A national industry Pest Specific Incursion Management Plan (PSIMP) for Carrot rust fly (Psila rosae)

Marc Poole
Department of Agriculture & Food
Western Australia

Project Number: VG06114

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Diagnostic Protocol for Carrot Rust Fly (*Psila rosae* Fabricius, 1794)

Marc Poole *et al*.

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Government of Western Australia
Department of Agriculture and Food

Diagnostic Protocol for Carrot Rust Fly (*Psila rosae* Fabricius, 1794)

Prepared for:

Horticulture Australia Limited

VG06114

Marc Poole and Ruben Flores Vargas

**Department of Agriculture and Food,
Western Australia.**

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Project description: Carrot rust fly has been identified by Plant Health Australia as one of the top threats to the Australian carrot industry. In 2007 Horticulture Australia Ltd (HAL) commissioned the Department of Agriculture and Food Government of Western Australia to develop a Pest Specific Incursion Management Plan, a Pest Risk Assessment and a Diagnostic Protocol for carrot rust fly. It is recommended that these documents to be considered a permanent draft documents to be updated regularly as new information becomes available.

The scientific and technical content of this document is current to the date published and all efforts were made to obtain and published information.

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Figures

Introduction

The Carrot rust fly, (*Psila rosae* Fabricius, 1794, [Diptera: Psilidae]) is one of the more serious pests of carrots (*Daucus carota* L.) and related crops in temperate regions of the world (Berry et al. 1995).

Carrot rust fly is well known for the characteristic rust coloration caused by the larval mines on the tap root (Bernie 1971). The larvae hatch from eggs laid at the base of the host plant. The newly hatched larvae burrow into the soil and feed on the side roots of the host plant during the first two instars. The last instar larvae feed on the taproot. Brown scars appear where tunnels near the surface have collapsed. Larval feeding and burrowing can cause young plants to wilt and die. Damaged plants may also become stunted and with roots becoming bulbous and forked. In addition, fungi and bacteria may invade the damaged tissue and cause severe rot (Petherbridge et al. 1942). Carrot rust fly attack to the carrot is cosmetically unacceptable, rendering carrots unmarketable

Recorded host plants

While the host range of the carrot rust fly seems to be restricted to the Apiaceae family (Appendix 1), the majority of species within this plant family may be considered potential host plants (Degen et al. 1999; Villeneuve et al. 2007). Ellis et al. (1992) recorded 121 species of Apiaceae hosts. Plant species such as cabbage (*Brassicaceae*, beet (*Beta* spp.), endive (*Cichorium endivia*), chicory (*Cichorium intybus*), lettuce (*Lactuca sativa*) and potato (*Solanum tuberosum*) may be used by the larva if an Apiaceous host has been removed and there is nothing else for the larvae to feed upon, but in the field the female fly will only lay eggs on plants of the Apiaceae family. In the United Kingdom hemlock (*Conium maculatum* L.) is an important wild host (Capinera 2001).

World distribution

Taken from CABI Crop Protection Compendium 2007.

Europe: Austria, Belarus, Belgium, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Hungary, Ireland, Italy, Latvia, Netherlands, Norway, Poland, Portugal, Russia, Slovakia, Spain, Sweden, Switzerland, Ukraine, United Kingdom.

Asia: Georgia, Japan (Hokkaido), Mongolia, Turkey.

North America:

Canada Alberta, British Columbia, New Brunswick, Newfoundland, Nova Scotia, Ontario, Prince Edward Island and Quebec

USA California, Colorado, Connecticut, Georgia, Illinois, Maine, Maryland, Massachusetts, Michigan, New Hampshire, New York, Ohio, Oregon, Pennsylvania, Utah, Washington and Wisconsin.

South America: Chile.

Oceania: New Zealand, (Smith & Charles 1998). In Australia carrot rust fly has not been recorded but has been intercepted and it is categorised as an exotic plant pest.

Africa South Africa (Myburgh 1988).

Figure 1. World map showing carrot production countries ● and carrot rust fly ● (source: http://www.cabicompendium.org).

Taxonomic information

Kingdom:	Animalia Linnaeus, 1758
Phylum:	Arthropoda Latreille, 1829
Class:	Insecta Linnaeus, 1758
Order:	Diptera Linnaeus, 1758
Suborder:	Brachycera
Family:	Psilidae
Genus:	*Psila*
Scientific name:	*Psila rosae* Fabricius, 1794

Synonyms or changes in combination or taxonomy

Chamaepsila rosae (Fabricius, 1794)

Musca rosae Fabricius, 1794; preocc. [ICZN App. pending]

Chamaepsila hennigi Thomson & Pont, 1994

Carrot rust fly was first described in the genus *Musca* by Fabricius (1794) and later removed to the genus *Psila*. In Papp, L. and D. Bela (1998), it is placed in the genus *Chamaepsila*, previously regarded as a subgenus of *Psila*, (Soos 1984). However, Shatalkin (1986) considered that the species should be placed in the genus *Psila*, a combination followed by Iwasa (1991). Thompson & Pont (1994) showed that *Musca rosae* is a preoccupied name and proposed the new name *Chamaepsila hennigi* but there is a submission to the International Commission for Zoological Nomenclature (ICZN) to ensure continued use of the well known name '*rosae*' for carrot rust fly (Chandler 1998) (Crop Protection Compendium 2007).

Common names

Carrot rust fly (Australasia, USA)

Carrot root fly (UK)

Carrot fly (UK)

Morphological identification

Commonly called the rust flies, there are at least 38 species in 4 genera. The carrot rust fly (*Psila rosae*) is a member of this group. Australasian/Oceanian representation is meager with only undescribed specimens of *Chyliza* and *Loxocera* from Australia, and the pest species, *Psila rosae* (recorded as an immigrant) is found in carrot fields in northern New Zealand (Evenhius 1996).

Traditional taxonomic methods based on keys and descriptions are adequate for identification of carrot rust fly adults at species level.

The keys to identify to genera, family and species level is by Papp (2000) and Iwasa (1998).

The key to identify larvae (maggots) to family and species level is by; Ferrar (1987a), Ferrar (1987b) and Smith (1989).

Molecular or DNA based identification methods are not used currently to identify carrot rust fly. As routine diagnostic identification is possible using the distinctive morphological features of carrot rust fly adults. Molecular techniques could prove to be of value in determining the correct species of larvae, eggs and pupae (that are collected dead or can not be reared). A molecular genetic technique known as random amplified polymorphic DNA polymerase chain reaction (RAPD-PCR) is used to differentiate the primary screwworm from the secondary screwworm (the species most commonly misidentified in the early life stages) (Skoda et al. 2002).

In China RAPD-PCR were used to identify six *Bactrocera* species (Sheng & Bao 2007), in addition, these techniques could assist in determining the origin of an incursion, or determining biochemical or physiological attributes, such as insecticide resistance.

