INDUSTRY BIOSECURITY PLAN
FOR THE GRAINS INDUSTRY

Threat Specific Contingency Plan

Leaf spot of field peas

Alternaria humicola

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Plant Health AUSTRALIA

GRDC Grains Research & Development Corporation

CRC PLANT biosecurity

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1 Purpose of this Contingency Plan

This Contingency Plan provides background information on the pest biology and available control measures to assist with preparedness for an incursion into Australia of leaf spot of pea caused by the fungal pathogen *Alternaria humicola*. It provides guidelines for steps to be undertaken and considered when developing a Response Plan to this pest. Any Response Plan developed using information in whole or in part from this Contingency Plan must follow procedures as set out in PLANTPLAN and be endorsed by the National Management Group prior to implementation.

2 Pest information/status

2.1 Pest details

Alternaria humicola Oudemans

Leaf spot of field pea

2.1.1 General information

Taxonomic position – Phylum: Ascomycota; Class: Ascomycetes; Order: Pleosporales; Family: Pleosporaceae

Leaf spot of field pea (*Alternaria humicola*) is a fungal disease which infects a small number of grain legume species. Infection of host plants occurs through seed borne transmission or planting into infected soil, where rain splash or leaves coming in direct contact with the soil leads to infection.

Infected plants present symptoms starting as small lesions on the leaves and seed pods of peas and beans, which grow in size over time. Under heavy pathogen load the infection and symptoms can spread to the stems and pods where it can have a detrimental effect on seed quantity and quality.

There is very little information on *A. humicola* as a plant pathogen and indeed whether Koch's postulates have been satisfied for it being a pathogen of peas and other legumes. *"A. humicola"* has been frequently found in soils, river sands and estuarine deposits, and on plant material. It has also been associated with fungal infections of humans. The confused nature of *Alternaria* taxonomy means that many of these records must be treated with caution and that it may not be the same fungus in all reports.

2.1.2 Disease cycle of *A. humicola*

No detailed studies of the disease cycle and epidemiology of *A. humicola* appear to have been done. The following disease cycle applies to some other Alternaria diseases and is a possible disease cycle for this leaf blight.

Inoculum, in the form of spores, either survives in the soil during absence of hosts or is carried on seeds. "*A. humicola*" has been isolated from soils, such as cropping soils in Israel (Joffe, 1963) and

old pastures in Oklahoma (England & Rice, 1957). Seed borne inoculum occurs with other Alternaria diseases; this multiplies and becomes established in the soil following planting, and it is from here that the pathogen infects the plant once it reaches a susceptible stage. Leaves become infected either through contact with the ground or through rain splash transfers to the lower leaves. From here the pathogen slowly transfers to other leaves.

Temperature conditions for *A. humicola* infection of peas are unknown. For *A. alternata* infection of peas, the optimum temperatures are 16–24°C with prolonged periods of high humidity (Hagedorn, 1984). *Alternaria* spores germinate on the surface of the leaves (both upper and lower) producing multiple germ tubes. These produce appressoria on the leaf surface and directly infect through the epidermis. Occasionally the infection occurs through the stomata.

Following penetration, hyphae grow through the leaf tissue both intra- and extra-cellularly. Hyphae infect cells directly beneath the epidermis and the parenchyma cells, flattening them, but will not infect vascular tissue. The flattening of the cells results in a substantial reduction in leaf thickness. Some *Alternaria* spp. produce non-host specific toxins that contribute to cell death and collapse, and the development of the lesions (e.g., *A. triticina*, Kumar & Rao, 1979a).

Sporulation of *Alternaria* spp. occurs abundantly in older lesions, with conidia disseminated by wind that provide secondary inoculum for disease spread. Conidia of *A. humicola* were found in air during the dry season over rice fields in India but not in the wet season (Uddin & Chakraverty, 1994).

Infections of wheat heads and pods of legumes and crucifers by Alternaria pathogens lead to seed infection, with seed-borne inoculum being primary inoculum to initiate infections in the next crop.

2.2 Affected hosts

2.2.1 Host range

Major host	*Pisum sativum* L.
Minor hosts	Other legumes

2.2.2 Geographic distribution

A. humicola, causing leaf spot of peas, has been reported from:

- Europe
    - Serbia, Montenegro

A. humicola, associated with fungal infections of fingernails and toenails (onychomycosis) of humans, has been reported from:

- Asia
    - India (Wadhwani & Srivastava, 1985).

