

Farm Biosecurity Manual for the Organic Grains Industry

Reducing the risk of new pests entering and
becoming established on your farm

Version 1.0



Plant Health
AUSTRALIA



Department of
Primary Industries



Plant Health Australia (PHA) is the lead national coordinating body for plant health in Australia. PHA works in partnership with industry, governments, researchers and others, providing national coordination to improve biosecurity policy and practice across Australia's plant industries and to build capacity to respond to plant pest emergencies.
www.planthealthaustralia.com.au



Grain Producers Australia (GPA) is committed to representing the national interests of grain producers throughout Australia. Our commitment is to develop national policies aimed at cultivating a strong, innovative, profitable, globally competitive and environmentally sustainable grains industry. GPA represents the Australian grains industry as a member of PHA.
www.gpau.com.au

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Six easy ways to protect your farm

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You have an important role to play in protecting your farm, the organic grains industry and the entire Australian grains industry from biosecurity threats.

Here are six simple farm practices you can implement to reduce the threat of new pests entering and establishing in your property. These practices should be embedded in your farm's everyday management as they make good business sense by reducing the risk of spreading any pest. Don't put your livelihood at risk by neglecting farm biosecurity.

1. Be aware of biosecurity threats

Make sure you and your farm workers are familiar with the most important grains pest threats – exotic and established. Conduct biosecurity induction sessions to explain required hygiene practices for people, equipment and vehicles on your farm.

2. Ensure your seed is pest free, and preferably certified

Ensure all seed and other farm inputs (e.g. fodder) are fully tested, visually checked and preferably certified pest free.

3. Keep it clean

Take care to prevent the entry and movement of pests onto your farm. Provide a designated visitor's parking area, and cleaning facilities for people (hand wash, footbath) and vehicles, to ensure that workers, visitors, vehicles and equipment are free from pests before they enter and leave your farm.

4. Check your crop

Monitoring your crops frequently for pests will help you and your staff to notice anything unusual. Keep written and photographic records of all unusual observations. Constant vigilance is essential for early detection of any exotic plant pest threat.

5. Abide by the law

Support and be aware of laws, regulations and quality assurance systems established to protect your farm, the organic industry, the grains industry and Australian agriculture.

6. Report anything unusual

If you suspect a new pest – report it immediately to the Exotic Plant Pest Hotline.

If you see anything unusual, call the Exotic Plant Pest Hotline





Overview of the organic grains industry in Australia

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Organic grain production is an increasingly important industry in Australia, worth more than \$17 million in 2012. The majority of production is in NSW and Qld with a small number of producers in other states. While this value makes up a very small component of total grain production in Australia, it is important in contributing to Australia's domestic market. Nearly all organic grain production in Australia is consumed here, with imports required to meet the shortfall in supply. Despite domestic shortages, there is also an export market, with Australian organic grain highly valued by a number of specific overseas niche markets.

Organic grain production in Australia, comprising cereals, pulses and oilseeds is dominated by wheat production, followed by oats and barley. Soybeans are the largest legume crop produced, largely due to demand for organic soy milk. Demand for organic grains continues to grow for both human consumption and for the organic livestock industry.



Biosecurity is an issue of particular importance in organic farming systems. In order to reduce pest burden while complying with chemical use restrictions, the practices recommended in this manual should be adhered to diligently.





Biosecurity overview

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This manual is designed to assist you in protecting your farm and the organic grains industry from new and invasive pests. Implementing the recommended measures in your day-to-day operations will improve your biosecurity and that of your region and industry, while minimising crop losses and unnecessary costs and the risk of losing export markets.

What is biosecurity?

Biosecurity is about the protection of livelihoods, lifestyles and the natural environment, which could be harmed by the introduction of new pests.

Biosecurity is a national priority implemented off-shore, at the border and on-farm.

Australia's geographic isolation has meant that we have relatively few of the pests that affect plant industries overseas. Freedom from these exotic pests is an important part of the future profitability and sustainability of Australia's plant industries. Biosecurity allows us to preserve existing trade opportunities and provide evidence to support new market negotiations.

The definition of a **pest** used in this manual covers all invertebrates (e.g. insects, mites, snails, nematodes), pathogens (diseases) and weeds that may harm plants or plant products. **Exotic** pests are those not currently present in Australia. **Established** pests are those present within Australia.

What is farm biosecurity?

Farm biosecurity is a set of management practices and activities that are carried out on-farm to protect a property from the entry and spread of pests. Farm biosecurity makes good business sense and is your responsibility as well as that of every person visiting or working on your property.

Growers can play a key role in protecting themselves and the Australian organic grains industry from exotic pests by implementing effective farm biosecurity. If a new pest becomes established on your farm, it could mean increased farm costs (e.g. changing of rotations, and other management strategies that need to be put in place), reduced productivity (yield and/or quality) or loss of markets. For organic production new pests could also adversely affect your ability to grow particular crops or varieties organically, and may interrupt organic certification if the only option for effective control involves chemical management.

Early detection and immediate reporting increase the chance of effective and efficient control or eradication.



Regional biosecurity

To strengthen the biosecurity measures you undertake on your property, consider starting biosecurity meetings and activities to promote biosecurity at the regional level. Through this collaborative approach, biosecurity threats to all properties in your region can be minimised.

Potential sources of biosecurity threats may be neighbouring farms, native vegetation, and garden and roadside plantings. Organic grain growers may be isolated from other organic operations, or surrounded by conventional grain farming systems, so meeting with neighbours to focus on protecting the region from unwanted pests can aid in communication and understanding the specific needs of both farming systems. This increased awareness by neighbours may also be of benefit in responding to an exotic incursion and may protect the organic status of your farming operation should pest eradication measures be employed.

Implementation of farm biosecurity underpins regional biosecurity, which in turn underpins national biosecurity. Promotion of biosecurity is enhanced through community action, knowledge of the region, and understanding the source and nature of potential threats. Biosecurity is strengthened through knowledge of the expertise base and resources available to the region, and a commitment from everyone to implement biosecurity measures, surveillance and reporting.

If farm measures are supported by community based measures, a regional framework for biosecurity can be coordinated and is achievable.

Genetically Modified Organisms

While Genetically Modified Organisms (GMOs) do not specifically fit the definition of a pest in the context of this manual (and on-farm contamination would not result in a response under the EPPRD – see page 13), they do represent a major risk to the organic grains industry which has a zero tolerance for GMOs, including residues or contamination from external sources. A number of practices suggested in this manual to protect against both established and exotic unwanted pests will also contribute to protecting against GMO contamination. While contamination from wind-blown sources is difficult to manage, employing good farm hygiene practices, sourcing inputs from reputable (certifiable) suppliers and ensuring good communication with neighbours can all positively contribute to minimising the risk of GMO contamination on your grain farm.

8 Biosecurity planning: the Organic Management Plan and Organic Handling Plan

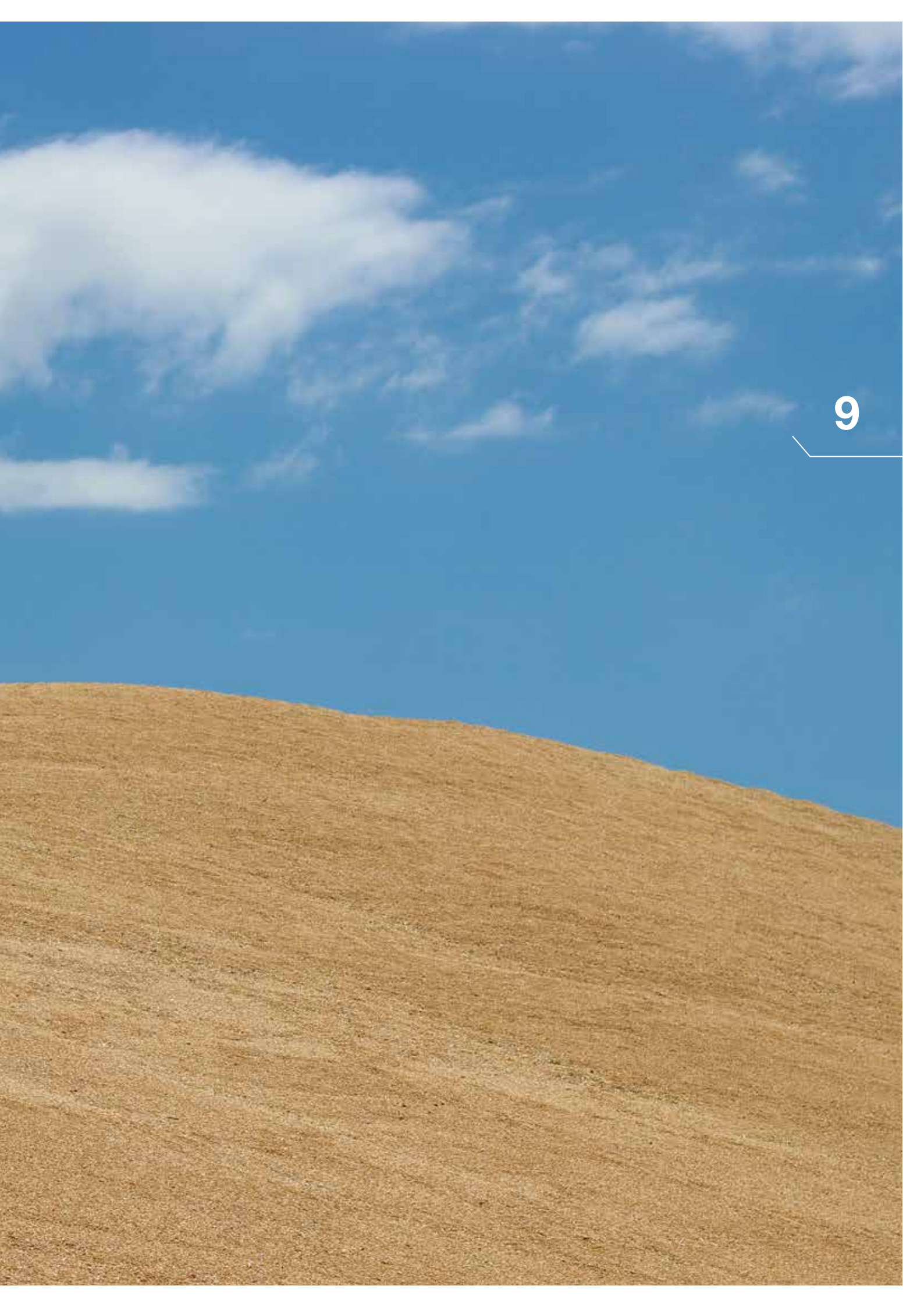
The recently developed Australian Standard for Organic and Biodynamic Products AS6000-2009 provides a framework for all produce labelled as organic in Australia. This standard, based on the export National Standard for Organic and Bio-Dynamic Produce (which until now has provided the only guidelines for organic production in Australia), outlines the minimum requirements for products on the market labelled as from organic (or biodynamic) systems. Additional stipulations and guidelines may be provided for farming operations that are also certified by one of a number of organic certification bodies in Australia.

