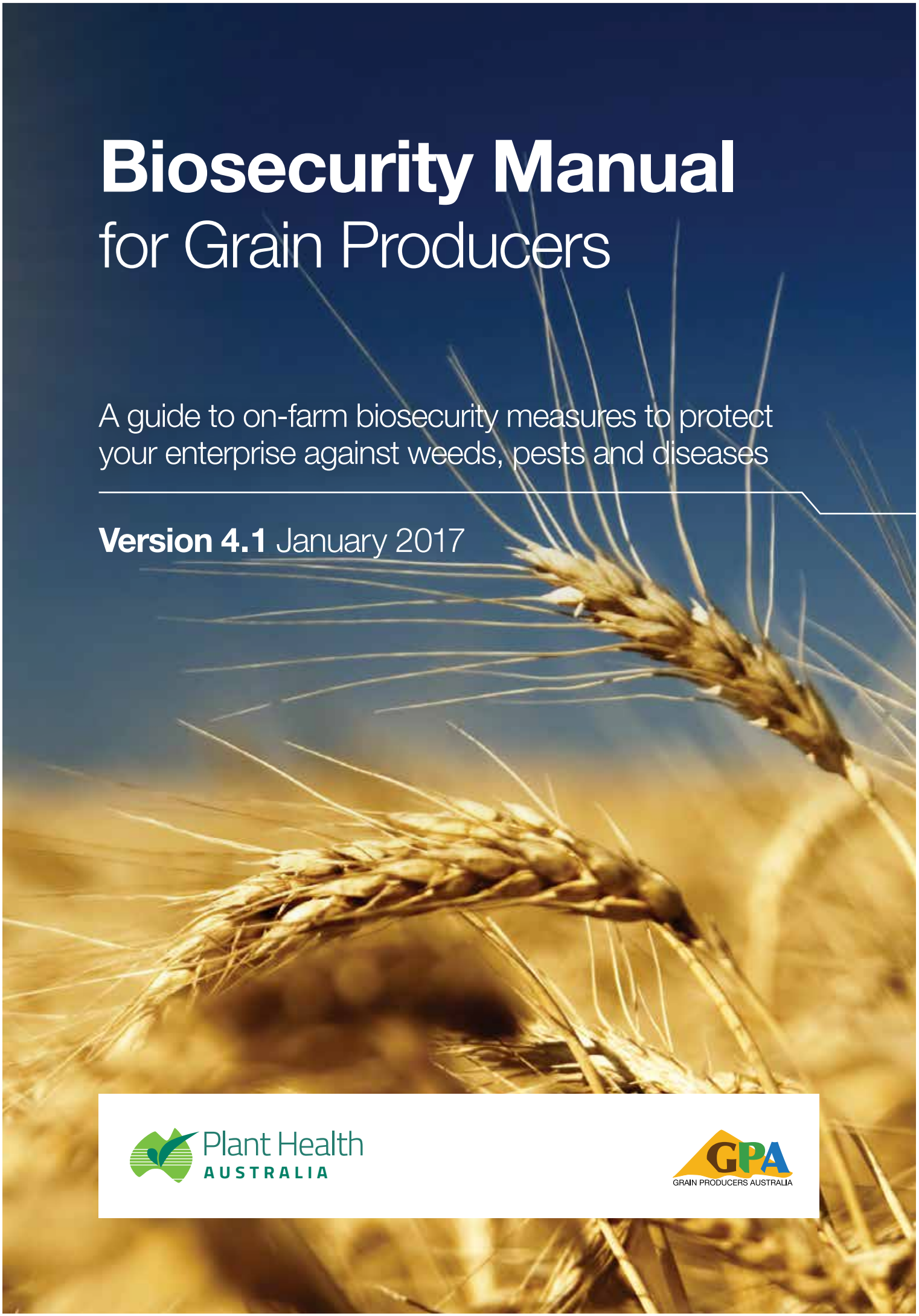
Biosecurity Manual
for Grain Producers

A guide to on-farm biosecurity measures to protect your enterprise against weeds, pests and diseases

Version 4.1 January 2017



Plant Health AUSTRALIA

GPA GRAIN PRODUCERS AUSTRALIA

Plant Health Australia (PHA) is the national coordinator of the government-industry partnership for plant biosecurity in Australia. As a not-for-profit company, PHA services the needs of Members and independently advocates on behalf of the national plant biosecurity system. PHA's efforts help minimise plant pest impacts, enhance Australia's plant health status, assist trade, safeguard the livelihood of producers, support the sustainability and profitability of plant industries and the communities that rely upon them, and preserve environmental health and amenity.
planthealthaustralia.com.au

Grain Producers Australia (GPA) is committed to representing the national interests of grain producers throughout Australia. GPA represents the Australian grains industry as a member of PHA.
grainproducers.com.au

The Biosecurity Manual for Grain Producers was developed by, and is supported through, the Grains Farm Biosecurity Program. This program is a joint initiative of PHA, Grain Producers Australia and the Western Australian, Queensland, Victorian, South Australian, and New South Wales state governments.

In referencing this document, the preferred citation is:

Plant Health Australia Ltd (2017) *Biosecurity Manual for Grain Producers* (Version 4.1, January 2017). Plant Health Australia, Canberra, ACT.

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An electronic copy of this manual is available from the website listed above and from the Farm Biosecurity website
farmbiosecurity.com.au

ISBN: 978-0-9872309-7-3

Current edition reprinted July 2019.

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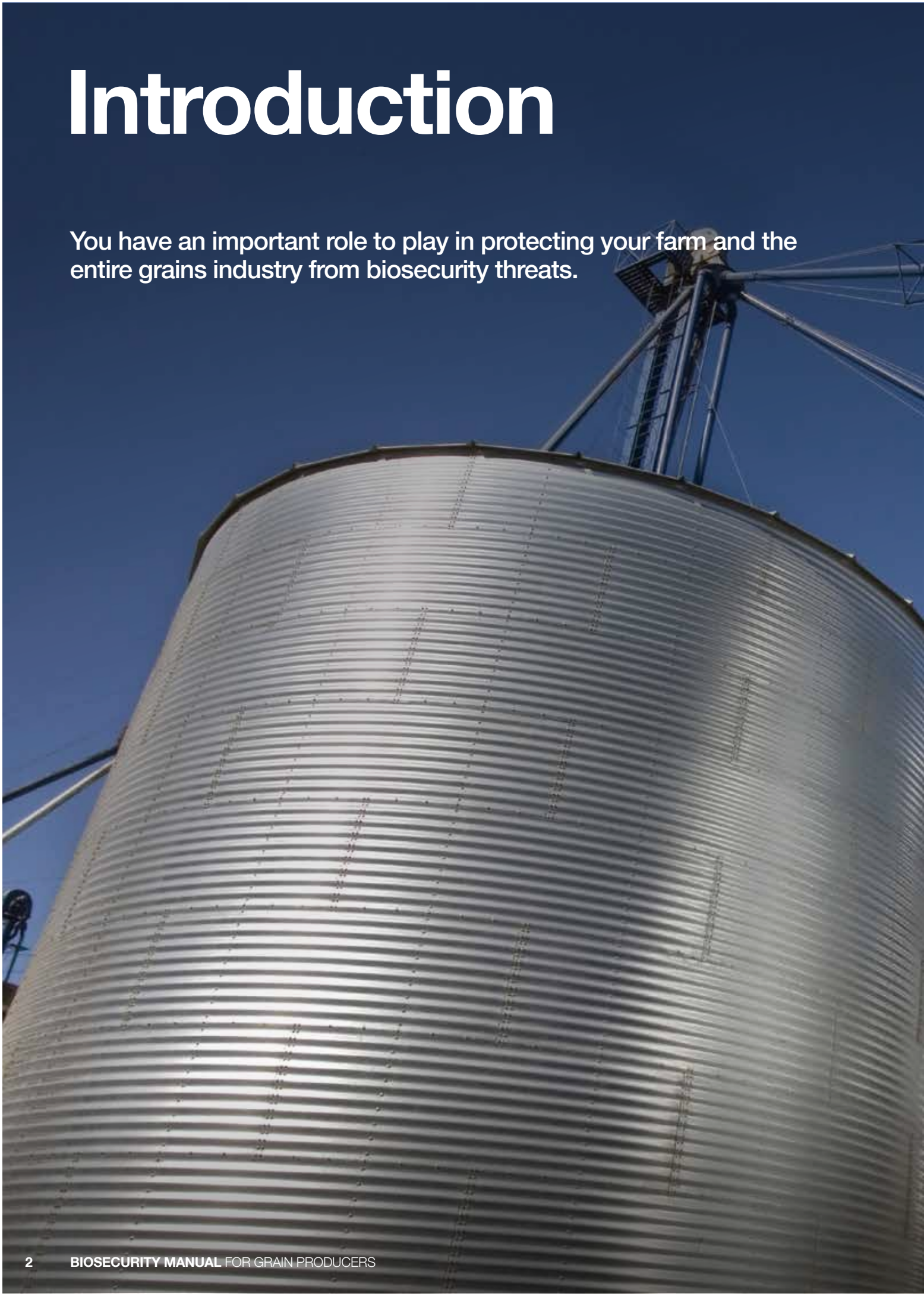
Introduction

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



This manual highlights simple farm biosecurity practices that will help you to keep your property free from new weeds, pests and diseases. It also describes the symptoms and appearance of exotic pest and disease threats to the grains industry so that any incursion into Australia can be detected quickly and controlled.

Every farm is different, so the general principles recommended in this manual will need to be tailored to suit your needs. The actual practices used will vary from site to site, depending on factors such as the size of your property/s, the resources and facilities available, risks and day-to-day management of operations.

Since grain growers also commonly run livestock, the manual includes a section on reducing risks associated with bringing feed or livestock onto the farm.

On page 26 there is a Biosecurity Best Practice Checklist. Working through the checklist will help you to assess and improve on your current biosecurity activities. Templates for records such as a visitor register, pest surveillance and grain fumigation treatments are also included.

By implementing the recommended measures in your day-to-day operations, you improve biosecurity on your farm and that of your whole region, while minimising control costs and production losses.

Grains Farm Biosecurity Program

The Grains Farm Biosecurity Program is an initiative to improve the management of, and preparedness for, biosecurity risks in the grains industry. The program is managed by Plant Health Australia and funded by growers through Grain Producers Australia, together with the New South Wales, Queensland, South Australian, Victorian and Western Australian governments.

Grains Biosecurity Officers in these five states helped to develop this manual. The officers have also compiled pest fact sheets and other awareness materials, and provide training for growers, consultants and industry stakeholders.