A. humicola has been isolated from air, soils, river sands and estuarine sediments in:

- Asia
    - India (spore trapping from air, Srivastava & Wadhwani, 1992; leaf litter, Singh *et al.*, 1990)
    - Iraq (soil, Al-Doory *et al.*, 1959)

  - Israel (soil, Joffe, 1963)
  - Turkey (soil, Őner, 1974)
- North America
  - Georgia (soil, Miller *et al*., 1957)
  - Michigan (surface of fruit, White & Fabian, 1953)
  - North Carolina (estuarine sediment, Borut & Johnson, 1962)
  - Oklahoma (soil, England & Rice, 1957)
  - Tennessee (rare on vegetables, Webb & Mundt, 1978)
  - Wisconsin (river sand, Gochenaur & Backus, 1967)

(note: several other records from Northern Hemisphere from soil and plant surfaces)

2.2.3 Symptoms

Symptoms of *A. humicola* infection of peas are not available. However, the leaf blights caused by *A. alternata* has the following symptoms:

Leaf symptoms are oval lesions with concentric rings, typical of symptoms caused by *Alternaria* spp. on other crops. The lesions are 5–8 mm with indistinct borders. The tannish brown centre blends to pale green at the edge where it merges with healthy tissue. The pod lesions are tiny, brown, raised areas (Hagedorn, 1984).

2.3 Entry, establishment and spread

2.3.1 Entry potential

Rating: High

A. humicola is seed-borne on peas and other legumes. Thus, entry potential is high if seed of peas or other legumes were introduced from areas where the pathogen occurs. Such seed could enter as:

- direct imports of seed for breeding purposes or consumption
- contaminants in bulk commodities, agricultural machinery and some bulk feed grains
- inadvertent entry (intentional or unintentional) with travellers' goods

There is a high frequency of travel between areas in India but a low frequency of direct travel to eastern Europe, where the pathogen exists, and Australian farming areas.

2.3.2 Establishment potential

Rating: High

There is no information about the rate of seedling transmission. However, for Alternaria leaf blight of wheat, the rate of seed transmission is high. If this is similar for *A. humicola*, then infected seed sown in an area suitable for development of Alternaria leaf blight would have a high potential for establishing the pathogen.

2.3.3 Spread potential

Rating: Medium

Once established in Australia, the fungus could be readily spread with movement of infected seed. In addition, spores of *Alternaria* spp. are major components of the air-borne microflora, with *A. humicola* detected in the air over crops in India. Wind dispersal could move spores from infected crops to adjacent crops. Spores are unlikely to move long distances in air between non-contiguous pea areas.

2.3.4 Economic impact

Rating: Medium

Production: Alternaria leaf blight caused by *A. alternata* is a minor disease of peas (Hagedorn, 1984) and it is likely that *A. humicola* would also be a minor disease causing little loss in production.

Social: *A. humicola* has been associated with human infections. Its potential to cause disease, particularly in patients with compromised defence systems from diabetes or following transplant surgery, needs to be assessed to determine the potential social cost. This cost could be very high.

Trade: There are no specific requirements by any country regarding the freedom of *A. humicola*, but if the fungus was found in Australia, some countries may require specific declaration (see Appendix 4).

2.3.5 Environmental impact

Rating: Negligible

There is no potential to degrade the environment or otherwise alter the ecosystems by affecting plant species composition or reducing the longevity or competitiveness of wild hosts. However, in view of its potential as a human pathogen, there is a need to consider possible infection of animals.

2.3.6 Overall risk

Rating: Moderate[1]

2.4 Diagnostic information

2.4.1 Diagnostic protocol

Identification of *Alternaria* spp. requires considerable experience. Recent advances in understanding this large genus use morphology, toxin production and molecular analysis including sequencing (see Murray & Plant Health Australia, 2009). The wide range of habitats from which ~~"~~*A. humicola*" has been described in the earlier literature (see sections 2.1 and 2.2) suggest that new studies using current techniques may show that these belong to different species. It is particularly important to determine

[1] Although there is a high risk of introduction, the risks of economic loss are low

whether the fungus associated with human mycoses is the same as that associated with disease of peas and other legumes.

Figure 1 shows spores of the fungus isolated from human fingernails.

