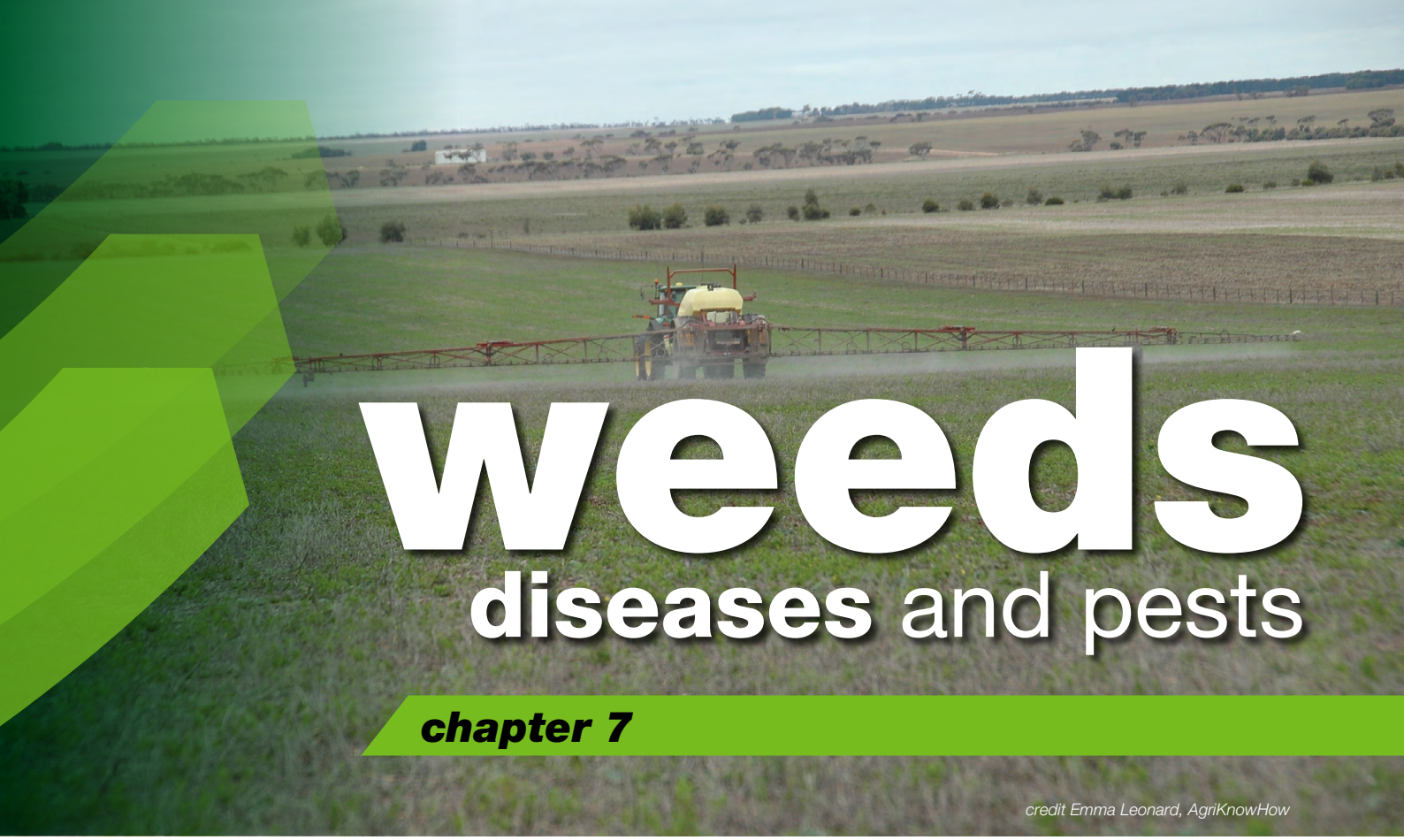


weeds diseases and pests

chapter 7

credit Emma Leonard, AgriKnowHow

Weeds

Impact on hay quality

- Contamination
- Colour
- Taints
- Toxins

While oats are more competitive with weeds than other cereals, pre-seeding weed control is vital. This is because in-crop weed control options are limited as oats are more sensitive to herbicides than other cereals.

Weeds not only impact on hay yield but also on quality. Broadleaf and grass weeds can reduce hay quality due to contamination and reduced visual and sensory characteristics.

Exporters will have standards for acceptable inclusion of weeds and admixture; generally it is 5% of the hay by weight.

Non-selective knockdown herbicides are the most economic option for pre-seeding weed control. In 2016, there are few on-label herbicide recommendations for weed control in oats or for soil active weed control when sowing oats.

Some herbicides for pre- and post emergent weed control in oat hay crops are listed in Table 7.1.

Some states, such as South Australia (SA), have supplementary lists for herbicide use in oats.

Advice should be sought from your agronomist and herbicide reseller.

In-crop weed control should be carried out when weeds are small and easily killed and before GS32 to minimise the impact of crop damage in wheel tracks.

Check the Australian Pesticides and Veterinary Medicine Authority (APVMA) website for current registrations and permits (www.apvma.gov.au).

Details of variety tolerance to different herbicides can be found on the National Variety Trials (NVT) website (www.NVTonline.com.au).

Always ensure that stockfeed withholding periods are met for grazing and hay.

Grass weeds

Wild oats cause yield loss, increased levels of cereal cyst nematode (CCN), are a source of rust inoculum and have a detrimental effect on quality due to early maturity. To prevent wild oats negatively impacting on hay quality or setting seed, hay paddocks should be cut as near as practical to the wild oats flowering. For most oat hay varieties, this means cutting the hay before flowering as wild oats generally flower before commercial oat varieties. Some of the early maturing varieties may coincide with wild oats. Very late maturing varieties should be avoided where wild oats are expected.

