Industry Biosecurity Plan for the Grains Industry
Threat Specific Contingency Plan

European wheat stem sawfly
Cephus pygmaeus

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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 European wheat stem sawfly (*Cephus pygmaeus*). 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

Cephus pygmaeus Linnaeus 1767

Other Names: *C. pymeus* Linnaeus, *Sirex pygmeus* Linnaeus 1767, *Tenthredo longicornis* Geoffroy 1875, *T. polygona* Gmelin 1790, *Banchus spinipes* Panzer 1801, *Astatus florialis* Klug 1803, *B. viridator* Fabricius 1804, *C. subcylindricus* Gravenhorst 1807, *C. leskii* Lepeletier 1823, *C. atripes* Stephens 1835, *C. flavisternus* Costa 1882, *C. clypealis* Costa 1894, *C. notatus* Kokujev 1910, *Cephalus tanaiticus* Dovnar-Zapol'skij 1926, *C. pyramalus* Coaker 1987

Common Names: European wheat stem sawfly

2.1.1 General information

Taxonomic position – Phylum: *Arthropoda*; Class: *Insecta*; Order: *Hymenoptera*; Family: *Cephidae*

European wheat stem sawflies (*Cephus pygmaeus*) are not flies but are primitive fly-like wasps, belonging to the order Hymenoptera. The name sawfly originates from the saw-like ovipositor of adult females. The lack of a strong division between the thorax and abdomen in this group is the main characteristic in which they differ from other groups of wasp. The European wheat stem sawfly is widely distributed throughout Asia, Europe and North America, where it attacks a number of grass crop species. This pest can infest over 25% of individual plants in a single crop (Özberk *et al.,* 2005), which can lead to a reduction in grain yield of over 50% (Botha *et al.,* 2004) as a result of larval feeding within the stem. The larval feeding weakens the stem and also destroys vascular tissue, affecting nutrient transfer to the filling heads.

European wheat stem sawflies have a single generation per year, with adults emerging from pupation in the stem crown at a time coinciding with the emergence of seed heads. Females lay a single egg per stem following mating, and lay up to 50 eggs in total. Unfertilised eggs will produce male wasps. The resulting larvae feed along the stem, before undergoing diapause in a chamber formed within the stem, where they will over-winter.

Control of infestation is difficult, with research trials showing the use of insecticides to not be cost-effective. While there are a number of sawfly parasites, the best control measures are the use of solid stem varieties of wheat. These slow the movement and development of the larvae and results in higher mortality rates (Özberk *et al.,* 2005).

2.1.2 Life cycle

C. pygmaeus produce one generation per year. Larvae over winter low to or under the ground surface, boring down into the stem crown. The crown is usually several centimetres underground, depending on how deep the seed was planted. Wasps emerge within 1-2 weeks after pupation. Emergence coincides with the emergence of heads in wild grasses. If found in Australia, over wintering adults would probably emerge in spring.

After mating females lay a single egg per stem, usually before the head of the grass has emerged. One stem may receive eggs from numerous wasps, and each wasp will lay approximately 50 eggs. Incubation lasts from 7-10 days and unfertilized eggs produce male wasps.

Newly-emerged larvae are characterized by their considerably enlarged head, and are armed with a powerful pair of mandibles. They commence feeding immediately. Frass is found both fore and aft of larvae when stems are examined, which indicates the larvae make their way up and down the stem several times during their life. The larvae undergoes two or three moults (3-4 instars are found), however, the precise number of instars is uncertain, as only head masks and part of the anal region have been found.

Larvae diapause in a chamber created by cutting a groove around the inside of the stem, plugging the lumen, and remaining in the basal portion during the winter or dry season. Increased temperatures, moisture and /or photoperiod terminate diapause (Shanower & Hoelmer, 2004).

Mature larvae cut a notch around the inside circumference of the lower stems. The larval phase lasts for about one month, after which pupation occurs, usually near the roots.

