

Office of the Chief Plant Protection Officer

Threat Specific Contingency Plan

Common Names

Cabbage Seedpod Weevil

Brassica Pod Midge

Scientific names

Ceutorhynchus assimilis Paykull, 1792

Dasineura brassicae Winnertz, 1853

Cabbage Seedpod Weevil (*Ceutorhynchus assimilis* Paykull) is the primary pest that allows access to the secondary pest (*Dasineura brassicae* Winnertz). Both cause damage to a range of *Brassica* species, with the second pest causing the more severe damage.

Drafted by

OCPPPO

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THREAT SPECIFIC CONTINGENCY PLAN
CABBAGE SEEDPOD WEEVIL / BRASSICA POD MIDGE

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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 of the two pests, or complex involving the primary pest Cabbage Seedpod Weevil (*Ceutorhynchus assimilis*) which allows the secondary pest Brassica Pod Midge (*Dasineura brassicae*) to infest and damage *Brassica* plants. It provides guidelines for steps to be undertaken and considered when developing a Response Plan to this pest complex. Any Response Plan developed using information in whole or in part from this Contingency Plan must follow procedures as set out in PLANTPLAN (Plant Health Australia 2010) and be endorsed by the National Management Group prior to implementation.

2 Pest information/status

2.1 Pest details

- **PRIMARY PEST:**

Ceutorhynchus assimilis Paykull, 1792

Synonyms: *Curculio assimilis* Paykull, 1792

Curculio alauda Fabricius, 1792

Curculio pseudostigma Marsham, 1802

Common Names: Cabbage seed weevil, cabbage shoot weevil, turnip seed weevil, cabbage seedpod weevil, radish seed weevil.

- **SECONDARY PEST:**

Dasineura brassicae Winnertz, 1853

Synonyms: none known

Common Names: Brassica pod midge, pod gall midge

2.1.1 General information

Taxonomic Position –

- **PRIMARY PEST:**

Order: COLEOPTERA Superfamily: Curculionoidea Family: Curculionidae

Subfamily: Ceutorhynchinae Genus: *Ceutorhynchus* Species: *assimilis*

- **SECONDARY PEST:**

Order: DIPTERA Suborder: Nematocera Family: Cecidomyiidae

Subfamily: Cecidomyiinae Tribe: Oligotrophini Genus: *Dasineura*

Species: *brassicae*

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In Australia, this pest complex (i.e. the weevil being the primary host that provides the opportunity for the secondary pest, the midge to enter) would be of most threat to *Brassica napus* var. *napus*, i.e. canola. Other hosts are almost always *Brassica* species, including turnip rape, mustards, most brassica vegetables, some weeds (e.g. shepherds purse, wild charlock, wild radish, hedge mustard), with only white mustard appearing resistant to *C. assimilis*. Some hosts support the full life cycle, while others only act as food hosts for adults.

The oviposition behaviour of *C. assimilis* allows for some direct damage to forming host seed pods, and for entry of *D. brassicae* to these pods, causing further and often greater damage. Oviposition of *C. assimilis* is restricted to 23 *Brassica* species, of which 20 are important crops (Dmoch 1965).

The pest complex represented by *C. assimilis* and *D. brassicae* would find establishment relatively difficult in Australia, and would potentially spread slowly since they require a specific set of climatic conditions and timing. In addition, *C. assimilis* has only one life cycle per year, and both prefer a relatively narrow range of host plants, being restricted to canola as a major host crop. Eradication would be a realistic objective if any isolated incursion were found early and prompt action taken.

Vigilant quarantine would present the most useful means of avoiding an incursion, with a focus on soil and leaf litter associated with any *Brassica* species where overwintering *C. assimilis* and pupae of *D. brassicae* might be found.

2.1.2 Life cycle

***Ceutorhynchus assimilis* Paykull (Cabbage Seedpod Weevil)**

Only one generation per year occurs. Weevils overwinter in diapause as sexually immature adults in dry soil, leaf litter, other vegetation around paddock margins or associated woodland, though often closely (usually less than 200 metres) associated with the previous (*Brassica*) crop (Alford, 2003). Best sites are often sheltered from large swings of temperature by some thermal insulation, for example deep leaf litter, or by digging down into soil (up to 10cm).

Adults emerge in early spring. This only occurs following a cold period of 16 weeks at or below 4°C required to break diapause (Carcamo *et al.*, 2001), and/or only after air temperatures are at or above 9°C - 11°C for more than two days (Dmoch 1965). At this time food is sourced from *Brassica* weeds or other hosts, since the major host, canola has usually yet to begin flowering at this time. Mating occurs before they move to budding or flowering canola (or other seed containing *Brassica* crops), usually when temperatures begin to exceed 15°C (Jermy & Balázs, 1990; Kjaer-Pedersen, 1992).

Adults feed on flowers, buds, stems and pods. Females have mated and are ready to lay eggs upon entering crop fields. They bore a small hole through the pod wall with their rostrum and place a single egg inside with their ovipositor. They can lay eggs for 45 to 74 days, reaching egg totals between 25-240 eggs (Jermy & Balázs, 1990). A deterrent pheromone placed on the outside of the pod prevents oviposition by other weevils (Kozłowski *et al.*, 1983; Mudd *et al.*, 1997).

Eggs hatch after 6-10 days (longer in cold conditions) and larvae feed on the inside of the pods and immature seeds for 14-21 days, eating up to 5 seeds before leaving the pod and falling to the ground via a pinhead sized hole they bore in the pod wall. They dig into soil to a depth of 1 to 10cm and produce a white-grey shiny cocoon where they pupate (Dmoch, 1965; Alford, 2003). New adults emerge after 15-19 days and feed on pods of remaining crop or other *Brassica* plants before they seek a suitable site for overwintering.

This life cycle timing for *C. assimilis* is based on observations in Europe and the weevil life cycle tends to best synchronise with winter rather than spring crops in the northern hemisphere, perhaps making such timings less accurate were the weevil to be present in Australia.

***Dasineura brassicae* Winnertz (Brassica Pod Midge)**

Again, this information is based on observations in the northern hemisphere.

Pupae in soil emerge as adults through the (Northern Hemisphere) spring usually around the middle of the day. They have a relatively short adult life (1-3 days) and mate soon after emergence, with females then flying with any wind toward host crops. Eggs are laid upon arrival on young seed pods, with oviposition made through the pre-existing holes made by *C. assimilis* or a few other *Ceutorhynchus* species and possibly a few other insects.

Larval development takes approximately two weeks, and up to 100 larvae can be present in a pod, feeding predominantly on the pod wall. Mature larvae exit the pod and burrow into soil, building small silk cocoons for pupation. More than one generation is possible through the growing season, with higher proportions of pupae entering diapause as the season completes. Diapause can last up to 5 years.

The preferred hosts are *Brassica napus* and *B. campestris*, with greater larval survival on *B. napus*. Other hosts can be used, although observations suggest *B. napus* is greatly preferred.

2.2 Affected hosts

2.2.1 Host range

Both pest species have a relatively narrow host range, essentially limited to *Brassica* species and mainly preferring *B. napus*. This suggests canola is the prime broadacre crop of interest for these pests in Australia.

Both pests are recorded as being able to host on many other *Brassica* species and so all *Brassica* species can be considered as potential hosts, however the literature suggests that *B. napus* is the crop of greatest interest.

While these pests could find many opportunities in Australia to become established on *Brassica* species of importance to horticulture, their apparent preference for *B. napus* agricultural crops drives the focus of this Contingency Plan, though much of the content would have relevance for other *Brassica* crops.

2.2.2 Geographic distribution

Current distribution is as shown in Figures 1 and 2 (below) for *Ceutorhynchus assimilis* and *Dasineura brassicae* from CAB International (2005).

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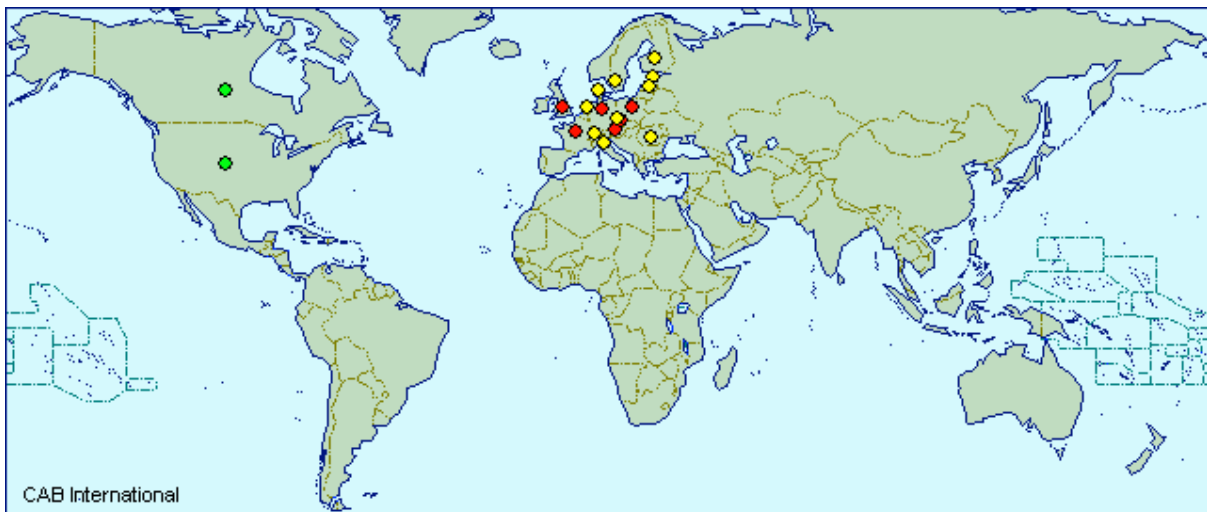


Figure 1. World distribution of *Ceutorhynchus assimilis* (Paykull) (CAB International, 2005).