There is no safe chemical option for the control of wild oats in oat hay crops although the use of trifluralin applied in no-till systems has given partial control but is

not permitted in all states. Check the APVMA website for the latest updates on trifluralin registration. Terbyne® is registered only for suppression of wild oats.

Ryegrass is a particular issue for oat hay production because hay is often included in the rotation to provide non chemical control of ryegrass. However, ryegrass hosts the annual ryegrass toxicity (ARGT) complex that can poison animals fed hay containing ryegrass infected with the toxin. Initially, the export market limited the ryegrass level in oat hay to 5%, but as ryegrass itself makes very good quality hay, often higher levels can be marketed as long as the hay is free from ARGT.

Good ryegrass control with herbicides can be difficult to achieve in oat crops but metolachlor (pre-seeding or post sowing pre-emergent) and chlorsulfuron (for Group B susceptible populations) have been used.

Grass weeds such as barley grass, silvergrass and brome grass reduce palatability and visual quality.

After bales have been removed from the paddock, regrowth of oats and other grass weeds can be controlled with paraquat or glyphosate.

Hay growers now have the option to desiccate hay crops prior to mowing using the herbicide Weedmaster® DST® (Group M). Desiccating one to 11 days pre-mowing offers the benefits of:

- reducing weed seed set;
- preventing hay and weed re-growth;
- preserving soil moisture; and
- maintaining or improving hay quality.

Before desiccating hay check this is an acceptable practice with your export hay buyer.

For some growers, the wheel tracks from the spray can be an issue for mowing but this is best managed by spraying in a different direction to the hay mower.

Broadleaf weeds

Weeds with a thick stem such as Salvation Jane and small-flowered mallow/marshmallow (*Malva parviflora*) cause visual downgrading and cure at a different rate to oats. Dark, unsightly patches or mouldy hot spots can result from the inclusion of broadleaf weeds.

Capeweed is a particular problem as it causes yield loss and has a detrimental effect on quality by causing unsightly dark and low nutrient patches in bales.

Brassica weeds and Bifora can result in unacceptable taints to the hay that will reduce livestock intake. Some weeds, such as Melilotus, can impart taints to milk.

Sharp, spiky weeds, such as thistles, can cause intake problems as well as impact on handling. About 80% of cows in Japan are fed by hand and the presence of thistles is easily noticed.

Annual ryegrass toxicity (ARGT)

ARGT is caused by toxins produced by the bacterium *Rathayibacter toxicus* that infect the seed heads of ryegrass. These toxins can prove fatal if ingested by livestock. The bacterium is transferred to ryegrass seed heads by a nematode (*Aguina spp.*). The nematode, which only has one lifecycle each year, invades the ryegrass during winter and in spring produces a gall that replaces a developing seed in the immature seed head. If the bacterium is present, it quickly multiplies during early spring, swamping the nematode and takes over the gall. After ryegrass flowers, the bacterium begins to produce potent toxins called corynetoxins. Toxin production increases rapidly just before the grass hays off. The toxin is very stable and persists in dry pasture or hay.

Circumstances that favour development of ARGT are:

- paddocks with moderate to high frequency of cropping;
- poor ryegrass control in previous year often associated with herbicide resistance;
- poor ryegrass control in-crop;
- ryegrass seed heads are cut or spray-topped after flowering has commenced allowing nematodes to complete their lifecycle;
- successive short growing seasons favour nematode multiplication;
- spread of galls from infected areas within or surrounding the paddock; and
- pasture phase under-grazed during spring, allowing infected ryegrass seed heads to mature and continue infection cycle.

Infected seed heads usually show no visual signs of infection. Sometimes excessive bacterial growth causes the emerging seed heads to become twisted and deformed. In this case, the bacterium will appear as a yellow exudate. When dry, the exudate turns orange and becomes brittle and transparent. Close inspection of the spikelets will often reveal that individual seeds have been replaced by nematode galls, most of which will be colonised by the bacterium.

The twist fungus (*Dilophospora alopecuri*) causes ryegrass seed heads to become distorted and 'twisted'. Twist is a plant parasitic fungus, but it needs the nematode to carry its spores into the plant. The spores quickly colonise the galls produced by the nematode.

This relationship makes the twist fungus a useful biological control for the nematode and is now established in many areas affected by ARGT. However, symptoms of the fungus indicate the nematode is present in the paddock, and that the bacterium may also be present. Significant levels of the fungus reduce but do not eliminate the risk of poisoning to stock. Stockists of the twist fungus can be found on the internet.

Testing for ARGT bacterial contamination in export hay and straw is compulsory. Local hay buyers may also require test results. Check on line for details of laboratories accredited for testing ARGT.

The reputation of Australian oat hay depends on the constant sampling and testing of export hay to minimise the likelihood of toxicity reaching animals.

Procedures and sampling protocols to minimise the risk of corynetoxin contamination in export hay can be sourced on the Federal Government Department of Agriculture and Water Resources website via the Biosecurity link – Hay Export Procedure (http://www.agriculture.gov.au/).

Table 7.1 Herbicides for weed control in oat hay crops – *source Agrilink Agricultural Consultants and Consult Ag 2016.* Always check the label before use as registrations vary between states.