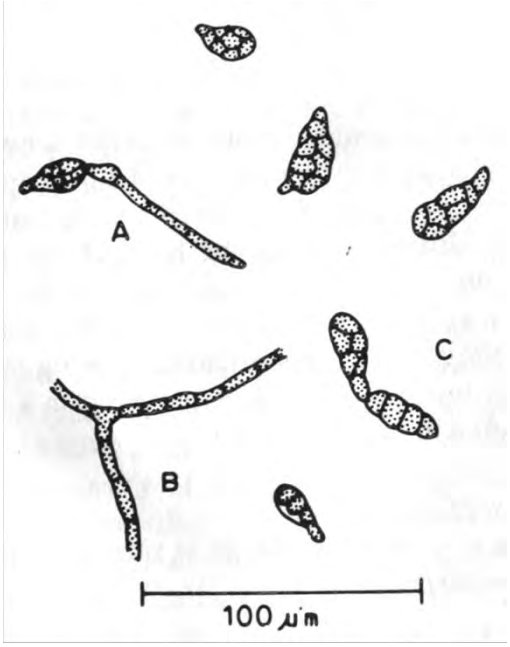

Figure 1. *Morphology of the conidia of A.humicola isolated from human nail. Figure taken from Wadhwani & Srivastava, 1985*

2.5 Response checklist

Guidelines for Response Checklists are still to be endorsed. The following checklist provides a summary of generic requirements to be identified and implemented within a Response Plan:

- Destruction methods for plant material, soil and disposable items
- Disposal procedures
- Quarantine restrictions and movement controls
- Decontamination and farm cleanup procedures
- Diagnostic protocols and laboratories
- Trace back and trace forward procedures
- Protocols for delimiting, intensive and ongoing surveillance
- Zoning
- Reporting and communication strategy

Additional information is provided by Merriman & McKirdy (2005) in the Technical Guidelines for Development of Pest Specific Response Plans.

2.6 Delimiting survey and epidemiology study

Delimiting surveys should comprise local surveys around the area of initial detection concentrating on areas to poor growth. The normal procedure is to collect symptomatic plants and to test them to confirm the presence of *Alternaria* sp. If confirmed, plants taken at random from the same crop should be tested to enable an estimate to be made of the disease incidence. Surrounding crops would then be surveyed. The extent of the survey beyond the initial infected crop should be guided by the test results from surrounding crops.

Seed trace-back and trace-forward will indicate how many seed lots and crops will need to be tested. If the seed used has been sown at several sites, delimiting surveys should be conducted at each site.

2.6.1 Sampling method

Once initial samples have been received and preliminary diagnosis made, follow up samples to confirm identification of the pathogen will be necessary. This will involve sampling directly from the infected crop, and sampling crops over a larger area to determine the extent of disease distribution. The total number of samples collected at this point may run into the hundreds or even thousands. It is vital that a system of sample identification is determined early in the procedure to allow for rapid sample processing and accurate recording of results. Follow up samples will be forwarded to the nominated diagnostic laboratories for processing.

Samples should be initially collected over a representative area of the infected crop to determine the disease distribution. Depending on the stage of infection the symptoms may appear as (see Section **Error! Reference source not found.** for full details):

- Plants with leaf lesions
- Plants with premature defoliation
- Patches of plants dying within the crop

It is important to note the distribution of disease in the initial crop, as this will indicate whether the disease has been seed-borne, carried on trash from adjacent paddocks or originated from contaminated machinery or human movement.

It is vitally important that all personnel involved in crop sampling and inspections take all precautions to minimise the risk of disease spread between crops by decontaminating between paddocks.

Any personnel collecting leaf samples for assessment should notify the diagnostic laboratory prior to submitting samples to ensure expertise is available to undertake the diagnosis. General protocols for collecting and dispatching samples are available within PLANTPLAN, Appendix 3 (Plant Health Australia, 2008a).

2.6.1.1 NUMBER OF SPECIMENS TO BE COLLECTED

The initial outbreak will appear as small to larger lesions on plants in groups within the planting. These will be associated with spread from the initial seed-borne infection. If only a small area is affected, all plants with symptoms should be collected. If there are several foci of infection, collect up to 10 plants with a range of symptoms from up to 10 locations within the affected planting.

2.6.1.2 HOW TO COLLECT

Leaves are the main organ infected with *Alternaria* sp., however under heavy infection and humid conditions the fungus can infect leaf sheaths and seeds. Samples should be collected that represent a range of symptoms observed in the infected crop. Preferably enough material should be collected to allow for immediate processing and retention of a portion that can be placed into long term storage as a reference.