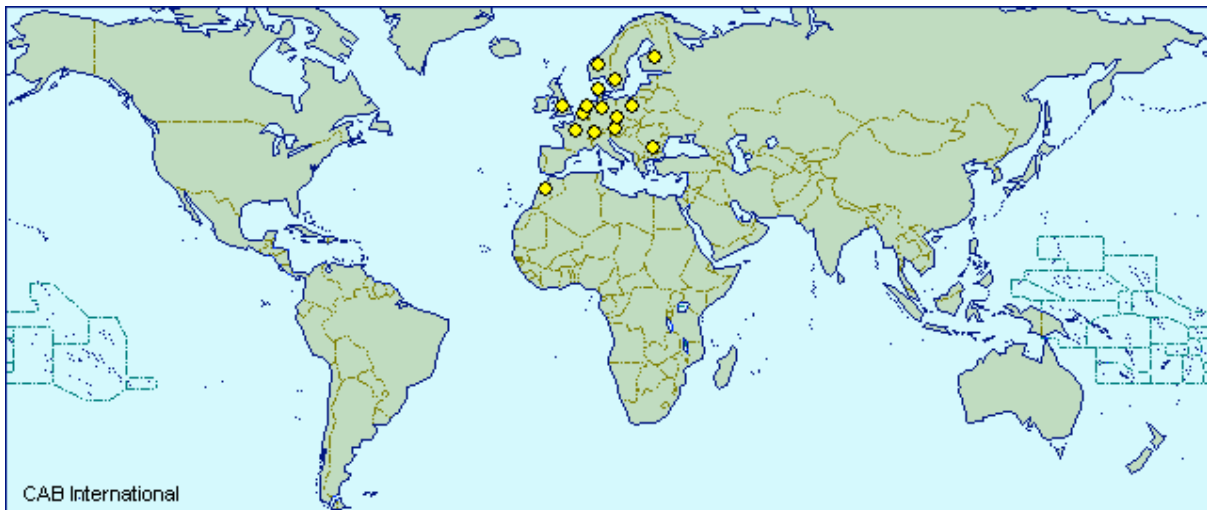


Figure 2. World distribution of *Dasineura brassicae* (Winnertz) (CAB International, 2005).

It is apparent that *C. assimilis* Paykull and *D. brassicae* Winnertz are established across much of Europe, though only *C. assimilis* is present in North America and Canada, with some evidence that it is also present in parts of the Middle East and Africa.

Considering potential distribution within Australia, both pests would be generally restricted to the southern and coastal areas of the continent, primarily due to climatic conditions and host presence (Hughes & Evans, 1999) (Figure 3).

The areas of greatest potential suitability for these pests also coincide with the major broadacre cropping areas, notably for canola in Australia, as well as vegetable and other horticultural production in coastal areas, Victoria and Tasmania.

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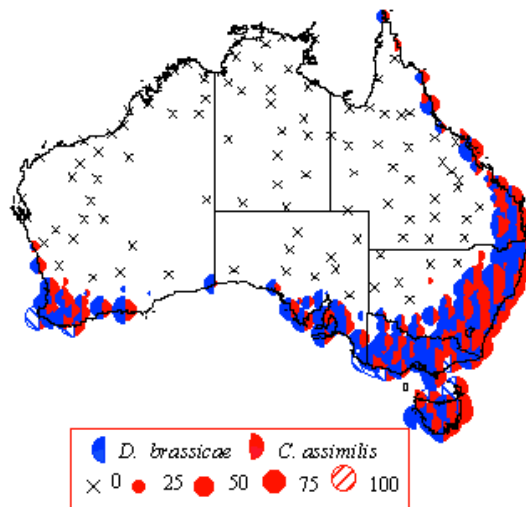


Figure 3. Potential distribution in Australia of *C. assimilis* (Paykull) and *D. brassicae* (Winnertz) (Hughes & Evans, 1999)

2.2.3 Symptoms

C. assimilis

Adults feed on buds, causing bud-blasting and reduced yield potential especially in dry years. While this adult feeding can reduce oil content, seed weight and seed germination, this damage is minimal as plants are able to compensate for adult feeding damage (Hiiesaar *et al.*, 2003).

Larvae feeding within the developing pods cause more damage. While each larva will consume on average 2.5-5.0 seeds in a pod during development, these pods are predisposed to premature shattering and infestation. These pods show lightened flecks on the outside, where larvae have eaten seeds inside the pod. Mature pods show small pinhead-sized emergence holes, visible in the discoloured areas of the pod walls.

C. assimilis (Paykull) damage (holes) allows *Dasineura brassicae* (Winnertz) to lay eggs inside the pod, which leads to 'bladder pod' symptoms with swollen yellow pods and premature shedding of seed. The larval activity of the *D. brassicae* causes busting of the pods and losses can then reach 80% (Jermy & Balázs, 1990. See figures 4 and 5 for damage from *C. assimilis*).

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Figure 4. Destroyed seed and reaction of the septum separating the 2 rows of seed



Figure 5. *C. assimilis* (Paykull) larva emergence hole on damaged pod

D. brassicae

Developing pods turn yellow, ripen prematurely and may be twisted and deformed, with localised small swellings (gall formation). Pods containing the midge contain up to 100 white or yellow-white, gregarious larvae, preventing normal seed development. Larvae feed mainly on the pod wall causing the pod to swell and split, prematurely shedding the seed (Free *et al.*, 1983a), thus dramatically reducing yields.

See Figures 6, 7 & 8 for symptoms of *D. brassicae* damage to canola pods.

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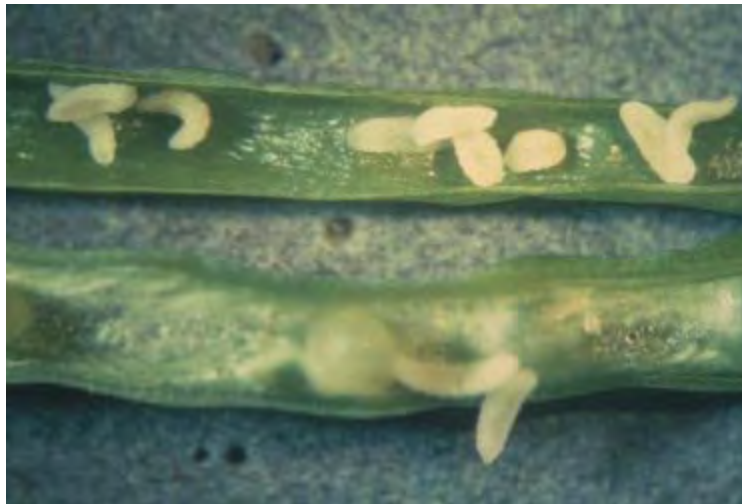


Figure 6. *D. brassicae* (Winnertz) larvae in canola pod



Figure 7. *D. brassicae* (Winnertz) larvae in mature canola pod

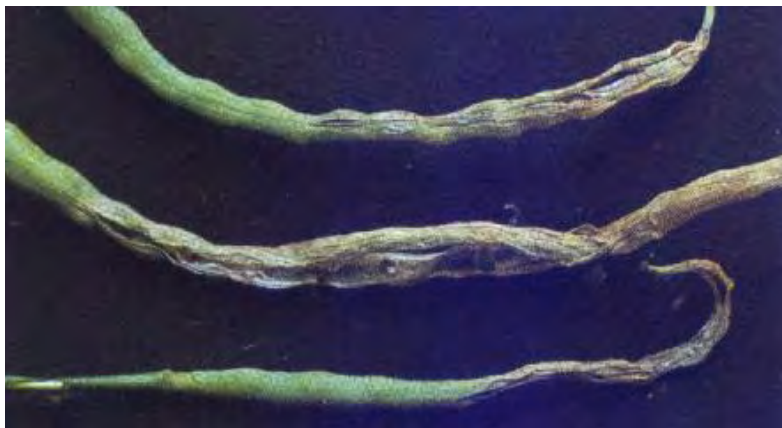


Figure 8. *D. brassicae* (Winnertz) damage

2.3 Entry, establishment and spread

Entry of *C. assimilis* and *D. brassicae* is considered highly unlikely via grain or seeds and very limited by plant material, since pods containing eggs would be necessary. Australia imports very little canola grain and very limited seed.

Diapausing adults overwintering in soil or leaf litter is thought to be the more likely entry route. Efforts aimed at continuing to prevent entry of soil would remain important.

C. assimilis adults can fly well, potentially travelling some kilometres, and *D. brassicae* is small and can also travel reasonable distances on wind, though tend not to move more than 0.5 km away from host crop areas.

2.3.1 Entry potential

Rating: LOW

The pathway most likely to bring the Cabbage Weevil into Australia is as diapausing adults with soil, either as imported material or with tourists. Grains and other seeds are not considered a likely avenue for entry. Similarly, this pathway of soil (carrying pupae) is also the main potential entry route for Brassica Pod Midge.

While immature Weevil adults can live for over a year, and so could survive transport to Australia, they only have one generation per year. They also need to find a suitable host plant relatively quickly following emergence, in addition to mating, before laying eggs. These requirements would make the ability to travel into Australia and then to complete a life cycle more difficult than for many other pests, and so reduce the risk of an actual successful entry followed by a completed life cycle.

Cabbage Seedpod Weevil eggs and larvae are relatively small and difficult to detect since generally only one egg or larva are present in each pod, and pods need to be broken open for detection. The presence of the small oviposition hole is a more easily noted symptom indicating possible infestation. However, the importation of (preferably live) *Brassica* species plants with pods at the ideal stage for infestation would be considered relatively rare, making this route of entry quite unlikely.

Weevil adults are also small (3 to 3.5mm long) and are matt grey in colour, making their detection in soil or leaf litter difficult, which makes this route of entry more likely. Being able to live for up to a year makes their ability to emerge, mate and lay eggs a possibility if contaminated soil were to enter Australia, though this also requires proximity to suitable hosts.

The Brassica Pod Midge adult is very small making detection also difficult, though they only live for a few days, and need to mate and lay eggs in a suitable host for entry and establishment to occur. This is considered unlikely unless they are travelling with a live, suitable host. Again, eggs and larvae are relatively small making detection more difficult, though the symptoms of pod damage would be more indicative of presence. Similar to Cabbage Seedpod Weevils, pupae contained in soil would present the most likely route of entry, since they are small and can remain viable for up to 3 years.

Both these pests have a relatively narrow host range, constrained almost entirely to *Brassica* species, with canola being the only broadacre crop at risk. Additionally, for the Brassica Pod Midge to successfully infest hosts the prior infestation of Cabbage Seedpod Weevil is required, with this combination of both pests entering and occurring together in an incursion event considered quite unlikely. However, the need for vigilance concerning soil contamination remains a prime means of minimising risk of entry.