Herbicide groups	Active ingredient	Examples of brand names	Timing	Comments
B	metosulam	Eclipse®	Apply late post emergent.	Post emergent broadleaf weed control.
B	flumetsulam	Broadstrike®	Apply late post emergent.	Post emergent broadleaf weed control.
B	chlorsulfuron triasulfuron	Glean®, Siege® Logran®	Apply post emergent.	Used post emergent for Group B susceptible weeds.
C	bromoxynil	Buctril®, Bromicide®	Apply after GS13. Avoid spraying in warm conditions.	Can be used in a tank mix with diflufenican (Group F). Grazing withholding periods must be followed for export hay to prevent residue.
C	diuron	Diuron, Diurex®	Apply pre-seeding, post seeding/pre-emergent or early post emergent.	Used as a residual herbicide before emergence or as a tank mix partner early post emergent.
C	terbuthylazine	Terbyne®	Pre-sowing application for control of certain grasses.	Vary rates by soil type. Low rates should be applied on lighter soils.
G	carfentrazone	Affinity®	Apply after GS14 but before GS31.	Particularly good as a tank mix partner to control Bifora and bedstraw.
I	dicamba	Cadence® Banvel®	Apply before GS25.	Common mixing partner for wireweed and legume control.
I	MCPA Ester MCPA LVE MCPA Amine	MCPA LVE MCPA 500	Apply between GS13 and GS37. Rate dependent at differing growth stages.	Can be used in a tank mix with diflufenican to broaden spectrum. Appears to be less damaging than equivalent rates of 2,4-D products.
I	2,4-D Amine	Amicide®	Apply between GS31 and GS37. Rate dependent at differing growth stages.	Only at low rates as scorching and yield loss can occur at high spraying rates. Some varieties are more sensitive to 2,4-D.
I	clopyralid	Lontrel® Archer®	Apply at any growth stage.	**Lontrel® cannot be used on export hay.** Good for thistles and legumes with some short term soil residual. Can be residual in hay.
K	metolachlor	Dual® Dual Gold®	Apply pre-seeding or post seeding pre-emergent.	Usually applied as post sowing pre-emergent, often in combination with diuron. Highly soluble so damage can occur in sandy soils or shallow sown crops.
C, I	bromoxynil+dicamba +MCPA	Broadside®	Apply after GS13 to late tillering.	Effective control of a wide range of broadleaf weeds. Best applied while weeds are small.
C, I, F	bromoxynil+MCPA +picolinafen	Flight®	Can be applied from GS13.	Broadleaf weed control.
I, F I, F	diflufenican+MCPA picolinafen+MCPA	Tigrex® Paragon®	Apply at GS13 to late tillering.	Very effective on brassica weeds such as wild radish. Blotching on leaves can occur, so spray early with lower rates on small weeds.
H, I	MCPA + pyrasulfotole	Precept®	Post-emergent broadleaf weed control.	Very strong on brassica weeds. Apply in bright sunny conditions. Very crop safe and unlikely to cause leaf discolouration.

Some of the above chemicals are not covered by label registrations but only by supplementary permit registrations that may only relate to certain states. Check details on the APVMA website (www.apvma.gov.au). Mention of trade names does not imply endorsement of any company's products and availability may change over time.

Disease

Impact on hay quality

- Colour
- Feed test

A wide range of diseases can affect all plant parts and attack at different growth stages (Table 7.2) resulting in reduced hay production and quality. Pest damage of significance is generally confined to emerging crops, however aphids occasionally cause yield loss but are more significant as transmitters of barley yellow dwarf virus (BYDV).

The effect of diseases on the key chemical determinants of hay quality - digestibility, fibre content and water soluble carbohydrates (WSCs) - has not been quantified. Diseases, especially foliar diseases, reduce the desirable green colour to yellow, red, and brown which may result in hay being downgraded. The smell of hay is adversely affected by crops heavily infected with stem and leaf rust spores.

Take an integrated approach to disease and pest control using genetic resistance, chemical control and agronomy practices. Genetic resistance is the most desirable and sometimes the only means of disease control, e.g. for bacterial blight. However, pathogens can evolve and reduce the effectiveness of genetic resistance. Tables 7.3 and 7.4 detail the diseases for which fungicides are currently available. When selecting a variety, it is important to understand the dominant disease constraints in a region (Figure 7.1).

Varieties with the best combination of resistance to key diseases in a region should be selected (see Tables 4.3a & b).

Table 7.2 Details of common diseases of oat hay by Zadok's growth stage
– source SARDI, National Oat Breeding Program.
For more information on growth stages see 'The oat hay year planner' (Chapter 2).

Growth stage (GS)	Disease
GS0 - 25	Root diseases - stem nematode, cereal cyst nematode (CCN), pratylenchus, take-all and rhizoctonia Foliar disease – barley yellow dwarf virus (BYDV)
GS25 - 30	Septoria, bacterial blight, BYDV and pyrenophora leaf blotch
GS30+	Septoria, bacterial blight, BYDV, red leather leaf, stem and leaf rust