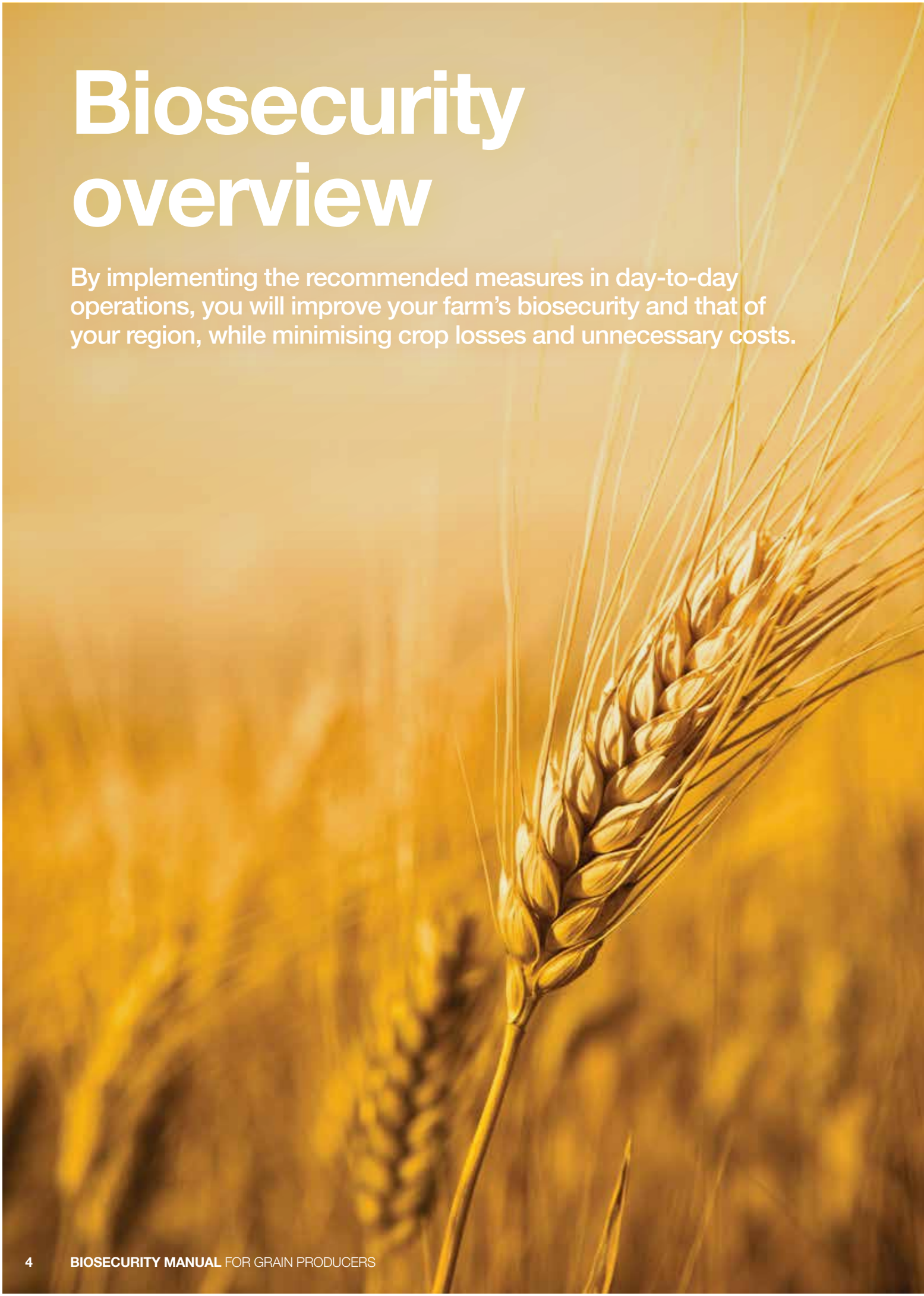
If you need help or advice about biosecurity, a Grains Biosecurity Officer can assist you to implement biosecurity on your farm. Their contact details are on page 31 of this book.

More information about the Grains Farm Biosecurity Program, biosecurity and pests is available from **phau.com.au/gfbp.**

An electronic copy of this manual is available from the grains industry page on the Plant Health Australia website **planthealthaustralia.com.au** and the grains section of the Farm Biosecurity website **farmbiosecurity.com.au**. Biosecurity is an issue of particular importance in organic farming systems, and growers of organic grain are also referred to the Farm Biosecurity Manual for the Organic Grains Industry (as an additional resource) to reduce pest burden while complying with chemical use restrictions.

Biosecurity overview

By implementing the recommended measures in day-to-day operations, you will improve your farm's biosecurity and that of your region, while minimising crop losses and unnecessary costs.



What is biosecurity?

Biosecurity is the management of risks to the economy, industry, the environment and the community from pests and diseases entering, establishing or spreading.

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

Due to Australia's geographic isolation we have relatively few of the pests that affect plant industries overseas. Freedom from these exotic pests is a vital 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.

What is farm biosecurity?

Farm biosecurity is a set of management practices and activities carried out on-farm to protect a property from the entry and spread of pests. Farm biosecurity is essential for your business.

Growers can play a key role in protecting themselves and the Australian grains industry from exotic pests by implementing effective farm biosecurity.

Farm biosecurity makes good business sense. If a new pest becomes established on your farm, costs will increase due to:

- Necessary changes to production such as using additional chemical controls and changing crop rotations.
- Reduced productivity in terms of yield, quality or both.
- Potential loss of access to some grain markets.

Biosecurity practices will help to protect you from weeds and established pests of all kinds as well as from exotic pests in the event of an incursion.

More information on how to secure your farm and secure your future can be found online at **farmbiosecurity.com.au.**

Regional biosecurity

Pests don't respect farm boundaries or state borders. Biosecurity threats can be introduced from neighbouring farms either active or abandoned, garden and roadside plantings and native vegetation.

You can strengthen biosecurity for your enterprise by collaborating with others in your area. Consider starting biosecurity meetings and activities to promote biosecurity at the regional level to reduce threats to all local properties.

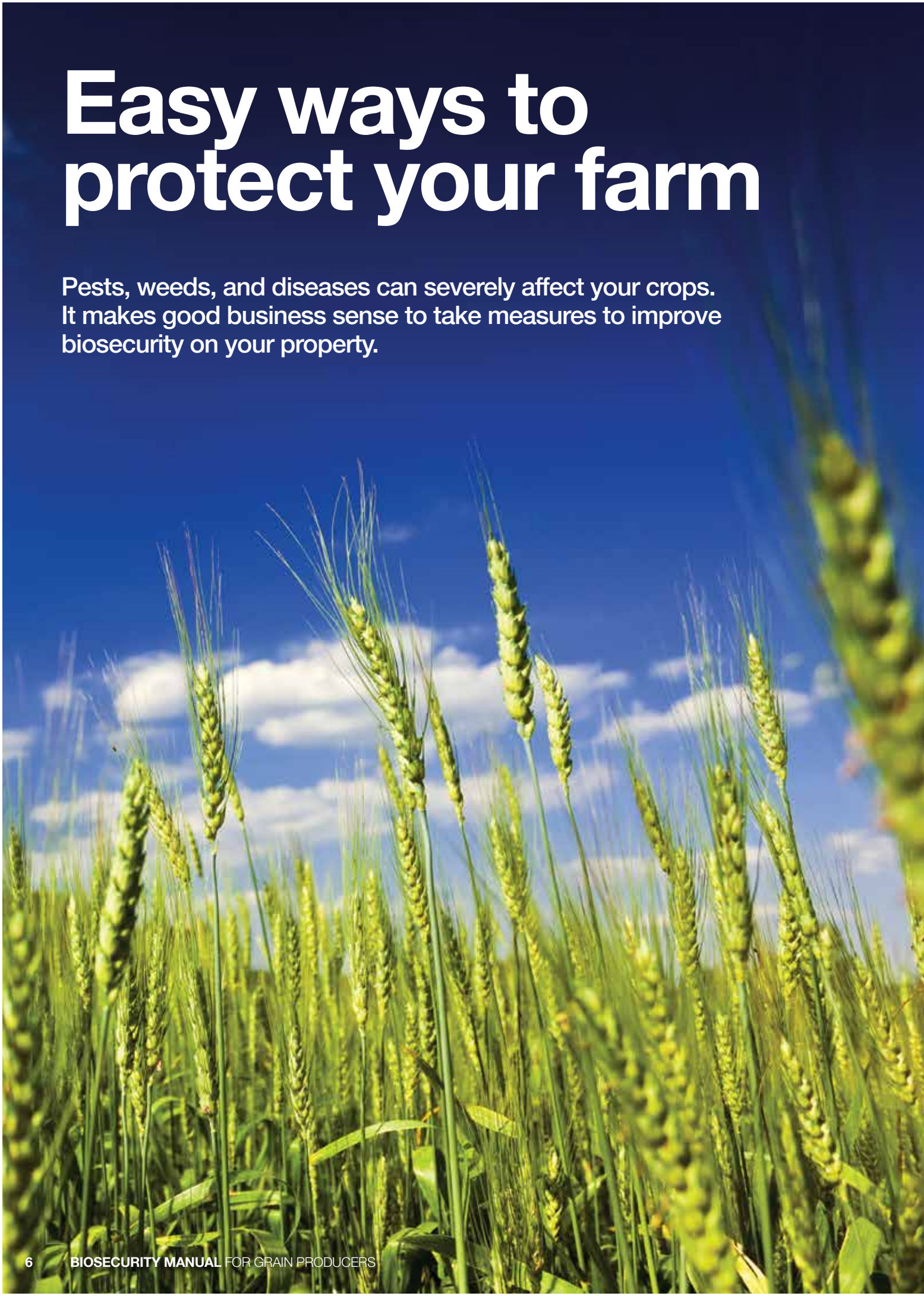
Promotion of biosecurity at the regional level is enhanced through understanding the region, the source and nature of potential threats, and having knowledge of the expertise and resources available to the region. This is supported by a commitment from everyone to implement biosecurity measures, carry out surveillance and report suspect pests.

Simple preventative measures, together with monitoring and quick reporting of anything unusual, will help reduce the risk of a new pest establishing on the farm.

The definition of a **pest** used in this manual covers all 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.

Easy ways to protect your farm

Pests, weeds, and diseases can severely affect your crops. It makes good business sense to take measures to improve biosecurity on your property.



Here are six simple, routine farm practices to reduce the risk of new pests entering and establishing on your farm. Each practice should be embedded in everyday management activities. Don't put your livelihood at risk by neglecting farm biosecurity.

Monitor your crops for the presence of pests

Check your crops regularly for pests. Record crop monitoring activities. Be aware of the serious exotic pests of grains and the symptoms they cause. Keep written and photographic records of all unusual observations. Constant vigilance is vital for early detection of any exotic plant pest threat. See page 9.

Report anything unusual

If you suspect a new pest – **report it immediately to the Exotic Plant Pest Hotline**. Early detection provides the best chance of eradicating a new pest. See page 10.

Manage people movement

People can inadvertently carry pests with them as they move about. Use farm biosecurity signs to direct all visitors to notify you of their presence, record visits and make sure visitors have clean footwear and clothing. Take particular care with contractors, utility providers and visitors from overseas. Train farm workers about your requirements. See page 12.