The probability of entry for *Ceutorhynchus assimilis* (Paykull) and *Dasineura brassicae* (Winnertz) is rated as **LOW** based on:

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- Entry being essentially most likely only by contaminated soil containing diapausing adults or pupae,
- The requirement of both pests to mate and find suitable hosts relatively soon after emergence,
- The narrow host range,
- The relatively specific climatic requirements that restrict emergence and egg laying activity of both pests, and,
- Vigilance at entry points especially for the presence of soil with imported plant material especially *Brassica* species should prevent entry, especially given that no incursions of either pest (or the complex of both together) have occurred to date.

2.3.2 Establishment potential

Rating: LOW

Most of Australian canola production occurs in areas where the climatic conditions would be considered suitable for both pests. However the low temperature requirement (4°C for at least 16 weeks) for emergence of *C. assimilis* would restrict the more likely suitable areas to Victoria and southern NSW.

That *C. assimilis* only has one life cycle per year makes this pest more vulnerable to encountering unsuitable conditions for a successful establishment were it to enter Australia, since this would depend on the location of entry providing such suitable climatic conditions, coupled with the presence of suitable hosts at the right growth stage. Such a combination of favourable circumstances would be considered unlikely.

D. brassicae can diapause for some years, and it is unclear if specific climatic conditions (other than springtime) are required for emergence. It is possible that climatic conditions in Australia may rarely be favourable for emergence, or could stimulate emergence at a time when hosts are unavailable.

A major consideration related to climatic conditions is that canola in Australia is grown in the winter with flowering and pod setting occurring in the spring – early summer period, whereas in the northern hemisphere it is summer grown, with flowering and pod setting occurring in the autumn – early winter. This could possibly make establishment difficult, though not impossible, for these pests. In the northern hemisphere they emerge as temperatures rise in the spring, following diapause through the cold weather of the northern winter. This would be expected to also occur in Australia. They are then known in the northern hemisphere to feed on hosts as the crop grows in the summer before laying eggs in pods as these become available, prior to entering diapause as winter begins. While such feeding and damage to pods may occur as canola pods are formed and filled in the late spring in Australia, the end of the crop life cycle coincides with entry to a hot dry summer in most canola growing areas, which may not allow hosts for them to complete life cycles, or may likely upset diapause patterns for both pests.

The effect of different temperature regimes in relation to the life cycles of both pests has not been extensively studied (Hughes and Evans, 1999), though it is believed that larval survival in soil varies when soil is dry and temperatures high, as would occur were larvae to drop to soil in late spring or early summer conditions in Australia (Fox and Dosedall, 2003).

The availability of suitable hosts to coincide with the appropriate life cycle stage of each of the pests is also important for their establishment. Such availability will be determined by climatic conditions, which may be very much different in Australia than in the northern hemisphere. Fox and Dosedall (2003) found that the presence only of food source hosts (as opposed to hosts that can sustain full life

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cycle development) prevented establishment of *C. assimilis*. Among the species that sustain full life cycle development for both pests are canola and several *Brassica* weeds (Dmoch, 1965). Many of the weed species (for example *Raphanus raphanistrum*) also have a winter dominant life cycle in Australia, which may coincide with the period of diapause in these pests, thus making establishment difficult.

When considering the complex as provided by these two pests operating together, it is the ability for *D. brassicae* to infest host plants (e.g. canola) that causes the greatest damage. Damage from *C. assimilis* alone, while important, is generally more minor than that from *D. brassicae*, and much less than the additive damage from both operating together. A concurrence of circumstances is required for *D. brassicae* to successfully find and infest a host plant. It must find a suitable plant host at the appropriate growth stage, be recognised by the female, have suitable holes for oviposition in the pods, and be able to provide adequate food for the larvae.

The absence of any one of these factors may prevent or severely reduce the establishment of *D. brassicae*. Of these, the reliance of *D. brassicae* on *C. assimilis* having laid eggs and so providing oviposition holes in pods provides the greatest weakness for the establishment of the Brassica Pod Midge in Australia.

While it is possible that some other pests of canola (or other *Brassica* species) may provide suitable ovipositing holes for Brassica Pod Midge, these either are not present in Australia (*Lygus* spp.). Only Rutherglen bug may theoretically provide suitable holes for *D. brassicae* to access canola pods suitable for oviposition.

The probability of establishment for *C. assimilis* and *D. brassicae* is rated as **LOW** based on:

- A relatively limited area where canola hosts are grown in climatic conditions notionally suitable for the pests,
- *C. assimilis* having only one life cycle per year,
- Australian canola production occurring in winter as opposed to summer in the northern hemisphere, making the climatic conditions and timing of diapause very different for both pests,
- The potential unreliability of availability of hosts to coincide with life cycles, as related to the above point,
- The potential unsuitability of soil conditions through summer in Australia to support diapausing adults or pupae,
- The heavy reliance of *D. brassicae* on the presence of *C. assimilis* for provision of oviposition holes in pods, plus the lack of alternate pests that provide similar pod damage.

2.3.3 Spread potential

Rating: MEDIUM

With regard to canola, only southern NSW, Victoria and perhaps some cooler areas of South Australia and WA would provide climatic conditions considered suitable for spread of both pests. Natural spread from east to west coast would be reduced by the climatic barriers existing across these distances and locations. There are no known vectors for either pest.

Some overseas studies suggest that where adequate hosts and climatic conditions exist, spread can be up to 60km per year (Dosdall and Moisey, 2004).

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Unfortunately there are no known natural enemies of the pests in Australia, based on knowledge of such enemies overseas. This could mean that if the pests were to enter and establish, the lack of specific natural enemies may allow for a greater rate of spread in Australia.

Both pests can fly, however distances travelled without wind assistance is minor and restricted to travel toward host crop areas, though may range to a few kilometres for *C. assimilis*.

It would only be necessary to control *C. assimilis* to effectively limit the spread of both pests, since this would remove the ability for *D. brassicae* to infest pods.

Control methods are limited and would include:

- Limited cultural control options, with the planting of trap crops around canola crop paddocks being a marginally realistic option at present,
- A reliance on chemical control, with the use of various organophosphorus, synthetic pyrethroid or possibly newer insecticides being likely the most effective. Insecticide use may only need to target *C. assimilis* for effective control of both species.

The use of insecticidal based control may fit with existing fungicide or herbicidal control regimes used in canola crops in Australia, but it is unlikely that a highly effective control option is immediately available for these pests, with this absence of highly effective control options contributing to a somewhat heightened risk of spread.

There are no reports of successful eradication of these pests in overseas studies, again suggesting a potential for spread in Australia. However, considering all factors outlined in the above sections, it is possible that eradication would be achievable if a single location incursion were to be detected early and the factors that mitigate establishment were realised.

The potential for spread for *C. assimilis* and *D. brassicae* is rated as **MEDIUM** based on:

- The existence of reasonably large areas where the canola host and climatic conditions (theoretically at least) coincide,
- Overseas experience where spread has occurred and eradication has been unsuccessful, and,
- The lack of highly effective control measures ready for deployment.

2.3.4 Economic impact

Rating: MEDIUM

Damage from *C. assimilis* and *D. brassicae* varies and tends to increase over the first several years before becoming 'established' in canola growing areas. Even then, damage varies between years and geographical areas (Dmoch, 1965).

Heavy infestations of the weevil can reduce canola yields by up to 30% in European studies (Tuilisalo *et al.*, 1976, Ambrus in Jermy and Balazs, 1997), though in general damage from *C. assimilis* is insufficient to warrant applying control measures (Buntin, 1999), and in some cases canola crops can produce compensatory growth of secondary racemes (Tatchell, 1983). Such damage is greater when the following infestation of *D. brassicae* is significant, also due to the later timing of infestation of pods by this pest leading to higher yield loss in maturing pods.

The literature is inconsistent in reporting damage from these pests, with some estimates of up to 35% loss (Harmon and McCaffery, 1997) in North America, and others of non-economic losses (Alford *et al.*, 1996) in the UK.

Hughes and Evans (1999) suggested that economically damaging infestations of these pests could be supported in Australia, and so the overall economic impact is rated as **MEDIUM**.

2.3.5 Environmental impact

Rating: LOW

While several Brassicaceous hosts are present in Australia, including crops and weeds, it is noted that the pests are mainly attracted to the crop and weed plant species. As such their environmental impact is likely to be generally benign.

2.3.6 Overall risk

Rating: VERY LOW

This rating is based on an index calculated from the low risk of entry, low risk of establishment and medium risk for spread, with the **Low** risk of entry and establishment responsible for this level of overall risk. While this does not minimise the requirement of minimising entry, since detection of both pests in soil and leaf litter can be challenging, and both have long diapause period, the combination with only medium spread and economic risks, and low environmental impact, make these pests only moderately important for quarantine and incursion management considerations. Nonetheless, effective quarantine and awareness among canola growers will be essential elements of keeping these pests from becoming established in Australia.

2.4 Diagnostic information

2.4.1 Diagnostic protocol

Direct diagnosis of Cabbage Seedpod Weevil adults, eggs and larvae

Adults are matt ash-grey, 2-3.5 mm long, with a distinctive, long, narrow, downward-curved rostrum (snout) on the front of the head. The rostrum is more than five times as long in front of the eyes as it is wide just in front of the eyes. The prothorax has a notch in the middle of the underside front edge where the rostrum can rest. There are seven segments in the antennal funiculus. The elytra are black, but the elytral interstices have fine hairs and greyish white scales (about 60 µm long) all over, which results in an overall grey appearance. Near the mid-line of the elytra, the interstices have 1-3 irregular rows of scales along their length. There is no tooth on the hind femora and all tarsi are black to dark brown, similar in colour to the femora and tibiae. The tarsal claws are **simple, not toothed**.

Adults are very similar to several other *Ceutorhynchus* species that are common on host plants. They can be distinguished from *C. pallidactylus* (Marshall) and *C. napi* (Gyllenhal) by their black to dark-brown, rather than reddish-yellow, tarsi. They can be distinguished from *C. rapae* Gyllenhal by the absence of a tooth on the hind femora.

The eggs are creamy white, smooth, cylindrical with rounded ends, and about 0.6 mm long by 0.4 mm wide. They are often covered with a mucus-like material.