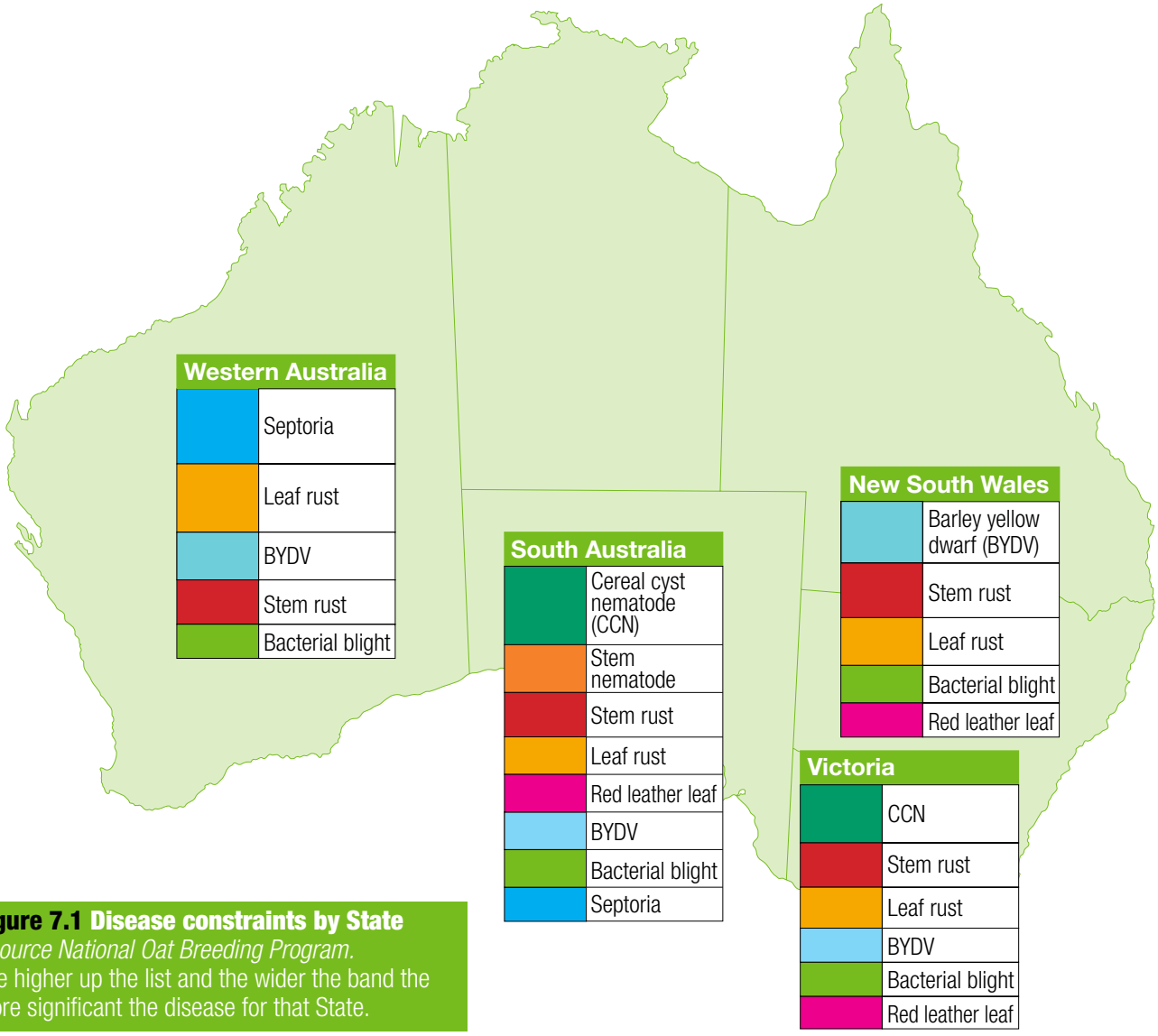


Figure 7.1 Disease constraints by State
- source National Oat Breeding Program.
The higher up the list and the wider the band the more significant the disease for that State.

Table 7.3 Seed dressings registered for disease and insect control of oats – *source APVMA and CropLife 2016.*

Active ingredients	Fungicide groups	Insecticide group	Example of brand name	Disease control	Insect control
Carboxin | Cypermethrin	7	3a	Vitaflo C®	Loose smut, covered smut	Selected grain storage insects.
Imidacloprid | Tebuconazole	3	4a	Hombre®	Loose smut, covered smut	Early feeding caused by cereal and wheat aphid. Reduces the spread of BYDV and selected grain storage insects.
Imidacloprid | Triadimenol	3	4a	Zorro®	Loose smut, covered smut	Early feeding caused by cereal and wheat aphid. Reduces the spread of BYDV and selected grain storage insects.
Cypermethrin | Ipconazole	3	3a	Rancona C®	Loose smut, covered smut	Selected grain storage insects.
Metalaxyl-M | Sedaxane | Difenoconazole	3, 4, 7		Vibrance™	Loose smut, suppression of rhizoctonia	
Metalaxyl-M | Sedaxane | Thiamethoxam | Difenoconazole	3, 4, 7	4a	Vibrance™ Extreme	Loose smut, suppression of rhizoctonia	Selected grain storage insects.
Penflufen	7		Evergol® Prime	Covered smut, loose smut, suppression of rhizoctonia	
Thiram | Carboxin	M3, 7		VitaVax®	Loose smut, covered smut	
Flutriafol | Cypermethrin	3	3a	Vincit®	Loose smut, covered smut	Selected grain storage insects.
Flutriafol	3		Impact®	Take-all*	

Chemical labels should be read and rates should be checked before using fungicides as registrations may vary between states. Check details on the APVMA website (www.apvma.gov.au).

Mention of trade names does not imply endorsement of any company's products and availability may change over time.

**No in-furrow fungicides are currently registered for use on oats in WA.*

Loose and covered smut are not common in oat hay but should infection occur from seed or paddock carryover severe taints in the hay could result.

Table 7.4 Foliar fungicides registered for disease control in oat hay crops – *source APVMA and CropLife 2016.*

Active ingredients	Fungicide groups	Disease control	Examples of brand names
Epoxiconazole | Pyraclostrobin	3, 11	Septoria leaf blotch	Opera®
Epoxiconazole |Azoxystrobin	3, 11	Septoria leaf blotch	Tazer Xpert™
Propoconazole	3	Stem rust, crown rust, suppression of septoria leaf blotch	Tilt®
Prothioconazole | Tebuconazole	3	Stem rust, leaf rust, septoria blotch	Prosaro®
Propiconozole | Tebuconazole	3	Stem rust, crown rust, suppression of septoria leaf blotch	Cogito®
Sulphur | Tebuconazole	3	Crown rust	Unicorn®
Tebuconazole	3	Crown rust	Folicur®

Chemical labels should be read and rates should be checked before using fungicides as registrations may vary between states. Check details on the APVMA website (www.apvma.gov.au).