Common to all organic grains farming operations is the production of an Organic Management Plan (OMP) where farmers set out how they will maintain the integrity of their organic operation. Protection against unwanted pests is a key part of the OMP and it is here that biosecurity plays a major role. Being able to identify pests and limit their establishment allows minimal chemical use on-farm and can assist in maintaining organic status. For exotic plant pests, this is particularly important as non-chemical control measures may not be readily available in a rapid response eradication situation, highlighting the importance of ensuring that these pests are not introduced in the first place.

Organic standards require that the practices and procedures involved in the handling of grain (storage, transport, and processing) are documented in an Organic Handling Plan (OHP). OHPs aim to identify and address potential issues that could compromise the integrity of the organic product. An OHP includes the development of flow charts of product handling processes, identifying critical control points (point, step or procedure where intervention can be applied to minimise risk) and documenting procedures to address areas of risk¹. From a biosecurity perspective, pest exclusion, appropriate hygiene strategies during handling and processing, and the avoidance of intermingling with other products, are the key areas to be considered in the OHP.

The following sections provide a basis for addressing the risks posed by unwanted pests and the measures that can be employed to minimise their impact, and should be incorporated in OMP and OHP development. By considering and practicing some simple guidelines, biosecurity at the farm level can be greatly enhanced with benefits for the organic status of individual farms and for the entire Australian grains industry.

¹ Quality Assurance (QA) programs such as HACCP aim to achieve similar objectives as an OHP. HACCP is a systematic preventative approach to food safety that identifies physical, chemical, and biological hazards in production processes that can cause the finished product to be unsafe, and develops management options to reduce these risks to a safe level. OHPs are often used in conjunction with HACCP and other QA systems, however the OHP places specific emphasis on maintaining the organic integrity of an organic product throughout the handling and processing chain.



Pests

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High priority exotic pest threats of the grains industry

The following are some key high priority exotic pest threats (invertebrates and pathogens) for the Australian grains industry as identified through the development of the Grains Industry Biosecurity Plan (IBP). None of these pests are present in Australia and all would have serious consequences for the entire grains industry (organic and conventional) should they enter and become established.

Karnal bunt (*Tilletia indica*)

OVERALL RISK – EXTREME

- Hosts are wheat, durum and triticale.
- Parts of seeds are blackened (fungal spores) and crush relatively easily.
- Infected grain has a distinct fishy smell.
- If it became established in Australia, access to over 45 international markets would be restricted and grain price would fall significantly.



PaDIL

Khapra beetle (*Trogoderma granarium*)

OVERALL RISK – HIGH

- Adults are small (2-3 mm long) and do not fly.
- Spread in infested grain, wide host range of cereals, pulses and oilseeds.
- Larvae are hairy and can survive for over a year without food.
- If established, market access would adversely affected.



Ministry of Agriculture and Regional Development Archive, Bugwood.org

Russian wheat aphid (*Diuraphis noxia*)

OVERALL RISK – HIGH

- Primary hosts are wheat and barley.
- Light-green, elongated aphid (up to 1.8 mm long).
- Damage symptoms include:
 - white, purple or yellowish leaf streaks
 - rolling of leaves, flag leaf and awns
 - bleached heads with small grains.
- Crop losses up to 75% could occur.



Frank Peairs, Colorado State University, Bugwood.org

Hessian fly and Barley stem gall midge (*Mayetiola destructor* and *M. hordei*)

OVERALL RISK – HIGH

- Adults are small (2-4 mm long) and look like mosquitoes.
- Pupae have a 'flaxseed' appearance.
- Attacks leaves, stems and heads of cereals.
- Most chemical controls are not effective.
- Cereal crop losses up to 40% could occur.



Scott Bauer, USDA Agricultural Research Service, Bugwood

Sunn pest (*Eurygaster integriceps*)

OVERALL RISK – MEDIUM

- Brown bug with wide oval-shaped body (12 mm long) with a wide triangular head.
- Attacks most cereal crops.
- Colonies can be seen on cereal heads in spring.
- Injects enzymes into the plant as it feeds which can result in grain damage and abortion.



ICARDA

Barley stripe rust (*Puccinia striiformis* f. sp. *hordei*)

OVERALL RISK – HIGH

- Would infect barley in all Australian growing regions.
- Approximately 80% of Australia's barley varieties would be susceptible.
- Yellow stripes of fungal spores produced between veins of leaves.
- Can be spread by wind and rain, or on clothing, machinery and tools.
- Any stripe rust on barley should be reported.



PaDL

Wheat stem rust, pathotype Ug99 (*Puccinia graminis* f. sp. *tritici*)

OVERALL RISK – HIGH

- Pathotype that has overcome several stem rust resistance genes, identified in Uganda in 1999.
- Many Australian wheat varieties will be susceptible.
- Elliptical blisters produced on stems, which break open to reveal a mass of rust coloured spores.
- Any stem rust on known resistant varieties should be reported.



University of Georgia Plant Pathology Archive. Bugwood.org

Soybean cyst nematode (*Heterodera glycines*)

OVERALL RISK – MEDIUM

- Considered most damaging pathogen of soybean worldwide.
- Affects the roots, resulting in patchy growth, poor tillering and stunting of plants.
- Spreads rapidly. Female nematodes contain eggs that remain viable for up to 10 years without a host.



C.R. Grau, University of Wisconsin-Madison

Remain observant for anything unusual on your farm and in storage facilities.

If a pest is found that you haven't seen before, it may be new not only to your farm, but to the region, state or even Australia.



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Organic standards require pest management practices to prevent pest incursions. Strategies include the removal of pest habitat, food sources and breeding areas, as well as preventing the access of pests to grain storage and processing areas. Monitoring strategies for pests are integral components of an OMP and OHP. Pest and disease monitoring tools can include the installation of traps (such as sticky, pheromone, pitfall and light traps), disease forecasting and modelling using weather data. Regular and thorough monitoring of weeds can prevent isolated plants turning into large incursions. Many organic farmers check their crops and pastures with a weeding hoe on hand.

Pest surveillance

Crop monitoring and surveillance involves looking for and recording the presence, absence and population levels of pests. Regular monitoring is a fundamental part of farm management and gives the best chance of spotting a new pest before it spreads.

Active pest surveillance is necessary because:

- Early detection of exotic pests improves the chance of eradication or containment within a region. If eradication or containment is not feasible, early detection, in conjunction with contingency planning and preparedness by government and industry, assists with a more rapid and effective response.

- For market access, export destinations for grain require 'proof of absence' data for exotic and some established and endemic pests. The Australian grains industry, in collaboration with governments, must prove that exotic pests are absent. Surveillance data underpins claims of 'area freedom' where a pest is 'known not to occur'.
- Surveillance at the farm level contributes essential information to regional biosecurity efforts and ultimately to the national status (presence/absence) of a pest.
- Surveillance for organic farms provides the best early detection management system for limiting spread and controlling pests using organic-approved systems.

All pest (exotic and established) surveillance activities carried out on your property should be recorded, as well as all pest management practices undertaken on your property. These records can be used in the response to a pest outbreak and provide support to industry surveillance activities. An example of a pest surveillance datasheet is included in this manual.

Some farm areas may be at greater risk of pest infestation than others. High traffic areas, as well as stocked areas can increase the risk of pest movement around a farm as well as potential introduction from outside. Dams and waterways should also be checked for pests that may have moved in from areas outside of the farm.



Beneficial surveillance

An integrated approach to pest management is important in controlling unwanted pests within an organic farming system. One element might be encouraging beneficial insects or pathogens that naturally occur within your farming system, to prey on, parasitise or attack unwanted pests (beneficials). Knowing the beneficials that live on, or in the vicinity of, your farm can help to keep pest populations at levels that do not require control, or stop them from spreading onto your farm from neighbouring areas. Surveillance for beneficials can be as useful as monitoring pest populations.

Knowledge of the beneficials present around your farm may also lead to practices that can encourage them. This may involve including areas of plant species that encourage the build up of particular beneficials such as strips of a specific crop species or larger areas of trees along boundaries. Consider the insects you wish to encourage when you choose the species to plant. These plantings can have the additional benefit of providing a physical barrier between farms, to protect from spray drift or GMO contamination.

The Emergency Plant Pest Response Deed (EPPRD) and the Grains Industry

The EPPRD is a formal, legally binding document between Plant Health Australia (PHA), Australian and state/territory governments, and plant industry signatories. As a signatory to the EPPRD, Grain Producers Australia (GPA) has a seat at the decision making table and also contributes to funding if an approved Response Plan is implemented to eradicate an Emergency Plant Pest (EPP).

Under the EPPRD, the grains industry, including the organic grains sector, has a responsibility to report suspect pests. The earlier a new pest is detected, the greater the chance an eradication response will be mounted and the more likely it is to succeed.

Within an approved Response Plan, reimbursement payments (Owner Reimbursement Costs) are included for direct costs incurred as a result of eradication of a pest incursion. The organic status of a farm will be taken into account when preparing a Response Plan for the eradication of an EPP. If however organic compatible eradication measures are not readily available, an exotic pest incursion may result in chemical control measures which could result in loss of organic status. This short-term impact could save long term management of pests in the future.





14 Report suspect pests

If you observe something you are not familiar with, you should have it checked. Symptoms may not be immediately apparent, or may not appear until the pest population has built up, by which time control or eradication may be more difficult or require more extreme measures, including those which may affect organic systems. Early detection and reporting may prevent or minimise the long-term impact on your farm and the grains industry as a whole.

If you see anything unusual, call the Exotic Plant Pest Hotline on 1800 084 881.

Calls to the Exotic Plant Pest Hotline will be forwarded to an experienced person in your state or territory government, who will ask some questions about what you have seen and will either arrange to collect a sample or give information on how and where the sample should be sent.

Do not send samples without first speaking to someone from the state department, who can discuss the correct type of sampling protocol, such as packaging, handling and transport to the laboratory assigned for diagnosis. Incorrect handling could spread the pest further or render the samples unfit for diagnosis.

In some states, the Exotic Plant Pest Hotline operates only during business hours. Outside these hours, leave your full contact information and a brief description of the issue and your call will be followed up as soon as possible. Every report will be checked out and treated confidentially.

If you have found a suspected exotic plant pest, the following precautions should be taken immediately to contain the pest and protect other parts of your farm:

- Do not touch, move or transport affected plant material.
- Wash hands, hats, clothes and footwear that have been in contact with affected plant material or soil.
- Mark the location of the pest detection and limit access to the area. Establish a quarantine area around the detection and restrict the movement of people, stock and equipment near the affected area.
- Restrict operations in the area while waiting for the identification of the suspected exotic pest.

In the event that control measures incompatible with organic production are required, a defined quarantine area could reduce the impact on the organic enterprise.

If you see anything unusual, call the Exotic Plant Pest Hotline

**EXOTIC PLANT PEST HOTLINE
1800 084 881**



Crop rotations and resistant varieties

While crop rotations and growing pest resistant crop varieties can help to manage specific established pests, they may have little impact in the event of an exotic incursion. Many exotic plant pests are variants of established pests (e.g. Wheat stem rust, pathotype Ug99), so resistant varieties may have little resistance to new incursions. Exotic pests are continually mutating to form even more new variants. Likewise, crop rotation will help to suppress established plant pest populations, but may have little effect on a new exotic species and may indeed provide alternative suitable hosts.