The larvae are grub-like, legless and without eyes. There are three larval instars. Head capsule measurements: L1=0.21-0.22 mm, L2=0.30-0.32 mm, L3=0.49-0.52 mm. Body length: L1=0.75-0.8 mm, L2=1.8-3.2 mm, L3=4.5-5.3 mm (Bonnemaison 1957 in Jermy & Balázs, 1990). They have a creamy white body and a yellow to brown head capsule. The body is normally slightly curved ventrally. The fully-grown larva also has the following features:

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- epicranial suture half the length of the head
- mandible longer than wide and bidentate at the apex
- maxillary palps two-segmented
- labial palps two-segmented
- the basal segment extremely short
- abdominal segments each with four transverse folds dorsally

Larvae are similar to several other weevil larvae. Other mining larvae of *Ceutorhynchus* species, such as *C. pallidactylus* (Marsham) are virtually identical and are best distinguished by where they are found.

Pupae are about 4-4.5 mm long and occur in earthen cells in the soil. They are initially white, but then turn yellow. The pupa also has the following features:

- is exarate with projecting legs, rostrum and elytra
- has nine tergites and 5 sternites visible ventrally the elytra are smooth with five visible fine grooves

More details on how to avoid misidentification of *Ceutorhynchus assimilis* from other *Ceutorhynchus* species can be found in the Pest Risk Review for these pests (see PHA website).

Direct diagnosis of Brassica Pod Midge adults, eggs and larvae

The adults are 1.0-1.5 mm long. The thoracic area is brown and has white hair on the upper side. The abdomen is yellow to reddish with dark spots laterally on each abdominal segments surrounded by whitish setae. Adults are delicate flies with long legs and the antennae in both sexes are composed of 13-15 bead-like segments. The maxillary palps are 4-segmented. The iridescent wings are approximately 2 mm long. The wing venation is simple and the main longitudinal vein (R4 + 5) runs close to the leading edge of the wing and joins it well before the wing tip, as in most *Dasineura* species. Females have a telescopic ovipositor and the terminal cerci are fused into a single lobe.

Whilst a large majority of *Dasineura* species oviposit on the surface of host food plants, *D. brassicae* (Winnertz) usually lays its eggs on the interior of the pods of brassicaceous plants (Stechmann & Schutte, 1978). Eggs are small, less than 0.3-0.35 mm long (barely visible without magnification), spindle-shaped, translucent, and with a reddish central spot. They are usually laid in clusters of 20 - 30 eggs in the pods, generally inserted into feeding holes made by *C. assimilis* (Paykull) or into similar wounds (Alford, 2003; Ambrus in Jermy & Balázs, 1997).

Larvae usually hatch from the eggs a few days later and will feed on the pod walls for approximately a month. The larvae are initially transparent then white, and finally yellowish-white often pinkish. Full-grown third-instar larvae are relatively featureless and are without legs or a head capsule. They are 0.5–1.5 mm long, with a median, ventral, chitinized sternal spatula on the prothoracic segment. The blade of the spatula is weakly bilobed and its eroded appearance appears to be characteristic of the species (Alford, 2003).

On falling to the ground, fully-grown larvae burrow beneath the soil to a depth of approximately 5 cm or less and pupate in small silken cocoons.

D. brassicae (Winnertz) is morphologically very similar to many other species of *Dasineura*, both in adult and larval stages, but for practical purposes is distinguished by its restricted host associations and the symptoms produced by larval feeding.

Diagnosis by symptoms of damage to host plants

▪ ***CEUTORHYNCHUS ASSIMILIS***

Larvae eat the inside of the pods and consume an average of five seeds from the time they hatch from the egg, till they exit the pod to pupate in the soil. Adults may also feed on late seeded rape by feeding directly on the seeds through the pod wall.

▪ ***DASINEURA BRASSICAE***

Eggs are laid inside the pods. Larvae consume mostly the inside of the pod but also the seeds.

2.5 Response checklist

Guidelines for Response Checklists are still to be endorsed. The checklist and short comments below provide a summary of generic requirements to be considered within a Response Plan:

Destruction methods for plant material, soil and disposable items:

- Suspected contaminated soil would be expected to provide some risk of containing sexually immature diapausing adults of *C. assimilis* and pupae of *D. brassicae*, hence destruction would need to cater for these.
- Suspected infected plant material would most likely be immature seed pods, possibly containing eggs or larvae of either *C. assimilis* or *D. brassicae*. Therefore, destruction of plant material would need to ensure that flowers and pods were catered for as a priority.
- Destruction would be by normal AQIS approved methods.

Disposal procedures

- Mainly needed for contaminated soil, plant material (flowers, pods) and adults caught from beat traps other non-destructive traps.

Quarantine restrictions and movement controls

- Need to consider the flight characteristics of the adult of pests, plus contaminated soil and any *Brassica* species plant material movement.

Decontamination and farm cleanup procedures

- Consider contaminated soil management, and disposal (as above) of any *Brassica* plant material (especially pods) potentially carrying either of these pests eggs or larvae.

Diagnostic protocols and laboratories

- Consider difficulties in having required expertise needed for diagnosing these pests, and the potential for misdiagnosis.

Trace back and trace forward procedures

- Consider the most likely host to be canola, though the pests can be introduced with other *Brassica* species, and as immature life stages, with the potential delays in emergence from soil as adults. Will need AQIS assistance.

Protocols for delimiting, intensive and ongoing surveillance

- Active flight makes design and operation of surveys difficult, need to take into account wind direction and speed. Additionally, the possible length of overwintering periods, requirements

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for various temperature regimes for emergence and length of life (up to 5 years diapause for *D. brassicae*).

Zoning

- Much of southern Australia is likely to provide acceptable climatic.

Reporting and communication strategy

- Consider the major host at risk as canola when designing any communications strategy.

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

2.6 Delimiting survey and epidemiology study

Such surveys should consider the initial area of incursion / detection, in addition to information able to be gained from trace back / trace forward activities. However, this may be complicated by active flight characteristics of the adults. In consideration of the latter feature, weather and wind conditions would need to be taken into account in any surveys following detection.

Additionally, the characteristics of the overwintering features of *C. assimilis* in requiring a period of cool to cold weather prior to emergence and the potential long life of *D. brassicae* (including while in soil) can impact on survey methods. However, the high likelihood that canola would provide the major host for these pests can be used to focus surveys and epidemiological studies.

If *C. assimilis* (Paykull) and *D. brassicae* (Winnertz) are included in exotic pest surveys, then all hosts, including potential Australian native host plants, must be included. Surveys around ports and airports must include sampling of Brassicaceous weeds and plants.

2.6.1 Sampling method

C. assimilis (Paykull) adults are found on flowers and developing pods and can be sampled by beating the top of flowering plants over a tray, which should be reasonably large (for example, 30 cm by 25 cm) and preferably white to contrast well with the dark adults (Walters & Lane, 1994a). *C. assimilis* (Paykull) remains still for a while after landing on the tray, whereas pollen beetles (*Meligethes* spp.) run or fly off. Alternatively, plants can be shaken over a large funnel with a collecting bottle beneath.

Sweeping can also be used; a standard sweep is a 180-degree swing of a 38cm diameter net through the upper canopy in warm weather. When the adult is common, many can be observed on buds, in flowers or on young pods without the need to beat or sweep the plants. Inspections should be done on warm (at least 15°C), dry days with little wind.

C. assimilis (Paykull) adults can also be trapped in yellow water traps, particularly if baited with isothiocyanates or other components of the odour of *Brassica* plants.

To detect larvae, it is necessary to collect developing or mature pods and cut them open. Larvae are found in between the seeds. Damage can also be assessed by collecting mature pods and inspecting them for the exit holes made by emerging adults.

The most direct method of detection of *D. brassicae* (Winnertz) is by field inspection of developing crops to detect infested pods and confirm the presence of midge larvae. It may also be possible to detect adult females ovipositing in pods during periods of peak activity. Various devices have been used to monitor adult midges, including wind-sock traps, water traps, sweep-netting and suction traps

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(Winfield, 1992) but these all depend on accurate determination of the caught adults which have to be separated from the other trap contents.

Increasing knowledge of the pheromones released by females may result in the development of effective pheromone traps, but this will only monitor male rather than female activity.

When planning any surveys the following features should be taken into account:

- Adults can fly, especially when assisted by prevailing winds. Surveys should range several km (up to ten) from a detection site with a bias in a downwind direction.
- Diapausing immature adults of *C. assimilis* and the pupae of *D. brassicae* can be difficult to detect in soil, so attention should be paid to finely inspecting any soil samples taken from the survey.
- The damage from *C. assimilis* (pin holes in pods) and *D. brassicae* (distorted and larvae filled pods) is relatively specific to this pest complex.

2.6.1.1 NUMBER OF SPECIMENS TO BE COLLECTED

Ideally, it is best to collect multiple specimens from as many life stages as can be found. Larvae or adults will in most cases be the easiest to find and collect though the adult life stage is the easiest to use for identification.

It is important to record the host plant, location (including GPS co-ordinates if possible), distance and direction to identifiable landmarks, and other host crops or plants where the specimen has been located. If private land, note the landholders contact details.

2.6.1.2 HOW TO COLLECT PLANT SAMPLES

Where adults are unable to be collected, it is possible that plant material showing feeding damage or with containing larvae may be collected. The likely plant parts to be collected will be pods, or possibly flower racemes.

2.6.1.3 HOW TO PRESERVE PLANT SAMPLES

Plant samples with immature life stages associated or attached should be packed between dry paper sheets (or moistened paper for leaves), and sealed in plastic bags. Double bagging is recommended with additional paper also placed in outer bags. Bags should be placed in crush resistant containers for transport.

2.6.1.4 HOW TO TRANSPORT PLANT MATERIAL

Sample material can be transported in vehicles or registered courier methods.

Where possible samples should be kept away from extreme temperatures and the use of refrigeration equipment should be used where possible.

2.6.1.5 HOW TO PRESERVE INSECT SAMPLES

Adults should be killed by standard methods – freezing, cyanide, ethyl acetate.

Larvae are killed by standard methods (fixed by placing into boiling water or KAA preservative (kerosene – acetic acid – alcohol)). They are then preserved in 80% ethanol. Larvae may be dry

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mounted on a pin after being dissected and stuffed with cotton wool. However, the latter requires the larvae to be killed by freezing or in a killing jar to retain its colour and allow easy dissection.

Eggs and pupae should be stored in 80% ethanol (if not required for rearing purposes).