Mention of trade names does not imply endorsement of any company's products and availability may change over time.

When diagnosing diseases, it is important to know the history of the paddock because disease development is influenced by:

- pathogen presence and abundance (green bridge, oat stubble, infected seed);
- variety susceptibility; and
- environmental conditions.

Leaf and stem diseases

During the growing season, regular paddock inspections should be carried out for disease.

Care should be taken to avoid spreading foliar diseases during such inspection; this is especially important if bacterial blight is present.

Aerial fungicide applications are preferable when applied at later growth crop growth stages in order to minimise crop damage from wheel traffic.

The export market is concerned about the residual nature of some fungicides. Therefore, it is advisable to check with your hay buyer before fungicides are applied. Follow the grazing/forage and fodder withholding periods for all fungicides.

Leaf and stem diseases – fungi

Stem Rust, *Puccinia graminis f. sp. avenae*

Severity	Stem rust is one of the most devastating diseases of oats. It occurs in all oat growing regions of Australia. Because the pathogen has the ability to produce multiple cycles of spores, early infection of the plant can result in complete crop failure. A pathotype that overcomes most resistance genes for stem rust is now present in southern Australia. Therefore, it is important to monitor oat crops for early detection of rust, so fungicide applications can be applied to control the diseases.
Source and spread	Volunteers, spread by wind.
Main hosts	Oats, wild oats.
Plant part attacked	Leaves, stems and heads.
Symptoms	Stems and leaves have dark reddish-brown powdery spores. Spore pustules are elongated. Similar to leaf rust but darker and seen on stems and upper leaves first.
Control methods	
rotations & variety choice	Avoid most susceptible varieties. Resistance tends to be short lived.
weed control	Tillage, burning, grazing and spraying to control volunteers.
fungicides	Numerous fungicide options are registered for control of oat stem rust. Apply as a preventative in high risk situations or when infection levels are very low in order to minimise yield loss. With early infections, a second application may be required. Once the crop is heavily infected with stem rust, the ability of fungicides to prevent yield or quality loss is limited. Use high water rates to maximise coverage and use full label rates. Withholding periods must be observed.
Other comments	Infection requires temperatures between 15°C to 30°C and humid conditions.

Leaf Rust, *Puccinia coronata f. sp. avenae*

Severity	Leaf rust occurs in all oat growing regions in Australia. Similar to stem rust, leaf rust produces multiple cycles of spores, but generally will not result in complete crop failure. Early infection in a very susceptible variety can result in crop failure.
Source and spread	Weeds, volunteers, spread by wind.
Main hosts	Oats, wild oats.
Plant part attacked	Leaves.
Symptoms	Circular to oblong pustules on the upper leaf surface that produce orange, powdery spores. As the crop matures, the spores become black, forming a dark edge to the pustules.
Control methods	
rotations & variety choice	Sow resistant or moderately resistant varieties. Resistance tends to be short lived.
weed control	Control volunteers and wild oats.
fungicides	Numerous fungicide options are registered for control of oat leaf rust. Disease may be controlled for up to four weeks with use of foliar fungicides. Repeat applications may be necessary if infection occurs early. Withholding periods must be observed.
Other comments	Disease promoted if temperature is 15°C to 22°C and conditions are moist. Leaf and stem rust in oats look similar. Leaf rust pustules are smaller and rarely found on stems but do move to leaf sheath later in the season.

Septoria Leaf Blotch, *Septoria avenae*

Severity	Septoria causes leaves, and in severe cases panicles, to turn reddish brown, reducing visual quality. The spores are splash dispersed and continue to move up the plant if climatic conditions are conducive.
Source and spread	Stubble, wind, rain splash.
Main hosts	Oats.
Plant part attacked	Leaves and stems.
Symptoms	Leaves have dark, elongated spots with a yellow surround. Entire leaf can die. Stems can be infected and lodging may result.
Control methods	
rotations & variety choice	Sow partially or resistant varieties. Avoid sowing into or near infected stubbles. Do not grow oats continuously.
time of sowing	In high rainfall areas, do not sow early.
stubble management	Burn or bury infected stubbles.
fungicides	Numerous fungicide options are registered for control of septoria in oats. In high yield and disease pressure situations, a double application of fungicide can be economically viable. It is most important to protect the Flag leaf and Flag minus 1. Withholding periods must be observed.
Other comments	Early infections of septoria can be confused with Pyrenophora leaf blotch.

Pyrenophora Leaf Blotch, *Pyrenophora avenae*

Severity	Seedlings have purple irregular spots that can spread to the upper leaf canopy when cool moist conditions persist.
Source and spread	Infected seed.
Main hosts	Oats.
Plant part attacked	Leaves.
Symptoms	Pyrenophora symptoms are small, reddish purple, oval lesions. Cold wet conditions favour the development of this disease. As the season progresses, the crop generally recovers with the upper leaf canopy free of disease. Hence, visual hay colour is not usually affected.
Control methods	Seed treatment, sanitation, rotation, and cultural methods to promote rapid seedling development.
Other comments	This disease is a minor problem in oats and generally does not require control. Symptoms may be confused with septoria.

Red Leather Leaf, *Spermospora avenae*

Severity	Very little is known about this disease, but it is known to be favoured by cool, moist conditions.
Source and spread	Stubble, spread by rain splash.
Main hosts	Oats.
Plant part attacked	Leaves.
Symptoms	Leaf symptoms begin with yellow circular areas. Red/brown areas that may cover the majority of the leaf area surround lesions. Plants may be stunted.
Control methods	
rotations & variety choice	Avoid susceptible varieties in areas where the risk is high. Growing oats in tight rotation can increase pathogen levels. Avoid sowing near or into infected stubbles.
stubble management	Burn or bury infected stubbles.
Other comments	Disease more likely to occur in high rainfall areas.