Reduce risks posed by vehicles and equipment

Direct all visitors to park in a designated parking area that can be monitored for new pests. Ensure that all machinery and vehicles that enter production areas are clean. A wash-down facility provides good protection. See page 16.

Manage produce carefully

Purchase seed from reputable sources and record where it came from. Monitor stored grain regularly, keep the area around them free of spilt grain and aerate it to keep conditions too cool for insects to breed. If pests are found, fumigate with a suitable pesticide. Only fumigate in sealed (gas-tight) silos. Always follow all label instructions when using fumigants. See page 18.

Manage risks posed by livestock and feed

Ensure that fodder or grain bought to feed livestock is free from weed seeds. Buy locally when possible and request a Commodity Vendor Declaration. Isolate new stock for 10-14 days. See page 24.

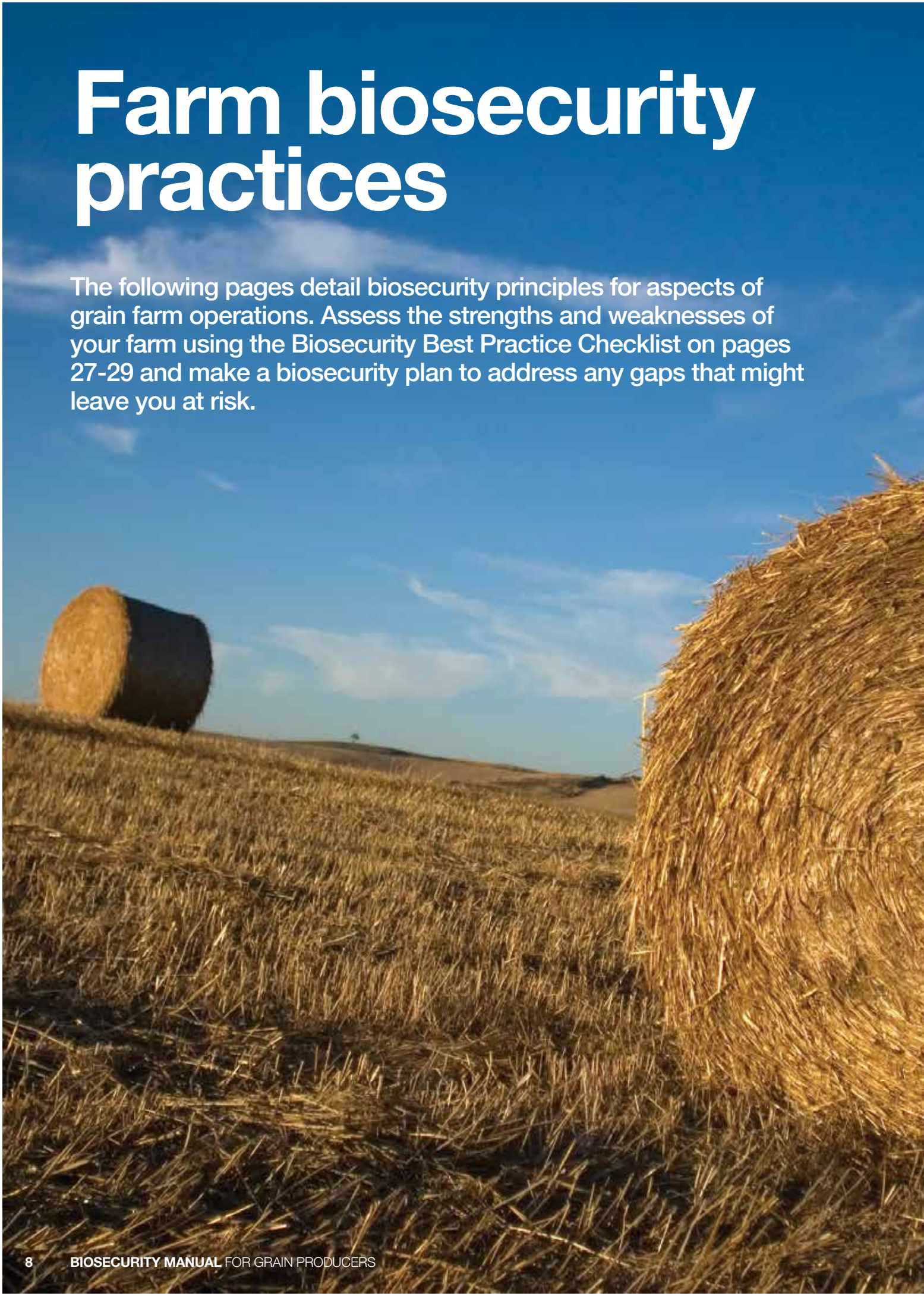
If you see anything unusual, call the Exotic Plant Pest Hotline

EXOTIC PLANT PEST HOTLINE
1800 084 881

To learn more about protecting your property from biosecurity risks visit the Farm Biosecurity website **farmbiosecurity.com.au**

Farm biosecurity practices

The following pages detail biosecurity principles for aspects of grain farm operations. Assess the strengths and weaknesses of your farm using the Biosecurity Best Practice Checklist on pages 27-29 and make a biosecurity plan to address any gaps that might leave you at risk.



Crop monitoring

Monitoring the health of your crops is a fundamental part of crop production and gives you the best chance of spotting a new pest or disease.

You, your workers or an agronomist should be checking paddocks on a regular basis. Early detection is important for controlling pests.

Pay particular attention to high risk areas where pests are most likely to enter and establish on your property such as along public roads, on periodically flooded land or gateways.

The green bridge should be treated or removed, because it can harbour pests during the non-growing season and as a reservoir for disease in the next growing season.

Keep records of monitoring activity

Crop monitoring or pest surveillance involves looking for pests or symptoms of pests and diseases, and then recording their presence (including population levels) or absence. A suitable pest surveillance record sheet is on page 33.

In addition to assisting with farm management, crop monitoring is important for the biosecurity status of the grains industry.

Detecting exotic pests

Should an exotic pest make it into Australia, pest surveillance increases the chances that a new pest is detected early and can be contained and eradicated. A new pest in your crops might not only be new to your property but also new to the region or the country.

Exotic pests of grain crops are detailed at the back of this manual. The tables include exotic pests of winter cereals, canola, pulses, summer grains and sunflower.

Some common pests of stored grain are also described, as well as two particularly important exotic pests, Karnal bunt and khapra beetle.

Use a 2 mm mesh sieve to separate insects from grain.

Maintaining market access

Export destinations can require ‘evidence of absence’ data for particular exotic pests, and some established pests, of grains. The Australian grains industry, in collaboration with governments, must prove through surveillance that certain pests have been looked for and found to be absent. Pest surveillance on-farm can assist in providing evidence of absence and keep trade markets open to Australian grains.

Reporting unusual pests and diseases

Prompt reporting is vital to minimise the long-term impact of exotic pests on your farm and the grains industry as a whole.

Australia has one of the strictest border control systems in the world but there is always the chance that an exotic pest will make it into the country. The numbers of passengers and imported goods is increasing, and a serious exotic pest of the grains industry might only be a day's flight away.

What do I do if I find an unusual pest?

If you find an unusual plant pest or disease, take the following precautions to contain it and protect other parts of your farm:

- Mark the site and limit access to the area.
- Do not touch, move, or transport affected plant material.
- Wash hands, clothes and footwear that have been in contact with affected plant material or soil.
- Call the Exotic Plant Pest Hotline on 1800 084 881, report it to your state/territory department of agriculture or speak to your local agronomist.
- Restrict the movement of people, stock and equipment near the affected area.
- Restrict operations in the area while waiting for identification.

Grain growers have an important role to play in reporting any unusual pests or diseases immediately to minimise any potential damage. All reports will be checked and treated confidentially.

What happens if I call the Exotic Plant Pest Hotline?

Calls to the Exotic Plant Pest Hotline are confidential. They will be forwarded to an experienced person in your state or territory government, who will ask some questions and arrange for an assessment of what you've found. If the hotline in your state operates only during business hours, leave your full contact information and a brief description of the issue and your call will be followed up as soon as possible.

Do not send samples until you have received advice on the correct protocol for sampling, packaging, handling and transport to the laboratory assigned for diagnosis.

Reporting if a resistant variety becomes infected

Crop varieties that are rated as resistant to particular pathogens can prove sensitive to that pathogen in time. It might be that the pathogen has evolved to overcome resistance, or it could be a new strain that has entered Australia.

If the variety that you planted was rated as resistant but becomes infected you should report it immediately.

The Emergency Plant Pest Response Deed

The Emergency Plant Pest Response Deed (EPPRD) is the formal, legally binding agreement between Plant Health Australia (PHA), the Australian government, all state and territory governments, and plant industry signatories, which sets out how incursions of Emergency Plant Pests are handled in Australia, and how any response is cost shared between industry and governments.

As a signatory to the EPPRD, Grain Producers Australia (GPA) has a seat at the decision making table in the event of an Emergency Plant Pest incursion.

If an eradication response plan is agreed by the signatories to the EPPRD, GPA will have a say in what happens. The industry may also have to contribute to the funding of the response as part of the cost sharing arrangements.

Also under the EPPRD, the grains industry has a responsibility to report suspect pests. This is because the earlier a new pest is detected, the greater the chance an eradication response will be mounted and the more likely it will be successful.

More information on the EPPRD is at **planthealthaustralia.com.au/epprd.**

Owner Reimbursement Costs

An underlying principle of the EPPRD is that growers are not worse off as a result of reporting a suspected Emergency Plant Pest.

The agreement allows for grower reimbursement payments, known as Owner Reimbursement Costs (ORCs), for direct costs incurred as a result of the implementation of an approved response plan.

ORCs may cover direct grower costs or losses through such actions as the destruction of crops, enforced fallow periods, replacement of crops and additional chemical treatments.

Calculation of ORCs is prescribed in the EPPRD, including the different formulae used to accommodate the wide range of crops grown in Australia, including grains.

For more information, see: **planthealthaustralia.com.au/owner-reimbursement-costs**.

It is important to remember that ORCs only apply to approved response plans aimed at eradication, which are more likely to be developed following early reporting.

Russian wheat aphid

Russian wheat aphid (*Diuraphis noxia*) is a new pest to Australia, first detected in cereal crops in South Australia in May 2016.

The incursion was dealt with under the Emergency Plant Pest Response Deed, however it soon became clear that the aphid was present over a wide area of South Australia and in Victoria.

As a result of the late detection of the aphid, the National Management Group (NMG) agreed that it was not technically feasible to eradicate in June 2016. As a result, any further detections are not dealt with under the Deed.

Managing people movement

People can carry weeds, pests and diseases onto and around your property without realising it. Pests can be spread in soil and on plant material on vehicles, equipment, footwear and clothing.

Anyone visiting your property could bring in pests. This includes guests, people living on the property, workers, and all visitors such as suppliers, contractors, researchers, vets, transporters, stock agents, and consultants.