Specimens for DNA analysis should be collected directly into absolute ethanol (adults or larvae).

Where taxonomic expertise is readily available and identification can be carried out quickly it may be practical to keep adults alive.

2.6.1.6 HOW TO TRANSPORT INSECT SAMPLES

Live insects (any life stage) should not be transported unless it is considered essential, and then such that containers are only opened in PC3 or QC3 containment facilities.

Vials containing the samples in a preservative should be sealed to avoid leakage and packed in a manner to minimise shock to the vials (i.e. with cushioning material in a strong box). It is important to ensure that vials are filled with preservative so as to remove excess air that will allow agitation of the preservative and quickly degrade the specimen.

Transport/airline regulations may preclude the transportation of ethanol or acetone. Contact the relevant transport authority or company for advice.

2.6.1.7 REGARDING QUARANTINE

Where a quarantine situation occurs, special authority will be needed to remove live exotic insects from the quarantine area.

On receipt of the samples the diagnostic laboratory should follow strict quarantine and processing guidelines. In keeping with ISO 17025 refer to PLANTPLAN (Plant Health Australia, 2010).

2.6.2 Epidemiological study

The extent of any infestation following an incursion will depend on the initial population size and whether conditions have been favourable for the pest to spread from the initial location. Sampling should be based upon the origins of the initial sample(s). Factors to consider will be:

- The proximity of other host plants to the initial infestation source. Both pests have a relatively restricted host range, being *Brassica* species almost exclusively, and canola as the most likely host of interest. While a survey covering other *Brassica* species would be warranted, a focus on canola crops would be most likely to yield any results.
- Machinery or vehicles that have been into the infested area or in close proximity to the infestation source, especially those that can or do carry soil, or where any adult weevils or midges may hide and be carried.
- The extent of human movements into and around the infested area. A possible link to the recent importation of plant material or soil from other regions should also be considered.
- If any other crops have been propagated from the same source and/or distributed from the affected area or property.
- The Brassica Pod Midge can potentially have several generations per year, while the Cabbage Seedpod Weevil only has one.

2.6.3 Models of spread potential

The only known model is a computer-based farmer advisory service or decision support system (DSS) for the management of pests of canola, including *C. assimilis* (Paykull), developed in the UK (Mann *et al.*, 1986). Systems for forecasting damage have also been developed in France (Lechapt, 1980) and Germany (Riedel, 1989).

2.6.4 Pest Free Area guidelines

Determination of Pest Free Areas (PFAs) should be completed in accordance with the International Standards for Phytosanitary Measures (ISPMs) 8 and 10 (IPPC, 1998a, 1999).

Points to consider are:

Design of a statistical delimiting field survey for symptoms on host plants and for the presence or absence of eggs, larvae, pupae and diapausing adults of both species.

Surveys in the first instance would concentrate on canola crops as hosts.

All relevant information (including absence of the pest) should be recorded.

Plant sampling should be based on a representative number of plants taken at random from each crop and from the same area over at several years (top cater to the possibility of the life of *D. brassicae* to last for up to 5 years).

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 PFAs 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

Chemical methods are the main means of control of these pests.

2.7.1 General procedures for control

Spraying of canola crops (assuming this to be the major host involved) would be carried out by normal boomspray operations. Application methods (carrier volume, use of adjuvants, and other mechanical adjustments) would be determined by consulting the label of the insecticide products used. All insecticide products should be registered for control of these pests in Australia, or if not, then advice from the APVMA, state Departments of Agriculture / Primary Industry or suitable chemical industry expertise sought.

2.7.2 Control if small areas are affected

If only larvae, pupae or adults are detected before any distribution of the infested plant material or soil has occurred, normal quarantine procedures should be followed. It is likely that eradication of a small area infestation of adults, larvae or pupae will only be achievable where adults have not been able to travel out of the area. In these circumstances severe control methods would be employed for quite

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small area incursions (e.g. an isolated area in a paddock, and where small numbers of affected host plants in a crop are involved). Eradication would still be achievable after larvae or pupae are detected in a wider field situation, though it would require relatively swift action.

If a preliminary survey has indicated that no more than one localised infestation is present, and that no adults have moved from that area, then in that isolated area eradication may be achieved using a consolidated chemical approach, focussing on control of all larvae by application to all potential host plants in the area for a period sufficient to cover the possible length of activity of both pests, or until any *Brassica* hosts have matured. If the infestation is confined to only one paddock or a few hectares, it may be easier to simply destroy all canola plants in that area.

Associated soil and any plant material, especially flower racemes and pods, should be examined closely and also treated so as to kill any larvae, pupae or immature adults.

2.7.3 Control if large areas are affected

Where large areas are affected and adults are suspected or observed as having been active, the likelihood of eradication can still be considered. Treatment of large areas with suitable insecticides is the only available option.

Follow up surveys for up to 5 years in the affected area will be needed to be carried out to cover the possibility of any longer lived immature adults or overwintering diapausing pests of specifically *D. brassicae*, with the timing of these targeted for the spring period coinciding with the commencement of flowering of any canola plants nearby.

2.7.4 Cultural control

The only cultural control methods available are the use of trap crops around canola crops, where the trap crop is planted at a time (some weeks earlier than normal canola planting time) to provide a suitably attractive environment for *C. assimilis* to infest the trap crops which can be controlled by destroying the crop.

2.7.5 Host plant resistance

No host plant resistance is known to exist against either pest in Australian *Brassica* species at present.

2.7.6 Chemical control

While several insecticidal compounds are likely to be effective against both these pests, none are likely to be registered for their control in canola crops in Australia, since the pests are still exotic.

Organophosphates have been usually used for control of both pests in Europe, applied post flowering, though some resistance has been found, and so synthetic pyrethroids are now often preferred, and would be favoured in Australia.

In the US ethyl or methyl parathion can provide very good control of larvae and also eggs inside pods. These compounds would not be suitable for widespread use, though may be chosen for a small incursion or very limited paddock scale infestations, though a permit from the APVMA would be needed.

2.7.7 Mechanical control

Mechanical control activities will be in general unreliable, though some soil disturbance may assist with control of overwintering immature adults or pupae, though this would be considered an unreliable approach for use in an incursion situation, since full control of all individuals present could not be expected.

2.7.8 Biological control

While there are several natural control agents of *C. assimilis* and *D. brassicae*, notably some ectoparasitoid wasps, none of these are present in Australia.

3 Course of action – eradication methods

3.1 Destruction strategy

The decision to eradicate should be based both on the potential economic impact of host damage resulting from infestation of either *C. assimilis* or *D. brassicae* and on technical feasibility. Eradication costs must factor in long-term surveys to prove the success of the eradication program. Up to 5 years with no detections of the pests (especially *D. brassicae*) will be necessary before pest free status can be declared.

No specific eradication matrix has been determined for either pest, however the general decision process as outlined in Figure 2 should be followed in determining if an incursion of these pests will be eradicated or managed/contained. The final decision between eradication and management will be made through the National Management Group.

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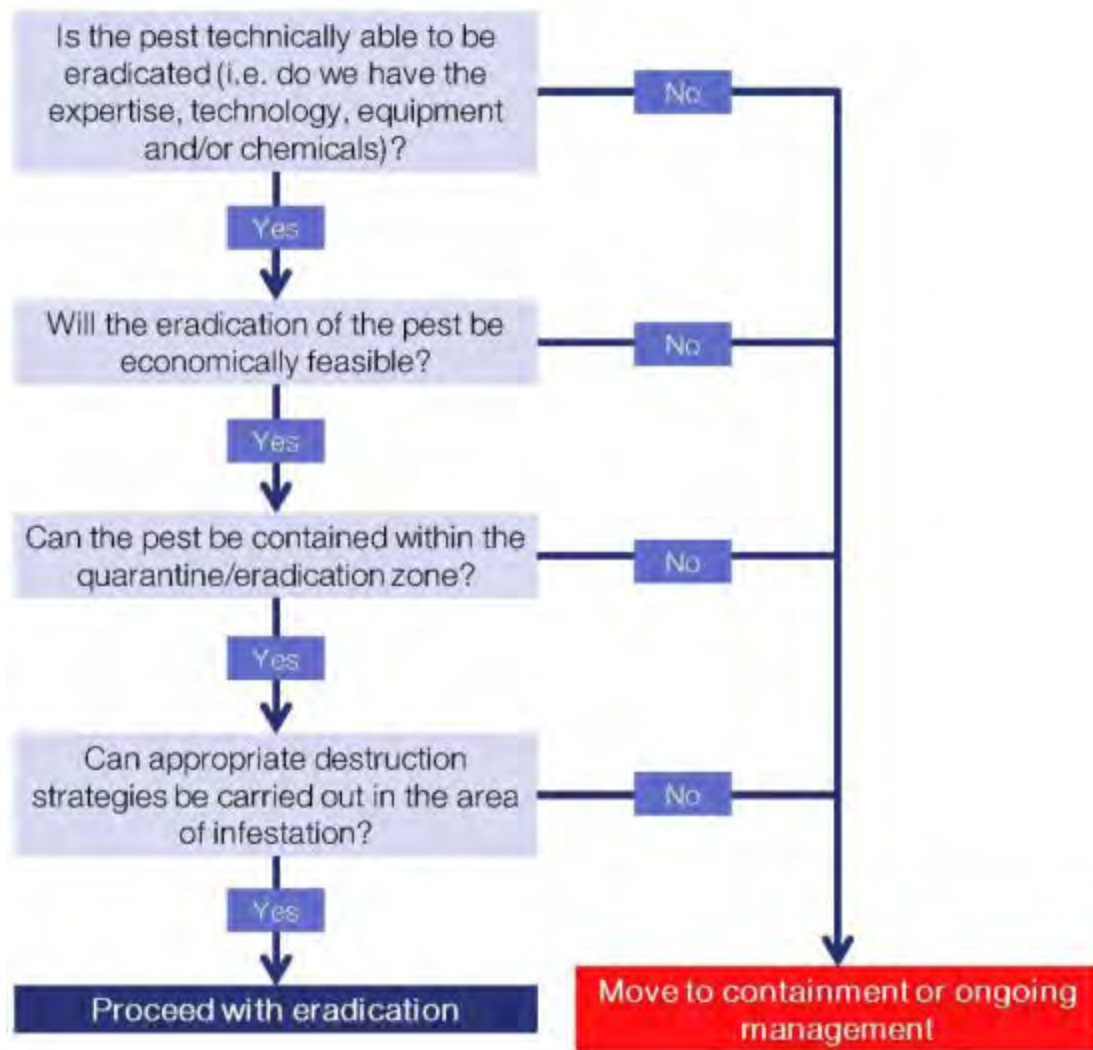


Figure 9. Decision outline for the response to an exotic pest incursion

3.1.1 Destruction protocols

General protocols:

- Disposable equipment, infested plant material or growing media/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.
- Machinery used in destruction processes needs to be thoroughly washed, preferably using a detergent or farm degreaser.