Leaf and stem diseases - bacteria

Fungicides are not effective in controlling bacterial diseases such as halo and stripe blight, collectively referred to as bacterial blight; genetic resistance is the only option to provide plant protection to this disease.

Bacterial Blight, *Pseudomonas syringae*

Halo blight
Pseudomonas syringae pv. coronafaciens

Symptoms - leaves will have light green oval spots up to 10mm surrounded by yellow areas, which can join together to form blotches on the leaf.

Stripe blight (Bacterial stripe)
Pseudomonas syringae pv. striafaciens

Symptoms - leaves have brown stripes with narrow yellow edges. Leaves wither and die.

Severity	Bacterial blight is prevalent early in the growing season when conditions are cool and moist. Two forms, halo and stripe, are collectively known as bacterial blight. Symptoms can either be brown oval lesions or brown stripes on the leaves. Eventually the brown areas disintegrate to form 'windows'. Symptoms often become apparent after a frost. As the growing season progresses, plants generally grow away from this disease.
Source and spread	Transfers on tyres, stubble, seed, spread by rain splash and insects.
Main hosts	Oats.
Plant part attacked	Leaves.
Control methods	
rotations & variety choice	Avoid susceptible varieties. Genetic resistance is an option for plant protection. Avoid sowing into infected stubbles.
stubble management	Burn or bury infected stubbles.
clean seed	Do not use seed from infected crops.
Other comments	Common early in the season when conditions are wet and cool. Paddock hygiene is important. To prevent disease spread, paddock operations should be avoided after frost or when leaves are wet.

Leaf and stem diseases - viruses

Barley Yellow Dwarf Virus (BYDV)

Severity	Barley yellow dwarf virus (BYDV) is prevalent in high rainfall areas. Aphids introduce and spread the virus in the crop.
Source and spread	Volunteers, spread by aphids.
Main hosts	All cereals, many grass weeds.
Plant part attacked	Leaves.
Symptoms	Yellowing of leaves begins at the tips, yellow stripes extend to the base, and leaves turn red. Symptoms may not be evident until sometime after the initial infection. More commonly seen in patches, especially at paddock margins. Early infection results in dwarfing of the plant and sterile panicles.
Control methods	
rotations & variety choice	Sow resistant or tolerant varieties.
time of sowing	Avoid early growth coinciding with periods of peak aphid activity.
weed control	Tillage, grazing and chemical controls of weeds and volunteers over summer to reduce aphid build up.
pesticides	In high risk situations, seed can be treated with a seed dressing containing imidacloprid to prevent early aphid infection. A prophylactic spray of alpha-cypermethrin at the 2-3 leaf stage of the oats can have an anti-feeding effect to reduce the likelihood of aphid infection and the transmission of viruses. Seek advice from a local agronomist on best practice for insect resistance management.
Other comments	Disease transmitted by aphids. More prevalent following an early break in the season. Can be confused with nutrient deficiencies, red leather leaf and water logging.

Root Diseases - nematodes

Nematodes that infect oats are small and usually about 0.2mm long. They cause major soil-borne diseases, limiting dry matter production and grain yield in certain areas throughout Australia.

Oat varieties differ in their ability to host nematodes. Resistant varieties act as excellent break crops limiting nematode multiplication, while susceptible varieties increase the severity of the disease.

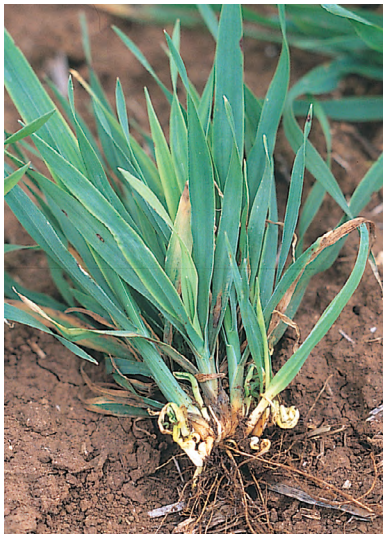
However, varieties also differ in their ability to develop normally and produce hay in the presence of the nematode. Tolerant varieties will develop normally in the presence of high nematode populations, but in the same situation, intolerant varieties would have poor growth or could even die.

Therefore, if nematodes are a problem, it is advisable to select a variety with both resistance and tolerance (see Tables 4.3a & b).

Cereal Cyst Nematode, *Heterodera avenae*

Severity	Cereal cyst nematode (CCN) causes stunted root systems, resulting in reduced plant growth and yellowed leaves. Oat varieties can be resistant or susceptible to CCN (a variety's ability to control nematode numbers). They are also tolerant or intolerant to CCN (relating to the variety's ability to yield when nematodes are present). Severe infestations cause seedling death in intolerant oat varieties.
Source and spread	Soil, weeds, volunteers. Spread by cultivation.
Main hosts	Susceptible cereals - wheat, barley, oats, wild oats.
Plant part attacked	Roots.
Symptoms	Yellow or pale green patches appear in crops in early winter. Stunted plants. Fewer tillers. Patches 1m to over 100m in diameter. Shallower root systems. Oats have thickened roots but no knotting. White cysts, about 1mm in diameter, appear on roots 11 to 13 weeks after sowing.
Control methods	
rotations & variety choice	Disease break - at least one out of every two years with non cereals or resistant cereals. Resistant varieties prevent CCN build-up. Tolerant varieties have a lower yield loss when CCN is present. Both resistance and tolerance reactions are reported for all oat varieties released in Australia from the National Oat Breeding Program.
time of sowing	Early sowing helps reduce yield loss by allowing good crop establishment before large numbers of nematodes hatch.
weed control	Tillage, grazing and chemical control of host plants in break crops and pastures.
soil fertility	In fertile soils, plants with well established roots obtain nutrients and have a better recovery.
Other comments	CCN can be more of a problem in alkaline, sandy or less fertile soils. Reduced soil disturbance decreases CCN numbers.