There are simple steps that you can take to minimise the risk these movements pose.

Inform visitors of your requirements

Make sure that staff, guests, regular visitors, and anyone entering your property know about your biosecurity requirements. Biosecurity signs are a good way to alert them to your requirements and of the potential risk that their visit poses to your business. Parking restrictions will limit any problems posed by their vehicles.

Make sure workers know about any biosecurity risks in the region or issues on the property. They should also be familiar with everyday pests on the property and know how to report anything unusual.

If you hold a field day or equipment demonstrations on your property, clearly indicate any entry requirements and be especially vigilant in checking for new pests and diseases afterwards.

Keep a record of visitors

It's good practice to maintain a visitor register to document who has been on your property, including where they have come from and where they are going. A suitable recording sheet is on page 32. Visitor records are the single most useful tool in the event of a serious pest incursion in a region. It assists authorities to pinpoint the origin and spread of any incursion.

Records should allow you to trace the movement of people, machinery and plant material to and from your farm.

Keep it clean

Since weed seeds and pathogens like rusts can enter on people's footwear and clothing, it helps to have a clean clothes and boots policy for employees and visitors. Provide scrubbing brushes and footbaths for people arriving with dusty or muddy boots, or give them rubber boots to wear in your production areas. Footwear should also be cleaned when people leave your farm. Dedicated clothing should be used in areas of the property that you know to be contaminated. Sock protectors will minimise the spread of weed seeds.

Control people movement

Controlling and limiting access to production areas is the key factor in minimising biosecurity risks. Make sure that you limit access points to the property.

Direct all visitors to a designated parking area away from production areas and ask everyone to notify you of their presence. This gives you a chance to check people and their vehicles for any potential risks and helps you manage safety risks of having people on your property. Limit visitor contact with crops or plant materials and, where possible, eliminate unnecessary contact all together.

Biosecurity signage

Well-designed signs demonstrate your commitment to farm hygiene. They also serve to alert people to the potential impact of their visit, and remind them that they share responsibility for maintaining biosecurity.

Place signs at the main entrances, in visitor parking areas and near wash-down facilities. 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. Include contact details, such as the home telephone number, mobile number and/or UHF channel.

For further information on obtaining biosecurity signs for your property, contact your state Grains Biosecurity Officer. Contact details are on page 31.

You can download a template to produce your own sign at **phau.com.au/gfbp** or purchase one on the Farm Biosecurity website **farmbiosecurity.com.au/toolkit**.

Managing high-risk visitors

You should make an assessment of the level of risk that each visitor to your farm poses.

There is a risk classification explanation to help you at **farmbiosecurity.com.au/toolkit/records.**

You can then take additional steps to reduce the chance of them bringing new pests onto the farm.

Providing places for visitor parking helps to reduce risk to others.

Overseas travellers

People returning from overseas may pose a biosecurity threat, 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.

Ideally, visitors from overseas or family members and employees returning from overseas, should ensure that clothing, hair and footwear has been washed before they go into crops. Check that they have not brought any plant or animal material with them.

Contractors and utility providers

Anyone who travels from farm-to-farm and region-to-region poses an increased biosecurity risk to your property.

Notable examples are harvesting contractors, earthmoving companies, power, water, gas and communications employees, research personnel, consultants and mining operators, any of whom might enter farms in their day-to-day operations.

Pests can be easily spread on a visitor's clothing, equipment and vehicles. Grain trash and hay in contractors' machinery when they arrive at your farm is a common problem in the grains industry.

Controlling the movement of these visitors with signs and using a visitor's register, is particularly important.

Where possible, engage contractors who are signatories to an industry recommended hygiene protocol or program.

You have the right to request that visitors to your property and their vehicles and equipment are clean and free from pests, weed seeds and plant material. Providing a suitable wash-down facility away from production areas is an easy way to ensure that this requirement is complied with.

To ensure that 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 present on your farm, so that they can take steps to avoid transferring them to the next place.

A contractor biosecurity fact sheet is available from the PHA website, **phau.com.au/gfbp.**

You can provide this information to visitors when they sign in, or leave copies at external gate entrances to help raise awareness of farm hygiene.


GRAINS FARM BIOSECURITY PROGRAM

IS YOUR VISIT A BIOSECURITY RISK TO THE AUSTRALIAN GRAINS INDUSTRY?

Good travel hygiene is essential for all visitors coming from overseas or when travelling between grain growing regions within Australia.

You may be attending a conference or an agricultural event such as a field day, be part of a delegation of industry members or a visiting researcher. If your itinerary includes visiting rural properties or grain industry related sites there is a risk that a biosecurity incident could be inadvertently spread between grain growing regions as a result of your travels. Whatever the reason for your visit, you have a duty of care to minimise biosecurity risks.

Plant pests and weed seeds can potentially enter Australia on footwear and clothing. Travellers are known to have inadvertently carried fungal spores into the country on their clothes, and weed seeds can easily be carried in soil on boots and clothes. Some pests can also hitch hike on vehicles, equipment or in personal luggage.

BIOSECURITY TIPS

BEFORE YOU COME TO AUSTRALIA

- Ask the organisers of your trip if there are any specific biosecurity requirements for the area you are visiting.
- Wash and scrub your footwear with soap and water, and then a treat with a disinfectant.
- Wash all the clothes you plan to wear before you come to Australia, including hats and caps.

AS YOU ENTER AUSTRALIA

- Declare if you have been on a farm.
- Declare any items listed on the incoming passenger card.

IF YOU SEE ANYTHING UNUSUAL, CALL THE EXOTIC PLANT PEST HOTLINE

1800 084 881

Managing vehicles and equipment

Any machinery or vehicles coming onto your property, whether it is hired, borrowed, second-hand, contractor's machinery, or privately owned can spread pests, diseases and weeds.

Vehicles can spread pests in soil and plant material. It is impractical to stop all vehicle and equipment movement on and around the property, but there are steps you can take to minimise the entry and spread of weeds, pests and diseases.

Reducing risks posed by vehicles

Biosecurity risks posed by vehicles are best dealt with by either restricting their movement or making sure they're clean. Having vehicles park in a designated area gives you more control over risks. You can inspect vehicles, talk to the driver about where they've come from and decide whether they are an acceptable risk.

Use a dedicated farm vehicle to move through production areas whenever possible; otherwise offer the use of a wash-down facility to clean vehicles before allowing them access to production areas.

In cropping areas, keep vehicle movement to a minimum, especially on wet soil. Stick to regular pathways to minimise the threat of spreading pests and inspect these areas regularly for any problems.

Parking areas provide the opportunity to contain any potential pests away from production sites.

Wash-down facilities

A dedicated area for cleaning vehicles and equipment provides a great deal of protection against the introduction of new weeds and pests onto your property.

High pressure water or compressed air allows easy cleaning of all farm vehicles and equipment, and any visitor vehicles that need to enter production areas.

Locate a wash-down facility after the parking area or reception, and away from production areas. A sealed (concrete or bitumen) surface or a pad of packed gravel is ideal, with a sump to collect waste water and debris. Make sure mud, soil and plant material are kept away from crops, storage areas and waterways.

Inspect the wash-down facility regularly for the presence of pests and weeds, and treat as required.

The wash-down area may be the same as that used for chemical wash-down of vehicles and equipment. If so, all health and safety issues associated with chemical wash-down areas must be taken into account.

A wash-down facility allows farm employees, contractors and visitors to clean their vehicles and equipment in an easily managed area.

Privately owned vehicles or machinery can spread pests, diseases and weeds.

Reducing risks posed by machinery and equipment

Soil, plant and grain material containing pests and weeds can be carried on and inside equipment such as harvesters, sprayers, seeders, balers, augers and field bins.

It's important to keep all farm equipment clean and ensure that any machinery brought onto your property doesn't pose a risk. It's best practice to keep a record with machinery of when it was last cleaned. There's a suitable record sheet on page 35.

Regularly clean all tools and equipment, preferably with air or water steam high pressure or a farm cleaning product.

Cleaning grain equipment.

Tips for effective cleaning

- While compressed air might be best for cleaning radiators and some machinery, anything muddy will need to be cleaned down with high-pressure water.
- Clean machinery from the top down to avoid contaminating areas already cleaned.
- For additional protection, an added detergent-based degreaser or disinfectant (for example, Septone Truckwash®, Castrol Farmcleanse® or Virkon®) may be appropriate. Seek advice from re-sellers on the best product for your situation. For best results, remove as much soil and plant material as possible from the equipment before using the disinfectant.
- Dismantle vehicles and equipment as far as possible to give access to internal spaces.
- Leave covers off after cleaning so equipment dries thoroughly and to allow easier inspection.
- Get a second opinion – a fresh look will often pick up contamination you may have missed.

If possible, install a sump to collect waste water and debris.

Product management

Good biosecurity practices are important at every step of product management; from ensuring seed is pest and weed free, to the responsible use of chemicals, and good grain storage practices.

Purchase seed from a reputable source

Seed can be a source of diseases, pests and weeds. You cannot accurately assess seed quality just by sight. Seed that carries pests can appear clean and healthy at the time of purchase.

Obtain seed from reputable suppliers. 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.

Traceability

It is very useful to be able to trace the movement of produce onto and off your property. Traceability is often a component of Quality Assurance schemes such as Graincare QA, or Better Farm IQ or an industry Best Management Practice program.

Records (including seed source, health testing specifics and authenticity records) should allow you to trace grain on your farm back to its source. Similarly, these records should also include where grain or hay goes when it leaves your property.

Being a member of an Auditable Quality Assurance scheme is recommended for biosecurity purposes as well as ensuring that you comply with requirements for market access, meeting trade specifications, customer expectations and food safety.

Effective storage of grains

In a deregulated grain market, on-farm grain storage is becoming more common and brings additional biosecurity risks to your property. If stored grain is not properly managed it can become infested with pests that can be difficult and costly to control.

To maintain pest-free stored grain of good quality and value, growers need to:

- Maintain good hygiene around storage areas.
- Use aeration cooling.
- Identify pests early through monthly monitoring.
- Select the right storage treatments and apply them correctly.

Maintain good hygiene

Spilt or residual grain can provide shelter and food for pests allowing large numbers of storage pests to fly and infest other grain storage sites once conditions warm at the start of spring.

Make sure that grain handling equipment like headers, augers, field bins, silos and bulk storages are cleaned before and after harvest.

It is good practice to separate the first grain to pass through headers and grain handling equipment at the start of harvest as there is a high risk that it may contain pests. Use it quickly for stock feed, or plan to aeration cool, then fumigate within four weeks.

Grain should be loaded and unloaded on compacted surfaces away from production areas. Containers and bags of plant and seed material should be covered during transport.

Aeration fans fitted to silos can rapidly reduce grain temperatures.

Aerate grain to keep it cool

Aeration fans fitted to grain stores reduce the grain temperature and the ability of pests to breed. Aim to keep grain at less than 23 degrees in summer and less than 15 degrees in winter. Aeration also reduces moisture content which maintains grain quality.