Ceutorhynchus assimilis destruction strategy:

- Knock down populations, by treating infected plants and the wider area (out to 1 km in diameter) with a suitable organophosphorus or synthetic pyrethroid insecticide.
- Infested plant parts can then be destroyed by enclosed incineration or deep burial.
- Methyl bromide is effective at killing eggs, larvae and pupae and should be used where such plant parts and infested soil can reasonably be treated.

3.1.2 Decontamination protocols

Machinery, equipment and vehicles in contact with infested plant material or growing media/soil, or present within the Quarantine Area, should be washed to remove plant material and growing media/soil using high pressure water or scrubbing with products such as a degreaser or a bleach solution (1% available chlorine) in a designated wash down area. When using high pressure water, care should be taken not to spread plant material. High pressure water should be used in wash down areas which meet the following guidelines:

- 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, growing media/soil or plant residues should be contained (see Appendix 18 of PLANTPLAN [Plant Health Australia, 2010]).
- Disposable overalls and rubber boots should be worn when handling infested plant material or growing media/soil in the field. Boots, clothes and shoes in contact with infested plant material or growing media/soil should be disinfected at the site or double-bagged to remove for cleaning.
- Skin and hair in contact with infested plant material or growing media/soil should be washed.

3.1.3 Priorities

- Confirm the presence of one or both pests, noting the life stage(s) present. Take particular note of eggs or larvae infested pods.
- Prevent movement of vehicles and equipment through affected areas, checking for any adults in vehicles located just outside affected areas, or given their small size, carry out thorough washdown with an insecticidal solution.
- Stop the movement of any plant material and soil that may be infested with the pupae or diapausing adults.
- Determine the strategy for the eradication/decontamination of the pests and infested host material and soil.
- Determine an appropriate communication strategy for the relevant industry or infested area.
- Determine the extent of infestation through survey and plant material trace back.

3.1.4 Plants, by-products and waste processing

Any soil or infested plant material removed from the site should be destroyed by (enclosed) high temperature incineration, autoclaving or deep burial.

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As the pests (including adults) can be mechanically transported, plant debris and any suspected soil from the destruction zone must be carefully handled and transported for destruction.

Infested areas, crop areas or nursery yards should remain free of susceptible host plants until the area has been shown to be free from the pests.

3.1.5 Disposal issues

Particular care must be taken to minimise the transfer of infested plant material or insects from the area.

Host material, including leaf litter, should be collected and incinerated or double bagged and deep buried in an approved site.

3.2 Quarantine and movement controls

The November 2010 (version 2) of PLANTPLAN, (Plant Health Australia) should be consulted.

3.2.1 Quarantine priorities

Plant material and soil at the site of infestation are 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.

Adult weevils and midges can fly and can be dispersed from emergence sites by winds currents for several kilometres, making establishment of quarantine more difficult.

3.2.2 Movement control for people, plant material and machinery

If these pests were to become established over a wide area, they may be very difficult to eradicate. Any zoning, quarantine or movement controls will be directed to containment and management unless detection occurs soon after establishment and adults have not moved away from the initial incursion site. If Restricted or Quarantine Areas are practical, movement of equipment or machinery should be restricted and movement into the Area should only occur by permit.

The canola industry and potentially other industries involved with alternate host plant crops will need to be informed of the location and extent of the incursion.

Movement of people, vehicles and machinery, from and to affected farms, must be controlled to ensure that infected soil, leaf litter 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 to be by permit only.
- Clothing and footwear worn at an infested site should either be double-bagged prior to removal for decontamination or remain until thoroughly disinfected, washed and cleaned.

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- Where dwellings and places of business are included within the Restricted and Control Areas, limitation of contact with infested plant areas should be enforced.
- If an infested property is situated within the Restricted Area, trading of canola grain may be able to continue subject to strict conditions to ensure any potentially infested soil or plant material cannot leave the property, due to the possibility of pest spread.
- Residents should be advised on measures to minimise the inadvertent transport of either pest from the infested area to unaffected areas.
- All machinery and equipment should be thoroughly cleaned down with a pressure cleaner prior to leaving the affected location. 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.

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 infested property to other infested properties and areas of host plants.

The National Management Group will determine this during the production of the Response Plan.

Further information on quarantine zones in an Emergency Plant Pest (EPP) incursion can be found in Appendix 10 of PLANTPLAN (Plant Health Australia, 2010). These zones are outlined below and in Figure 3.

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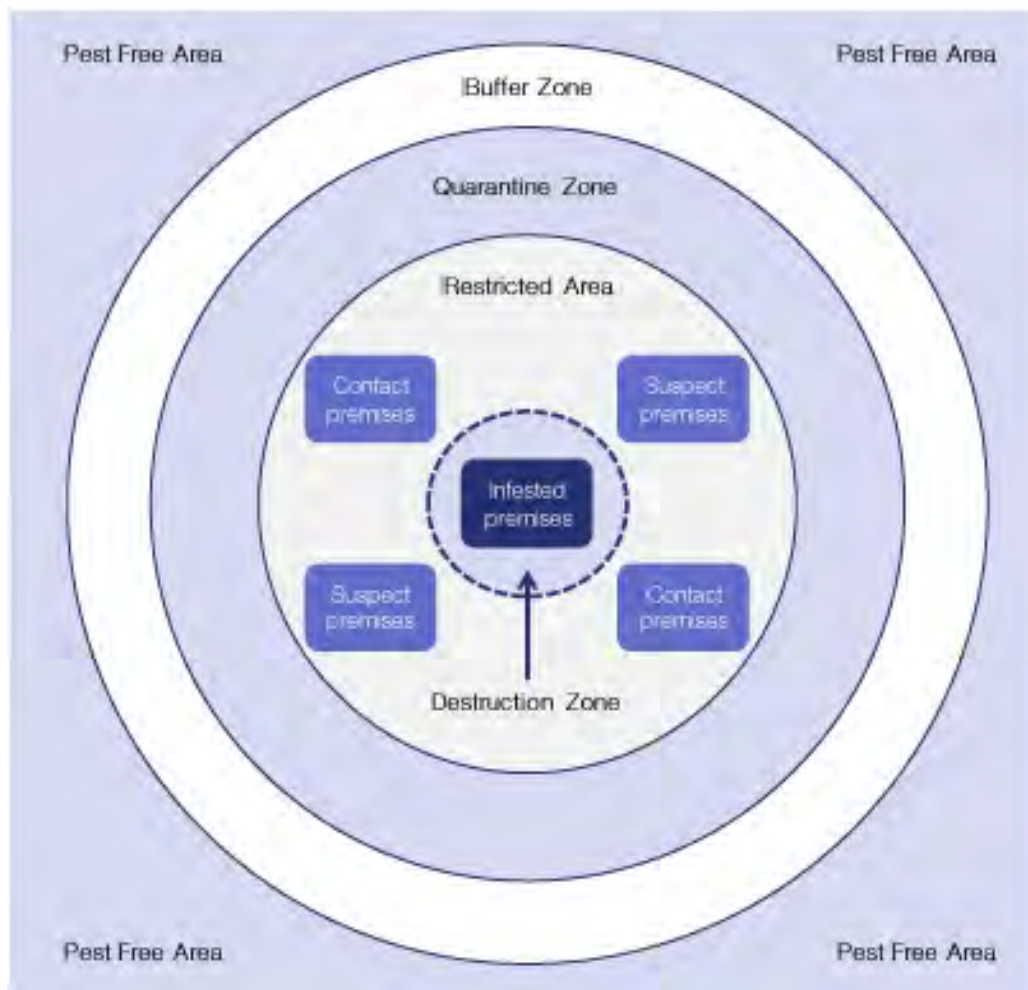


Figure 10. Schematic diagram of quarantine zones used during an EPP incursion (not drawn to scale)

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), climatic conditions, time of season (and part of the pest life cycle being targeted) and factors that may contribute to the pest spreading.

The entire crop or population of host plants in the zone should be destroyed after the level of infection has been established. The delimiting survey will determine whether or not neighbouring host plants are infected and need to be destroyed. The Destruction Zone may be defined as contiguous areas associated with the same host plant presence as the infected area (i.e. the entire paddock in the case of a canola crop, or as indicated by survey results where the incursion of one or both pests could have occurred prior to the infection being identified). If the movement of *C. assimilis* or *D. brassicae* to neighbouring areas appears likely through the flight of adults, host plants in these areas will also need to be carefully surveyed and potentially destroyed.

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 or properties. These restraints may include restrictions or movement control for removal of plants, people, soil or contaminated equipment from an infested property.

3.3.3 Buffer Zone

A Buffer Zone may or may not be required depending on the nature of the incursion. It is defined as the area in which the pests do 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 infested area and suspected infested area. 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 infested areas / premises and all suspected infested areas / 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 pests thus preventing their spread to other areas.

3.4.1 Decontamination procedures

General guidelines for decontamination and clean up:

- Refer to PLANTPLAN (Plant Health Australia, 2010) for further information.
- Keep traffic out of affected area and minimize in adjacent areas.
- Adopt best-practice property hygiene procedures to retard the spread of the pest between growing areas/fields and adjacent properties.
- Machinery, equipment and vehicles in contact with infested plant material or growing media/soil present within the Quarantine Zone, should be washed to remove soil and plant

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material using high pressure water or scrubbing with products such as a degreaser or a bleach solution in a designated wash down area.

- Only recommended materials are to be used when conducting decontamination procedures, and should be applied according to the product label.
- Infested plant material or soil should be disposed of by autoclaving, high temperature (enclosed) incineration or deep burial.