Identification of the family Psilidae

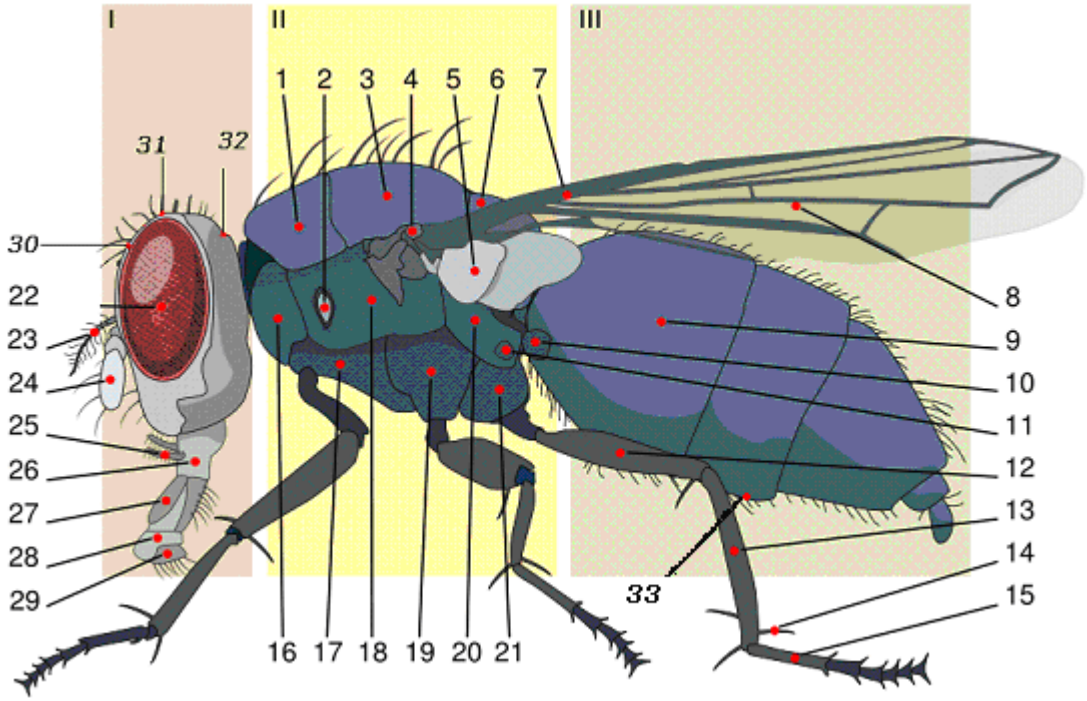

Figure 2. Carrot rust fly anatomy key.

***I**: head; **II**: thorax **III**: abdomen. — **1**: prescutum; **2**: anterior spiracle; **3**: scutum; **4**: basicosta; **5**: calypters; **6**: scutellum; **7**: wing vein; **8**: wing; **9**: abdominal segment (tergites); **10**: haltere; **11**: posterior spiracle; **12**: femur; **13**: tibia; **14**: spur; **15**: tarsus; **16**: propleuron; **17**: prosternum; **18**: mesopleuron; **19**: mesosternum; **20**: metapleuron; **21**: metasternum; **22**: compound eye; **23**: arista; **24**: antenna; **25**: maxilary palps; **26**: labium; **27**: labellum; **28**: pseudotracheae; **29**: tip; **30**: frons; **31** ocellar triangle, **32**: occiput, **33**. sternite.*
Adapted from [http://en.wikipedia.org/wiki/Image:Housefly_anatomy-key.svg#file).](http://en.wikipedia.org/wiki/Image:Housefly_anatomy-key.svg#file)

Adult

Head: globular, hemispherical or conical in profile (Figure 4).

Eyes nearly round and bare.

Frons broad, similar width in both sexes.

Ocellar triangle extending down at least to middle of frons.

Occiput swollen, flat or concave.

Antennae small or quite long, especially 3rd segment sometimes greatly lengthened.

Arista inserted subbasally or medially, rarely subapically; and tapering apically, but occasionally thick ended, and generally pubescent or short-haired.

Proboscis and palpus small in comparision to other Psilidae.

Chaetotaxy[1] 0-1 pvt, 1-3 vt, 1 oc, 0-2 ors (Iwasa 1998).

Thorax ordinary proportions or elongate (Fig. 3). Pleura (propleurom, mesopleuron, metapleuron) without setae. Anatergal callus sometimes distinctly protruding. Prosternum weakly sclerotized.

Chaetotaxy: 0 h, 0-1 np, 0-1 sa, 1pa, 0-4(6) dc, 0-(1) prsc, 1-3 sc (Papp & Bela 1998).

Legs normal, slender, without stout spine except short bristles; sometimes with a characteristic dense pad of short setae near tip of ventral side of hind femur.

Wing with a distinct subcoastal break before end of subcosta and a peculiar transverse hyaline line from its braks extending to posterior end of second basal cell (Fig. 5); distal parts of R4+5 and M1+2 parallel or slightly divergent: cubical cross vein not convex; halteres whitish to yellow.

Abdomen ordinary type; oval to elongate subparallel, rarely lengthened, without strong setae.

Male:

tergites tergites 1-6 large.

6th sternite sometimes with short spinules.

Epandrium nearly semicircular or conical in profile (Fig. 7).

Surtylus absent.

Hypandrium broad and flattened anteriorly, and connected at anterior end with aedeagal apodeme (Fig. 6).

Aedeagus memebraneous and mostly short.

[1] **Chaetotaxy** is the identification method based on the arrangement of bristles on an insect.

Parameres distinct (Figs. 6-7) and rarely pigmented, and sometimes situared insideof epandrium.

Cerci small and soft, mostly with hairs (Fig. 6)

Female:

Ovipositor short, cylindrical, membraneous and weakly sclerotised (Fig. 7)
Sclerotized spermatheca absent.

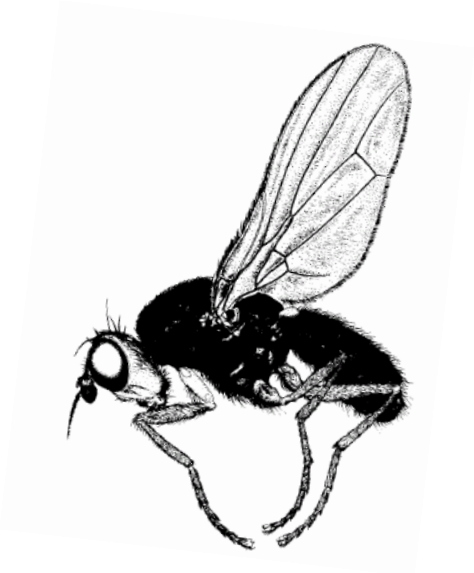

Figure 3. Adult carrot rust fly
(Smith & Charles 1998)
(www.hortnet.co.nz/.../images/hf401038.gif)
(drawn by D. W. Helmore).

