum* (Crown Rot fungus) can also cause FHB in some years through the rainsplash of conidia produced on lower stem nodes into heads.

SYMPTOMS

- ▶ In wheat, seen as premature bleaching of individual or several spikelets within a head.
- ▶ Frequently only part of the head (usually the upper half) is affected.
- ▶ During prolonged warm, humid weather infection also produces **salmon pink to orange spore masses (sporodochia)** of the fungus at the bases of infected spikelets.
- ▶ Infected wheat grains have a **chalky white appearance** and are usually shrivelled and lightweight. Infected wheat grain may also sometimes have a pink staining.
- ▶ Symptoms are different in barley; infected spikelets have browning or a water-soaked appearance, rather than bleaching.
- ▶ Infected barley grains have an orange or black encrustation on their surfaces rather than being chalky white.

MANAGEMENT

- ▶ Avoid sowing durum in close rotation with maize or adjacent to maize paddocks.
- ▶ Rotate to non-host pulse or oilseed crops.
- ▶ Control grass weeds in break crops and fallow.
- ▶ Sow partly resistant wheat and barley varieties in high-risk situations.
- ▶ Stagger planting within the recommended sowing window, or select varieties differing in days to maturity to minimise risk of all crops flowering during a period when weather is favourable for infection.



Durum wheat head infected with FHB. Note premature bleaching of infected spikelets. (Steven Simpfendorfer)



Barley head infected with FHB. Note brown water-soaked appearance of infected spikelets. (Steven Simpfendorfer)



Wheat grains infected with FHB are lightweight and have a chalky-white appearance. Pink staining may also be present. (North Dakota State University)

- ▶ Application of fungicides (e.g. tebuconazole) at early flowering can reduce infection. Note application timing and nozzle configuration are critical.
- ▶ Avoid high-risk rotational situations when using overhead irrigation.
- ▶ Use clean seed, or treat infected seed with thiram + carboxin to prevent seedling blight. Note that this does not control FHB later in the season.

Is my crop diseased?

- ▶ Inspect your crop regularly - is it healthy or diseased?
- ▶ When does the problem occur – early season, after heading, all season?
- ▶ Where does it occur – low spots, everywhere, ridges, individual rows?
- ▶ Are there patches, or does the crop generally lack vigour?
- ▶ Are there stunted, discoloured or dead plants?
- ▶ Has the crop gone on quickly?
- ▶ Are there whiteheads; if so, are they in patches or as scattered plants?
- ▶ Any evidence of insects or vermin?
- ▶ What's the weather been like – cold and wet, frosty, suddenly hot & dry?
- ▶ What chemicals have you used: last year, this year?
- ▶ What is the nutritional status of the crop?
- ▶ How does it compare with other crops?

Reducing losses from disease

These management practices work for all the diseases covered in this brochure:

- ▶ Don't grow wheat or barley after wheat, barley, or grassy pastures.
- ▶ Control weeds in crop and in fallow – some harbour disease and all compete with your crop for water and nutrients.
- ▶ Conserve soil moisture – many of the diseases in this brochure are worse in water-stressed crops.
- ▶ Fertilise to provide adequate nutrition – well nourished crops can cope better with disease.
- ▶ Grow resistant or tolerant crops and varieties where available (note: all varieties are equally susceptible to Take-all and Rhizoctonia bare patch).

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Further Information

Kevin Moore, Steven Simpfendorfer, Andrew Verrell, Bill Manning, NSW DPI, Tamworth, NSW. Tel: 02 6763 1100
NSW DPI website, www.dpi.nsw.gov.au

Wallwork, Hugh (2000), *Cereal Root and Crown Diseases*, the GRDC and SARDI. ISBN 1 875477 748. Available from Ground Cover Direct on Freecall 1800 11 00 44 or e-mail: ground-cover-direct@canprint.com.au

McRae, F.J, McCaery, D.W, Matthews, P.W (updated annually), *Winter Crop Variety Sowing Guide*, NSW DPI (available from all offices of NSW DPI).