Both practices are integral to established pest control within an organic grains production system, however they should not be relied upon as methods of protecting against exotic pest incursions. In the event of an incursion and its subsequent establishment if not contained, some rotations or resistant varieties may become redundant and may require change for continued use in an organic grains production system.

Water management

The quality of water for irrigation, stock and any on-farm processing should be assessed for potential contaminants. Water (including rivers and streams) sourced from outside the farm may contain unwanted contaminants such as weed seeds, chemicals and other pests. This is not only a biosecurity risk, but also a risk for organic certification. OMPs and OHPs require that the sources and quality of water are identified and that monitoring strategies are established.

Manures, composts and slurries

Manures, composts and slurries, particularly when obtained from off-farm sources, have the potential to contain pests and other unwanted contaminants. Organic standards require that details of the ingredients (feedstocks) and their sources be checked and that documentation to this effect is provided by the supplier.

Compost from non-certified sources and all manures purchased externally must be re-composted on-farm prior to application. Organic standards should be referred to for specific conditions regarding the preparation and application of composts. If using slurries and manures, farmers should not only refer to organic standards but also Environmental Protection Authority (EPA) regulations regarding acceptable levels of heavy metals and other contaminants.

Product management

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Purchase seed from a reputable source

Where crop and pasture seeds need to be obtained from outside your farming operation, to reduce the risk of introducing new pests, be sure to source it from a reputable supplier. Infected, infested or contaminated seed is a major source of pests and weeds to a farm. Seed that is certified organic does not necessarily mean it is pest free; ideally, the seed should be certified to be pest free.

While it is a requirement of organic standards that, in the first instance, every effort is made to use organic seeds, this should not compromise the biosecurity of your farming operation. Provision currently exists to utilise conventional seed if suitable organic seed is unavailable provided you can demonstrate that every effort has been made to source organic seed first. Note that seed used on organic farms is not permitted to be chemically treated with products such as fungicides or other non-approved pest control products.



Robyn Neeson, NSW DPI



A range of products are used by organic farmers as alternative seed treatments these include hot water, approved disinfectants, compost teas, herbal and biological treatments (e.g. essential oils) and commercial products. The efficacy of some of these treatments is unknown and therefore may or may not protect seed against pests. If unsure, seed should be inspected by an accredited laboratory prior to use. The use of GMO seed is prohibited in organic farming systems.

You cannot accurately assess seed quality just by sight. Seed which appears clean and healthy can still carry diseases without showing symptoms, and may also contain weed seeds. Hence, you should ask where the seed originally came from and always try to purchase certified or quality assured seed. Read the label for information on pure seed content or obtain a Statement of Analysis detailing seed purity, weed seed content and germination quality.

Keep a copy of the certification report on record as this will assist with any trace-back activities should a new pest be found. As well as records of your seed source, also keep trace-forward records of produce that has left your property. These records not only aid in containment/eradication of a potential exotic pest incursion but are also a requirement for organic certification.

Harvesting strategies

- Ensure header settings are correct. Damaged grain is more susceptible to attack by insect pests. Likewise grain handling equipment, such as conveyors should also be designed to minimise damage.
- Harvest grain at the correct moisture content. Grain that is harvested too moist will cake and mould quickly when stored, which creates heat and provides an ideal environment for insects. Grain drying and cooling facilities allow for grain to be harvested as soon as maturity is reached, which also reduces the opportunity for weather damage.
- Separate the first grain to pass through harvesters at the start of each season as there is a high risk that it may contain storage pests.
- Attach weed seed collectors to harvesting equipment to help reduce the build-up of the weed seed bank and the spread of weeds.
- Harvesting contractors should be made aware that equipment must be thoroughly cleaned prior to entry on the farm, both to comply with organic standards and to minimise biosecurity risks.
- Keep good records of grain movement.



18 Grain storage

Grain storage is an important aspect of organic grain production, especially in a closed system where grain may be retained for sowing of future crops. Ideally measures should be taken to reduce the risk of infestation in the first place, rather than relying on control measures after the event. This relies on maintaining good hygiene around your storage areas, including making sure grain handling equipment like headers, augers, field bins, silos and bulk storages are clean before use. This can be achieved using either high pressure air or water. Areas around grain storages should be kept clean to limit places where mice and insects can multiply.

Stored grain should be inspected every month for live insects and grain should only be treated when insects are found. A number of organic compatible practices are available to maintain grain quality and stop or eliminate a pest infestation.



L. Sheriff, DAFWA

Grain storage management and design

- Storage design should be compatible with maintaining good hygiene. Storages should allow easy cleaning and inspection. Staff should have proper training in safety and hygiene. Set up a system to record all checking and hygiene procedures.
- Sealed (gas tight) storages allow for the use of controlled atmosphere (CA) to eliminate insects. Seals should be pressure tested and any faulty rubber seals repaired. Once treated, a sealed silo prevents re-entry of insects as long as it is sealed.
- Keep stored grain as cool as possible since low temperatures slow or prevent insect development. Silos can be painted white to reflect sunlight and heat. Grain cooling can also be facilitated by aeration, which involves forcing air through ducts in the storage floor, usually at night.
- Use traps in and around storages, to detect pests at lower levels than can be detected visually. Note that maps of pest control traps and monitoring equipment are required for organic certification.
- Unless seed is being kept for planting, try keeping grain storage time to a minimum to avoid reinfestation.

Temperature treatments in storage

Aeration cooling

Aeration is the practice of moving air through stored grain to reduce the rate of grain deterioration and prevent storage losses.

Aeration is usually by means of ducts in the floor, through which cool air is fan-forced at low speeds and vented at the top, though it can be forced from top to bottom with extractor fans in the floor ducts. Aeration is generally done at night when the outside air is coolest.



Philip Burnill, DAFF Qld

In-store drying

In the Australian climate, in-store drying can often be achieved without artificial drying. Artificial drying systems can allow earlier harvest and less harvest time lost due to weather stress, however, it is easy to overheat grain in an artificial dryer. Temperature varies considerably and this can have a detrimental effect on dough properties of wheat.

Heat disinfestation

Heat disinfestation offers a rapid chemical-free process for the disinfestation of grain. While other techniques represent cheaper alternatives, heat disinfestation may become a useful strategy as technological advances are made. It is not yet available commercially.

Heat disinfestation aims to create high grain temperatures (around 63°C or higher) for brief periods (around a minute or so) and thus achieve a complete kill of insect pests. Rapid cooling following immediately after the required heat dosage minimises the damage to grain. For long-term storage, heat disinfestation needs to be integrated with other methods such as cooling or sealed storage to avoid re-infestation.



Jeff Russell, DAFWA

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Mineral dusts (Dryacide® and Absorba-Cide®)

Mineral dusts are based on diatomaceous earth and are compatible with organic production. They work by adhering to and absorbing the waxy coatings on insects resulting in death. They can be applied to grain using a pickle applicator, but grain must be stored at the normal standard moisture content for effectiveness. They can also be used to treat empty storages prior to use.

Mineral dusts are not accepted by bulk handlers and grain traders as it slows grain movement through augers and affects some grain qualities.

These products are therefore more suitable for on-farm storage of grain that is intended for re-use on the farm.

Controlled Atmospheres (CA)

Controlled atmosphere using carbon dioxide is an effective way to kill a pest infestation. Sealed (gas tight) storage is required, and carbon dioxide must remain at a concentration above 35% for 14 days at all points in the storage to kill all life cycle stages. Nitrogen gas is also being investigated as a potential treatment for insect pests.



Robyn Neeson, NSW DPI

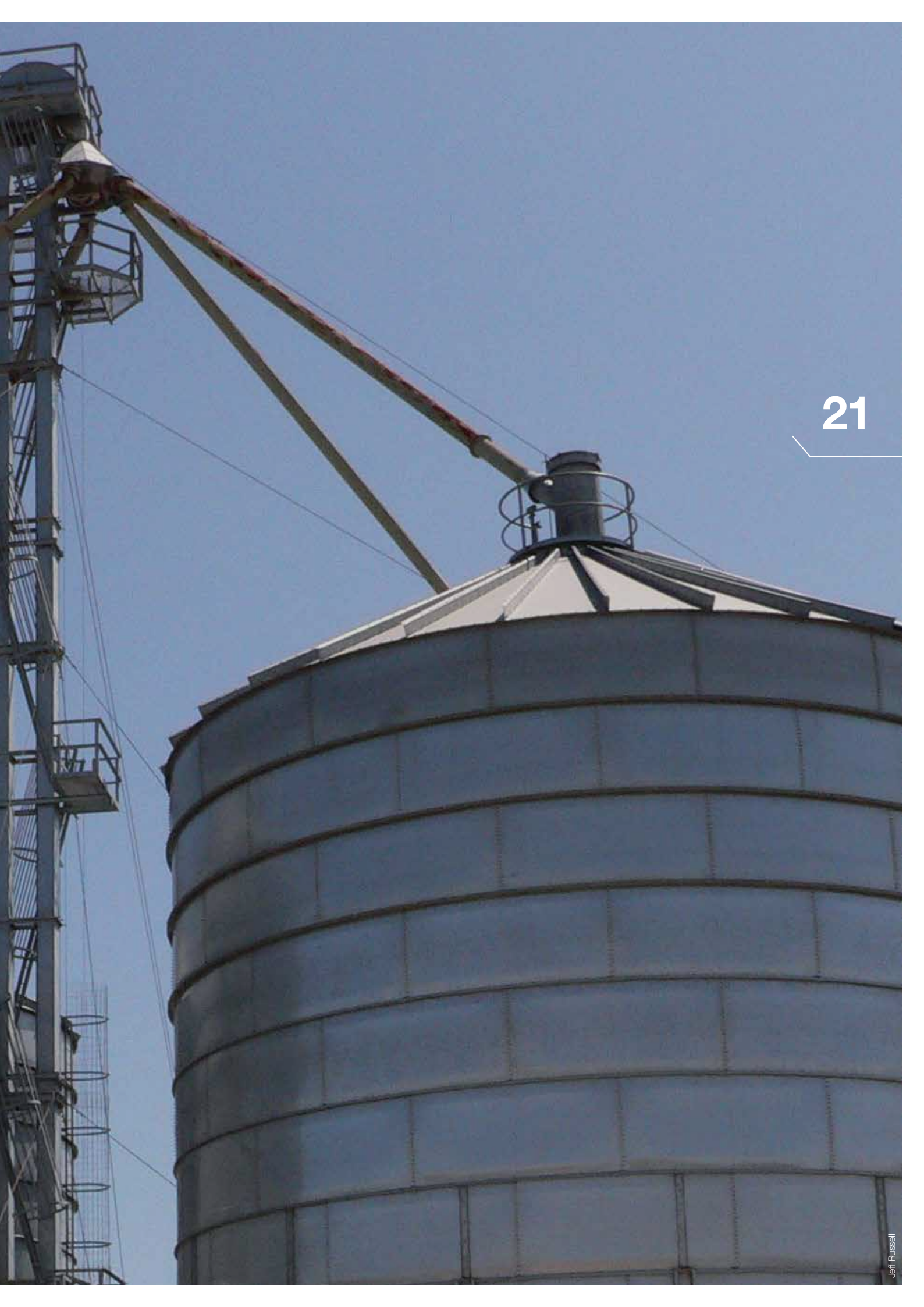
Silos being fumigated with carbon dioxide

Natural insecticides

Natural insecticides such as Neem (a botanical insecticide derived from a tree native to India, Pakistan and Bangladesh) are not permitted for storage of organic produce and are generally unsuitable for commercial use in their natural state, due to cost of production and instability.