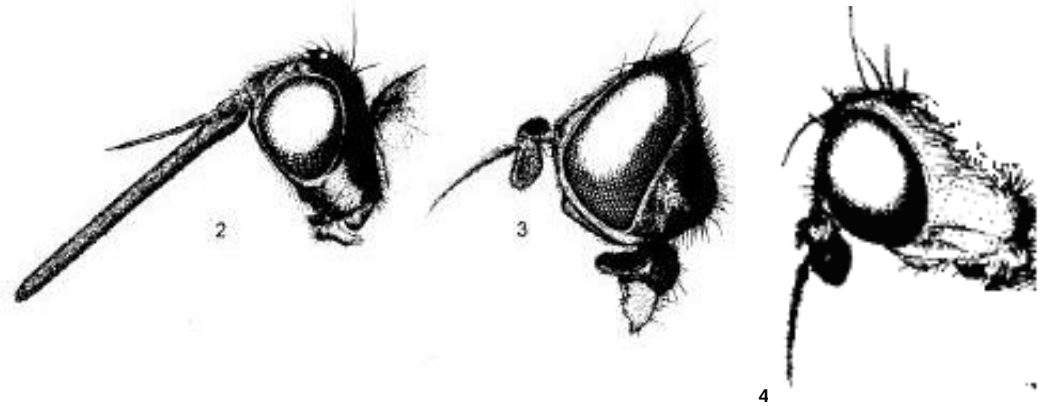

Figure 4. Characteristic head shape for three species of the Psilidae family
*Lateral view of head **2**. Loxocera fulviventris Meigen; **3**. Chyliza flavifrons Iwasa, **4**. Psila rosae Fabricio (Smith & Charles 1998)*
(www.hortnet.co.nz/.../images/hf401038.gif)

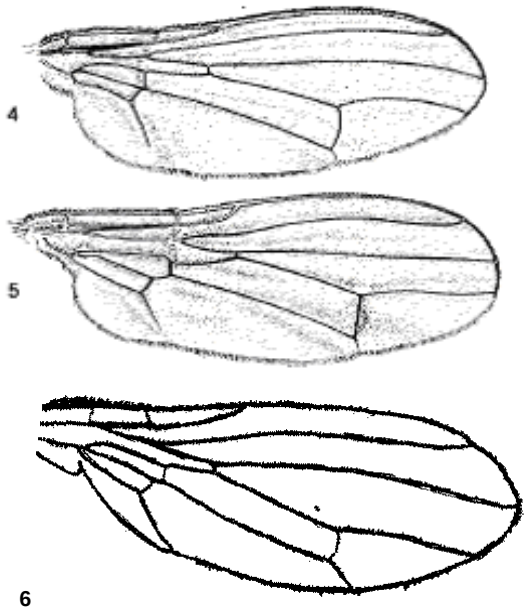

Figure 5. Characteristic wing shape for three species of the Psilidae family ***4****. Psila magna Shatalkin;* ***5.*** *Chyliza flavifrons Iwasa* ***6.*** *Psila rosae Fabricio (www.hortnet.co.nz/.../images/hf401038).*

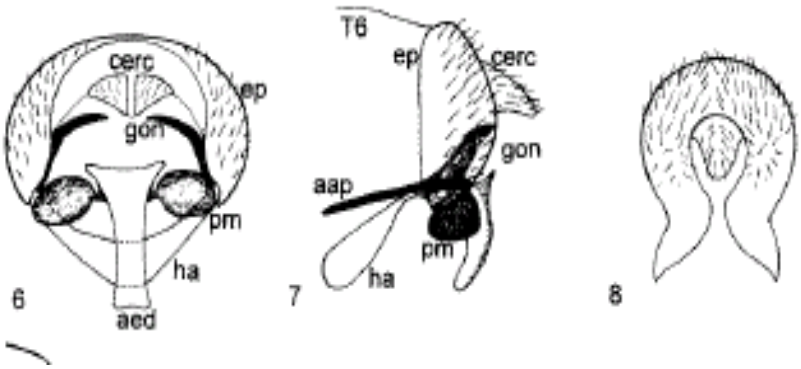

Figure 6. Male terminalia for three species of the Psilidae family. ***6-7****: Psila magna Shatalkin,* ***6****. caudal view,* ***7*** *lateral view* ***8*** *Chyliza flavifrons Iwasa posterior view.(abbreviations:* ***aap*** *– aedeagal apodeme,* ***aed*** *– aedeagus,* ***ep*** *– epandrium ,* ***cerc -*** *cerci* ***gon*** *– gonopod,* ***ha*** *– hypandrium,* ***pm*** *– paramere,* ***sg*** *– segment,* ***T*** *– tergite) (Papp & Bela 1998).*

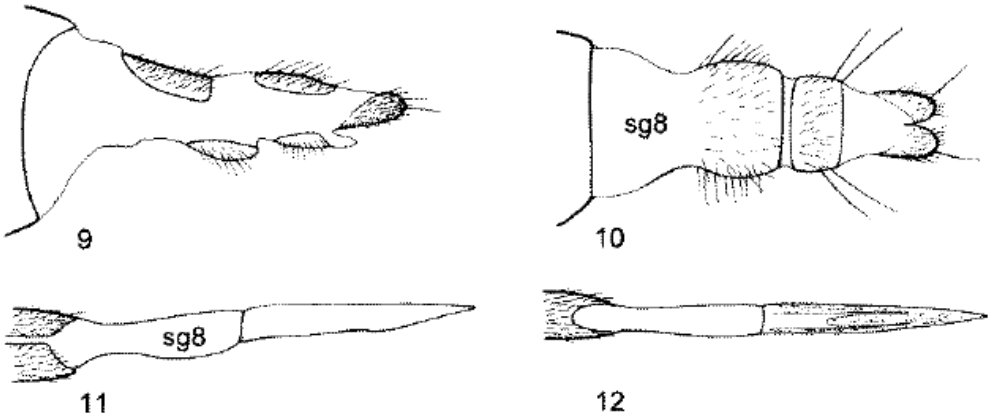

Figure 7. Female ovipositors of two species of the Psilidae family
9-10 Psila magna Shatalkin: 9. lateral view, 10. dorsal view (sg8 segment 8); 11-12 Loxocera lutulenta Iwasa: 11: lateral view, 12 dorsal view (Papp & Bela 1998).

Immature stages

Egg

White, cylindrical and slightly curved 0.6-0.7 mm long and 0.15 mm wide (Fig. 8). Chorion with longitudinal striations over whole surface, and with superimposed irregular reticulate pattern. Anterior end with a clearly visible micropyle comprising a round stalk which expanded into a circular cap with eight sockets around its circumference (Fig. 9). Larva or maggotthatches by rupturing chorion around micropyle, leaving eight protruding tongues of chorion corresponding to the eight micropylar sockets (Ferrar 1987a).

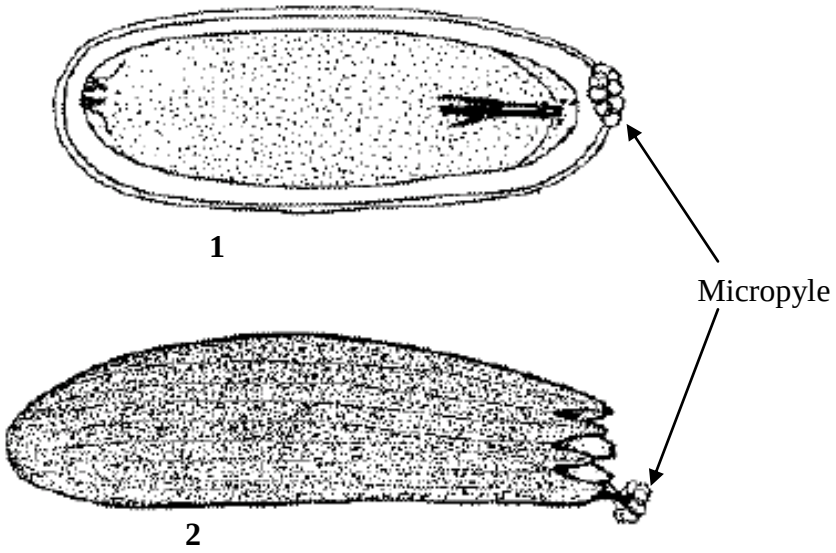

Figure 8. Egg of carrot rust fly
***1.** Egg containing embryo; **2.** shell of hatched egg (Ferrar 1987b).*

Figure 9. Micropyle of carrot rust fly egg (Ferrar 1987b).