Samples should be treated in a manner that allows them to arrive at the laboratory in a fresh, well-preserved state. An esky with ice packs or portable fridge should be carried when sampling crops. Samples should be wrapped in damp newspaper, bundled into a plastic bag and clearly labelled.

Samples should be processed as quickly as possible after sampling from the field if sub cultures are to be made from infected tissue. Once removed from the field, fresh plant samples can deteriorate and become contaminated by other mould fungi and bacteria, which may prevent successful sub-culturing of the pathogen. Sub-culturing should be done within three to four days after sampling from the field. Infected plant tissue to be used for PCR analysis can be placed in a –80^{o}C freezer and stored for an indefinite period without damaging fungal DNA.

Long term storage of isolates can occur as fungal cultures that can be freeze dried for future reference (without loss of viability) or as deep frozen plant specimens maintained at –80^{o}C, which can be used to extract DNA.

It is important to record the precise location of all samples collected, preferably using GPS, or if this is not available, map references including longitude and latitude and road names should be recorded. Property and owners names should also be included where possible.

It is important that all diagnoses of suspected exotic and emergency pathogens are undertaken according to the following parameters:

- The laboratory diagnostician has expertise in this form of diagnosis
- The test is undertaken as described in Section 2.4.1
- The results are confirmed by diagnosis in another recognised laboratory or by another diagnostician
- Where possible diagnosis is confirmed by a second method

2.6.1.3 HOW TO PRESERVE PLANT SAMPLES

Infected plant samples should be stored in a cool moist environment when to be used for subculturing fungi, or frozen at -80°C for DNA analysis. See above for details.

2.6.1.4 HOW TO TRANSPORT PLANT SAMPLES

Suspect samples should be marked —Plant Sample for Urgent Diagnosis" and sent to the nearest diagnostic laboratory (see Appendix 2 for addresses).

Green plant samples should be wrapped in moist but not wet paper and placed in a suitable plastic bag. Grain samples need to be tightly packed into a plastic container (preferably) or in a plastic bag.

Double bag the samples and wipe the outside of the bag with alcohol and allow to dry before dispatching the sample to the laboratory.

Additional information including the detail of the sample date, location and site must be recorded on an accompanying sheet, together with all relevant paperwork. This information should be placed in a

plastic bag, on which is also written the summary details of the sample and the address, and included with the samples that are dispatched.

All samples should be dispatched using an overnight courier service or Express Post.

Important: Prior to dispatch, the Manager of the laboratory to which the sample is being consigned should be advised by telephone (not e-mail — a more direct advice than e-mail is required) of the expected arrival date. Special arrangements may need to be made for weekends. If the receiving laboratory is in another state, then a permit from AQIS is required for the movement of seed into that State. Check with the State or Local Pest and Disease Control Headquarters that approval has been granted.

See PLANTPLAN for further details of sampling and transport (Plant Health Australia, 2008a).

2.6.2 Epidemiological study

The number of infected plants within a crop will depend on the amount of inoculum available and whether conditions have been favourable for the disease to spread from initial foci.

Sampling of crops within a district and beyond will be based upon the origins of the initial suspect sample(s). Factors to consider will be:

- The source of seed used and how long that seed has been used by the grower
- If any other crops have been sown from the same source seed
- The proximity of other susceptible crops to the initial infected crop, both in the current growing season and previous season. This will include the growers own crops and those on neighbouring properties.
- What machinery or vehicles have been into the infected crop.
- The extent of human movements into the infected crop. A possible link to recent overseas travel or visitors from other regions should also be considered.

2.6.3 Models of spread potential

No detailed information on *A. humicola* is available. The following general comments about possible mechanisms of spread are derived from knowledge of other Alternaria diseases:

- Movement of infected seed. The pathogen has the potential to be transmitted as infected seed. Small infected fragments can also be carried within infested seed lots. Initial infections will be in small patches around the seed carrying the fungus, and these will be random within the planting.
- Mechanical transmission through movement on contaminated vehicles and machinery. The initial infections may be associated with the first point of entry into the field.
- Small fragments of plant debris and spores released from infested plant debris can be blown into surrounding paddocks during harvesting and allow the pathogen to move considerable distances away from the infected crop. The initial infections will usually show a gradient with highest incidence along the side of the planting closest to the source of inoculum.
- Fungal spores that adhere to clothing, machinery or animals can be carried large distances into other legume crops. The initial infections may be associated with the first point of entry into the field.