Queensland DPI & F, *Wheat Varieties for Queensland* (updated annually) and *NSW Agriculture, Nitrogen Budgeting for Winter Cereals* (1998), ISBN 0 7313 1480 8

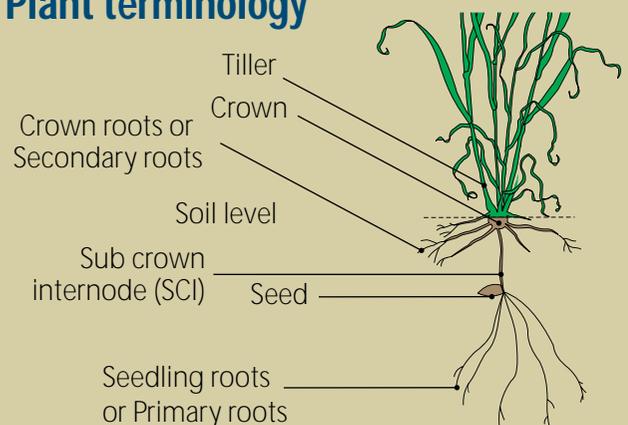
Identification



Whiteheads can have many causes: hail, mice, frost, insects, disease (in this photo, Crown Rot). Accurate identification is essential for effective disease management. (Kevin Moore)

- ▶ Do plants pull out easily or do they break off near ground level?
- ▶ Dig up plants, soak roots in water and shake gently to remove soil.
- ▶ Examine roots – a white tray with clean water makes this easier.
- ▶ Compare with roots of healthy plants.

Plant terminology



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Cereal Cyst Nematode (CCN)

(Cause - The nematode *Heterodera avenae*)

ONSET AND DISTRIBUTION

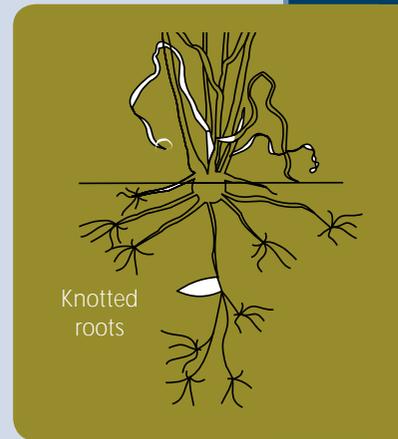
- ▶ Rare in northern NSW.
- ▶ Usually seen early in the season.
- ▶ Irregular patches in crop that persist throughout the season.
- ▶ Can occur on heavy and light soils.
- ▶ Barley is tolerant.

SYMPTOMS

- ▶ **Roots are always knotted.**
- ▶ Soil adheres to root knots and is difficult to wash off.
- ▶ Yellow or pale green patches appear in the crop in early winter.
- ▶ Affected plants are stunted, less vigorous, have fewer tillers and appear nutrient deficient.
- ▶ Plants are easy to pull up, often with a 'ball' of soil clinging to them.
- ▶ Roots are severely stunted and may be swollen, but are not discoloured.
- ▶ In late winter/early spring white cysts 1–3 mm in diameter develop in the knots; these cysts eventually turn brown.



Knottling of roots and shortened lateral roots are symptoms of CCN. (Kevin Moore)



MANAGEMENT

- ▶ Use rotations with non-cereal crops or resistant cereal varieties.
- ▶ A two-year break is needed to reduce nematode numbers.
- ▶ Control wild oats and susceptible cereal volunteers in break crops and pastures.
- ▶ Use adequate fertiliser.

Rhizoctonia Bare Patch

(Cause - The fungus *Rhizoctonia solani*)

ONSET AND DISTRIBUTION

- ▶ Usually seen early in the season.
- ▶ More likely where sulphonylurea herbicides have been used.
- ▶ More likely in light soils.

SYMPTOMS

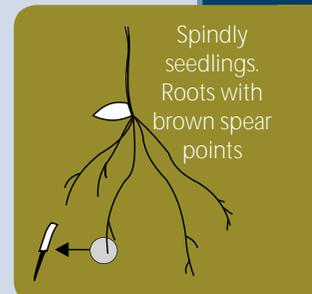
- ▶ **Well defined patches** in crop up to several metres across that persist throughout the season.
- ▶ **Some roots are always shorter, and these always have spear-pointed tips.**
- ▶ Affected plants are very stunted and have reduced tillers and erect leaves that are often reddish/purplish.
- ▶ Affected plants either die or remain stunted throughout the season.

MANAGEMENT

- ▶ Soil disturbance to 5–10 cm below sowing depth at, or within 2 weeks of, sowing.
- ▶ In a no-till system, use modified sowing points that provide soil disturbance below the seed.
- ▶ Take care with using Group B herbicides especially on alkaline soils.
- ▶ Optimise crop nutrition through application of fertiliser.



Rhizoctonia often produces well defined patches in the crop. (Kevin Moore)



Affected plants on the left show shortened, spear-pointed root; healthy plant on the extreme right. (Kevin Moore)

- ▶ Consult with the authors of this brochure or your local agronomist for further options.