2.2 Affected hosts

2.2.1 Host range

C. pygmaeus is a pest of cultivated grass crop species, as listed below:

- Major hosts: *Avena sativa* (oats), *Hordeum vulgare* (barley), *Secale cereale* (rye), *Triticum aestivum* (wheat)
- Minor hosts: *Avena fatua* (wild oat), *Bromus* (bromegrasses), *Lepidium draba* (hoary cress), *Phleum* (timothies)

2.2.2 Geographic distribution

C. pygmaeus is present in Europe, Asia, Africa and North America, as follows (information taken from www.cabicompendium.org):

- Asia: Armenia, Azerbaijan, Republic of Georgia, Iran, Israel, Kazakhstan, Kyrgyzstan, Syria, Turkey, Turkmenistan, Uzbekistan
- Europe: Austria, Belgium, Bulgaria, former Czechoslovakia, Denmark, former Yugoslavia, France, Germany, Greece, Hungary, Italy, Latvia, Luxembourg, Moldova, Netherlands, Poland, Portugal, Romania, Russian Federation, Spain, Sweden, Switzerland, Ukraine, United Kingdom
- Africa: Algeria
- North America: Canada, USA

2.2.3 Symptoms

The most obvious signs of infestation of crops with *C. pygmaeus* are broken stems resulting from weakened zones where larvae have fed on constructed pupation chambers. During pupation chamber construction the larvae will cut the stem leaving only the outer epidermal layers intact. Grain yield and quality is also significantly reduced (Parker *et al.,* 2001), with seeds showing signs of discolouration, smaller size and shrivelling.

Symptoms by plant part affected:

- Fruits/pods: abnormal shape
- Inflorescence: abnormal colour
- Seeds: discolourations
- Stems: internal discolouration, external discolouration, internal feeding
- Whole plant: plant dead, dieback, uprooted or toppled

2.3 Entry, establishment and spread

Entry potential: Rating = Medium

The adult wasps are delicate and short lived. The eggs and young larvae are mainly found in growing grass stems; however the older larvae and pupae occur in root stubs and straw, the most likely stages at which they become transported. Packing material and ballast with larvae and pupae would be the main pathways of entry (Botha *et al.,* 2004).

Establishment potential: Rating = High

The climatic conditions in the south-western wheat belts of WA and southern Australia would probably be highly suitable to *C. pygmaeus* (Botha *et al.,* 2004).

Spread potential: Rating = High

Human-assisted spread of larvae and pupae is the major concern. Natural spread through adult flight normally only occurs over short distances and can be reduced by cultivation practices such as crop rotation and the use of non-host pastures (Botha *et al.,* 2004).

Economic impact: Rating = Medium

C. pygmaeus is a serious pest throughout its range in Europe and Asia and also in North America and Africa. In Europe losses of up to 56% in wheat and 50% in barley have been recorded (Botha *et al.,* 2004).

Environmental impact: Rating = Unknown

Overall risk: Rating = Medium

2.4 Diagnostic information

2.4.1 Diagnostic protocol

There are no diagnostic protocols currently available for this pest. However a general description of the insect follows.

C. pygmaeus eggs are reniform in shape and between 1.05-1.19 mm in length and 0.42-0.56 mm in width (Ries, 1926). Larvae grow to 10-14 mm in length and have a nearly cylindrical, almost hairless body with only three pairs of highly-reduced legs. There are two thoracic and eight abdominal spiracles with the terminal abdominal segment having a prominent dorsal tubercle on the mid-line, which has a chitinous ferruliform ring apically. The ventral lobe has stout spines on both sides. They have four-segmented antennae and a prominent labrum (upper lip) with notched edges, strongly toothed mandibles and four-segmented maxillary palps (Ries, 1926). Larvae are almost transparent when newly hatched, with the exception of the head, with colour development through a yellow-white body and brown head to a yellow green colour in mature instars.

Pupa are white when first formed but darken to black spotted with yellow over the period of a couple of days (Ries, 1926), and are 10-12 mm in length by 1-2 mm wide.