2.6.4 Pest Free Area (PFA) guidelines

Points to consider are:

- Design of a statistical delimiting field survey for symptoms on host plants (see section 2.6.1 for points to consider in the design).
- Plant sampling should be based on at least 100 plants taken at random from each crop.
- Seed sampling should be based on a minimum of 400 seeds as infection levels in seeds can be low.
- Surveys should also consider alternative hosts (see Section 2.2.1) and not be limited to the primary infected host.
- Survey around irrigation systems or waterways that may have transported spores. Also, the high humidity around these will provide the most likely conditions for infection.

Additional information is provided by the IPPC (1995) in Requirements for the Establishment of Pest Free Areas. This standard describes the requirements for the establishment and use of pest free areas as a risk management option for phytosanitary certification of plants and plant products. Establishment and maintenance of a PFA can vary according to the biology of the pest, pest survival potential, means of dispersal, availability of host plants, restrictions on movement of produce, as well as PFA characteristics (size, degree of isolation and ecological conditions).

2.7 Availability of control methods

2.7.1 General procedures for control

- Keep traffic out of affected areas and minimize movement in adjacent areas.
- Stop irrigating affected (irrigated crops) areas and use bunding to divert overland flood flows around them (both irrigated and dryland crops).
- Adopt best-practice farm hygiene procedures to retard the spread of the pest between fields and adjacent farms.
- After surveys are completed, destruction of the infected crop is an effective control.
- On-going surveillance of infected paddocks to ensure leaf spot is eradicated.
- Ensure that planting seed production does not take place on affected farms and do not use seed from these farms to plant next crop as leaf spot can be seed borne.
- Zero-tillage can be used to take advantage of the lower survival of *Alternaria* on the soil surface in comparison to plants buried in the soil.
- Do not grow susceptible plants in infected fields for at least two years following eradication of the disease.

2.7.2 Control if small areas are affected

Collect all plants in the area into bags and destroy by burning or burial. Do not sow any legumes in the area for two years.

2.7.3 Control if large areas are affected

A large area may become affected if a large quantity of infected seed has been widely distributed or if the disease has gone unnoticed for a number of years.

Implementation of large area controls will depend on the ability to determine the original source and track/trace the spread. It will also depend on whether the source is infected seed or another source (e.g., contaminated clothing or machinery). If the disease is found to be confined to a single seed lot and only found in a specific crop species, it may be possible to eradicate the disease by destroying all crops of that type in the region.

If eradication was attempted, there would need to be ongoing monitoring of infected paddocks to ensure there was no opportunity for the pathogen to re-establish on self sown plants.

2.7.4 Specific control for *A. humicola*

2.7.4.1 CULTURAL CONTROL

Hot water treatment and some fungicides reduce seed-borne inoculum of *A. triticina* on wheat (refer to Leaf blight of wheat contingency plan[2]).

2.7.4.2 HOST PLANT RESISTANCE

There are no reports of resistance to leaf blight of peas caused by the better studied *A. alternata* (Hagedorn, 1984) and no reports of resistance to *A. humicola*.

2.7.4.3 CHEMICAL CONTROL

Several fungicides are available to control *A. triticina* on wheat (refer to Leaf blight of wheat contingency plan) and these could be applied, if permits are sought, on peas.

2.7.4.4 MECHANICAL CONTROL

There are no mechanical controls for other Alternaria leaf spot and blight diseases.

2.7.4.5 BIOLOGICAL CONTROL

There are no reports of biological control for this disease.

[2] Available for download from the Plant Health Australia website (**www.planthealthaustralia.com.au/biosecurity/grains**)

3 Course of action – eradication methods

Additional information is provided by the IPPC (1998) in Guidelines for Pest Eradication Programmes. This standard describes the components of a pest eradication programme which can lead to the establishment or re-establishment of pest absence in an area. A pest eradication programme may be developed as an emergency measure to prevent establishment and/or spread of a pest following its recent entry (re-establish a pest free area) or a measure to eliminate an established pest (establish a pest free area). The eradication process involves three main activities: surveillance, containment, and treatment and/or control measures.