Waste management

It is important to include a waste management system as part of the biosecurity plan and OHP. Waste by-product that is allowed to accumulate can attract pests. Types of waste could include old grain, spoiled fodder and livestock carcasses. A waste management plan should identify the most appropriate disposal methods to minimise the risks and could include strategies such as the use of on-site dumpsters or off-site waste removal services, material recycling, composting, field application and burial.





People and biosecurity

Biosecurity signs

Well designed signage informs visitors that biosecurity is a focus on your farm and that they share responsibility for maintaining it. The signs serve to alert people to the potential impact of their visit. A sign can incorporate the organic status of your farm, communicating your particular needs to visitors, contractors and passers-by.

Signs also demonstrate your commitment to farm hygiene, safety and audit systems. Biosecurity signs should be placed at the main gate, external entrances, visitor parking areas and wash-down facilities.

Biosecurity signs at entrances or near storages should direct visitors to contact the owner or farm manager to formally register their presence, before entering any production areas. The sign should include important contact details, such as the home telephone number, mobile number and/or UHF channel.



Contact PHA or your local Grains Biosecurity Officer (contact details at www.phau.com.au/gfbp) for further information on obtaining biosecurity signs for your property.

Managing people movement

23

People moving between farms and regions can spread pests on vehicles, equipment, boots and clothing. The most obvious risks are pests carried in soil and plant material.

Implementing the following measures will reduce the threat of people movement introducing new pests onto your farm:

- Maintain a Visitor register (example on page 38), that records visitor movements and help manage safety issues.
- Brief all workers, contractors and visitors on your farm biosecurity measures.
- Ensure employee and visitor footwear and clothing is free of soil and plant material before they enter or leave the farm.
- Provide scrubbing brushes, footbaths, boot covers, rubber boots and protective clothing such as disposable overalls, for people entering your farm, moving from contaminated to clean areas, or moving from non-organic to organic areas.





24 Overseas travellers

People returning from overseas are a biosecurity risk, especially if they have visited crops, farms or markets where plant or animal material was sold.

Clothes, hair and even watchbands can carry fungal spores such as rust and bunt, and weed seeds can easily lodge in clothes and pant cuffs.

Great care should be taken to prevent the accidental introduction of overseas crop pests into Australia. Be aware that plant pests are only a few hours away by air travel.

Check that family members, employees and visitors recently returned from overseas have washed their clothes, cleaned their footwear and have declared any plant or animal material they may have brought back.



Contractors and utility providers

The term 'contractors' includes farm contractors, earthmoving companies, utility providers, research personnel, consultants and mining operators who enter a farm in their day-to-day operations. While their contribution may be highly valued, they are a particular biosecurity threat because they move from farm-to-farm and region-to-region. They can potentially spread pests on their clothing, equipment and vehicles.

OMP and OHP require organic producers to provide detailed descriptions relating to use of contractors and the precautions taken to avoid contamination from external sources. In order to retain certification, organic producers should keep detailed records and/or contractor declarations of contracting procedures.



Jim Moran, VIC DPI

Placing biosecurity signs on external farm gates can play an important part in raising farm biosecurity awareness with contractors. Limit the risk of contractors introducing new pests onto your property by requesting that all contractor's vehicles and equipment are cleaned before starting work on your property. Provide wash-down bay or advise contractors of the location of suitable facilities.

Pests can be transported onto your farm in many different ways. For example, they can be contained within the final bale of hay that is left in the contractors' machine from the previous property when they arrive at your farm. In this case, all hay in the machine should be removed before entering your paddocks.

Raise awareness among contractors by providing them with a copy of PHA's Grains contractors fact sheet available from: www.phau.com.au/industries/grains. Have contractors sign a visitor register (page 38) to record movement between properties.

To ensure your property does not become the source of pest infections for others, you have a responsibility to inform contractors of any declared or notifiable pests already present on your farm. This allows them to clean down properly or take other appropriate actions.

Equipment and vehicles

26 Movement of vehicles and machinery

Vehicles and farm equipment can carry pests in soil and plant material. Pests can then be introduced to a previously clean property or crop.

Unless you operate a fully closed farming system, it is impractical to stop all vehicle and equipment movement on and off the property. Using dedicated farm vehicles, washing down machinery on concrete or packed gravel pads and denying access to dirty machinery can aid in reducing the spread of unwanted pests around your property.

Contractors, re-sellers, service providers and drivers of delivery trucks and earth moving equipment entering the property should clean vehicles and equipment before entering your farm. Inspecting and cleaning machinery is more time and cost effective than managing a new pest.



Properties open to growers (e.g. for field days, equipment demonstrations) have a heightened risk. It is essential to have designated parking areas away from production sites for such events.

Measures to reduce the risk of pest entry on your property include:

- Clean vehicle floors and tyres of soil, plant material and pests, especially after visiting other properties.
- Where possible, use your own vehicle to carry visitors around your farm.
- In cropping areas, keep vehicle movement to a minimum, especially on wet soil. Stick to regular pathways through the farm to minimise the threat of spreading pests.
- Hose off and disinfect machinery with an organically approved product in a designated wash-down area before moving between properties. Regularly monitor areas around wash-down facilities.
- Ensure contractor equipment is washed down thoroughly to remove any plant material or soil before entering your farm.
- Use high pressure water or air to remove plant material and soil from larger equipment and machinery. Ensure that waste water and debris don't enter production or storage areas.
- Always make sure that borrowed and second-hand equipment and machinery is cleaned of all plant material and soil before bringing them onto your farm.
- Regularly clean all tools and equipment with organic approved cleaning solutions.



Designated parking areas

A well sign-posted designated parking area should be provided for all visitors. Ideally, dedicated farm vehicles should be used for transport around your property with other vehicle movement limited to direct entry to a designated visitor parking area only.

Parking areas contain the entry of new pests away from production sites. They also allow for the inspection of tyres, equipment, floor mats and boots for soil and plant material which may carry new pests. This area should be regularly monitored for the presence of new pests.

A biosecurity sign in the parking area will remind visitors of the threat of spreading pests between properties. Do not allow the movement of farm machinery through the parking area.



NSW DPI

Wash-down facilities

A wash-down facility allows farm employees, contractors and visitors to clean their vehicle and equipment in an easily managed area where waste water is contained.

For additional protection, an added organic compatible detergent-based degreaser or disinfectant may be appropriate. For best results, seek advice from re-sellers on the best product, and remove as much soil and plant material as possible from the equipment before using the disinfectant. Always ensure any cleaning product is permitted within the Australian Standard for Organic and Biodynamic Products and approved (in writing) by your Certifier. Some chemicals to consider may include vinegar and biodegradable detergents but check with your certifier before use. Ideally wash down should occur away from the organically certified production area.

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The wash-down area should have a sump or waste water collection area. The sump and area surrounding the wash-down facility should be treated and checked regularly for the presence of pests and weeds.

In some cases, using compressed air is a better method for cleaning machinery (for example, when cleaning a harvester) while machinery with mud attached will need to be cleaned down with high-pressure water.

When cleaning equipment, preferably with high pressure air or water, make sure mud, soil and plant material are kept away from crops, storage areas or waterways. There's no point cleaning weed seeds and plant pests out of machinery if they're blown or washed into a nearby crop, silo, hayshed or dam.

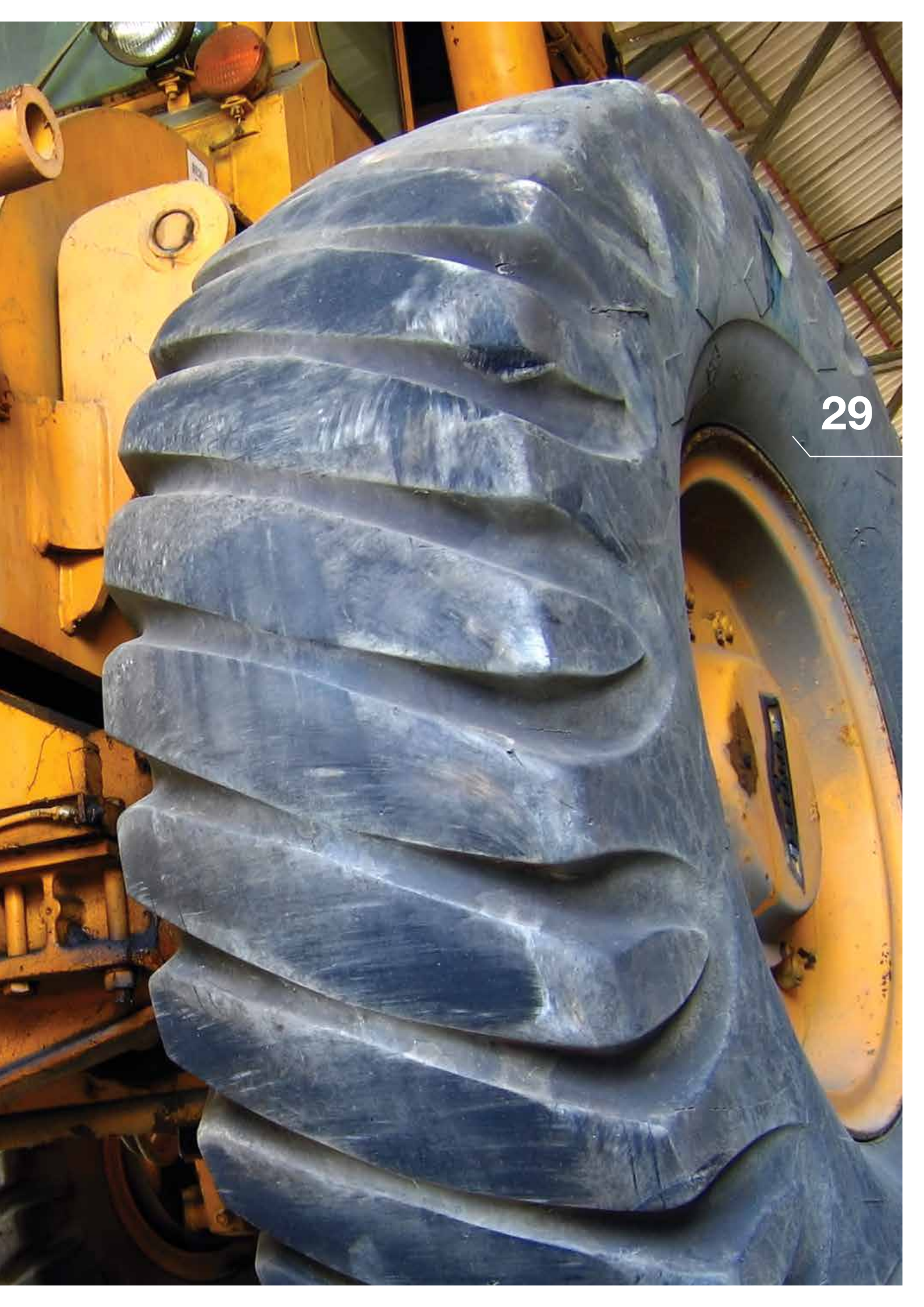
Clean machinery from the top down to avoid contaminating areas already cleaned, and consider the following points:

- Dismantle as far as practically possible to give access to internal spaces.
- Leave covers off after cleaning to allow inspection.
- Get a second opinion – a fresh look will see contamination you may have missed.