Larvae

First instar

Body 0.6-2.0 mm long. **Cephalopharyngeal** skeleton (A heavily chitinized structure withdrawn into the anterior segments: an invaginated portion of the mouth part) with two large mouthhooks, each with one stout accessory tooth ventrally; (Fig. 8) intermediate sclerite set very close to or fused with pharyngeal sclerite (Ferrar 1987a).

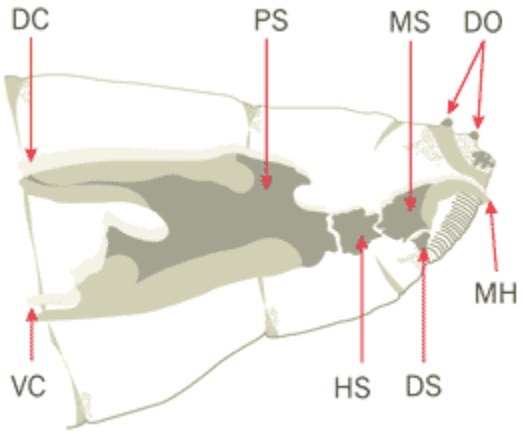

*Figure 10. Cephalopharyngeal skeletons of fly larvae (3rd-instar) **PS** -pharyngeal sclerite **DC** -dorsal lobes **VC** -ventral cornua **HS** -hypostomal sclerite **MS** -mandibular sclerite **DS** -dental sclerite **MH** –mouthhook **DO** -dorsal sensory organs. (http://www.flycontrol.novartis.som/includes/teaser).*

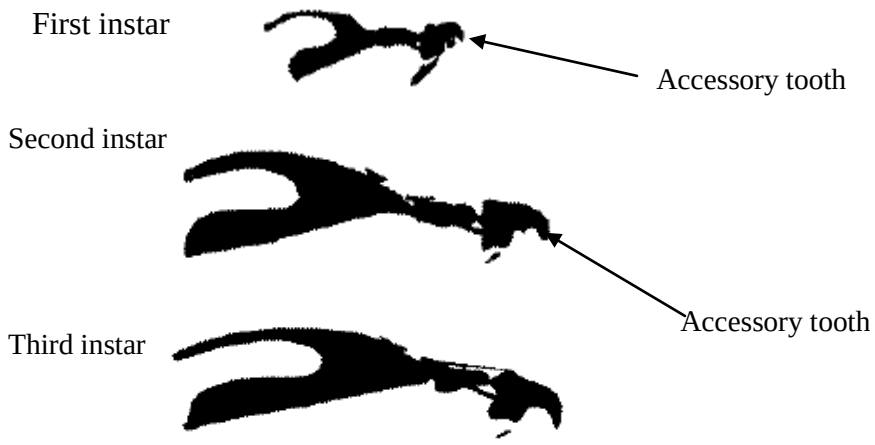

Figure 11. Cephalopharyngeal skeleton of carrot rust fly larvae (Ferrar 1987b).

Posterior spiracular plates circular; peritreme[2] of each plate extended dorsally into a long, straight, it seems, it is straight in the first instar only conical spine; a single oval aperture in each spiracular plate (Fig. 9).

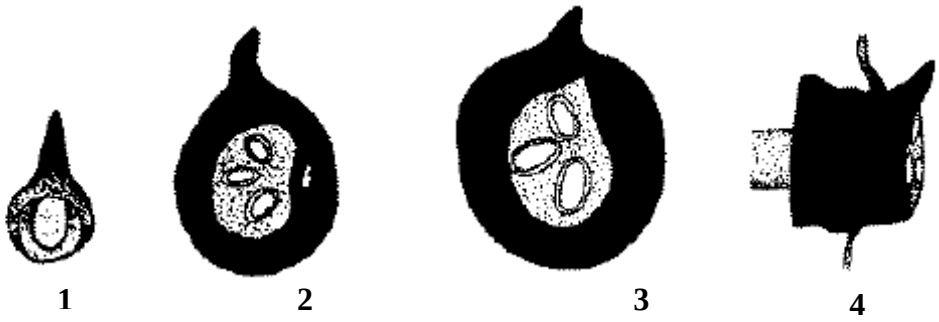

Figure 12. Posterior spiracular plates of carrot rust fly larvae: ***1****. 1st instar;* ***2****. 2nd instar;* ***3****. 3rd instar;* ***4****. 3third instar (lateral view (Ferrar 1987b).*

Second instar

Body 2-5 mm long. Cephalopharyngeal skeleton similar to 1st instar, except that accessory tooth and dental sclerite proportionally smaller (Fig. 8). A small, flattened dorsal bridge is present on the pharyngeal sclerite. Anterior spiracle a rosette-shaped approximately 7 poorly-defined lobes visible (Fig. 10). Posterior spiracular plates (Fig 9) each with heavily sclerotized peritreme extended dorsally into a curved spine proportionally smaller than that of the 1st instar; each plate with 3 oval slits in a radiating pattern.

[2] Part of the integument of an insect which surrounds the spiracles.

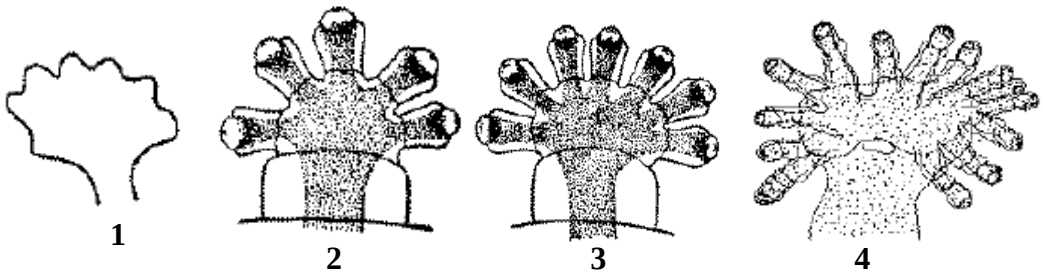

*Figure 13. Anterior spiracle of the larvae of three species of the Psilidae family **1-2**. 2nd and 3rd instar (Psila rosae); **3.** 3rd instar (Psila nigricornis); **4.** 3rd instar (Chyliza vittata) (Ferrar 1987b).*

Third instar

Body slender, cylindrical, 5-9 mm long. Cephalopharyngeal skeleton heavily sclerotized, mouthhooks without accessory tooth (Fig. 8). Anterior spiracles with 5 lobes (Fig. 10).