Stem Nematode, *Ditylenchus dipsaci*



Severity	Stem nematode is limited in its distribution but devastating to oat crops when present. This nematode causes multi-tillering and swelling at the base of the seedling, leaf crinkling, and severe dwarfing of plants. An intolerant variety affected by stem nematode could result in crop failure.
Source and spread	Soil, stubble, seed.
Main hosts	Oats, wild oats, faba beans, peas, chickpeas, vetch, three horned bed straw and some other broadleaf weeds.
Plant part attacked	Crown/stem base.
Symptoms	Multiple, stunted tillers.
	Poor emergence in soils where nematode numbers are high. Often seedlings of intolerant varieties do not survive and plants that survive frequently do not produce panicles.
Control methods	
rotations & variety choice	Disease break - avoid successive susceptible hosts, especially prior to oat crops. Where damage has been severe, avoid a susceptible and intolerant crop for three or more years, growing resistant oats or other cereals. Field peas and chickpeas will prevent nematode numbers increasing, but are very intolerant and can suffer significant losses. Faba beans are more tolerant than peas but are susceptible, allowing populations to multiply.
weed control	Control susceptible host plants in break crops and pastures.
hygiene	Avoid spreading infested plant material by cleaning equipment before leaving infested paddocks and by minimising soil movement and erosion.
Other comments	Stem nematode prefers heavy soils. Dry years favour survival in the absence of a host.

Testing for root and crown disease

The potential for damage by key root and crown diseases can be tested by a single soil test. Soil samples for the PreDicta B soil test (http://pir.sa.gov.au/research/services/molecular_diagnostics/predicta_b) are collected in summer/early autumn. Coordinated by accredited local agronomists and resellers, PreDicta B provides a DNA prediction of soil inoculum levels of multiple diseases including rhizoctonia, take-all, cereal cyst nematode, pratylenchus, stem nematode and crown rot.

Root Lesion Nematode, *Pratylenchus – P. thornei, P. neglectus, P. teres, P. penetrans*

Severity	Root lesion nematode (RLN) prunes the plant's root system resulting in thin stands of yellowing plants. Less is known about the resistance and tolerance reactions to RLN in oat varieties than for CCN and stem nematode, but differences have been demonstrated between varieties and RLN species.
Source and spread	Soil, weeds, volunteers.
Main hosts	Wheat, barley, canola, vetch, medic, chickpeas, corn, oats, many grass and broadleaf weeds.
Plant part attacked	Roots.
Symptoms	Different species of *Pratylenchus* have similar symptoms. Stunted plants. Plants prone to wilting. Yellow lower leaves in some varieties. Fewer lateral roots. Black or brown lesions on roots.
Control methods	
rotations & variety choice	Disease break – avoid successive susceptible hosts. In the year before growing oat hay, grow resistant cereals, lupins, field peas and faba beans (moderately susceptible to *P. thornei* but resistant to *P. neglectus*). Grow cereal varieties with resistance and tolerance where nematode numbers are high.
weed control	Control susceptible weed species (especially wild oats, barley grass, brome grass and wild radish) and volunteers in pastures or non-host crops.
tillage	Nematode survival is greatly reduced where soils are cultivated dry but the risk of soil erosion should be evaluated.
soil fertility	Application of ammonium based fertiliser reduces root invasion by nematodes, as ammonium compounds are toxic to nematodes. Good nutrition encourages healthy plants with greater tolerance to root damage.
Other comments	Root lesion nematodes multiply most rapidly in plant roots growing in warm soils and can produce three to four generations in a year.

Root and crown diseases

Rhizoctonia Root Rot, *Rhizoctonia solani*

Severity	Rhizoctonia root rot is an on-going concern in many areas as its occurrence and severity are difficult to predict. Control options are limited and may only provide partial reduction in disease expression and yield loss.
Source and spread	Soil, plant roots.
Main hosts	All plants are hosts to some degree.
Plant part attacked	Roots.
Symptoms	Bare patches in crops. Stunted growth. Root rotting, causing 'speared tips'. Pale plants. Shorter root systems. Oats are marginally more tolerant than triticale and wheat, while barley is the most susceptible of all the cereals.
Control methods	
weed control	Grass weed control is essential before cereals. At least two weeks prior to sowing, remove all green growth.
tillage	Minimise time between cultivation and seeding. The ability of the fungus to cause infection is greatly reduced by deep cultivation prior to or at sowing.
soil fertility	Improving soil fertility will help plants tolerate root damage.
fungicide	There are several fungicide dressings registered in oats for the suppression of rhizoctonia (Table 7.3). These seed dressings reduce the yield impact of rhizoctonia but do not replace the traditional management techniques.
Other comments	Rhizoctonia is most common in low fertility soils such as calcareous or slightly acid sands. Direct drilling can increase the risk of rhizoctonia. Sulfonylurea herbicides should be avoided on alkaline soils as this can result in increased rhizoctonia in barley sown in the following year.

Fusarium Crown Rot, *Fusarium pseudograminearum, Fusarium culmorum*

Severity	Oats are susceptible but tolerant so do not display any symptoms of fusarium crown rot; however, they can result in a small carryover of inoculum.
Source and spread	Soil, stubble.
Main hosts	Wheat, barley, oats, triticale, barley grass, other grass weeds.
Other comments	Crown rot only needs to be considered in terms of the whole rotation. Most commonly observed to cause severe damage following dry conditions in spring. Initial infection of plants is favoured by wet conditions, but the fungus grows rapidly when plants are moisture stressed. Damage may occur on all soil types, but is more severe on heavy soils.