Wash-down areas should:

- Be readily accessible and located between the driveway and farm roads.
- Be isolated from production areas.
- Have access to power and high-pressure water.
- Have a sealed (concrete or bitumen) or packed gravel surface.
- Not drain into a waterway or cropping areas.
- Have a sump or collection area for easy inspection.





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Feed and livestock

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Pests can be easily introduced and spread onto the farm when you bring in grain, hay or livestock. Organic producers must give organic feed to livestock to retain their organic status (Note: there are some exceptions during drought – check with certifier) so the sources of feed are more limited, and therefore the risks of bringing in unwanted pests may be greater.



When buying fodder, be aware of where it has come from and inspect it for pests and weed seeds. The main risk is during dry seasons when fodder may not be locally available and is transported long distances from other localities. While not always possible, buying locally can help prevent the introduction of new pests to the region.

When buying grain, ask the seller about pests that are present on their farm or crop. If possible, obtain a vendor declaration of weed status or have a sample checked by a seed/plant testing laboratory. If in doubt have the grain cleaned. Like organic certified seed for grain production, stockfeed that is certified organic does not necessarily mean it is certified pest free.

Additionally, livestock should be fed in the same paddock or in the same area of each paddock. Inspect for unwanted germinated weeds or new pests at the break of the season or after rain.

Newly purchased certified organic livestock should be isolated in a quarantine paddock for at least seven days. The organic standard requires at least 3 weeks in isolation for stock that is not certified organic to allow weed seeds to pass through their digestive system and also helps to contain any weeds transported in fleeces, coats and hooves.

Ideally the holding paddock should be near the house so that regular checks can be conducted on the animals themselves and to control any germinated weeds.

Farm biosecurity self-assessment

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To ensure your farm has the best protection against the introduction and spread of new pests, identify the strengths and weaknesses of your farm biosecurity activities through the following self-assessment questions. This can be done alone, or when updating your OMP and OHP to aid in planning and implementing these practices. Completing the checklist will help determine the greatest risks to your farm. For example, it may be the number of people entering the farm, the introduction of new plant material or livestock, or storing grain.

Once risks are identified, simple, non-costly and practical procedures can be implemented to strengthen areas of greatest risk to your farm. Place a name and a date for implementation next to each practice to ensure the job is completed.

While changing everyday practices can take more effort in the short term, these will become second nature with time and are easier and cheaper than dealing with the introduction of a new pest onto the farm.



Robyn Neeson, NSW DPI

For further information and help in improving the biosecurity practices on your property contact the Grains Biosecurity Officer in your state
www.phau.com.au/gfbp.

Cleaning plus disinfection equals decontamination. Add to this farmer vigilance, determination and monitoring and you have a recipe for defending against the establishment and spread of plant pests.

Biosecurity best practice checklist

Date of biosecurity check: _____

RECOMMENDED PRACTICES	YES	TO DO	COMMENTS
Pests			
Crops and pastures regularly inspected for exotic pests. Maintain vigilance for anything unusual			
Active pest surveillance is regularly conducted, with activities and results recorded even when nothing is found			
You are aware of the beneficial organisms present on your farm and promote their activity			
You, your staff and family are familiar with the high priority pest threats for the grains industry			
You, your staff and family know how and where to report suspect pests			
Organic Management Plan integrates multiple management practices for established and exotic pest management			
Work with neighbours, government agencies, Landcare and/or pest control groups to reduce the spread of unwanted pests			
Product management			
Seed is checked to be free from pests			
Seed is certified to be pest-free			
Records of seed and its source maintained			
Grain loaded and unloaded on compacted surfaces away from production areas			
All grain storage and handling equipment thoroughly cleaned out at least three weeks before harvest			
Areas around grain silos kept free of spilt grain, weeds and general rubbish			
Silos pressure tested to ensure they are gas tight			
Aeration units for cooling and/or drying stored grain fitted to storages			
Bins, containers and bags of plant and seed material covered during transport			

RECOMMENDED PRACTICES	YES	TO DO	COMMENTS
People movement			
Biosecurity sign advising visitors to make contact, located on gates and fences, with phone numbers, or UHF channel			
Visitor access restricted to designated visitor parking areas			
All visitors sign a visitor register on arrival to track on-farm movements and for trace-back purposes in case of biosecurity emergency			
Only on-site farm vehicles used to transport visitors and equipment around the farm. All visitor vehicles remain in designated parking area or pass inspection prior to entry			
Contractor entry to the farm conditional on being made aware of farm biosecurity plans and hygiene protocols. Site biosecurity inductions delivered where appropriate			
Contractors are signatories to an industry recommended hygiene protocol or program and maintain records and log books			
Contractors and visitors made aware if property has a declared or notifiable pest			
Visitor's clothing, footwear and tools are free of loose soil or plant matter before entering or leaving the farm			
All people recently returned from overseas have clean footwear and clothes before entering the farm			
Farm biosecurity plan available for farm personnel, consultants, contractors and visitors			
Farm personnel trained in biosecurity and farm hygiene practices (e.g. pest management, equipment, vehicle and personal hygiene practices and reducing risks from livestock and fodder transport)			
Personal hygiene supplies available where appropriate (e.g. hand sanitiser, gloves, masks, disinfectant foot baths, disposable over boots and overalls)			



RECOMMENDED PRACTICES	YES	TO DO	COMMENTS
Equipment and vehicles			
Designated parking area for non-farm vehicles and contractor equipment available and clearly signed. Area checked regularly for new pests			
Cleaning and wash-down facilities, preferably on a concrete pad, provided for people, machinery and equipment and clearly signposted with instructions			
High pressure water and air available for use to remove plant material and soil from equipment and machinery			
Machinery entering the farm is inspected for insects, soil and plant material prior to entry			
Borrowed and second-hand machinery and equipment is cleaned of all plant material and soil before use			
Sump installed in wash-down facility to catch unwanted weeds and waste, and stop excess run-off into waterways			
Wash-down facility and surrounds inspected on a quarterly basis (i.e. check that everything works, clean the sump and check it for unwanted pests). Records kept and updated			
Vehicle movement kept to a minimum in production areas			
Machinery cleaned before being moved off property			
Feed, water and livestock			
Ensure that all grain and hay purchased for stock feed is free from unwanted weeds, soil and pests. Undertake an audit of known outbreaks of pests in the area of origin			
Purchased grain and hay fed out in the same area which is monitored regularly for new weed growth and pests			
Newly purchased livestock isolated in a holding paddock for 7 days (organic certified stock only, at least 21 days for other)			
Quarantine paddock regularly checked for new weeds and pests			
All livestock movements onto and within the farm recorded in a stock diary			
Boundary fences and gates maintained to prevent straying animals, unwanted visitors and unintentional equipment entry			
Stray animals captured and isolated as soon as possible			
Inspect dams and waterways regularly for pests and weeds			

Useful contacts

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Contact details	
Plant Health Australia	Phone: 02 6215 7700 Email: biosecurity@phau.com.au Website: www.planthealthaustralia.com.au
Grain Producers Australia	Phone: 02 6273 3000 Website: www.gpau.com.au
Farm Biosecurity	Phone: 02 6215 7700 Email: info@farmbiosecurity.com.au Website: www.farmbiosecurity.com.au
Organic certifiers/organisations	
Organic Federation of Australia	Email: chair@ofa.org.au Website: www.ofa.org.au
Biological Farmers of Australia	Email: info@bfa.com.au Website: www.bfa.com.au
Australian Certified Organic	Email: certification@aco.net.au Website: www.australianorganic.com.au
Aus-Qual Pty Ltd	Email: ausqual@ausqual.com.au Website: www.ausqual.com.au
NASAA certified Organic	Email: enquiries@nasaa.com.au Website: www.nasaa.com.au
Bio-Dynamic Research Institute	Website: www.demeter.org.au
Organic Food Chain	Email: ofc@organicfoodchain.com.au Website: www.organicfoodchain.com.au
Safe Food Queensland	Email: info@safefood.qld.gov.au Website: www.safefood.qld.gov.au
Tasmanian Organic-Dynamic Producers	Website: www.tasorganicdynamic.com.au

Contact details**Australian Government****Australian Government – Department of Agriculture, Fisheries and Forestry**

Phone: 02 6272 3933

Website: www.daff.gov.au**State Government****New South Wales – Department of Primary Industries**

Phone: 1800 808 095 or 02 6391 3100

Website: www.dpi.nsw.gov.au**Northern Territory – Department of Primary Industry and Fisheries**

Phone: 08 8999 5511

Website: www.nt.gov.au/d/**Queensland – Department of Agriculture, Fisheries and Forestry**

Phone: 13 25 23 or 07 3404 6999

Website: www.daff.qld.gov.au**South Australia – Department of Primary Industries and Regions**

Phone: 08 8207 7820

Website: www.pir.sa.gov.au**Tasmania – Department of Primary Industries, Parks, Water and Environment**

Phone: 1300 368 550

Website: www.dpipwe.tas.gov.au**Victoria – Department of Primary Industries**

Phone: 13 61 86 or 03 5332 5000

Website: www.dpi.vic.gov.au**Western Australia – Department of Agriculture and Food**

Phone: 08 9368 3333

Website: www.agric.wa.gov.au

**If you see anything unusual,
call the Exotic Plant Pest Hotline**

**EXOTIC PLANT PEST HOTLINE
1800 084 881**

Visitor register

Please enter your details to assist us with our farm biosecurity records

Date	Time on property		Name	Reason for visit	Vehicle registration and mobile	Details of last contact with grain crop
	Arrival	Departure				

If you see anything unusual, call the Exotic Plant Pest Hotline on 1800 084 881

An electronic version of this visitor register can be downloaded from the Farm Biosecurity website at www.farmbiosecurity.com.au/industry/crops/grains



Pest surveillance data sheet

Farm: _____

Name of person inspecting: _____

Date: _____

		Established pests				Exotic pests				
Paddock	No. sites	Pest 1	Pest 2	Pest 3	Pest 4	Pest 1	Pest 2	Pest 3	Other pests found	Comments

If you see anything unusual on your farm call the Exotic Plant Pest Hotline on 1800 084 881

EXOTIC PLANT PEST HOTLINE
1800 084 881

Estimated established pest infestation level (e.g. zero/low/med/high or % crop affected) and established pests presence/absence should be scored.
Pests targeted by surveillance must be named before surveillance initiated (for both established and exotic pests)

An electronic version of this pest surveillance datasheet can be downloaded from the Farm Biosecurity website at www.farmbiosecurity.com.au/industry/crops/grains

Soybean cyst nematode

What is Soybean cyst nematode?