3.4.2 Decontamination if pest is identified in small or large areas.

▪ ***FOR SMALL AREAS:***

Decontamination of small areas, for example a small area of a canola crop where adults are not known to have spread, may need to be determined on an individual basis involving the farm or site manager, the state or territory departmental officers and/or federal officers. The decontamination procedures should consider:

- the source and location of the infestation
- the size of enterprise (e.g. paddock, or number of plants that are infested)
- life stage of the pest infestation
- climatic conditions
- the proximity to other areas where host plants may exist
- workplace safety matters
- environmental impact of the disinfectant protocol
- legislative requirements (occupational health and safety, environmental protection, chemical use)

▪ ***FOR LARGE AREAS:***

Considerations for large areas include:

- A large area may be affected, especially if adults have begun movement.
- Limited or no control over movement of plants, people or agricultural machinery.
- Limited or no ability to thoroughly decontaminate the wider area.
- Decontamination restricted to movement of personnel and equipment in and out of the infected area.
- Potentially a very wide group of stakeholders.

Large areas where infestations have occurred, such as broadacre cropping areas, are areas where normally there is little or no control of movement of agricultural machinery, plant material and personnel. As such, decontaminating these areas as part of an incursion response will often be difficult to manage due to the lack of control of these movements and the large areas potentially involved.

Decontamination procedures may have a significant impact on the environment, and a wide group of stakeholders might be affected by control measures.

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Decontamination programs will tend to be limited to decontamination of personnel, vehicles, equipment, plants and soil moving out of the affected area. There may be multiple access points that need to be considered as decontamination points.

The potential exists for litigation resulting from recommendations made to the general public or action taken by authorities. Under such circumstances, decontamination procedures must be simple and safe to people and equipment. Decontamination procedures should rely primarily on good cleaning procedures, using products that would normally be available for such purposes. Decontamination control measures that may be applied include:

- installation of signage and wash down bays at entry and exit points, or at strategic points around the control area;
- production of technical literature explaining how the general public may identify the pests and undertake reporting, control and cleaning or disinfection procedures;
- for commercial operators working within the infected area, establishment of logbook systems that document when decontamination procedures are undertaken; and
- communication and training activities for those frequently entering or leaving infected areas.

3.4.3 General safety precautions

For any chemicals used in the decontamination, follow all safety procedures listed within each Material Safety Data Sheet.

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 pests retain market access and appropriate quarantine zones are established.

Initial surveillance priorities include the following:

- Surveying all host growing properties and businesses in the pest quarantine area.
- Surveying all properties and businesses identified in trace-forward or trace-back analysis as being at risk.
- Surveying all host growing properties and businesses that are reliant on trade with interstate or international markets that may be sensitive to either pest.
- Surveying other host growing properties and areas.

Awareness is an essential surveillance tool. Information about the risks posed by *C. assimilis* and *D. brassicae* should be regularly made available to target groups through media outlets. This should be supplemented with readily available and referable information sources such as exotic pest data sheets and Internet sites. The damage characteristics of *C. assimilis* are distinctive and colour pictures plus point-form information (e.g., Appendix 1), should feature in any information aimed at target groups.

Horticulture extension officers in State Departments of Agriculture or Primary Industry should be aware of the pest, and have information readily available for occasional reminders in grower newsletters or production talks. Ideally, all target groups should have ready access to State

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Departments of Agriculture or Primary Industry run free identification services that can confirm the identity of suspect adults, pupae or larvae and/or refer them to specialists.

▪ **CONSIDERATIONS FOR GROWERS, AGRIBUSINESSES AND WHOLESALERS/RETAILERS:**

Canola crop growers, and the businesses that supply them and market their produce, should have information regularly made available through trade journals and industry information sources about this pest complex. Industry biosecurity plans developed for the relevant industries should be widely promoted through the relevant producer associations.

▪ **CONSIDERATIONS FOR URBAN COMMUNITIES AND HOME GARDENERS:**

There is a likelihood that the initial site of incursion of *C. assimilis* and *D. brassicae* could be in urban areas. Therefore, home gardeners, nurseries and media catering to these groups should be targeted in “community surveillance” programs. Displays at shows and events aimed at urban communities can have information leaflets available. State Departments of Agriculture or Primary Industry that have information and/or technical services for urban target groups should have readily available information on both pests, perhaps of the same type as made available to Grower groups by Extension officers.

▪ **CONSIDERATIONS FOR QUARANTINE AUTHORITIES (AUSTRALIAN QUARANTINE AND INSPECTION SERVICE)**

AQIS information on ICON (Import Conditions database) should consider including information on pests such as *C. assimilis* and *D. brassicae*, especially where queries about commodities on risk pathways from risk countries are made by importers or the public. Such information should be available to AQIS inspectors, who should receive training that includes such information. Of particular importance is knowledge of risk countries where these pests occur, and the risk pathways that could lead to their introduction. The aim of this approach is an awareness of what might be found during an inspection.

General surveillance based on awareness that triggers recognition of an insect that is exotic, out of place, or unusual relies on random recognition and is qualitative, rather than quantitative and directed.

▪ **TARGETTED SURVEILLANCE**

Targetted surveillance requires specified sampling plans based on knowledge of pest biology, accepted detection method, and statistically defined methods that allow estimation of population presence, absence and / or size. The main role for targetted surveillance is to determine the likelihood of presence or absence of an exotic organism.

Identifying the presence of these pests is reliant on physical evidence of damage to host plants, specifically immature pods. In Australia the practice of windrowing canola crops as they near maturity by contract operators is relatively common. These operators may be best placed to notice any infestations since they are present in large areas of canola crops at about the correct timing to coincide with a possible infestation. As such, some effort aimed at targeting these operators as part of a general surveillance program should be considered.

The size of any incursion and the subsequent weather conditions may influence the type and timing of control treatment and give the ability to predict possible spread of an outbreak.

Targetted surveillance for these pests may be conducted with different objectives:

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- 1 To provide a statistically reproducible sampling methodology to establish the absence of the pest complex at a defined level of confidence
- 2 To determine presence or absence of the pest complex in a district or region, in the event that they have been found elsewhere and it is necessary to delimit the extent of the infestation
- 3 To determine the size of a population that has been detected, with a view to deciding on treatment actions that may be taken. This is the most usual situation in determining action levels in commercial pest control.

The most common and efficient method of determining the presence or absence of *C. assimilis* and *D. brassicae* is by beating or sweeping canola plants at the appropriate stage of development, when one or both pests are likely to be present. These methods can also determine the abundance and spread of larvae in a crop, and can estimate the number of larvae per square metre for control purposes. This sampling method is designed to assess action thresholds for control of these pests in infested regions. It is not applicable to incursion detection or management where eradication may be the objective.

By the time signs of crop damage are visible on inspection, such as pin holes in pods or distorted growth of pods and missing seeds, coupled with presence of larvae, it may be too late to save crops with control methods.

▪ **EXOTIC PEST SURVEY**

Although the potential for entry into Australia by these pests is low, the most desirable situation for control is continued surveillance of imported commodities and people from infested regions entering Australia. Once established, eradication of these pests may be difficult, though remain feasible if early action is taken prior to any movement of significant numbers of adults out of the first site of infestation. Exotic pest surveys of regions surrounding Australia (e.g. islands) and monitoring spread in other overseas countries from where *Brassica* species plant material may come is desirable to assist with monitoring or surveillance measures.

3.5.2 Survey regions

Establish survey regions around the surveillance priorities identified above. These regions will be generated based on the zoning requirements, and prioritised based on their potential likelihood to receive an incursion of these pests. 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. Detailed information regarding surveys for these pests has been outlined elsewhere in this plan.

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.

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Table 1. Phases to be covered in a survey plan

| | |
|---------|--|
| Phase 1 | Identify properties that fall within the buffer zone around the infested premises 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 premises is a property containing susceptible host plants, which are known to have been in direct or indirect contact with an infested premises or the pest. Contact premises may be determined through tracking movement of materials from the property that may provide a viable pathway for spread of the pest. Pathways to be considered are: <ul style="list-style-type: none"> • Items of equipment and machinery which have been shared between properties including bins, containers, irrigation lines, vehicles and equipment • The producer and retailer of infested material if this is suspected to be the source of the outbreak • Labour and other personnel that have moved from infested, contact and suspect premises to unaffected properties (other growers, tradesmen, visitors, salesmen, crop scouts, harvesters and possibly beekeepers) • Movement of plant material and growing media/soil from controlled and restricted areas |
| Phase 5 | Surveillance of production and retail nurseries, gardens and public land where plants known to be hosts of the pest 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 pests has been achieved will be determined by a number of factors, including cropping conditions, the previous level of infestation, the control measures applied and the pest biology.

Specific methods to confirm eradication of *C. assimilis* and *D. brassicae* may include:

- Monitoring of sentinel plants that have been grown at the affected sites. Plants are to be monitored for symptoms or other indications of *C. assimilis* presence.
- If symptoms or suspect insects are detected, samples are to be collected and stored and plants destroyed.
- Targeted surveys for the weevil should be considered within the Quarantine Zone to demonstrate pest absence for a period of up to 2 years for *C. assimilis* and 5 years for *D. brassicae* after eradication has been achieved.

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5 Appendices

Appendix 1. Standard diagnostic protocols

More comprehensive identification material is presented in the Pest Risk Review for Cabbage Seedpod Weevil and Brassica Pod Midge. This includes a detailed description of the major identification features and the differences between *Ceutorhynchus assimilis* and other *Ceutorhynchus* species. The Pest Risk Review also contains additional pictures showing the identification features and differences between these species.