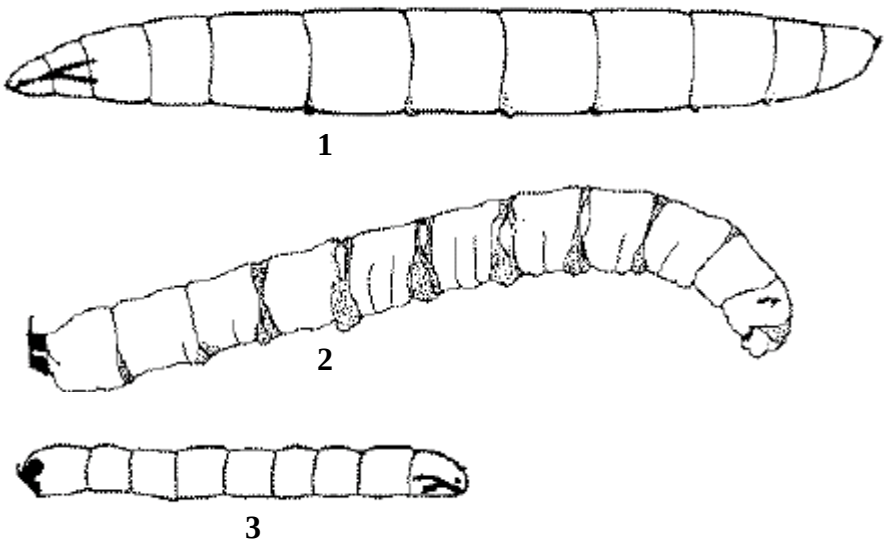

Figure 14. 3rd instar larvae of three species of the Psilidae family 1.Psila rosae; 2. Chyliza vittate; 3. Loxocera albiseta (Ferrar 1987b).

Puparium

Slender and roughly cylindrical 5-8 mm long (Fig. 12); uniformly yellow brown; anterior end obliquely truncated to produce a flat, anterodorsal plate with a thin rounded trim around its edge, this plate lifts off as the adult emerges.

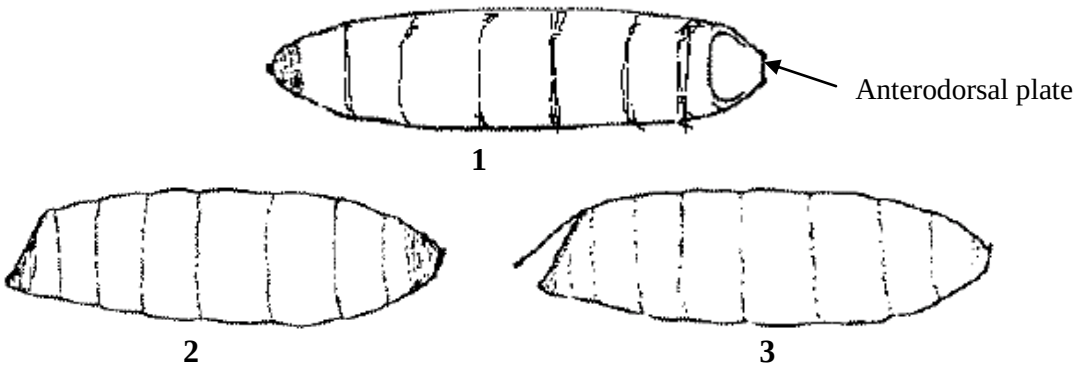

Figure 15. Carrot rust fly pupae
***1**. dorsal view; **2**. Lateral view unemerged; **3** lateral view adult emerged (Ferrar 1987b).*

female

Psila rosae

male

female

Psila negricornis

male

female

Psila fimentaria

male

Figure 16. Similarity and differences between three species of the family Psilidae. (http://www.diptera.info/photogallery.php?album_id=41).

Detection

Adult carrot rust fly males and females spends most of its time in the periphery of the fields, females flying into the field to lay eggs at the base of the carrot plants, and then leaving the field. After hatching, the larva moves down into the soil to feed on the carrot and eventually pupates in the soil. When the adult emerges from the pupal case, it flies to the periphery of the field.

Life Stage	Site of activity
Eggs	just below the soil surface adjacent to the host plants.
1st instar	larvae feed on the fine roots of host plants.
2nd instar	feed on the fine or lateral roots of host plants.
3rd instar	in the third instar stage, the carrot rust fly larvae penetrate the taproot (carrot) and feed in the taproot creating large holes or tunnels and rust colored frass, larvae may also feed on the smaller roots of hosts plants.
Pupae	in the soil.
Adult	adults are found on the foliage of host and non host plants, in hedges and field margins.

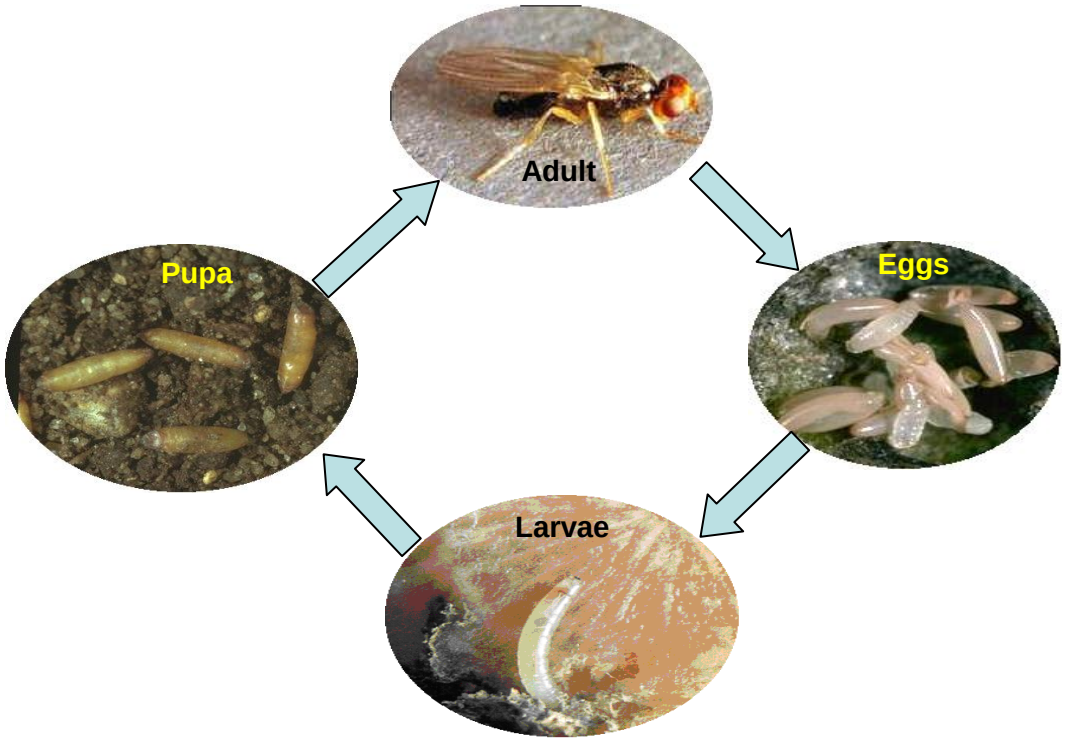

Figure 17. Life cycle of carrot rust fly.
(http://www.diptera.info/photogallery.php?album_id=41)
(www.puyallup.wsu.edu.)
(www.yates.co.nz).