Monitor grain regularly

Regular monitoring of stored grain is essential. Stored grain should be inspected every month for live insects and grain should only be treated when insects are found. Seek advice on the best way to treat any pest you detect.

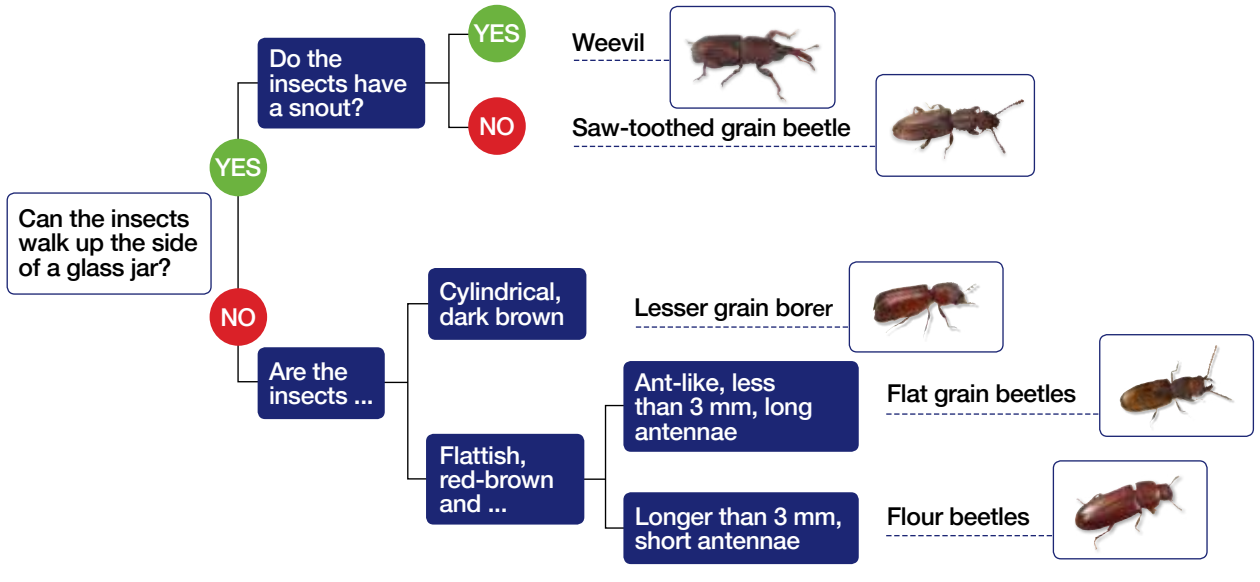
Fumigate pests effectively

Grain markets demand that delivered grain is free from live insects, but they also have limits on acceptable levels of chemical residues. Identify the particular pest, use an appropriate fumigant, and check that grain buyers or potential markets will accept any insecticides you intend to use.

When fumigating stored grain, always read the product label, follow all directions, and abide by withholding periods. Fumigants such as phosphine are only effective when used in well-sealed grain storage facilities.

For more information about the biosecurity of stored grain and identifying insects, see the Monitoring stored grain on-farm booklet, available from a Grains Biosecurity Officer or from **phau.com.au/gfbp.**

Stored grain pest identification chart



Source: QDAF

Probe traps pushed into grain at help detect the first signs of an insect infestation.

Use chemicals strictly according to instructions

Since most grain ends up being used as human food, even if fed to livestock, inappropriate use or application of pesticides can pose a risk to human health through the presence of chemical residues. Chemical residues on grain can result in grain being rejected from export and domestic markets.

Pesticides must be used in accordance with label instructions. In most states and territories, farmers and contractors who apply pesticides must complete an accredited chemical training course (for example ChemCert® or SMARTtrain) to gain the appropriate training, knowledge base and legal requirements for the safe use of pesticides.

Details about regulations for agricultural and veterinary chemicals can be found on the Australian Pesticides and Veterinary Medicines Authority website **apvma.gov.au**, or from relevant state agencies. Be aware that regulations change over time, so you need to check for updates regularly.

Follow all safety and application directions when mixing and applying fumigants.

Sealable (gas-tight) silos for fumigation of pests

From a biosecurity perspective sealable, aerated silos are the best storage facility for grains. In addition to protecting the quality of the grain, effective fumigation of pests can only be carried out in a sealed, gas-tight silo. Check that a new silo meets the Australian Standard for sealable silos (AS2628) and pressure test regularly to ensure it remains gas-tight over time.

Pressure testing a silo.

How to tell if your silo is well sealed

Australian Standard AS2628 states that new sealable silos must pass a five minute half-life pressure test. Existing silos are considered to be well-sealed when they pass a three minute half-life pressure test.

Passing a three minute half-life pressure test means that once pressurised, using the silo's aeration fan or an air compressor, it will take more than three minutes for the pressure inside the silo to drop by 50%. If the pressure drops by 50% in less than three minutes the silo is not well sealed and shouldn't be used for fumigation until it has been made sufficiently sealed to pass the test.

For more information on sealable silos, pressure testing silos and grain storage please see GRDC Grain Storage Extension at **storedgrain.com.au.**

How to pressure test your silo

1. Close all lids and latch them closed.
2. Using the silo's aeration fan or an air compressor (which you can attach to the silo by installing a tubeless tyre valve to the silo when it's empty), pressurise the silo and record the pressure (i.e. the fluid levels in the oil relief valve). Some silos may not have an oil relief valve; if so these can be purchased from some silo manufacturers and installed to your existing silos.
3. Turn off the fan or air compressor and begin timing.
4. After three minutes check the fluid levels in the oil relief valve. They should not have dropped by more than 50% in three minutes. If they have dropped by more than 50% the silo is not sufficiently sealed to use for fumigation and must be checked for leaks. This can be done by pressurising the silo and spraying soapy water on the seals to find where the air is escaping. Once found damaged seals should be repaired or replaced before retesting the silo.

Phosphine fumigation and pest resistance

Phosphine fumigation is a commonly used and inexpensive method for treating insects in grain storages, but phosphine-resistant insects are becoming more common. Inadequate fumigation or under-dosing results in the survival of insects with increased phosphine tolerance. They can survive fumigation and jeopardise the acceptance of grain consignments by buyers or authorities.

Resistance to phosphine in stored grain pests is a biosecurity threat to Australia's grain trade.

Eventually phosphine will not be effective if poor fumigation practices continue.

The right way to use phosphine

Phosphine fumigation must be carried out in sealable (gas-tight) storages so that the fumigant stays at the appropriate level for the duration of the fumigation. A high concentration is required to control insects at all life stages (eggs, pupae, and larvae).

Grain residues can provide shelter and food for pests. Make sure that grain handling equipment like headers, augers, field bins, silos and bulk storages are cleaned before and after harvest.

Always follow the label instructions when using phosphine. For safety, place signs on all access points to the site while fumigation and ventilation is being completed. The sign must contain the words DANGER – POISONOUS GAS – KEEP AWAY, and preferably indicate the start and finish date of the fumigation and ventilation periods.

The sign below is suitable and a template for producing one is in the toolkit on the grains industry page at **farmbiosecurity.com.au** or from a Grains Biosecurity Officer (see page 31).

Record the fumigation so that you can demonstrate that you have met the withholding period. A fumigation record keeping sheet is available on page 34.

No more than three phosphine fumigations should be conducted on any single parcel of grain.

Seeking sentinel silos

Farmers with silos that are not subjected to chemical control of pests are being asked to participate in the Silo Surveillance Program. The new program is being rolled out across grain growing regions of Australia to provide an early warning system for exotic pest incursions.

Sentinel plants or animals provide early indicators of the presence of a pest or disease, often because they are more sensitive or vulnerable to infection.

In this case, the program is seeking sentinel grain stores that are more likely to become infected because chemicals are not used to treat pests, or because they are largely unmanaged, possibly for months at a time. Often this situation occurs where farmers are storing grain on-farm for animal feed. Grain destined for export markets is not suitable for the program since pest control is a prerequisite.

The initiative is being set up as part of the Grains Farm Biosecurity Program in order to boost protection against exotic pests.

Starting with seven sites in Victoria in 2016, sentinel silos will be checked every three months using insect probes, running grain through sieves and pheromone traps.

Participating farmers will be doing the grains industry a huge service and will receive advice on improving their on-farm biosecurity and grain storage systems. The location of chosen sites is strictly confidential.

The program is also seeking silos near the coast or near a port, a big grain bunker or receival sites for testing.

Farmers who would like to take part are asked to contact their local Grains Biosecurity Officer (contact details on page 31).

DAFWA

Managing risks posed by livestock and feed

Pests and weeds can be easily introduced and spread onto the farm when you bring in grain, fodder or livestock.

Buy clean stock feed

When buying fodder or feed grain, be aware of where it originally came from and inspect it for pests and weed seeds.

The main risk is during dry seasons when fodder is transported long distances from other localities with different pest problems. Buy locally whenever possible to avoid importing new pests to the region.

When buying grain, ask the seller about pests that are present on their farm or in their 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.

It's good practice to always put out feed for animals in the same place each time. Inspect this area for new weeds or pests regularly.

Inspect fodder for pests and weed seeds.

Isolate new livestock

New livestock should be isolated in a holding paddock for at least 10-14 days to contain any weeds transported on fleeces and coats and allow any weed seeds to pass through their digestive system. Weed seeds will germinate after rain or in the next growing season and should be treated before they produce seed.

Isolation of new or returning stock can be combined with procedures to minimise introducing new animal diseases onto a property such as drenching to control parasites. Ideally the holding paddock should be near the house so that regular checks can be conducted on the animals themselves and to control any weeds that may have been introduced.

All livestock movements onto and within the farm should be recorded in a stock diary. Boundary fences and gates need to be maintained to prevent animals from straying. Any stray or potentially sick animals should be isolated as soon as possible.

Always wash and disinfect hands before and after coming into contact with livestock.

For more information on livestock biosecurity see **farmbiosecurity.com.au**.

Store animal feed in a clean, dry area that can be secured to prevent access by wild and feral animals.

Biosecurity best practice checklist

To ensure that your property has the best protection against the introduction and spread of new pests, use the following self-assessment questions to identify the strengths and weaknesses of your farm activities.

This process forms the basis of a farm biosecurity action plan which will allow you to systematically address any risk areas that you have identified.

While changing everyday practices takes effort in the short term, with time they become second nature. Changes are easier and cheaper than dealing with the introduction of a new pest.

You can get further information and help in improving the biosecurity practices on your property from the Grains Biosecurity Officer in your state, and at **farmbiosecurity.com.au**.