Take-all, *Gaeumannomyces graminis var. avenae*

Severity	Wet springs in the year prior to sowing tend to increase inoculum levels so severity is seasonally dependent. Only the oat attacking strain *Gaeumannomyces graminis* var. *avenae* causes significant yield reduction in oats.
Source and spread	Soil, stubble, weeds, volunteers.
Main hosts	Wheat, barley, oats, triticale, barley grass, brome grass, silver grass.
Plant part attacked	Roots.
Symptoms	Early in the season plants can be stunted and pale. Reduced tillering. White heads. Black lesions in centre of root, seen when snapped open. Blackening of crowns and lower stems in severely infected plants.
Control methods	
rotations & variety choice	A one year disease break before sowing oats for hay. Break crops include pulses, oilseeds, oats (for non-oat attacking strain), grass-free pasture or fallow, cereal rye. Systems that increase microbial activity can suppress the take-all fungus. After liming, non-hosts should be considered.
time of sowing	Delayed sowing may reduce the impact of the disease.
stubble management	Encourage decomposition of stubble prior to sowing susceptible cereals.
weed control	Grass hosts and volunteer cereals should be removed early in the break year.
seed dressing	Seed dressings offer some degree of protection.
soil fertility	Plants low in phosphorus, nitrogen and manganese are more susceptible to take-all. Take-all is suppressed in soils with low pH (acid soils).
fungicides	In some states, fungicides can be used in furrow and on seed.
Other comments	Moist but well-drained alkaline soils favour growth of the fungus. Wet springs cause the disease to build up, while summer rains reduce it. Take-all can be confused with crown rot and common root rot, which also cause white heads.

Pests

Impact on hay quality

- Contamination
- Stem diameter
- Staining and moulds

A vigorously growing oat hay crop with a plant density of about 250 plants/metre square is able to withstand considerable pest damage with little yield loss. However, in crops sown too deep or under moisture stress pest damage will increase.

Oat hay crops are a little more robust than other cereals in relation to pests of emerging crops such as snails, slugs and earwigs. In some areas, bird damage by cockatoos can be a problem and cause substantial crop loss.

In general terms pest management and insect thresholds in oat hay crops are the same as other cereals. These are best sourced from local agronomists.

Diligent crop monitoring is required throughout the growing season and chemical controls should only be applied if local thresholds for pest species are approached or breached. Routine spraying without monitoring pest numbers can increase the development of insecticide resistance.

Tables 7.3 and 7.5 detail insecticides currently registered for use in oat hay crops. Insecticide groups should be rotated.

Always ensure that stockfeed withholding periods are met for grazing and hay.

Lucerne flea

Oats are particularly palatable to lucerne flea (*Sminthurus viridis*). Heavy infections prior to GS25 can cause very high levels of damage and result in plant death. Left unchecked, low initial infestations can complete several lifecycles in oats and produce many over-summering eggs. These can cause crop damage when they hatch the following year.

Control can be achieved cheaply with a range of insecticides. Prior to crop emergence, soil residual insecticides are useful but when there is plant material available to spray after emergence, the systemic products such as dimethoate and omethoate give outstanding results. Once lucerne flea is controlled, plant recovery is rapid.

Red-legged earth mite (RLEM) and Blue oat mite

Red-legged earth mite (*Halotydeus destructor*) and blue oat mite (*Penthaleus major*) also cause severe and rapid damage to oats as well as allowing lifecycles to be completed to cause problems for the following year. Control is similar to lucerne flea, although the results achieved with soil residual products are usually greater. Some control is achieved at all stages with a range of synthetic pyrethroids, which are generally weak on lucerne flea. The response to dimethoate and omethoate is rapid when foliage is sprayed. Once again when the mites are controlled, plant recovery is rapid.

Aphids

Aphids can occasionally cause yield loss in oats when their numbers are very high in early spring. In some situations, control is warranted. Of more importance is that aphids transmit viruses, particularly barley yellow dwarf virus (BYDV) that can cause high yield losses, in favourable years, in hay crops. Therefore, most aphid control is aimed at reducing or preventing BYDV. For this reason, control needs to be achieved early in the season. Controls include seed treatments or by spraying insecticides (usually synthetic pyrethroids) at the early growth stages, often as a preventative application.

Check with your agronomist for the latest information on Russian Wheat Aphid.

Mice

Mice can be a problem in hay stores and baiting is recommended. Bait stations should be placed so that mice are lured out of the hay and preferably die away from the store.

Contact your local reseller or adviser about pest control products.

Table 7.5 Foliar insecticides registered for use in oat hay crops – *source APVMA and CropLife 2016.*

Insecticide actives registered on oats APVMA portal	Group	Examples of brand names	Insect control
Permethrin (40:60:CIS:TRANS)	3A	Stakeout®	Armyworm, southern armyworm, redworm, pink or common cutworm
Methomyl	1A		Armyworm
Esfebvalerate	3A	Sumi-apha®	Cutworm
Dimethoate	1B	Rogor® Dimethoate	Lucerne flea, red-legged earth mite (RLEM), wingless grasshopper, brown wheat mite, blue oat mite, leafhopper, cereal aphids
Omethoate	1B	Le-Mat®	
Chlorpyrifos	1B	Lorsban®	Cutworm, pasture webworm, armyworm, RLEM, lucerne flea
Beta-cypermethrin	3A	Banshee®	RLEM, cutworm, common armyworm
Alpha-cypermethrin	3A	Alpha	RLEM, cutworm, common armyworm

Chemical labels should be read and rates should be checked before using insecticides as registrations may vary between states. Check details on the APVMA website (www.apvma.gov.au).

Mention of trade names does not imply endorsement of any company's products and availability may change over time.