3.1 Destruction strategy

3.1.1 Destruction protocols

- Infected crops should be destroyed by burning and ploughing. This will prevent aerial dispersal of the pathogen via infected crop residues. Knockdown herbicides will not prevent some additional development of *A. humicola* on killed tissue since the fungus probably has good saprophytic ability. Dessication herbicides, while not reducing the fungus, would prepare the crop residues for burning.
- Disposable equipment, infected plant material or soil should be disposed of by autoclaving, high temperature incineration or deep burial
- Any equipment removed from the site for disposal should be double-bagged

3.1.2 Decontamination protocols

If containment, eradication and/or best practice hygiene measures are implemented, machinery, equipment, vehicles in contact with infected plant material or soil or present within the Quarantine Area, should be washed to remove soil and plant material using high pressure water or scrubbing with products such as a farm degreaser or a 1% bleach (available chlorine) solution in a designated wash down. General guidelines for wash down areas are as follows:

- Located away from crops or sensitive vegetation
- Readily accessible with clear signage
- Access to fresh water and power
- Mud free, including entry and exit points (e.g. gravel, concrete or rubber matting)
- Gently sloped to drain effluent away
- Effluent must not enter water courses or water bodies
- Allow adequate space to move larger vehicles
- Away from hazards such as power lines
- Waste water, soil or plant residues should be contained (see PLANTPLAN 2008b Appendix 18)
- Disposable overalls and rubber boots should be worn when handling infected soil or plant material in the field. Boots, clothes and shoes in contact with infected soil or plant material should be disinfected at the site or double-bagged to remove for cleaning

- Skin and hair in contact with infested plant material or soil should be washed

3.1.3 Priorities

Specific priorities for eradication:

- Confirm the presence of the pathogen
- Prevent movement of vehicles and equipment through affected areas
- Priority of eradication/decontamination of infected host material
- Determine the extent of infection through survey and seed trace back
- Stop the movement of any seed that may be infected with the pathogen

3.1.4 Plants, by-products and waste processing

- Seeds harvested from infected plants and any soil or infected plant material removed from the infected site should be destroyed by (enclosed) high temperature incineration, autoclaving or deep burial (in a non-cropping area)
- As the pathogen can be mechanically transmitted, killed crops should be ploughed in or burnt
- Infested paddocks should remain free of susceptible host plants until soil has been shown to be free from the pathogen

3.1.5 Disposal issues

- Particular care must be taken to minimize the transfer of infected soil or plant material from the area
- Raking infected crops is not an option as this procedure is likely to spread the pathogen greater distances during the raking process
- No particular issues with resistance of disease to chemicals or physical treatments are known to exist

3.2 Quarantine and movement controls

3.2.1 Quarantine priorities

- Plant material and soil at the site of infection to be subject to movement restrictions
- Machinery, equipment, vehicles and disposable equipment in contact with infected plant material or soil to be subject to movement restrictions
- Harvesting of infected crops should be prevented as the dust created during harvesting can spread the disease to neighbouring areas

3.2.2 Movement control for people, plant material and machinery

Movement of people, vehicle and machinery, from and to affected farms, must be controlled to ensure that infected soil or plant debris is not moved off-farm on clothing, footwear, vehicles or machinery. This can be achieved through:

- Signage to indicate quarantine area and/or restricted movement in these zones
- Fenced, barricaded or locked entry to quarantine areas
- Movement of equipment, machinery, plant material or soil by permit only
- Clothing and footwear worn at the infected site should either be double-bagged prior to removal for decontamination or should not leave the farm until thoroughly disinfected, washed and cleaned
- Hay, stubble or trash must not be removed from the site
- All machinery and equipment should be thoroughly cleaned down with a pressure cleaner prior to leaving the affected farm. The clean down procedure should be carried out on a hard surface, preferably a designated wash-down area, to avoid mud being re-collected from the affected site onto the machine (see Section 3.1.2)
- Seed from the affected site should not be used for planting new crops, feeding stock or for human consumption

3.3 Zoning

The size of each quarantine area will be determined by a number of factors, including the location of the incursion, biology of the pest, climatic conditions and the proximity of the infected property to other infected properties.

3.3.1 Destruction Zone

The size of the destruction zone (i.e. zone in which the pest and all host material is destroyed) will depend on the ability of the pest to spread, distribution of the pest (as determined by delimiting surveys), time of season (and part of the pest life cycle being targeted) and factors which may contribute to the pest spreading.