Damage to the crop is caused by the larvae which chew into lateral roots and can result in the death of the seedlings young roots. If the seedling survives, the resultant root may be distorted or forked (Hooper 1997). The first signs of carrot rust fly attack are when the foliage of infested plants turns red or yellow. Seedlings wilt and many die as a result of larval damage to the tap root (Ellis 1999). As the larvae age, their oral hooks develop enabling them to rasp the tougher and more nutritional cortex of the root. The roots usually survive the attack but are unmarketable because of the larval mines and associated secondary root infections from fungi and bacteria (Howard et al. 1994). Heavy levels of infestation and associated levels of fungal infestation may destroy the root. Mining can occur in any portion of the root although Hill (1974) found that the highest proportion of mining occurred in the lower one-third of the root and that there is no apparent limit to the depth of the mining, even roots 30 cm. long are damaged to their tips.

Sampling (Monitoring)

In the cultivation of field vegetables where carrot rust fly is present, monitoring is probably the most efficient supervised control method. Most monitoring programmes use similar basic trap designs (standard sticky trap, P9A and P10B) but number, positioning and orientation of traps in the field vary (Finch et al. 1999).

Monitoring practices for carrot rust fly established in different countries.

Traps		N° of traps per field	Position of traps
Type	**Option for selectivity**		
Orange-yellow sticky trap (P9A, P10B)  Yellow sticky trap in carrot field www.omafra.gov.on.ca/facts/facts/93-07706	●Inclined at 45°, glue only on the lower surface glued side facing into the field ●Netlonhood (in regions with high cattle density)	Five traps should be used up to 2 ha. For larger fields, a second set of 5 traps should be sited in a different part of the field	●In line 5-10 m in from the most sheltered edge of the crop. Greater numbers of flies are expected alongside woodland strips, windbreaks, ditches and tall adjacent crops. ●Distance between traps:10-25 m.
The trap faces the nearest border and is supported so that its lower edge is about 10 cm above the foliage of the carrot crop. Renew the traps on a fortnightly basis			

Sticky traps need to be checked every week for carrot rust fly, and collected and replaced once a fortnight. In the laboratory, sticky traps need to be dried for two days, examined on both sides, and then stored in labeled zip lock bags.

The preliminary identification of the adult carrot rust fly by examination of characteristic morphological features of the fly such as the shape and colour

of the body (slender, shiny, black fly approximately 6-8 mm long) the colour of the head (redish), the colour of the legs (long yellow)

Records

Detailed information should be recorded for all specimens identified. Records should follow the level of detail set out in ISPM No. 27 (FAO 2007a) and include:

- Scientific name of the plant pest identified.
- Code or reference number of the sample (for traceability).
- Nature of the infected/infested material including scientific name of host where applicable.
- Origin of the infected/infested material.
- Description of signs or symptoms (including photographs where relevant).
- Methods, including controls, used in the diagnosis and the results obtained with each method.
- For morphological methods, measurements, drawings or photographs of the diagnostic features (where relevant), if applicable the developmental stage.
- For biochemical and molecular methods, documentation of test results such as photographs of diagnostic gels, printouts of results, on which the diagnosis was based.
- Where appropriate, the magnitude of any infection/infestation (how many individual pests found; how much damaged tissue).
- The name of the laboratory and the names of the person(s) responsible for and/or who performed the diagnosis, need to be recorded.
- The date of confirmation of diagnosis.
- Voucher specimens (FAO 2007b).
- Contact points for further information.

Appendix 1: List of family Apiaceae (host to carrot rust fly)

Species		Weed status	Present in Australia
Scientific name	**Common name**		
Aegopodium podagraria L.	Ashweed,bishop's-weed, goutweed, ground-elder, herb-Gerard	Naturalised, environmental, agricultural, escape, noxious, invasive.	Yes
Aethusa cynapium L.	Fool's-parsley	Escape, invasive.	Yes
Ammi majus L.	Bullwort, false bishop's-weed	Naturalised, escape, environmental, invasive, agricultural.	Yes
Ammi visnaga (L.) Lam. Khella	Lesser bishop's-weed	Naturalised, invasive, escape, agricultural.	Yes
Anethum graveolens L.	Dill, garden dill	Naturalised, invasive, escape, agricultural, environmental.	Yes
Angelica archangelica L.	Angelica, wild parsnip	Agricultural, invasive.	Yes
Angelica archangelica subsp. *archangelica*			No
Angelica archangelica subsp. *litoralis* (Fr.) Thell			No
Angelica laevis J. Gay ex Ave-Lall			No
Angelica sylvestris L.	Wild angelica	Environmental, escape.	Yes
Anthriscus caucalis M. Bieb	Bur chervil	Naturalised, escape, invasive.	Yes
Anthriscus cerefolium (L.) Hoffm.	Chervil, garden chervil	Agricultural, escape, invasive.	Yes
Anthriscus sylvestris (L.) Hoffm.	Cow-parsley, keck, wild chervil	Environmental, escape, noxious.	Yes
Anthriscus sylvestris subsp. *alpina* (Vill.) Gremli			No
Anthriscus sylvestris subsp. *fumarioide*s (Waldst. & Kit.) Spalik			No
Anthriscus sylvestris subsp. *nemorosa* (M. Bieb.) Koso-Pol			No
Anthriscus sylvestris subsp. *sylvestris*			No
Apium graveolens L.	Celery	Naturalised, escape, agricultural, environmental.	Yes
Apium graveolens var. *dulce* (Mill.) Pers.			No
Apium graveolens var. *graveolens*			No

Species		Weed status	Present in Australia
Scientific name	**Common name**		
Apium graveolens var. *lusitanicum* (Mill.) DC. (=*Apium graveolens* var. *graveolens*)			No
Apium graveolens var. *rapaceum* (Mill.) Gaudin			No
Apium graveolens cv. *secalinum* Alef. (=*Apium graveolens* var. *secalinum* (Alef.) Mansf.)			No
Apium graveolens var. *secalinum* (Alef.) Mansf.			No
Apium nodiflorum (L) Lag			No
Apium spp.			No
Astrantia major L.	Astrantia, greater masterwort		No
Astrodaucus littoralis (M. Bieb) Drude Ageomoron			No
Athamanta turbith (L) Brot.			No
Berula erecta (Huds.) Coville	Water parsnip		No
Berula pusilla Fernald (=*Berula erecta* (Huds.) Coville)			No
Berula thunbergii (DC.) H. Wolff (=*Berula erecta* (Huds.) Coville)			No
Bupleurum falcatum L.	Sickle-leaf, hare's ear		No
Bupleurum griffithii hort. (=*Bupleurum rotundifolium* L.)	Hare's-ear		No
Bupleurum praealtum L.			No
Bupleurum tenuissimum L.	Smallest hare's ear		No
Carum buriaticum Turcz			No
Carum carvi L.	Caraway	Environmental, agricultural, escape, noxious.	Yes
Caucalis platycarpos L.			No
Chaerophyllum aureum L.	Golden chervil		No
Chaerophyllum bulbosum L.	Parsnip chervil, chervilturnip-root	Agricultural, escape, invasive.	Yes
Chaerophyllum bulbosum subsp. *prescotti*i (DC.) Nyman			No
Chaerophyllum coloratum L.			No
Chaerophyllum hirsutum L.			No
Cicuta virosa L.	Cowbane, water hemlock		No