Soybean cyst nematode (SCN) (*Heterodera glycines*) is one of the most damaging pests of soybean worldwide. Yield loss caused by this nematode ranges from 30% in fertile soils to complete crop loss under low rainfall conditions. Broadacre hosts include soybean, bean (*Phaseolus* spp.), vetch, lupin and clover.

Several races (based on host plant resistance) of SCN occur worldwide and these can be distinguished by their multiplication on different host plants.

What can it be confused with?

Soybean cyst nematode damage can be similar to the effects of some herbicides, nutrient deficiencies or drought stress.

What should I look for?

Above ground symptoms include stunting and yellowing of plants, poor canopy closure, reduced seed size and plant dieback or early plant death. Patches of severely affected plants are often spread in the direction of tillage as cysts are dragged through the soil. SCN damages the roots and affects nutrient uptake, causing nutrient deficiency symptoms to increase.

Below ground symptoms include dark coloured and poorly developed roots. Tiny, lemon shaped cysts can be seen on roots 4-5 weeks after planting. Cysts will be smaller than plant nodules and SCN infection can reduce root nodulation.



CR Grau, University of Wisconsin-Madison

Soybean cyst nematode causes stunting and yellowing in patches



CR Grau, University of Wisconsin-Madison

Severe damage caused by soybean cyst nematode can result in plant death



How does it spread?

Soybean cyst nematode can be moved in infested soil by water, machinery, humans and stock. Cysts are highly resistant to desiccation, surviving for many years in dry soil.

Where is it now?

Soybean cyst nematode is found in most countries where soybean production occurs and has been recorded in China, India, Indonesia, Japan, Korea, Egypt, Canada, USA, Argentina, Brazil, Chile, Columbia, Ecuador, Paraguay, Italy, Russia and the United Kingdom.

How can I protect my farm from Soybean cyst nematode?

Check your farm frequently for the presence of new pests and unusual symptoms. Make sure you are familiar with the symptoms of common grain pests so you can tell if you see something different.

If you see anything unusual, call the Exotic Plant Pest Hotline



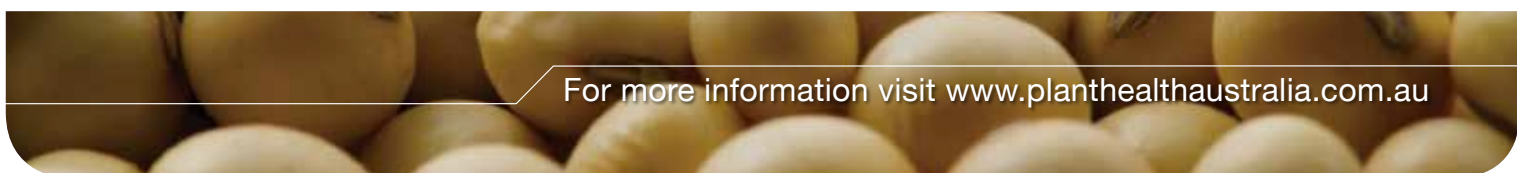
Small white cysts on soybean roots

CR Grau, University of Wisconsin-Madison



Cysts of soybean cysts nematode are smaller than nodules. Roots are poorly formed and darker

CR Grau, University of Wisconsin-Madison



For more information visit www.planthealthaustralia.com.au

Karnal bunt

What is Karnal bunt?

Karnal bunt (*Tilletia indica*) is a fungus affecting grains of wheat, durum and triticale. It reduces grain quality through the production of masses of powdery spores that discolour the grain and grain products. It is recognised by a dead fish smell.

If Karnal bunt was detected in Australia, grain export markets would be affected, as many countries have import restrictions for this pest. Therefore, this fungus poses a major threat to Australia's grain industry. The sooner a potential introduction of Karnal bunt is detected and reported, the greater the chance of rapid and effective eradication.

What does it look like?

Symptoms of this fungus are most easily seen in harvested grain, and range from pinpoint sized spots to thick black spore masses running the length of the groove in the grain. Usually only part of each grain is affected, although occasionally the whole seed will be blackened with a sooty appearance. Infected parts of each grain will crush easily producing a black powder between the thumb and forefinger. Often the grain will have a rotten fish smell. Detecting the pest on cereal heads in the paddock is difficult, as usually only a few seeds in each head are affected.

What can it be confused with?

Karnal bunt looks and smells very similar to Common bunt, which is found in Australia. However, Common bunt affects entire heads and seeds of the cereal plant while Karnal bunt usually affects only portions of some seeds in the head.

Karnal bunt is also similar to Loose smut, Flag smut and Black point. Loose smut converts grain seeds and flowering parts to masses of black spores and is very obvious. Flag smut affects the leaves. Black point is a dark discolouration at the ends and crease of wheat and barley seeds. It is caused by environmental conditions, so no spores are produced.



Karnal bunt affected stored grain

FAO



Karnal bunt affected wheat head

Ruben Durán, Washington State University, Bugwood.org



Blackened and hollow grain resulting from Karnal bunt infection

Ruben Durán, Washington State University, Bugwood.org





What should I look for?

Infected parts of grain will have a blackened and sooty appearance, and may produce a dead fish smell. Infected parts of grain may crush when handled producing a greasy black powder.

How does it spread?

Karnal bunt spores can survive in grain, soil and cereal trash, and spread with these commodities. These fungal spores are small, light and long-lived, and as such can be spread between paddocks by wind and water, and on machinery or in soil.

Where is it now?

Karnal bunt was first detected in India and is found in many middle-eastern countries. Although also present in South America, South Africa and the USA, it is confined to specific areas in those countries and is under quarantine.

How can I protect my farm from Karnal bunt?

Check your stored grain frequently for the presence of new pests and unusual symptoms. Make sure you are familiar with common grain pests so you can tell if you see something different.

If you see anything unusual, call the Exotic Plant Pest Hotline



Grain showing Karnal bunt infection symptoms

PaDL



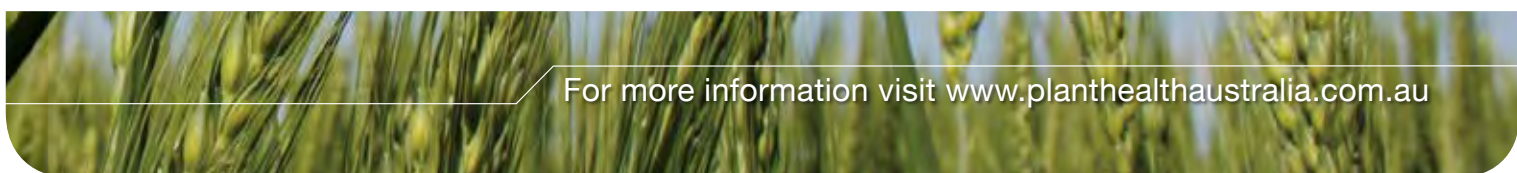
Symptom range of Karnal bunt in stored grain

Dept. of Plant Pathology Archive, North Carolina State University, Bugwood.org



Karnal bunt infected mature seed head

FAO



For more information visit www.planthealthaustralia.com.au

Khapra beetle

What is Khapra beetle?

Khapra beetle (*Trogoderma granarium*) is a serious pest of stored grain and dry foodstuffs worldwide. It can cause losses of up to 75% from direct feeding. Infested grain also becomes contaminated with beetles, cast skins and hairs from larvae, which can be a health risk and are difficult to remove from grain storage structures and transport vessels. This beetle is not present in Australia and poses a major threat to Australia's grains industry.

What does it look like?

Khapra beetle adults are small (2-3 mm long and 1-2 mm wide), brownish in colour with a smooth oval shaped body. There are 3 transverse bands (markings) of pale colour hairs on the wing covers. Eggs hatch into small hairy larvae that can grow up to 7 mm long, are reddish brown in colour and darken as they mature. Larvae have characteristic long hairs all over their body, especially at the rear end and can survive without food for over 12 months.

What can it be confused with?

Khapra beetle is almost identical to the Warehouse beetle, which is established in Australia, and some closely related native beetle species. If you find any beetle or hairy larvae fitting the description of the Khapra beetle, have it identified by an expert.

What should I look for?

As Khapra beetle is a stored grain pest it will only be found in stored products and around places where stored products are kept or transported. It can also be found between cracks and wall linings of storage containers. It will not be present in the field.

When examining grain samples, characteristic hairy larvae and cast skins are the most likely stage that will be seen.



Larvae on a maize kernel



Adult Khapra beetle



The adult Khapra beetle has a smooth, oval shaped body



How does it spread?

Khapra beetles are spread through the movement of stored grain and products or as contamination of seed, machinery and straw.

Where is it now?

Khapra beetle is found in Africa, India, Russia and many middle-eastern countries.

How can I protect my farm from Khapra beetle?

Check your stored grain and storage facilities frequently for the presence of new pests and unusual damage symptoms. Good hygiene measures around storage facilities, including cleaning up spillages, reduces the risk of storage pest infestations. Make sure you are familiar with common grain pests so you can tell if you see something different.

If you see anything unusual, call the Exotic Plant Pest Hotline

EXOTIC PLANT PEST HOTLINE
1800 084 881



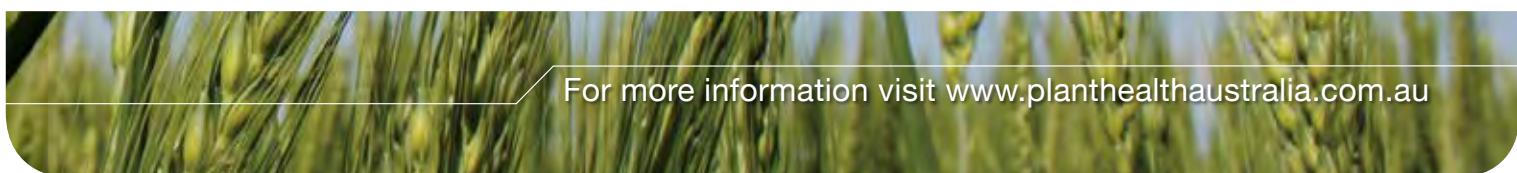
Khapra beetle adults, larvae and cast skins in stored grain

Ministry of Agriculture and Regional Development Archive,
Bugwood.org



Khapra beetle larvae

California Department of Agriculture



For more information visit www.planthealthaustralia.com.au

Russian wheat aphid

What is Russian wheat aphid?

Russian wheat aphid (*Diuraphis noxia*) is a soft bodied insect that feeds mainly on wheat and barley, but can attack most cereal crops. If this pest enters Australia, it has been estimated that it could cause significant damage to crops, resulting in up to 75% yield losses.

What does it look like?