Date of biosecurity check: _____

RECOMMENDED PRACTICES	ASSESSMENT	ACTION REQUIRED
Crop monitoring and reporting unusual pests		
Crops and pastures regularly inspected for both endemic and exotic pests.		
Pest surveillance activities and results recorded, even when nothing is found.		
Green bridge is treated or removed to prevent it from harbouring pests and diseases between growing seasons.		
You, your staff and family are familiar with the high priority pest threats for the grains industry.		
You, your staff and family know how to report suspect pests.		
Pest management plans developed for the farm.		
Managing people movement		
Biosecurity sign located on gates and fences, with house or mobile phone number and/or UHF channel shown.		
All visitors sign a visitor register on arrival.		
Visitors assessed and managed according to risk posed. On-site biosecurity inductions delivered where appropriate.		
Visitor's clothing, footwear and tools are free of soil or plant matter before entering or leaving the farm.		
All people recently returned from overseas have clean footwear and clothes before entering crops.		
Hygiene supplies available for use where appropriate (e.g. hand sanitiser, gloves, masks, disposable over boots and overalls).		
Equipment for cleaning and disinfecting footwear provided. Alternatively, footwear for use on-farm available.		
Farm personnel trained in biosecurity and farm hygiene practices (e.g. pest management, personal, equipment and vehicle hygiene practices, risks arising from livestock and feed).		
Contractor entry to the farm conditional on being made aware of biosecurity measures.		
Contractors are signatories to an industry recommended hygiene protocol or program and maintain records and log books.		
Contractors/visitors made aware if property has a declared or notifiable pest.		

RECOMMENDED PRACTICES	ASSESSMENT	ACTION REQUIRED
Managing vehicles and equipment		
Designated parking area for non-farm vehicles and contractor equipment available and clearly signed.		
Area checked regularly for new pests and weeds.		
On-site farm vehicles used to transport visitors and equipment around the farm.		
Vehicle access to production areas kept to a minimum.		
Machinery entering the production area 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.		
Cleaning and wash-down facilities, preferably on a concrete pad, provided for machinery and equipment. Facilities clearly signposted with instructions.		
High pressure water and air available for use to remove plant material and soil from equipment and machinery.		
Sump installed in wash-down facility to contain soil, pests and weed seeds, and to stop run-off entering waterways.		
Wash-down facility and surrounds inspected on a quarterly basis (i.e. clean the sump and check it for pests and weeds). Records kept and updated.		
Machinery cleaned before being moved off property.		
Any movement restrictions abided by.		
Product management		
Seed is certified to be free from pests and weed seeds. Records of seed and its source maintained.		
Seed is checked for pests.		
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.		
Silos pressure tested to ensure they are gas-tight.		
Aeration units for cooling and/or drying stored grain fitted to storages.		
Areas around grain silos kept free of spilt grain, weeds and general rubbish.		
Stored grain monitored for pests regularly.		
Fumigations carried out only when pests are present, in sealable (gas-tight) storages. Chemicals used according to label instructions.		
Warning signs displayed on grains silos during fumigation and ventilation.		

RECOMMENDED PRACTICES	ASSESSMENT	ACTION REQUIRED
Managing risks posed by livestock and feed		
Ensure all grain and hay purchased for stock feed is free from unwanted weeds, soil and pests. Checks done for known outbreaks of pests in the area of origin.		
Purchased grain and hay fed to animals in the same area which is monitored regularly for new weeds and pests.		
Newly purchased livestock isolated in a holding paddock for 10-14 days.		
Holding paddock regularly checked for new pests and weeds.		
All livestock movements onto and within the farm recorded in a stock diary.		
Boundary fences and gates maintained to prevent animals from straying on or off the property.		
Stray or potentially sick animals captured and isolated as soon as possible.		

Further information

More information on biosecurity, farm hygiene, pests and the grain industry can be found through the following sources.

Contact details	
ORGANISATION	
Grain Producers Australia	**Phone:** 0448 493 386 **Website:** www.grainproducers.com.au
Plant Health Australia	**Phone**: 02 6215 7700 **Email**: biosecurity@phau.com.au **Website**: www.planthealthaustralia.com.au
GOVERNMENT	
Australian Government – Department of Agriculture	**Phone**: 02 6272 3933 **Website**: www.agriculture.gov.au
New South Wales – Department of Primary Industries	**Phone**: 1800 680 244 **Website**: www.dpi.nsw.gov.au
Queensland – Department of Agriculture and Fisheries	**Phone**: 13 25 23 or 07 3404 6999 **Website**: www.daf.qld.gov.au
South Australia – Department of Primary Industries and Regions SA	**Phone**: 08 8207 7900 **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 Jobs, Precincts and Regions	**Phone**: 13 61 86 **Website**: www.djpr.vic.gov.au
Western Australia – Department of Primary Industries and Regional Development	**Phone**: 08 9368 3333 **Website**: www.agric.wa.gov.au

Grains Biosecurity Officers

State	Grains Biosecurity Officer	Phone	Email
NSW	Bill Gordon	02 6391 3275	billy.gordon@dpi.nsw.gov.au
QLD	Kym McIntyre	07 4529 1363	kym.mcintyre@daf.qld.gov.au
SA	Judy Bellati	08 8429 0746	judy.bellati@sa.gov.au
VIC	Jim Moran	03 5430 4479	jim.moran@ecodev.vic.gov.au
WA	Jeff Russell	08 9690 2229	jeff.russell@dpird.wa.gov.au

For more information about the Grains Farm Biosecurity Program email **biosecurity@phau.com.au** or visit **phau.com.au/gfbp.**

Farm Biosecurity Program

When deciding what actions to take, another helpful tool is the Farm Biosecurity Action Planner, which is available from **farmbiosecurity.com.au/toolkit**. The planner is for both crop and livestock producers, and explains the risks and actions to take to minimise the risks. The Farm Biosecurity website contains other resources such as videos, templates for records and signs, farm manuals for a wide range of industries, and personalised biosecurity toolkits. Go to **farmbiosecurity.com.au** for more information.

farmbiosecurity

secure your farm: secure your future

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 **farmbiosecurity.com.au**

EXOTIC PLANT PEST HOTLINE
1800 084 881

Pest surveillance record

It is important to record both the absence or presence of pests

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	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 **farmbiosecurity.com.au**

Sealed silo fumigation record

Supervisor's details (if applicable): _____

Applicator's details: _____

Name and location of fumigated silo: _____

Contents and approximate tonnage: _____

Pest ID/date found	Half-life press test	Silo capacity (m³ or tonnes of wheat when full)	Treatment product information				Fumigation			Ventilation		Withholding period (days)	Date of treatment residues removal	Date(s) of follow up inspection for insects
	Time for 25-12.5 mm drop in relief valve fluid levels		Treatment product/type (tablets, bag chains, etc.)	Application method/ location	Grain temperature (°C)	Dose/treatment quantity applied	Start date	Monitoring of fumigation levels (date/time/result (ppm))	End date	Ventilation type (natural or forced aeration)	Start date/end date			

An electronic version can be downloaded from the Farm Biosecurity website **farmbiosecurity.com.au**

Machinery biosecurity record

Machine identification (make, model, registration etc.): _____

Crop that the machine last worked in (please tick)									
Barley		Common (navy) bean		Linseed (flax)		Oats		Soybean	
Canary seed		Cowpea		Lupin		Peanut		Sunflower	
Canola		Faba bean		Maize		Pigeon pea		Triticale	
Cereal rye		Field pea		Millet		Safflower		Vetch	
Chickpea		Lentil		Mung bean		Sorghum		Wheat	

Other (Please specify): _____

List any noxious weeds known to be present at the previous property:

_____

_____

List any pests or diseases known to be present at the previous property:

_____

Was the machine washed down before it left the previous property?:

Yes ☐ No ☐

Name of operator: _____

Signature: _____

Date: _____

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

An electronic version can be downloaded from the Farm Biosecurity website **farmbiosecurity.com.au**

EXOTIC PLANT PEST HOTLINE
1800 084 881

Pests

There are more than 600 exotic pests identified that pose a threat to Australia's grain industry. The following exotic pests would pose particularly serious threats to the Australian grains industry if they enter and become established.

Exotic pest threats to the grains industry

Make sure that you and your staff are familiar with these pests. Suspicious pests or disease symptoms should be reported to the Exotic Plant Pest Hotline on 1800 084 881 or to your state or territory department of agriculture.

Additional information, including fact sheets, about these and other exotic pests of grain are available on the Plant Health Australia website **phau.com.au/industries/grains** and the Farm Biosecurity website **farmbiosecurity.com.au/crops/grains**.

Exotic pests of winter cereals

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

- Many of Australia's barley varieties could be susceptible.
- Damage to plants varies but losses can be up to 100%.
- Look for yellow stripes of fungal spores produced between veins of leaves. The disease can also form on barley heads.
- Spores can be spread by wind and rain, or on clothing, machinery and tools.
- Infection is often first noticed as patches of infected plants within the crop.
- Any stripe rust symptoms on barley should be reported.

Leaves take on a yellow colour under high levels of infection

Hessian fly (*Mayetiola destructor*) and barley stem gall midge (*Mayetiola hordei*)

- Larvae feed on leaves and stems of wheat and barley, resulting in leaf discolouration (leaves become darker green to blue-green, in seedlings new growth is yellow), stunted growth and reductions in grain yield and quality.
- Adults of both species are small (2-4 mm long) and look like mosquitoes.
- Larvae of both species feed on the base of plants under leaves. They are cylindrical, legless and grow up to 3-4 mm long.
- Causes cereal crop losses of up to 40%.
- There are no flies in Australia that attack cereal plants above ground that could be confused with these pests.
- Close to harvest, look for hessian fly pupa and puparium at the base of the plant. Hessian fly larvae are dark brown in colour, slightly tapered in shape and look like flaxseeds.
- Direct feeding by barley stem gall midge causes the formation of pea-sized galls between the leaf sheath and stem.

Adult Hessian fly looks similar to barley stem gall midge

Brown flaxseed-like Hessian fly pupae lodged at the base of the plant

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

- New pathotypes have been identified that have overcome several stem rust resistance genes.
- Any new pathotype (such as Ug99) would cause an increase in the cost of wheat production by overcoming host resistance.
- Like other pathotypes of wheat stem rust, Ug99 causes elliptical blisters produced on stems, which break open to reveal a mass of rust coloured spores.
- Stem rust on known resistant varieties should be reported.

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

Remain observant for anything unusual in your crops and storage facilities.

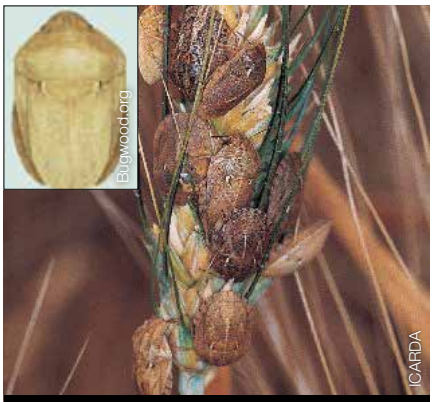
If a pest is found that is not normally present on your farm, it may be new not only to your farm, but to the region, state or even Australia.

Report anything unusual to the Exotic Plant Pest Hotline (1800 084 881).