The entire crop or pasture should be destroyed after the level of infestation has been established. The delimiting survey will determine whether or not neighbouring host crops are infested and need to be destroyed. The Destruction Zone may be defined as contiguous areas associated with the same management practices as the infested area (i.e. the entire trial, paddock or farm if spread could have occurred prior to the infestation being identified).

Particular care needs to be taken to ensure that soils and plant material are not moved into surrounding areas not showing symptoms of disease, as eggs or larvae can remain on seedlings and pupae can sometimes remain in the soil.

3.3.2 Quarantine Zone

The Quarantine Zone is defined as the area where voluntary or compulsory restraints are in place for the affected property(ies). These restraints may include restrictions or movement control for removal of plants, people, soil or contaminated equipment from an infected property.

3.3.3 Buffer Zone

A Buffer Zone may or may not be required depending on the incident. It is defined as the area in which the pest does not occur but where movement controls or restrictions for removal of plants, people, soil or equipment from this area are still deemed necessary. The Buffer Zone may enclose an infested area (and is therefore part of the Control Area) or may be adjacent to an infested area.

3.3.4 Restricted Area

The Restricted Area is defined as the zone immediately around the infected premises and suspected infected premises. The Restricted Area is established following initial surveys that confirm the presence of the pest. The Restricted Area will be subject to intense surveillance and movement control with movement out of the Restricted Area to be prohibited and movement into the Restricted Area to occur by permit only. Multiple Restricted Areas may be required within a Control Area.

3.3.5 Control Area

The Control Area is defined as all areas affected within the incursion. The Control Area comprises the Restricted Area, all infected premises and all suspected infected premises and will be defined as the minimum area necessary to prevent spread of the pest from the Quarantine Zone. The Control Area will also be used to regulate movement of all susceptible plant species to allow trace back, trace forward and epidemiological studies to be completed.

3.4 Decontamination and farm clean up

Decontamination practices are aimed at eliminating the pest thus preventing its spread to other areas.

3.4.1 Decontamination procedures

General guidelines for decontamination and clean up:

- Refer to PLANTPLAN (Plant Health Australia, 2008b) for further information
- Keep traffic out of affected area and minimize it in adjacent areas
- Adopt best-practice farm hygiene procedures to retard the spread of the pest between fields and adjacent farms
- Machinery, equipment, vehicles in contact with infected plant material or soil or present within the Quarantine Area, should be washed to remove soil and plant material using high pressure water or scrubbing with products such as a detergent, a farm degreaser or a 1% bleach solution in a designated wash down area as described in 3.1.2

3.4.2 General safety precautions

For any chemicals used in the decontamination, follow all safety procedures listed within each MSDS.

3.5 Surveillance and tracing

3.5.1 Surveillance

Detection and delimiting surveys are required to delimit the extent of the outbreak, ensuring areas free of the pest retain market access and appropriate quarantine zones are established.

Initial surveillance priorities include the following:

- Surveying all host growing properties in the pest quarantine area.
- Surveying all properties identified in trace-forward or trace-back analysis as being at risk.
- Surveying all host growing properties that are reliant on trade with interstate or international markets which may be sensitive to presence of *Alternaria* sp.
- Surveying commercial nurseries selling at risk host plants (if applicable)
- Surveying other host growing properties and backyards

3.5.2 Survey regions

Establish survey regions around the surveillance priorities identified above. These regions will be generated based on the zoning requirements (see Section 3.3), and prioritised based on their potential likelihood to currently have or receive an incursion of this pest. Surveillance activities within these regions will either allow for the area to be declared pest free and maintain market access requirements or establish the impact and spread of the incursion to allow for effective control and containment measures to be carried out.

Steps outlined in Table 1 form a basis for a survey plan. Although categorised in stages, some stages may be undertaken concurrently based on available skill sets, resources and priorities.