The aphid is small (up to 1.8 mm long), has a needle-like mouthpart, and is light green in colour. The body is elongated compared with other cereal aphid species. Adults can be winged or wing-less. Juveniles (nymphs) look similar to adults but lack wings.

Characteristic features include dual structures at the rear (cauda) of the insect giving it a double-tail appearance (see arrowheads in image top right) and lack visible siphuncles, structures that look like exhaust pipes (see right) that are characteristic for most aphids.

What can it be confused with?

If it were present, Russian wheat aphid could be found with other cereal aphids on crops. The elongated body shape and lack of 'exhaust pipes' distinguish this aphid from common cereal species (compare top image to middle image).

What should I look for?

Whilst feeding, the aphid injects salivary toxins into the plant tissue causing the leaves to roll up and white, purple or yellowish streaks to form. Often awns can be trapped by the rolled flag leaf, and grain heads can be bleached in appearance. Unfortunately, these symptoms can also be caused by other diseases and disorders such as herbicide and virus damage, nutrient deficiencies and frost. If these symptoms are found in combination with aphids, have them checked by an expert.



Frank Pearis, Colorado State University, Bugwood.org

Wingless adult Russian wheat aphid, showing the double tail end (cauda – arrowheads) but no exhaust pipe-like siphuncles (circled)



SARDI

Adult Oat aphid, with exhaust pipe-like siphuncles structures (circled) and no double tail



Frank Pearis, Colorado State University, Bugwood.org

Plant damage symptoms of Russian wheat aphid attack





How does it spread?

Adults can spread by flying or are carried on wind currents. Long distance dispersal also occurs by 'hitchhiking' on machinery, clothes or plant material. Like all cereal aphids, Russian wheat aphid overwinters on volunteer grasses and alternate host plants.

Where is it now?

This pest has spread throughout all major grain growing countries except Australia.

How can I protect my farm from Russian wheat aphid?

Check your farm frequently for the presence of new or unusual pests and plant damage symptoms. Make sure you are familiar with common grain pests so you can tell if you see something different.

If you see anything unusual, call the Exotic Plant Pest Hotline

**EXOTIC PLANT PEST HOTLINE
1800 084 881**



Colony of Russian wheat aphids on a wheat leaf that is showing streaking symptoms

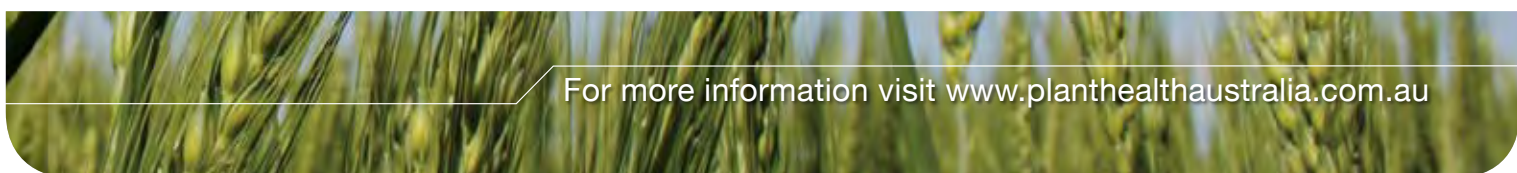
Frank Pears, Colorado State University, Bugwood.org



Trapped and bleached awns caused by Russian wheat aphid salivary toxins

Frank Pears, Colorado State University, Bugwood.org

For more information visit www.planthealthaustralia.com.au



Hessian fly and Barley stem gall midge

What are these pests?

Hessian fly (*Mayetiola destructor*) and Barley stem gall midge (*Mayetiola hordei*) are two serious fly pests of wheat and barley. They resemble mosquitoes, and feed on the leaves, stems and heads of plants, resulting in stunted growth and reductions in grain yield and quality. Hessian fly has been known to cause crop losses of up to 40%. Control of these pests would rely on host plant resistance and cultural control as chemical control methods are unreliable.

What do they look like?

These closely related flies are extremely difficult to tell apart and look similar to mosquitoes.

Adults are small flies 2-4 mm long, have one set of wings with a few weak veins, and beaded and elongated antennae. Larvae are maggots (legless) and can grow up to 3-4 mm in length with a cylindrical body shape tapered at one end.

Hessian fly larvae (initially white in colour and then turning brown) lodge between leaf sheaths above nodes. The pupa and puparium, present towards harvest at the base of the plant, are dark brown in colour, up to 6 mm long, slightly tapered in shape and commonly known as flaxseeds.

For Barley stem gall midge, larvae are pale red at first, becoming milky white. The most distinguishable characteristic that is produced from direct feeding is the formation of pea-sized galls (swellings of the plant tissue) at the base of host plants between the leaf sheath and stem.

What can they be confused with?

There are no flies in Australia that attack cereal plants above ground that could be confused with these pests. While these pests are difficult to tell apart, they are both exotic to Australia and any insect matching these descriptions should be reported immediately.



Adult Hessian fly

Scott Bauer, USDA Agricultural Research Service, Bugwood.org



Brown 'flaxseed' pupae lodged at the base of the plant

FAO



Hessian fly larvae can be seen feeding near the base of the plant

Department of Entomology, University of Nebraska - Lincoln





What should I look for?

Feeding damage on cereal plants can cause leaf discolouration, from a darker green to bluish green or yellowing of new growth in seedlings. Plants are often stunted and tillers can become weakened causing plants to lodge.

The flaxseed pupae imbedded into cereal stems, particularly on wheat, is the most detectable stage of Hessian fly development. Barley stem gall midge can be detected by the galls produced on barley stems.

How do they spread?

Adults actively fly and can be dispersed by wind currents. All life stages can also spread by 'hitchhiking' on straw and other plant material.

Where are they now?

Hessian fly is widespread in the USA and Europe. Other countries such as New Zealand, Africa and Russia have had detections of the pest. Barley stem gall midge has been recorded in northern Africa, Spain, UK and France.

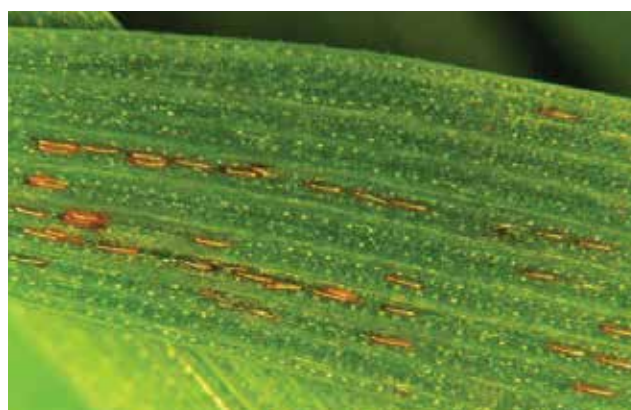
How can I protect my farm?

Check your farm frequently for the presence of new pests and unusual symptoms. Make sure you are familiar with common grain pests so you can tell if you see something different.

If you see anything unusual, call the Exotic Plant Pest Hotline



Hessian fly pupae with the characteristic flaxseed appearance



Hessian fly eggs deposited on the top surface of a wheat leaf



Discolouration and stunted growth resulting from Hessian fly infestation

Department of Entomology, University of Nebraska – Lincoln

Department of Entomology, University of Nebraska – Lincoln

Department of Entomology, University of Nebraska – Lincoln

For more information visit www.planthealthaustralia.com.au

Sunn pest

What is Sunn pest?

Sunn pest (*Eurygaster integriceps*) is a sap-sucking bug that feeds on grain crops, damaging leaves, stems and grain heads. Feeding damage is caused by the injection of toxins into the plant by their piercing and sucking mouthparts that can result in grain abortion and, in large infestations, plant death. In addition, the baking quality of the flour produced by infected grains is substantially reduced.

Sunn pest feeds on wheat, durum, rye, oats, sorghum, and barley.

What does it look like?

Adults (10-13 mm long) vary in colour from greyish-brown to reddish-brown and have a wide triangular head and oval-shaped body. They have needle-like sap-sucking mouthparts. Their wings are completely hidden by a hardened 'shield' that covers most of the body and is rounded on the bottom edge. Juveniles (nymphs) are rounder in shape and normally dark brown to black. Eggs are light green and are laid in two even rows on host plant leaves, and darken near hatching.

What can it be confused with?

There are several similar sap-sucking shield bugs. Differences in the 'shield' colouration differentiate the insects in this group.

What should I look for?

Sunn pest is most easily seen in spring on wheat heads. In the northern hemisphere, in the initial stages of infestation the insects are more abundant on the edge of the crop, near bushes and trees where they over-winter. When high numbers of insects feed on the crop, the plants can develop 'white-heads'.



ICARDA

Sunn pests clustered on wheat head



Natasha Wright, Florida DACS, Bugwood.org

Adult Sunn pest





The symptoms of a Sunn pest infestation include yellowing and dieback of the stem and leaves, and stunting of the growth of tips and buds. Feeding on other parts of the plant causes abnormal flower formation and discoloration. Feeding before grains develop can result in grain abortion or, if feeding occurs only after development, the grains are left shrivelled, discoloured (white) and/or empty.

Both adults and nymphs are capable of feeding on dry grain, providing moisture is present.

How does it spread?

Sunn pests have wings (hidden under the shield) and can fly over large distances. Adults migrate up to 250 km, particularly in areas with continuous crops. Sunn pest can also survive long periods without food in soil and can be spread with the movement of machinery or equipment.

Where is it now?

Sunn pest is found in parts of North Africa, West and Central Asia and Eastern Europe.

How can I protect my farm from Sunn pest?

Check your farm frequently for the presence of new pests and unusual symptoms. Make sure you are familiar with common grain pests so you can tell if you see something different.

If you see anything unusual, call the Exotic Plant Pest Hotline

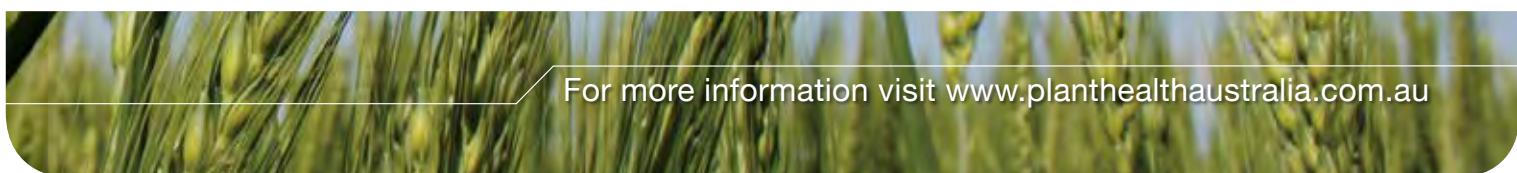
**EXOTIC PLANT PEST HOTLINE
1800 084 881**



Adult on young grain head



Sunn pest eggs, approximately 1 mm in diameter, are laid in clumps on host plant leaves



For more information visit www.planthealthaustralia.com.au

Fact sheet

Barley stripe rust

What is Barley stripe rust?