Adult *C. pygmaeus* are a slow flying, brightly coloured yellow and shiny black insect (Figure 1), with highly variable colours between and within populations. Adults are 7-12 mm in length with females being larger than males. Body and appendages are covered in many small setae, which are longer and denser on the sterna and apical terga. Antennae are filamentous and subcluvate, with 19-20 segments. The first 1-3 segments are slightly elongated. Adults and larvae can easily be confused with the wheat stem fly *C. cinctus* (Figure 2); therefore a specialist taxonomist should be consulted for species confirmation (Botha *et al.,* 2004).

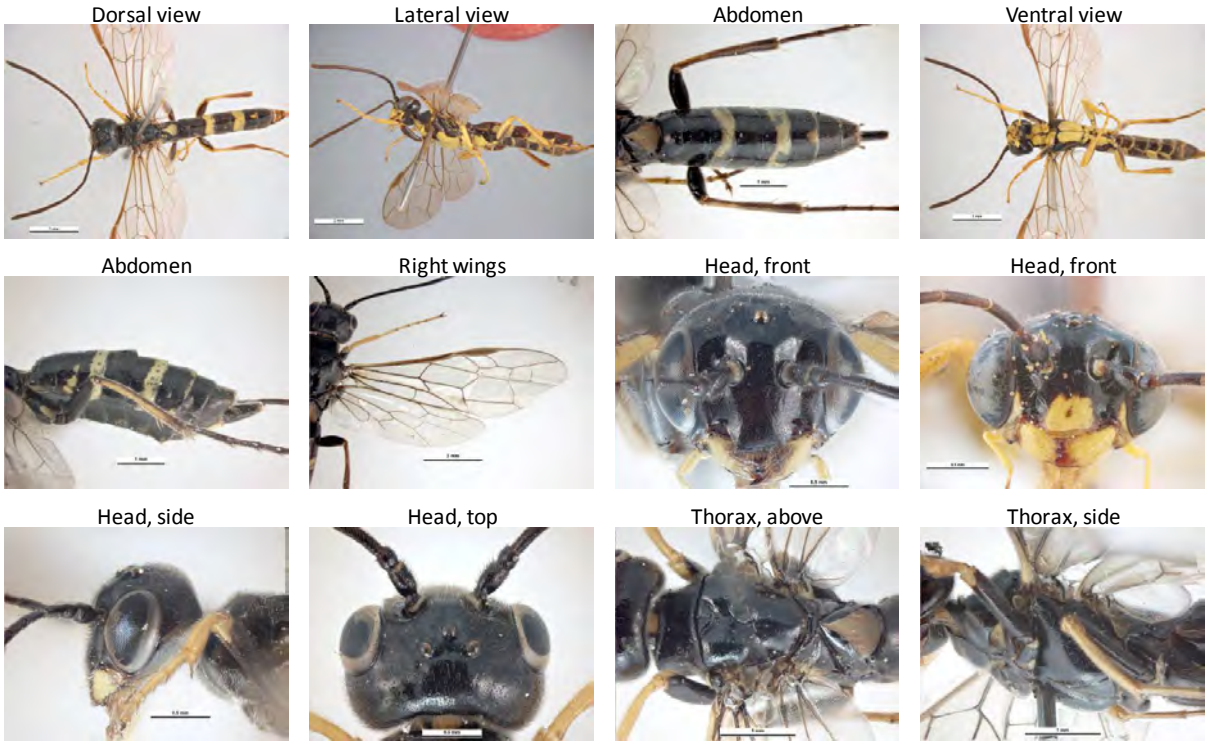
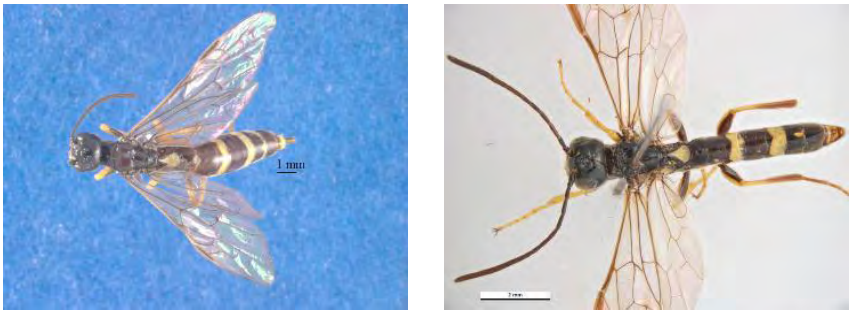


Figure 1. Diagnostic images of the European wheat stem sawfly. Images taken from PaDIL (www.padil.gov.au).