Table 1. *Phases to be covered in a survey plan*

Phase 1	• Identify properties that fall within the buffer zone around the infested premise • Complete preliminary surveillance to determine ownership, property details, production dynamics and tracings information (this may be an ongoing action)
Phase 2	• Preliminary survey of host crops in properties in buffer zone establishing points of pest detection
Phase 3	• Surveillance of an intensive nature, to support control and containment activities around points of pest detection
Phase 4	• Surveillance of contact premises. A contact premise is a property containing susceptible host plants, which are known to have been in direct or indirect contact with an infested premises or infected plants. Contact premises may be determined through tracking movement of materials from the property that may provide a viable pathway for spread of the disease. Pathways to be considered are: o Items of equipment and machinery which have been shared between properties including bins, containers, irrigation lines, vehicles and equipment o The producer and retailer of infected material if this is suspected to be the source of the outbreak o Labour and other personnel that have moved from infected, contact and suspect premises to unaffected properties (other growers, tradesmen, visitors, salesmen, crop scouts, harvesters and possibly beekeepers) o Movement of plant material and soil from controlled and restricted areas o Storm and rain events and the direction of prevailing winds that result in air-born dispersal of the pathogen during these weather events
Phase 5	• Surveillance of nurseries, gardens and public land where plants known to be hosts of pathogen are being grown
Phase 6	• Agreed area freedom maintenance, post control and containment

3.5.3 Post-eradication surveillance

The period of pest freedom sufficient to indicate that eradication of the pest has been achieved will be determined by a number of factors, including cropping conditions, the previous level of infection and the control measures applied. As a guide, the following activities should be carried out following the eradication of the pest:

- Establishment of sentinel plants at the site of infection
- Maintain good sanitation and hygiene practices throughout the year
- Sentinel plants should remain in place and inspected on a fortnightly basis for a further 6 weeks and then on a monthly basis. Sentinel plants showing signs of the disease should be immediately removed and destroyed
- Surveys comprising of plant and soil sampling for testing for *A. humicola* to be undertaken for a minimum of two years after eradication has been achieved

4 References

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4.1 Websites

CAB compendium (**www.cabicompendium.org/cpc/home.asp**)

5 Appendices

Appendix 1. Standard diagnostic protocols

For a range of specifically designed procedures for the emergency response to a pest incursion refer to Plant Health Australia's PLANTPLAN (**www.planthealthaustralia.com.au/plantplan**).

Appendix 2. Experts, resources and facilities

The following tables provide lists of experts (Table 2) and diagnostic facilities (Table 3) for use in professional diagnosis and advisory services in the case of an incursion.

Table 2. *Experts who can be contacted for professional diagnostic and advisory services*

Expert	State	Details
No experts have been identified in Australia		Dr Ian Pascoe (retired from DPI, Victoria) has expertise in morphological identification of *Alternaria* spp.

Table 3. *Diagnostic service facilities in Australia*

Facility	State	Details
DPI Victoria Knoxfield Centre	Vic	621 Burwood Highway Knoxfield VIC 3684 Ph: (03) 9210 9222; Fax: (03) 9800 3521
DPI Victoria Horsham Centre	Vic	Natimuk Rd Horsham VIC 3400 Ph: (03) 5362 2111; Fax: (03) 5362 2187
DPI New South Wales, Elizabeth Macarthur Agricultural Institute	NSW	Woodbridge Road Menangle NSW 2568 MB 8 Camden NSW 2570 Ph: (02) 4640 6327; Fax: (02) 4640 6428
DPI New South Wales, Tamworth Agricultural Institute	NSW	4 Marsden Park Road Calala NSW 2340 Ph: (02) 6763 1100; Fax: (02) 6763 1222

Facility	State	Details
DPI New South Wales, Wagga Wagga Agricultural Institute	NSW	PMB Wagga Wagga NSW 2650 Ph: (02) 6938 1999; Fax: (02) 6938 1809
SARDI Plant Research Centre - Waite Main Building, Waite Research Precinct	SA	Hartley Grove Urrbrae SA 5064 Ph: (08) 8303 9400; Fax: (08) 8303 9403
Grow Help Australia	QLD	Entomology Building 80 Meiers Road Indooroopilly QLD 4068 Ph: (07) 3896 9668; Fax: (07) 3896 9446
Department of Agriculture and Food, Western Australia (AGWEST) Plant Laboratories	WA	3 Baron-Hay Court South Perth WA 6151 Ph: (08) 9368 3721; Fax: (08) 9474 2658

Appendix 3. Communications strategy

A general Communications Strategy is provided in Appendix 6 of PLANTPLAN (2008, Version 1).

Appendix 4. Market access impacts

Within the AQIS PHYTO database, no countries appear to have a specific statement regarding area freedom from *A. humicola* (October 2008). Should *A. humicola* be detected or become established in Australia, some countries may require specific declaration. Latest information can be found within PHYTO, using an Advanced search —Search all text" for *Alternaria humicola*".