Barley stripe rust (*Puccinia striiformis* f. sp. *hordei*) is a fungal pest of barley, potentially affecting crops in all Australian growing regions. Barley stripe rust would have serious economic impacts following establishment in Australia, as it is estimated that approximately 80% of the barley varieties grown here would be susceptible. Damage to barley plants varies depending on the plant growth stage, but crop losses due to Barley stripe rust can be up to 100%.

What does it look like?

The fungus produces stripes of rust pustules between the veins of leaves, and can also form on barley heads. The pustules may be more yellow than orange, and hence the disease is sometimes referred to as yellow rust. Barley stripe rust can build up rapidly if conditions are cool and wet, and infection is often first noticed as 'hot spots' within the crop.

What can it be confused with?

Barley grass stripe rust (present in the eastern states of Australia), and occasionally Wheat stripe rust, can infect barley. However, any barley plants showing stripe rust symptoms should be sent for identification through laboratory analysis.

What should I look for?

The development of stripe rust symptoms on any barley plants. In certain conditions 'hot spots' of symptoms can develop in the crop.



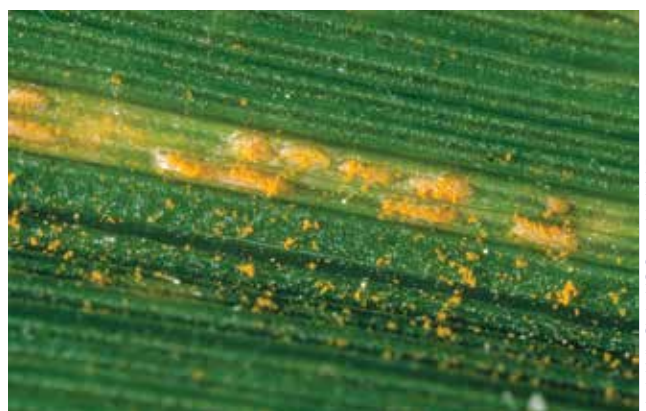
Lee F. Jackson, UC Statewide IPM Program

Stripe rust forms yellow orange stripes along leaf veins



John Francis

Stripe rust symptoms can develop as 'hot spots' in the crop



Jack Kelly Clark, UC Statewide IPM Program

The stripes of stripe rust are made up of many tiny pustules arranged between the leaf veins





How does it spread?

Rust spores are small, light and may survive for several days. They can be spread over large distances by wind and easily attach to clothing, machinery and tools, allowing movement and spread between farms and regions. They may also transfer across the world on travellers' clothing.

Where is it now?

Barley stripe rust occurs in Asia, Europe, Central Africa and North, Central and South America.

How can I protect my farm from Barley stripe rust?

Check your farm frequently for the presence of new pests and unusual symptoms. Make sure you are familiar with common grain pests so you can tell if you see something different.

If you see anything unusual, call the Exotic Plant Pest Hotline

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Colin Wellings

Stripe rust can also show symptoms on spikes, as demonstrated by this Wheat stripe rust infection



PaDL

Leaves take on a yellow colour under high levels of infection



Darrell Wiesenberg, Bugwood.org

Advanced symptoms present on barley leaf sheaths



For more information visit www.planthealthaustralia.com.au

Wheat stem rust, pathotype Ug99

What is Ug99?

Wheat stem rust (*Puccinia graminis* f. sp. *tritici*) is a fungal pest of wheat and other cereal crops. A number of pathotypes of this pest are already present in Australia and resistant wheat varieties have been bred to limit crop losses. However, a new pathotype was discovered in Uganda in 1999, known as Ug99, which has overcome the resistance gene *Sr31*. Two recently derived pathotypes have also acquired additional virulence for *Sr24* (2008) and *Sr36* (2009). While Australia uses other sources of resistance, it has been predicted that there will be significant increases in the cost of production to the wheat industry in Australia should this pathotype, or its derivatives, become established.

What does it look like?

As with other wheat stem rust pathotypes, the first symptoms are elliptical blisters on the stems and leaves of the plant running parallel to the long axis of the leaf or stem. These blisters break open after a couple of days to reveal a mass of rust coloured spores.

What can it be confused with?

Ug99 symptoms are identical to other wheat stem rusts already present in Australia. If stem rust is detected on any wheat lines that were thought to be resistant to Wheat stem rust, samples should be sent for testing.

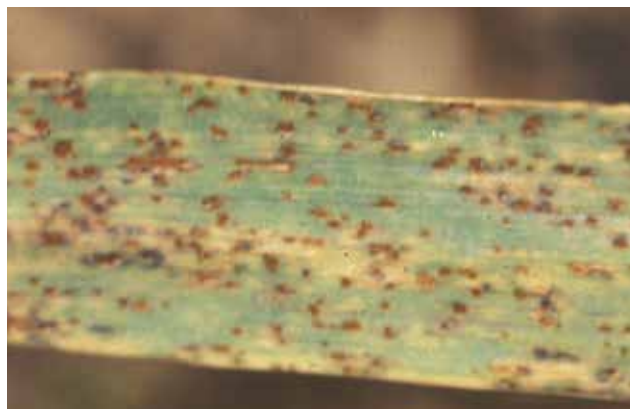
What should I look for?

The development of stem rust symptoms on wheat lines that are resistant to endemic species of stem rust.



R.L. Crossant, Bugwood.org

Spore pustule masses can develop on the leaf surface



University of Georgia Plant Pathology Archive, Bugwood.org

Spore pustules present on the leaf surface



University of Georgia Plant Pathology Archive, Bugwood.org

Wheat stem rust spores can build up to large levels under ideal conditions





How does it spread?

Rust spores are small, light and may survive for several days. They can be spread over large distances by wind and easily attach to clothing, machinery and tools allowing movement and spread between farms and regions. They may also transfer across the world on travellers' clothing.

Where is it now?

Pathotype Ug99 was first detected in Uganda in 1999, and subsequently reported in Kenya, Ethiopia, Sudan and Yemen. It was identified in Iran for the first time in 2007.

How can I protect my farm from Ug99?

Check your farm frequently for the presence of new pests and unusual symptoms. Make sure you are familiar with common grain pests so you can tell if you see something different.

If you see anything unusual, call the Exotic Plant Pest Hotline



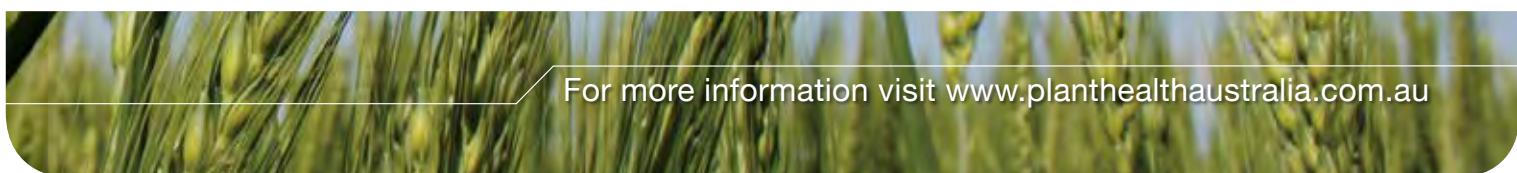
Cesar Calderon, USDA APHIS PPQ, Bugwood.org

Wheat stem rust spores present on cereal stem



Ida Paul, Small Grain Institute, Bugwood.org

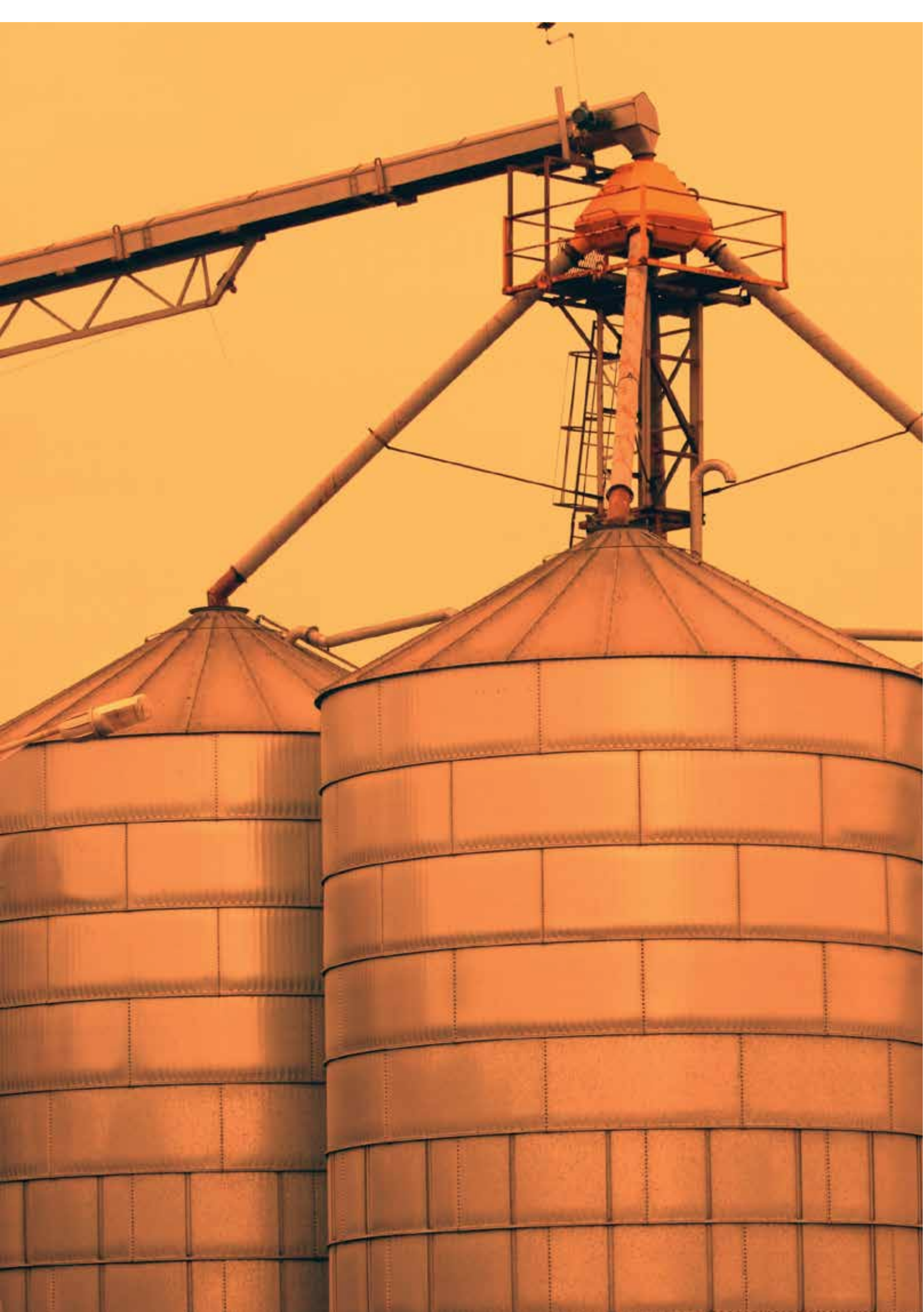
Stem rust spores visible on wheat head



For more information visit www.planthealthaustralia.com.au

Notes

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