C. cinctus *C. pygmaeus*

Figure 2. Comparison between the wheat stem sawfly (*C. cinctus*) and the European wheat stem sawfly (*C. pygmaeus*). Images taken from PaDIL (www.padil.gov.au).

2.5 Response checklist

2.5.1 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 showing strongest symptoms. The extent of the survey beyond the initial infected crop should be guided by the test results from the surrounding crops.

2.6.1 Sampling method

Field inspections should include a transect through a field that allows representative sampling of the entire field with, on average, one inspection site of 10 m^2 of plants per hectare. Plants should be assessed for the presence of insects and level of symptoms.

Stems should be examined for signs of 'girdling' and for signs of stem breakage and discolouration resulting from the presence of the larvae. Stems should be cut open to reveal eggs (difficult to see) and larvae. Infested stems will contain frass and chewed plant material. The adult wasps are weak fliers, and therefore the use of entomological sweep nets is effective for collecting the insects. General protocols for collecting and dispatching samples are available within PLANTPLAN, Appendix 3 (Plant Health Australia 2008).

Number of specimens to be collected

Where possible it is advisable to collect a large number of specimens of all life stages. With adult stages collect a number specimens with varying colour due to the highly variable colouration within populations (see Section 2.4.1).

How to collect insect samples if required

Collect multiple specimens that are in a good condition (i.e. complete with appendages such as antennae, wings and legs). Kill samples by freezing for 24 hours. Label each sample clearly using an alcohol-proof marker. If possible, retain and store duplicate sample in a secure location.

How to preserve insect sample

Adults and larvae can be placed in 70% ethanol and stored indefinitely, although their colour fades gradually with time. Specimens required for molecular diagnostic work should be killed and preserved in absolute ethanol or frozen at -80°C.

How to transport insect sample

Vials of ethanol should be sealed to avoid leakage and packed with cushioning material in a strong box.

How to collect plant samples if required

The eggs and young larvae are mainly found in growing grass stems. The older larvae and pupae occur in straw and root stubs, the most likely stages at which they become transported. Plant material with suspect pupae or larvae should be picked and placed between sheets of newspaper to permit slow drying. For laboratory rearing of adult wheat stem sawfly, plant material containing pupae or mature larvae can be collected in a large jar and kept in a constant temperature room for regular checking.

How to preserve plant samples

Plant material with suspect pupae or larvae can be stored between sheets of dry newspaper.

2.6.2 Epidemiological study

The number of infected plants within a crop will depend on the number of insects present and whether conditions have been favourable for the pest 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 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 entered 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.
- The movement of hay or plant material from sites of infestation.

2.6.3 Models of spread potential

No modelling data is available.

Some general information and comments about possible mechanisms of spread are:

- Adults are weak fliers and have been recorded to disperse over short distances. In areas of intensive cultivation or areas with a continuous presence of suitable hosts, adult insects may successfully disperse to adjacent grain fields.
- *C. pygmaeus* is readily transported with agricultural products in infested plants or hay, packaging, shipping containers, vessels, or vehicles carrying agricultural produce.
- Diapausing larvae survive long periods and can be dispersed as a result of contamination on clothing, birds or animals.
- The over wintering stage of *C. pygmaeus* can survive for long periods in stems, hay and stubbles and can therefore be spread via machinery or equipment.

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.
- Surveys should also consider alternative hosts (see Section 2.2.1) and not be limited to the primary infected host.
- Survey around transport routes of any machinery that may have inadvertently transported the pest.