Species		Weed status	Present in Australia
Scientific name	**Common name**		
Conium maculatum L.	carrot fern, fool's parsley, hemlock	Naturalised, invasive, environmental, agricultural, noxious,	Yes
Coriandrum sativum L.	Chinese-parsley, coriander	Naturalised, invasive, agricultural, escape.	Yes
Crithmum maritimum L.	Rock samphire, sea fennel		No
Cryptotaenia canadensis (L.) DC.	Honewort, white chervil	Environmental, agricultural.	Yes
Daucus capillifolius Gilli			No
Daucus carota L.		Naturalised, invasive, agricultural, escape.	Yes
Daucus carota cv. *atrorubens* Alef. (=*Daucus carota* var. *boissieri* Schweinf.)			No
Daucus carota subsp. *azoricus* Franco			No
Daucus carota var. *boissier*i Schweinf.			No
Daucus carota subsp. c*antabricus* A. Pujadas			No
Daucus carota subsp. *carota*			No
Daucus carota subsp. *commutatus* (Paol.) Thell			No
Daucus carota var. *commutatus* Paol. (=*Daucus carota* subsp. *commutatus* (Paol.) Thell)			No
Daucus carota subsp. *drepanensis* (Arcang.) Heywood			No
Daucus carota subsp. *fontanesii* Thell			No
Daucus carota subsp. *gadecaei* (Rouy & E. G. Camus) Heywood			No
Daucus carota subsp. *gummifer* (Syme) Hook. f.			No
Daucus carota var. *gummifer* Syme (=*Daucus carota* subsp. *gummifer* (Syme) Hook. f.)			No
Daucus carota subsp. *halophilus* (Brot.) A. Pujadas			No
Daucus carota subsp. *hispanicus* (Gouan) Thell			No
Daucus carota subsp. *hispidus (*Desf. ex Arcang.*)* Heywood *(=Daucus carota* subsp. *fontanesii*			No

Species		Weed status	Present in Australia
Scientific name	**Common name**		
Thell)			
Daucus carota subsp. *major* (Vis.) Arcang			No
Daucus carota subsp. *majoricus* A. Pujadas			No
Daucus carota subsp. *maritimus* (Lam.) Batt			No
Daucus carota subsp. *maximus* (Desf.) Ball			No
Daucus carota subsp. *parviflorus* (Desf.) Thell			No
Daucus carota subsp. *rupestris* (Guss.) Heywood			No
Daucus carota subsp. *sativus* (Hoffm.) Arcang			No
Daucus carota var. *sativus* Hoffm.			No
Daucus glochidiatus (Labill.) Fisch. & C. A. Mey			No
Daucus gracilis Steinh			No
Daucus involucratus Sm.			No
Daucus littoralis Sm.			No
Daucus maximus Desf. (=*Daucus carota* subsp. *maximus* (Desf.) Ball)			No
Daucus muricatus (L.) L.			No
Daucus pusillus Michx.			No
Eryngium agavifolium Griseb			No
Eryngium agavifolium Griseb			No
Eryngium dichotomum Desf.			No
Eryngium giganteum M. Bieb	Giant sea-holly, miss Willmot's gost	Agricultural.	Yes
Falcaria vulgaris Bernh.	Long leaf		No
Eryngium giganteum M. Bieb	Giant sea-holly, miss Willmot's gost	Agricultural.	Yes
Ferula communis L.	Giant fennel	Naturalised.	Yes
Ferula galbaniflua Boiss. & Buhse (=*Ferula gummosa* Boiss.)	Gallbanum		No
Ferula gummosa Boiss			No
Foeniculum vulgare Mill	Fennel	Agricultural, invasive, naturalised, noxious, escape environmental.	Yes
Foeniculum vulgare var. *azoricum*			No

Species		Weed status	Present in Australia
Scientific name	**Common name**		
(Mill.) Thell			
Foeniculum vulgare var. *dulce* (Mill.) Batt			No
Foeniculum vulgare subsp. *piperitum* (Ucria) Cout			No
Foeniculum vulgare var. *vulgare*			No
Grafia golaka (Hacq.) Reichenb			No
Heracleum lehmannianum Bunge			No
Heracleum mantegazzianum Sommier & Levier	Cartwheel flower, giant hogweed	Agricultural, invasive naturalised, noxious, escape, environmental.	Yes
Heracleum sphondylium L.	Meadow parsnip, cow parsnip, hogweed	Escape.	Yes
Heracleum sphondylium subsp. *montanum* (Schleich. ex Gaudin) Briq.			No
Heracleum sphondylium subsp. *sibiricum*			No
Heracleum sphondylium subsp. *sphondylium*			No
Heracleum sphondylium subsp. *ternatum* (Velen.) Brummitt			No
Heracleum sphondylium subsp. *transsilvanicum* (Schur) Brummitt			No
Lagoecia cuminoides L.			No
Laserpitium gallicum L.			No
Laserpitium hispidum Bieb			No
Laserpitium prutenicum L.			No
Levisticum officinale W. D. J. Koch	Lovage	Agricultural, invasive.	Yes
Libanotis buchtormensis (Fisch.) DC.			No
Ligusticum scoticum L.	Beach lovage, Scots lovage		No
Meum athamanticum Jacq.	Garden myrrh, sweet chervil, sweet cicely	Agricultural, escape, invasive.	Yes
Myrrhoides nodosa (L.) Cannon			No
Oenanthe aquatica (L.) Poir	Fine-leaf water, dropwort, water fennel	Environmental.	Yes
Oenanthe crocata L.	hemlock, water hemlock		No
Oenanthe fistulosa L.			No

Species		Weed status	Present in Australia
Scientific name	**Common name**		
Oenanthe lachenalii C.C.Gmelin			No
Oenanthe peucedanifolia Pollich			No
Oenanthe pimpinelloides L.	Corky-fruit water	Naturalised, environmental.	Yes
Opopanax chironium (L.) Koch	Hercules-all-heal		No
Orlaya daucoides (L.) Greuter			No
Pastinaca sativa L.		Naturalised, noxious, environmental, agricultural, escape.	Yes
Pastinaca sativa subsp. *sativa*			No
Pastinaca sativa subsp. *sylvestris* (Mill.) Rouy & E. G. Camus			No
Petroselinum crispum (Mill.) Nyman ex A. W. Hill	Parsley	Naturalised, escape, environmental, agricultural.	Yes
Petroselinum crispum var. *crispum*			No
Petroselinum crispum var. *neapolitanum* Danert			No
Petroselinum crispum var. *tuberosum* (Bernh.) Mart. Crov			No
Petroselinum hortense auct. (=Petroselinum crispum (Mill.) Nyman ex A. W. Hill)			No
Petroselinum sativum Hoffm., nom. nud. (=*Petroselinum crispum* (Mill.) Nyman ex A. W. Hill)			No
Petroselinum segetum (L.) W. D. J. Koch			No
Petroselinum vulgare Lag. (=*Petroselinum crispum* (Mill.) Nyman ex A. W. Hill)			No
Peucedanum alsaticum L.			No
Peucedanum baicalense (I. Redowsky ex Willd.) W. D. J. Koch (=*Kitagawia baicalensis* (I. Redowsky ex Willd.) Pimenov)			No
Peucedanum gallicum Labourr			No
Pimpinella anisum L.	Anise, sweet cumin	Agricultural.	Yes
Pimpinella major (L) Huds.	Great burnet-saxifrage		No
Pimpinella saxifraga L. - *Pimpinella saxifraga* var. *major* L. (=*Pimpinella major* (L.) Huds.)	Burnet saxifrage, pimpinella	Escape.	No
Pimpinella siifolia Leresche			No