Exotic pests of winter cereals (continued)

Sunn pest (*Eurygaster integriceps*)

- Attacks winter cereals, and occasionally sorghum and maize crops.
- Brown bug (12 mm long) with wide shield shaped body and a wide triangular head. Wings are completely hidden by a hardened 'shield'.
- Juveniles (nymphs) are rounder in shape and normally dark brown to black.
- Eggs are 1 mm in diameter, green and laid in rows on the leaves of the host plant.
- Colonies can be seen on cereal heads in spring.
- Look for yellowing and dieback of the stem and leaves, stunting, white heads and abnormal flower formation and discoloration.
- As it feeds it injects the plant with enzymes that cause grain abortion and damages gluten, lowering flour quality.
- Feeding before grain development can result in grain abortion. Feeding after grain development results in shrivelled, discoloured (white) or empty grains.



Sunn pests clustered on wheat head. Adult sunn pest (inset)

Wheat stem sawflies (*Cephus pygmeus* and *C. cinctus*)

- Serious insect pest of winter cereals and grasses.
- The wheat stem sawfly (*Cephus cinctus*) is found in North America and Kazakhstan.
- The European wheat stem sawfly (*Cephus pygmaeus*) is found in Asia, Europe and North America.
- Adults lay eggs in the stems where larvae feed, filling the stems with frass leading to lodging.
- Adults are short lived wasps. Both species are black with yellow stripes. The European wheat stem sawfly is 8–10 mm long and the wheat stem sawfly is 7–12 mm long.
- Wheat stem sawflies are spread primarily through movement of infested cereal straw as adults do not fly long distances.

Wheat stem sawfly larvae. Adult wheat stem sawfly Cephus cinctus (inset)

Recently detected in Australia

Russian wheat aphid (*Diuraphis noxia*)

- Primary hosts are wheat and barley but can attack most cereal crops.
- In 2016 Russian wheat aphid (RWA) was confirmed as present in some states of Australia.
- If detected in new areas, it should be reported to the Exotic Plant Pest Hotline.
- Observe the GRDC FITE Strategy: Find, Identify, Thresholds, Enact.
- Look for plant symptoms together with the presence of aphids.
- RWA is a light-green, elongated aphid up to 1.8 mm long. Adults can be winged or wingless and have two structures at the end of the abdomen giving the appearance of a double tail.
- Plant symptoms:
  - White, yellowish and purple/red streaks along leaves
  - Leaf rolling
  - Awns trapped by rolled flag leaf
  - Bleached appearance of heads.

Wingless adult Russian wheat aphid showing slim shape and 'double tail'

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

Exotic pests of canola

Cabbage seedpod weevil (*Ceutorhynchus assimilis* (Syn. *C. obstrictus*))

- Major pest of canola overseas. Will also feed on other Brassica crops such as mustards and cabbages.
- Adults are 3 mm in length with a matt grey body and greyish-black legs. They have a distinctive long, downward-curved snout (rostrum).
- Larvae are 5 mm long, creamy white with a yellow-brown head.
- Adults feed on stem, buds and developing pods causing crop damage (e.g. bud blasting).
- Larvae feed inside the pods and can cause yield reduction of up to 40%.
- Look for lightened flecks on the outside of the pod following larvae feeding.
- On mature pods look for pinhead sized exit holes surrounded by discoloured areas.
- Adults may be seen feeding on the flowers, stem, buds and developing pods.
- Looks similar to vegetable weevils but can be distinguished by its small size, elongated downward-curved snout and larva feeding inside pods.

Side view of cabbage seedpod weevil showing long downward curved snout and whitish lines

Larvae in a seed pod showing the feeding damage

Cabbage stem weevil (*Ceutorhynchus pallidactylus*) and Rape stem weevil (*Ceutorhynchus napi*)

- Serious pests of Brassica species resulting in losses of up to 30% in Europe.
- The larvae of the cabbage stem weevil (*Ceutorhynchus pallidactylus*) feeds inside canola, Indian mustard, radish, white mustard, sea kale and field penny cress stems.
- Rape stem weevil (*Ceutorhynchus napi*) larvae feed inside canola stems.
- Larvae of both species are white in colour with yellow heads and are up to 8 mm long.
- The adults of both species are small (less than 4 mm) dark grey to brown beetles.
- Plants infested with these weevils show symptoms such as stem distortion and splitting, loss of vigour, leaf loss, delayed flowering, lodging and holes where the larvae exit the stems to pupate in the soil.

Damage caused by rape stem weevil. Note stem splitting (arrow)

Exotic leaf miners (Family Agromyzidae)

- Agromyzidae is a family of small flies whose larvae feed internally on living plant tissue. There are exotic leaf miners in the *Agromyza, Cerodontha, Chromatomyia, Liriomyza, Phytomyza* and *Pseudonapomyza* genera that affect pulses, canola, sunflower and cereals.
- Infestations can cause significant damage and yield losses.
- Total crop losses can occur due to a combination of larval mining and leaf puncturing caused by females ovipositing and feeding.
- Adult leaf miners are up to 2 mm in length, predominantly black-grey in colour and some have a bright yellow marking on the base of the thorax.
- Larvae are legless, up to 3 mm in length and cream-yellow in colour.
- Larvae mostly feed internally on leaves and stems creating a tunnel or mine. Any suspect mining should be sent for identification.

Symptoms of exotic pea leaf miner (C. horticola) on pea leaves. Adult pea leaf miner (inset)

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

EXOTIC PLANT PEST HOTLINE
1800 084 881

Exotic pests of pulses

Bruchids (sub-family: Bruchinae)

- There are over 200 pest species in the Bruchinae sub-family including species in the *Acanthoscelides*, *Bruchus*, *Bruchidius*, *Callosobruchus*, *Caryedon* and *Zabrotes* genera. Several species are present in Australia, many are exotic.
- Larvae feed inside seeds causing reduced seed quality, germination and yields.
- *Bruchus* and *Bruchidius* species don't reproduce on stored grain and infestations don't persist in storage.
- *Callosobruchus*, *Acanthoscelides*, *Caryedon* and *Zabrotes* species can breed on stored grain and cause significant losses.
- Bruchids are small (1.5-4.5 mm long), globular, triangular or tear-drop shaped beetles that feed on seeds, especially legume seeds.
- Adults are usually dull coloured with white, red or black markings. They have wing covers that do not cover the entire abdomen.
- Larvae are up to 3 mm long, white or cream coloured and feed inside seeds.
- Look for round exit holes made by the insect as it left the seed.
- If you see bruchids that you are not familiar with contact an agronomist for identification.

Wing covers do not fully cover abdomen, small size and globular body shape, typical of bruchids

Exotic mexican bean weevil (Zabrotes subfasciatus) damage on common (navy) bean

Fusarium wilt of chickpea (*Fusarium oxysporum* f. sp. *ciceris*)

- Primarily affects chickpeas, but also pigeon peas, lentils and field peas.
- Causes wilting and stunting. Sometimes wilting does not occur and symptoms instead involve yellowing and drying of the lower leaves. Symptoms can develop anytime from seedling to podding stages.
- Roots appear healthy but when split vertically they show a brown discolouration of the internal tissues.
- Causes up to 60% yield losses overseas.
- The disease is caused by a soil-borne fungus that can survive in the soil without a host for many years.
- While wilting can be caused by a number of seedling and root diseases, wilting together with root tissue discolouration are key symptoms of the disease.

Yellowing symptoms of a chickpea plant affected by Fusarium wilt. Vascular damage on infected plant (left) compared to healthy plant (right) (inset)

Lentil anthracnose (*Colletotrichum truncatum*)

- The lentil strain of the pathogen also attacks faba beans and vetch.
- First symptoms are green-white lesions on the leaves that appear a week before flowering. These develop into brown lesions, followed by leaf drop.
- Brown lesions also form on the stems. Over time the stem lesions will girdle the stem, causing wilting and sometimes plant death. Older lesions will form black pinhead-sized structures (microsclerotia) making the stems blacken.
- Causes 60-70% yield losses overseas.
- Lesions and wilting can be easily confused with other pests, such as grey mould (*Botrytis cinerea*) and Stem rot (*Sclerotinia sclerotiorum*). Plants killed by Lentil anthracnose can be distinguished by their blackened stems.

Early infection on lentil leaf. Close up of stem lesion showing black microsclerotia (inset)

Lupin rust (*Uromyces lupinicola* and *U. renovatus*)

- Lupin rusts are major fungal pests of lupins overseas.
- Severe infections can build up rapidly when conditions are wet, causing wilting and defoliation.
- Lupin rust would have a serious economic impact if it established in Australia.
- The first sign of infection is small light coloured spots that grow and become brown in colour, often surrounded by a lighter coloured halo (which distinguishes it from endemic brown spot (*Pleiochaeta setosa*)).
- Look for characteristic brown spots surrounded by lighter coloured halos on the leaves of lupins. Symptomatic plants should be reported.

Brown spots surrounded by pale halo are signs of lupin rust

Soybean cyst nematode (*Heterodera glycines*)

- One of the most damaging pests of soybean worldwide.
- Hosts include soybean, common (navy) bean, vetch, lupin and some clovers.
- Complete crop losses can occur overseas.
- Causes stunting, yellowing, poor canopy closure, reduced seed size and yield. Heavy infections can cause plant death.
- Usually appears as patches of underperforming plants in the paddock.
- Patches of severely affected plants are often spread in the direction of tillage as cysts are dragged through the soil.
- Roots of infected plants are dark coloured, poorly developed and often have reduced nodulation. Tiny white cysts can be seen on roots 4-5 weeks after planting.

Soybean cyst nematode can cause patches of stunted and yellow plants. Cysts (inset)

Sudden death syndrome of soybean (*Fusarium* spp.)

- Serous fungal disease of soybean.
- Caused by four different fungal species in South America (*Fusarium virguliforme*, *F. brasiliense*, *F. cuneirostrum* and *F. tucumaniae*) and one in the United States (*F. virguliforme*).
- Infection causes yield losses of up to 80%.
- Foliar symptoms include interveinal chlorosis followed by necrosis. Leaflet death where the petiole remains attached is also common.
- Infection causes a browning of the vascular tissue in the lower part of the stem.
- Infected root systems are less vigorous and, in advanced cases, are covered in pale blue spore patches.

Root system of plant affected by sudden death syndrome (arrow). Note the patches of pale blue spores. Interveinal chlorosis and necrosis (inset)

Uromyces pea and lentil rusts

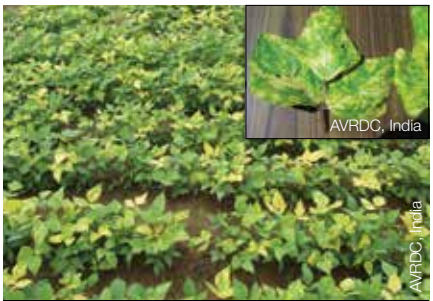
- The Uromyces pea and lentil rusts are major fungal pests affecting lentils, field peas, faba beans, vetch and other legumes.
- *Uromyces pisi* is not present in Australia and would likely cause yield losses in field peas.
- *Uromyces viciae-fabae* occurs in Australia on faba beans and vetch but not on field peas or lentils. If a pea or lentil strain was to enter Australia it would impact on the yield potential of both crops.
- First appears as minute spots that are whitish and slightly raised. Over time they enlarge and change to an orange-brown colour, often surrounded by a light coloured halo.
- Look for spots on leaves, stems and pods.
- If symptoms are seen on field peas or lentils, a sample should be sent for further testing to identify the species.