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

Wheat stem sawfly remains a serious pest in Europe and Asia and to a lesser extent in North America and Africa. In Europe losses of up to 56% in wheat and 50% in barley have been recorded. Larvae bore in stems reducing grain production and grain quality. The visible features are broken stems caused by larval tunnelling and during the construction of the hibernation and pupation chambers. Good hygiene methods are encouraged, including isolation of newly imported material to prevent any pest associated with a consignment spreading to other crops.

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. Do not move soil or plant trash from infested paddocks to non-infested paddocks.
- To minimise the build up of wheat stem sawfly populations, paddocks should be ploughed after crop harvest and shortly before sowing, and crop residues should be collected and destroyed before the onset of rains to reduce carry over from one season to the next.
- Sowing with resistant wheat varieties will reduce the severity of sawfly damage. The genetic Breeding section of the Department of Agriculture, Western Australia is collaborating with North Dakota (USA) to identify sawfly resistant wheat strains suitable for Australian conditions.
- After surveys are completed, destruction of the infected crop is an effective control.
- On-going surveillance of infected paddocks to ensure the European wheat stem sawfly is eradicated.

2.7.2 Control if small areas are affected

- As above in Section 2.7.1
- Host plants in affected fields should be killed by spraying or collected and destroyed by burning.
- Stems, hay, stubble and other plant residues may contain over-wintering pests, so should not be moved from the infested site. All plant material should be destroyed by burning.
- Raking of plant material is not an option as this may distribute the pest on plant residues.

2.7.3 Control if large areas are affected

If large areas were affected control methods would be similar to the control of small areas (as above in Section 2.7.2).

2.7.4 Cultural control

Burning of stubble and plant residues is a widely used method of control for *C. pygmaeus*, however due to many of the larvae being found belowground (up to 5 cm) in the hollow part of the stalk, this approach may be ineffective. The use of deep-ploughing is effective (Kontev, 1971), however wind-erosion of the soil can reduce the effectiveness of this approach.

Pest levels can be significantly reduced through crop-rotation with non-susceptible host species, especially due to the narrow host range of this pest (see Section 2.2.1). Additionally, trap-crops of Graminae can be planted around the margins of the grain fields if parasitic agents are available so that they receive heavy infestations or be parasitised more readily. However, the loss of time and acreage through this method is considered prohibitive (Wallace & McNeal, 1966).

2.7.5 Host plant resistance

Host plant resistance and cultural control strategies offer partial control, though both have significant drawbacks (Shanower, 2004). Three approaches to host-plant resistance have been used against *C. pygmaeus*, all with some level of success:

- Preventing or lessoning the probability of oviposition
- Suppression of incubation and reducing the effects of tunnelling by larvae
- Reducing the nutritional value of the host plant

The breeding of wheat varieties with solid lower stem segments has been the most successful and widely used approach to reducing the detrimental effects of the European wheat stem sawfly. Susceptible varieties have hollow stems. Solid stem varieties are filed with pith, especially in the lower portions of the plant, which reduces sawfly effects by limiting larvae feeding and movement through the stem, resulting in high mortality rates, reducing the adults ability to oviposit and maintains greater strength in the stem following feeding damage.

2.7.6 Chemical control

At the time of document preparation there were no insecticides registered for use against stem sawflies. Systemic insecticides which may be effective against the short-lived adults are few in number and are ineffective against the larvae and eggs, and research has shown their use not to be cost-effective (Özberk *et al.,* 2005).

Prior to application of any chemicals to the control the pest, an investigation will be required to confirm that chemicals identified below are registered and approved for use on the pest and/or host. New registrations for the use of chemicals can be obtained from http://www.apvma.gov.au. General enquiries on chemical use can be made to APVMA Ph: (02) 6210 4700.