Identification of *Ceutorhynchus assimilis* Paykull



Figure 11. *C. assimilis* (lateral)



Figure 12. *C. assimilis* (dorsal)

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Figure 13. *C. assimilis* adult on canola (<http://aav.vaat.it/>)



Figure 14. *C. assimilis* (Paykull) about to oviposit (<http://aav.vaat.it/>)

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Figure 15. *C. assimilis* (Paykull) on canola buds (<http://aav.vaat.lt/>)



Figure16. *C. assimilis* (Paykull) entrance holes into the flowers of canola (<http://aav.vaat.lt/>)

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Figure 17. *C. assimilis* (Paykull) egg in canola pod (<http://aav.vaat.it/>)

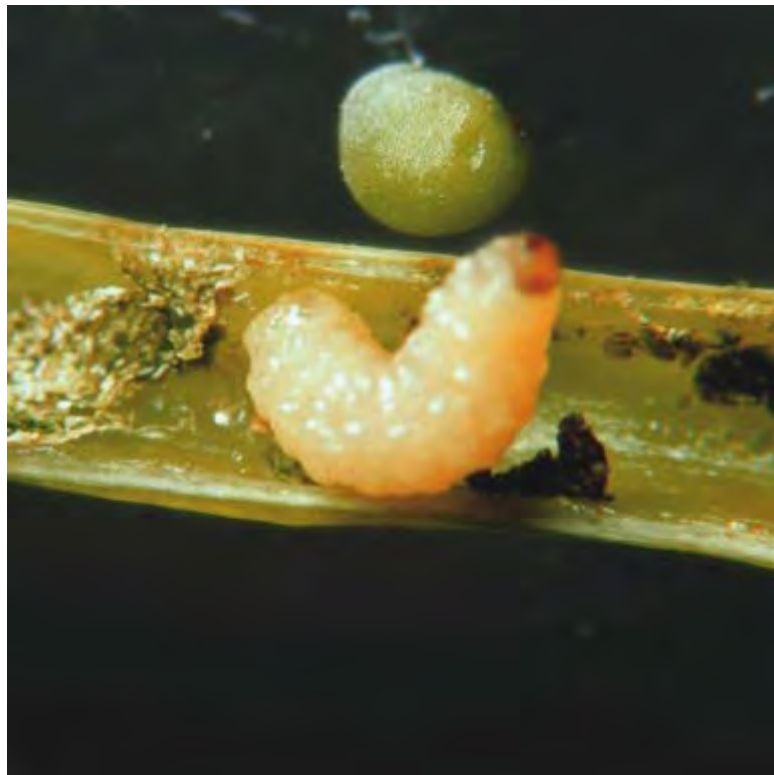


Figure 18. *C. assimilis* (Paykull) larva in canola pod (www.canola-council.org)

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Figure 19. *C. assimilis* (Paykull) larva about to leave the pod to pupate (<http://aav.vaat.it/>)



Figure 20. Destroyed seed and reaction of the septum separating the 2 rows of seed (www.inra.fr)



Figure 21. *C assimilis* (Paykull) larva emergence hole on damaged pod (<http://aav.vaat.it/>)

Identification of *Dasineura brassicae* Winnertz

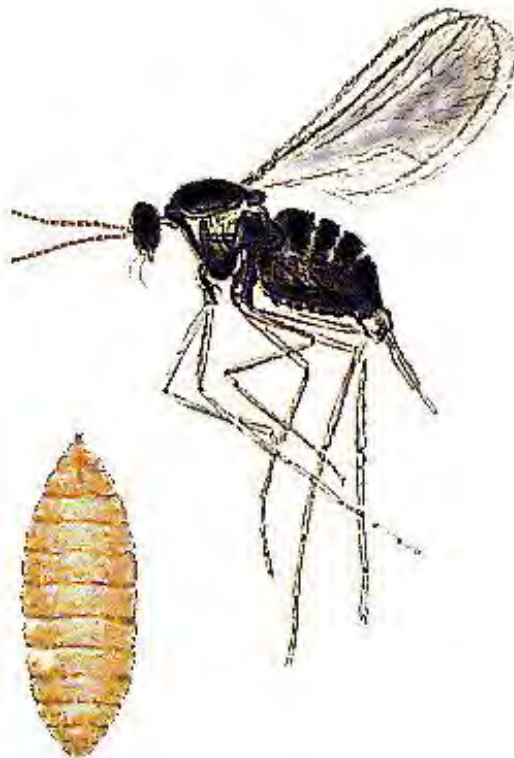


Figure 22. *D. brassicae* (Winnertz) adult and larva (www.inra.fr) (ACTA)

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Figure 23. *D. brassicae* (Winnertz) adult (www.inra.fr) (BASF)

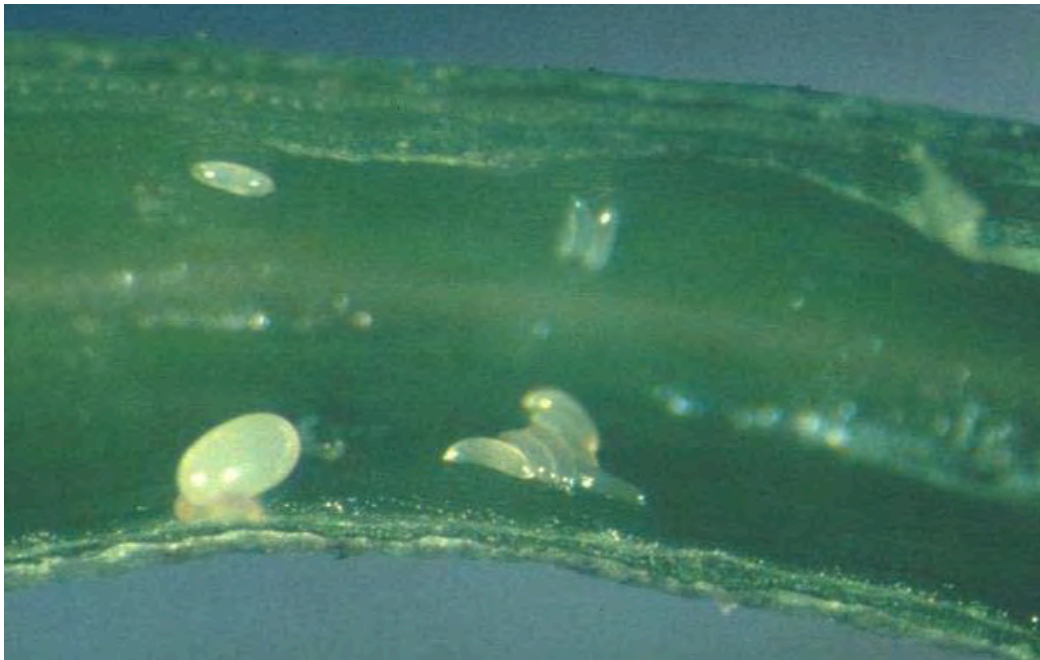


Figure 24. *C. assimilis* (Paykull) egg and *D. brassicae* (Winnertz) eggs in a canola pod (www.inra.fr) (Coutin R/ OPIE)

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Figure 25. *D. brassicae* (Winnertz) larvae in canola pod (www.inra.fr) (Coutin R/ OPIE)



Figure 26. *D. brassicae* (Winnertz) larvae in mature canola pod (www.farm-hespeler.de)

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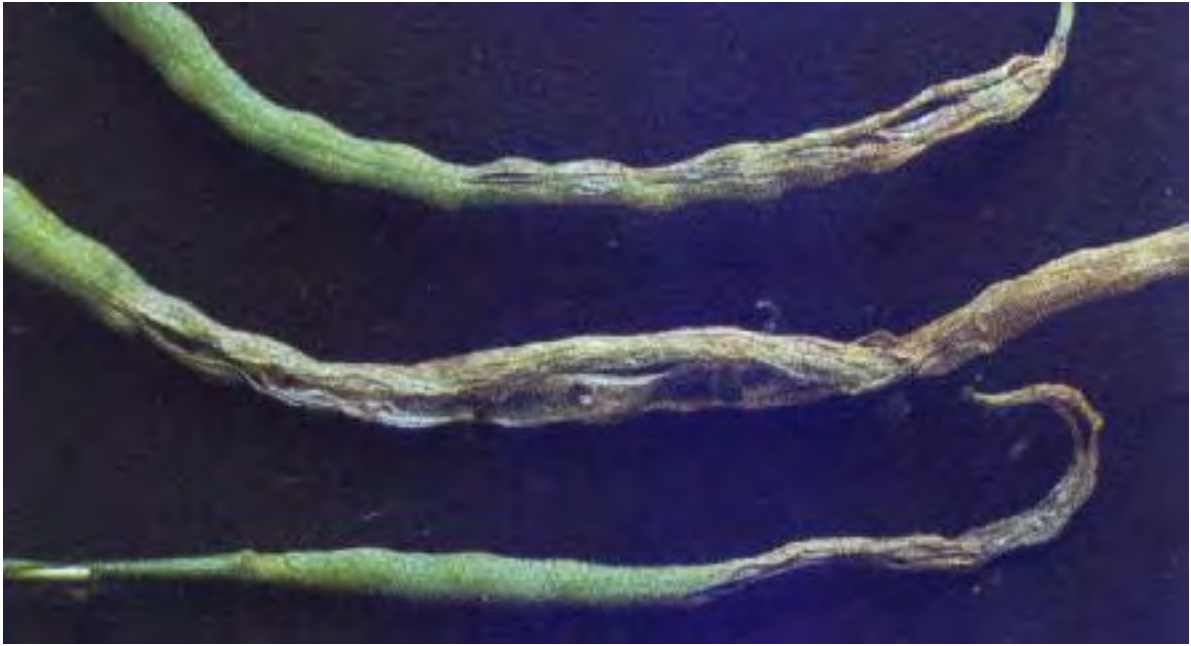


Figure 27. *D. brassicae* (Winnertz) damage (www.farm-hespeler.de)

Appendix 2. Experts, resources and facilities

There are few taxonomic experts in Australia with experience in identifying these pests. Competent entomologists are likely to reside in state department laboratories or within private industry, as listed in Table below.

Table 2. 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 |
| NSW DPI Diagnostic and Analytical Services (DAS) – Elizabeth Macarthur Agricultural Institute | NSW | Woodbridge Road Menangle NSW 2568 PMB 8 Camden NSW 2570 Ph: (02) 4640 6327; Fax: (02) 4640 6428 |
| NSW DPI Diagnostic and Analytical Services (DAS) – Orange Agricultural Institute | NSW | 1447 Forest Rd Locked Bag 6006 ORANGE NSW 2800 Ph: (02) 6391 3980 ; Fax: (02) 6391 3899 |
| NSW DPI – Tamworth Agricultural Institute | NSW | 4 Marsden Park Road Calala NSW 2340 Ph: (02) 6763 1100; Fax: (02) 6763 1222 |
| NSW DPI – 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 |

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| Facility | State | Details |
|--|-------|---|
| 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 (Plant Health Australia, 2010).

Appendix 4. Market access impacts

A search of AQIS PHYTO (http://www.aqis.gov.au/phyto/asp/ex_search.asp) database online yields no results concerning market access for any commodity or country, however a more detailed enquiry is warranted.