Older infection on faba bean. Note rust coloured spores and halos

Uromyces viciae-fabae infected leaves

Mungbean yellow mosaic virus (*Begomovirus*)

- Affects mungbean, black gram, pigeon pea, soybean, cowpea and common (navy) bean.
- Infected plants produce fewer flowers and pods. Any pods produced tend to be small, mottled, contain fewer and smaller seeds, curl upwards and mature later.
- Symptoms first appear as scattered yellow specks on the leaves. As the disease progresses the leaves show irregular green and yellow patches. New leaves may emerge completely yellow. Green areas on the leaf often become raised and the leaf may become papery white and thin.
- It is spread between plants by the silverleaf whitefly (*Bemisia tabaci*) which is in Australia.



Infected plants. Close up of infected leaf showing green and yellow mottling (inset)

Exotic pests of summer grains

Chinch bug (*Blissus leucopterus*)

- Serious pest of sorghum and maize crops in North and South America. Seedlings are most susceptible to injury.
- It feeds by sucking sap from plant stems and roots, weakening plants and causing stunting, lodging, wilting and sometimes plant death.
- Older plants may display reddish feeding marks behind leaf sheaths and reddish or yellowish streaking on the leaves.
- Adults are 4 mm in length, black with reddish legs, milky white wings and have a black triangular spot on the middle of their outer wing margin.
- Nymphs resemble adults in shape but are red to reddish-orange when first hatched, turning brown to black in colour and developing a white band across the back as they mature.
- Chinch bugs often aggregate and cluster in groups. Look for wilted or dead leaves at the growing point.

Chinch bug aggregation under sorghum leaf. Diagram showing nymphs and adults, with predator and size reference (inset)

Sorghum downy mildew (*Peronosclerospora sorghi*)

- Serious fungal disease of sorghum and maize.
- Occurs in most tropical and sub-tropical areas.
- Infected seedlings become stunted and chlorotic (yellow). Older leaves display yellow-green stripes. The chlorotic stripes eventually die and leaves become shredded. Under humid conditions the underside of the leaves may become covered in a white downy growth.
- Local infection symptoms are less dramatic, with short necrotic streaks (stipples) produced on leaf blades.
- Heads produced by infected plants are fully or partially sterile.
- Causes up to 30% yield losses.

Systemic infection causing chlorosis and necrosis. Underside of maize leaf with downy growth (inset)

Sorghum greenbug (*Schizaphis graminum*)

- A major aphid pest of sorghum and over 70 grass species, including major grain and cereal crops.
- Adults are 1.6 mm in length. Pale green to yellow coloured with a darker green stripe along their back.
- Whilst feeding, aphids inject salivary toxins into plant tissue causing red-brown spots on the leaves. Heavy infestations cause leaves to yellow and die. Infestations lead to smaller kernels and reduced yield.
- Damage can occur during the seedling phase, but most damage is likely to occur during the reproductive phase of the crop.
- Look for colonies on the underside of leaves, especially of underperforming plants. Also look for the presence of honey dew and sooty mould.
- This aphid can also spread a number of plant viruses.

Leaf discolouration typical of greenbug infestation

Stewart's disease of maize (*Pantoea stewartii*)

- Serious bacterial disease of corn in North and South America. Infection of seedlings results in a systemic infection and infection of older plants results in a leaf blight.
- Spread by an exotic insect vector (Corn flea beetle, *Chaetocnema pulicaria*) and seed transmission has also been demonstrated.
- Symptoms include water soaked lesions around insect vector feeding site followed by foliar chlorotic streaks parallel to the veins in some cases spanning the entire length of the leaf. Systemically infected plants can also develop a soft rot in the pith and growing point and copious tiller growth.
- Grain maize is less susceptible than sweet corn varieties.

Soft rot of the pith caused by Stewart's disease

Western corn rootworm (*Diabrotica virgifera*)

- Serious pest of maize causing economic losses in the United States. This pest is also found in central and eastern Europe.
- Larvae predominantly feed on the roots of maize but some strains also feed on soybean.
- Adult beetles feed on the above ground parts of maize, soybean, wheat and sunflower.
- Larvae are white to pale yellow with a brown head and a brown spot on top of the last segment of the abdomen.
- Adults are small to medium (5.5-7.5 mm in length) yellow and black beetles with three black stripes along the wing covers, differing in pattern between males and females.
- Most of the damage to crops is caused by the larvae feeding on the root system leading to plant stunting, lodging, 'goosenecking' and tillering.
- Adults feed predominantly on leaves, pollen and kernels.

Larvae of the western corn rootworm

Adult female (left) and male (right) western corn rootworms

Witchweed (*Striga* spp.)

- Parasitic weeds of grain (especially summer crops) and sugar crops.
- Some species can cause up to 70% yield losses overseas.
- Plants are short (30 cm tall) and spindly with colourful (white, red, yellow or pink) flowers.
- Witchweed has a large swollen root system that attaches to the host plant's roots by swellings (haustorium).
- Due to the parasitic nature of witchweed, host plant symptoms are often seen before the witchweed emerges from the ground.
- Infected plants wilt, become stunted and leaves turn yellow.
- Look for host symptoms such as yellowing leaves, wilting and stunted growth and the presence of witchweed plants (which may emerge after symptoms are first noticed).

Drought-like symptoms in a maize crop caused by witchweed (S. hermonthica)

Exotic pests of sunflower

Sunflower downy mildew (*Plasmopara halstedii*)

- Serious Oomycete foliar disease of sunflowers resulting in losses of up to 40%. Also causes disease in other members of the daisy family (Asteraceae).
- First reported in the United States and has since been found in all major sunflower producing countries, except Australia.
- Disease causes chlorosis on upper leaf surfaces which generally start along the veins and spread outwards. Patches of white spores and fluffy white growth develop on the underside of leaves. Infected plants have stunted growth.
- The pathogen causes damping off of seedlings.
- One type of spore (oospores) is dispersed in crop debris and soil (including contaminated vehicles, machinery and shoes) and can also be carried on seed from infected plants. Another spore type (zoospores inside sporangia) is wind dispersed over short distances resulting in localised spread.

Patches of white spores developing on the underside of an infected leaf

Sunflower moth (*Homoeosoma electellum*)

- The Sunflower moth is a significant pest of oilseeds such as canola and sunflower in North, Central and South America.
- This species lays its eggs in flowers where the larvae feed on pollen then the developing seeds.
- The adult Sunflower moth is a small (8-12 mm long), pale tan to cream coloured moth usually with speckled forewings. At rest the wings are held close to the body giving a cigar shaped appearance.
- Larvae are hairless, 19-25 mm long caterpillars with a brown head and alternating reddish-brown and cream coloured stripes.

Sunflower moths on sunflower head. Sunflower moth larvae (inset)

Sunflower stem weevil (*Cylindrocopturus adspersus*)

- Serious insect pest of sunflowers in North America.
- The female lays eggs in the sunflower stem, where they hatch and the larvae feed damaging the vascular tissue and causing lodging.
- Symptoms in infested plants include decreased vigour, small holes at the base of the stem from the female piercing the stem to lay eggs and lodging.
- Juveniles are creamy coloured, legless, up to 6 mm in length, generally C-shaped and have brown heads.
- Adults are grey/brown with white spots along the wing covers and 4-5 mm long with a dark head.
- Pupae are 4-5 mm long and yellow in colour.
- Sunflower stem weevils are vectors for the endemic fungal disease charcoal rot (*Macrophomina phaseolina*).

Adult sunflower stem weevil with spots along wing covers. Larva (inset). Note the curled C-shape

Common pests of stored grain

The following pests are those you might find in stored grain in Australia.

Being familiar with common pests that occur in your area allows you to choose control methods effectively, and helps you to recognise any new pests. Pests may not only be new to your property, but also to the region, the state or the country. For further information please see the Monitoring stored grain on farm booklet available from the Plant Health Australia website **phau.com.au/gfbp**.

Angoumois grain moth (*Sitotroga cerealella*)

Flat grain beetle (*Cryptolestes* spp.)

Booklice (*Liposcelis* spp.)

Indian meal moth (*Plodia interpunctella*)

Cowpea weevil (*Callosobruchus* spp.)

Lemon-scented mites (*Tyrophagus putrescentiae*)

Lesser grain borer (*Rhyzopertha dominica*)

Rust red flour beetle (*Tribolium castaneum*)

Pea weevil (*Bruchus pisorum*)

Saw-toothed grain beetle (*Oryzaephilus surinamemsis*)

Rice weevil (*Sitophilus oryzae*)

Warehouse moth (*Cadra cautella*)

Exotic pests of stored grain

There are a number of pests in other countries that affect stored grain. Two, Karnal bunt and khapra beetle, are of greatest concern to Australia's grain industry as they not only cause significant damage but can impact on Australia's ability to access some international markets.

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

Karnal bunt (*Tilletia indica*)

- Affects wheat, durum and triticale.
- Reduces grain quality and affects market access.
- Infected grain has a distinct fishy smell.
- Infections range from pinpoint sized spots to thick black spore masses along the grain's groove.
- Parts of infected seeds are blackened and crush relatively easily.
- Detection in the paddock is difficult, as usually only a few seeds in each head are affected. Most easily seen in harvested grain.
- Karnal bunt looks and smells very similar to common bunt (which is in Australia). However, common bunt affects entire heads and seeds while Karnal bunt usually affects only portions of some seeds in the head.

Karnal bunt affected wheat head. Blackened and hollow grain resulting from Karnal bunt infection (inset)

Khapra beetle (*Trogoderma granarium*)

- Serious pest of stored grain and dry foodstuffs.
- Presence will impact on market access.
- Infested grain becomes contaminated with beetles, cast skins and hairs from larvae.
- Can cause losses of up to 75% from direct feeding.
- Adults are small (2-3 mm long), brownish coloured beetles with three transverse bands (markings) of pale coloured hairs on the wing covers.
- Larvae are up to 7 mm long, hairy and reddish-brown coloured.
- Adults do not fly and are spread in infested material.
- When examining grain samples, characteristic hairy larvae and cast skins are the most likely stage that will be seen.
- Insects fitting the description of khapra beetles should be reported immediately.

Khapra beetle adult, larvae and cast skins in stored grain. Adult khapra beetle (inset)

Chris Warrick, ProAdvice

Plant Health AUSTRALIA

EXOTIC PLANT PEST HOTLINE
1800 084 881

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