2.7.7 Biological control

In general, biological control measures against Cephidae species has had limited success. The most effective control measures for *C. pygmaeus* have been members of the ichneumonid wasp family. *Collyria coxator* showed about a two-thirds parasitism of *C. pygmaeus* in the UK (Salt, 1931) and has now been introduced into Northern America (Wallace & McNeal, 1966). The presence of *Collyria*

coxator has been successful in adequately controlling recent outbreaks of *C. pygmaeus* (e.g. Filipy *et al.,* 1985; Banita *et al.,* 1992).

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

- 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.
- Herbicides could be used to destroy the infected crops or pastures.
- Infected crops or pastures could be ploughed in.
- Insecticides could be used to destroy the pest.
- Farm machinery used in destruction processes need to be thoroughly washed, preferably using a detergent such as Decon 90.

3.1.2 Decontamination protocols

If containment, eradication and/or best practices 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 disinfectant or a 1% bleach (available chlorine) solution in a designated wash down area. 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 2008 Appendix 18).
- All chemicals used according to the label.

General guidelines for personnel and equipment are as follows:

- 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.
- Decon 90 is a suitable detergent for using to decontaminate equipment or personnel.

3.1.3 Priorities

- Confirm the presence of the pest.
- Prevent movement of vehicles and equipment through affected areas.
- Priority of eradication/decontamination of infected host material.
- Determine the extent of infection through survey.
- Control European wheat stem sawfly populations to prevent further spread.
- Inform all groups within the industry.

3.1.4 Plants, by-products and waste processing

- All infested seedlings and alternate / susceptible host material from the infected site should be destroyed by (enclosed) high temperature incineration, autoclaving or deep burial (in a non-cropping area). Seeds harvested from infected plants will be of poor quality and shrivelled.
- As the European wheat stem sawfly can be mechanically transmitted, killed crops should be ploughed in or burnt.
- All infested plants, together with all susceptible and alternate host material such as wheat, rye, barley and oats, should be destroyed by burning as pupae can survive for long periods.
- Hay, straw and stubble residues should be collected and destroyed after harvest by burning to reduce carry-over from one season to another.
- Infested paddocks should remain free of susceptible host plants until soil has been shown to be free from the pest.

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 eggs, larvae and pupae 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.

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).

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 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).

If the movement of adult sawflies to adjacent crops appears likely, they will also need to be destroyed. Particular care needs to be taken to ensure that soils and plant material are not moved into surrounding areas not showing symptoms of disease. Where possible, destruction should take place in dry conditions to limit mud being spread within the field on boots and protective clothing.

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

Decontaminant 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 2008) 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 Decon 90 detergent, a farm degreaser or a 1% bleach (available chlorine) solution in a designated wash down area as described in 3.1.2.
- Only recommended materials are to be used when conducting decontamination procedures, and should be applied according to the product label.

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 *C. pygmaeus* presence.
- Surveying commercial nurseries selling at risk host plants.
- 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 below 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.

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:
  - Items of equipment and machinery which have been shared between properties including bins, containers, irrigation lines, vehicles and equipment;
  - The producer and retailer of infected material if this is suspected to be the source of the outbreak;
  - 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);
  - Movement of plant material and soil from controlled and restricted areas; and
  - 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 *C. pygmaeus* 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 (see Section 2.6.4).
- 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.
- Surveys comprising of plant and soil sampling for testing for *C. pygmaeus* to be undertaken for a minimum of 12 months after eradication has been achieved.

4 References

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4.1 Websites

Crop protection Compendium, CAB International; www.cabi.org/compendia/cpc

Pest and Disease Image Library, PaDIL; www.padil.gov.au

PLANTPLAN, Plant Health Australia; www.planthealthaustralia.com.au/plantplan

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.

Appendix 2. Experts, resources and facilities

The following table lists the experts who can be contacted for professional diagnostics and advisory services in the case of an incursion.

Expert	State	Details

The following table lists the facilities available for diagnostic services 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

Facility	State	Details
		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 PMB 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
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 PLANTPLAN

Appendix 4. Market access impacts

Within the AQIS PHYTO database, no countries appear to have a specific statement regarding area freedom from *C. pygmaeus* (August 2008). Should *C. pygmaeus* 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 *Cephus pygmaeus.*