Species		Weed status	Present in Australia
Scientific name	**Common name**		
Ridolfia segetum Moris			No
Scandix pecten-veneris L.	Shepherd's needle, venus' comb	Naturalised, escape, environmental.	Yes
Scandix pecten-veneris subsp. *Brachycarpa* (Guss.) Thell. Hegi			No
Selinum carvifolia (L.) L.			No
Selinum tenuifolium Salisb. (=*Selinum carvifolia* (L.) L.)			No
Seseli carvifolia L. (=*Selinum carvifolia* (L.) L.)			No
Seseli globiferum Vis.			No
Seseli transcaucasica Schishk			No
Seseli libanotis (L.) W. D. J. Koch			No
Sison amomum L.	Stone-parsley		No
Sium latifolium L.	Great water-parsnip		No
Sium sisarum L.	Skirret, chervis		No
Smyrnium olusatrum L.	Alexanders, black lovage, horse parsley	Agricultural, escape.	Yes
Smyrnium rotundifolium Miller			No
Todaroa montana Brouss. & Hooker			No
Tordylium maximum L.			No
Torilis arvensis (Huds.) Link	Spreading hedge-parsley		No
Torilis arvensis subsp. *arvensis*			No
Torilis arvensis subsp. *elongata* (Hoffmanns & Link) Cannon			No
Torilis arvensis subsp. *heterophylla* (Guss.) Thell			No
Torilis arvensis subsp. *neglecta* (Spreng.) Thell			No
Torilis arvensis subsp. *purpurea* (Ten.) Hayek (=*Torilis arvensis* subsp. *heterophylla* (Guss.) Thell)			No
Torilis japonica (Houtt.) DC.	Upright hedge-parsley		No
Torilis nodosa (L.) Gaertn	Knotted hedge-parsley		No
Trinia glauca (L.) Dumort			No
Turgenia latifolia (L.) Hoffm.			No

(USDA 2008);(CRC 2008).

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Pest Risk Assessment of Carrot rust fly (*Psila rosae* Fabricius, 1794)

Marc Poole *et al.*

Department of Agriculture and Food, Western Australia.

Project Number: VG06114

Government of Western Australia
Department of Agriculture and Food

Pest Risk Assessment of Carrot rust fly (*Psila rosae* Fabricius, 1794)

Prepared for:

Horticulture Australia Limited

VG06114

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Project description: Carrot rust fly has been identified by Plant Health Australia as one of the top threats to the Australian carrot industry. In 2007 Horticulture Australia Ltd (HAL) commissioned the Department of Agriculture and Food Government of Western Australia to develop a Pest Specific Incursion Management Plan, Pest Risk Assessment and Diagnostic Protocol for carrot rust fly. It is recommended that these documents to be considered a permanent draft documents to be updated regularly as new information becomes available.

Contents

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Tables

Executive Summary

The carrot rust fly (*Psila rosae* Fabricius, 1794) is one of the more serious pests of carrots and related crops of the Apiaceae family e.g. celeriac (*Apium graveolens* Rapaceum group); parsnip (*Pastinaca sativa*) that causes significant crop damage in different temperate regions of the world.

Carrots are an important vegetable crop in Australia that earns millions of dollars from the export market. This highlights the importance for developing a Pest Risk Assessment of this exotic insect pest. The carrot rust fly Pest Risk Assessment was developed under the research project (No. VG06114) of the Plant Biosecurity Research, Department of Agriculture and Food, Government of Western Australia, with the support of Horticulture Australia Limited (HAL).

The original range of the species was probably the Middle East and southern Europe. Subsequently, the carrot rust fly has become widely distributed around the world and includes North and South America, Europe, Asia, New Zealand and South Africa. Carrot rust fly has a limited natural spread due to poor flying capabilities, but humans can play a major part in their dispersal through the movement of infested plant material.

Australia's wide range of climatic conditions and carrot cultivation throughout the year provide favourable conditions for the establishment of carrot rust fly as indicated by our CLIMEX® (Bioclimatic) modelling.

There are two potential scenarios of concern to the Australian carrot industry:

i) That the introduction of the exotic carrot rut fly may cause pest outbreaks for carrot and hamper the carrot industry.

ii) That the carrot rust fly may find new host(s) as Australia has the highest plant diversity in the world. This would result quick spread, more economic damage and an impracticable eradications process.

This Pest Risk Assessment examined the published information regarding the host range, distribution, biology, severity and epidemiology of carrot rust fly. The methodology prescribed in the "Guideline for Import Risk Assessment, Draft September 2001", which is based on the "International Standards for Phytosanitary Measures No. 2: Framework for Pest Risk Analysis (FAO 2007a) was used to determine the risks of entry, establishment, spread and consequences of carrot rust fly should it establish in Australia. It is recommended that this Pest Risk Assessment be considered a permanent draft document to be updated regularly as new information becomes available.

The unrestricted risk presented by carrot rust fly on the importation of carrot is "Very low" when considered in association with "on-arrival carrot inspection" thus negating the need for additional phytosanitary measures should carrots be imported from countries where carrot rust fly is known to occur.

However, as zero risk is not an option and there is a “Very low” probability of entry, establishment and spread implies that there is some, albeit ‘very low’ likelihood of an incursion of carrot rust fly occurring. To counter this eventuality, the Industry Biosecurity Plans incorporate Pest Specific Incursion Management Plans to provide a pre-emptive process aimed to eradicate, contain or manage any incursion of carrot rust fly.

Introduction

The carrot rust fly, *Psila rosae* Fabricius 1794 is a key insect pest of carrots *(Daucus carota* L.) and related apiaceous crops e.g. celeriac (*Apium graveolens* Rapaceum group); parsnip (*Pastinaca sativa*) in many temperate regions of the world.

Carrot rust fly is well known for the characteristic rust coloration caused by the larval mines on the tap roots (Bernie 1971). The larvae hatch from eggs laid at the base of the carrot plant. Newly hatched larvae burrow into the soil and feed on the side roots of the host plant during the first two instars. During the last instar, larvae feed on the taproot. Brown scars appear where tunnels near the surface of the carrot have collapsed. Larval feeding and burrowing can cause young plants to wilt and die. Damaged plants may also become stunted and roots bulbous and forked. Additionally, fungi and bacteria may invade the damaged tissue and cause severe rot (Petherbridge et al. 1942). Such attack is cosmetically unacceptable, rendering carrots unmarketable (Berry et al. 1995).

Carrot is an important vegetable crop in Australia with the industry earning millions of dollars in exports to South East Asia and Middle East countries. Australian production of carrots was estimated at 316,000 t in 2004/05 (ABS 2008) The world average yield was estimated at 22.6 t/ha. In Australia, average yield is estimated at near 40 t/ha. However, good commercial operations often produce over 60 t/ha with 80 to 90 t/ha yields being achievable (CARD 2005; McKay 2006b).

In recent years, the Australian carrot industry has faced challenges in its export markets from China, a major carrot producing country. Export figures show that carrot exported from China increased rapidly from 138,000 t in 2002 to 390,000 t in 2005. At the same time carrot exports have fallen from 73,400 t to 58,200 t from Australia. Average carrot production costs in China are much lower than that in Australia due to cheap labour costs. Moreover, China has freight advantages because of its proximity to markets in the South East Asia and a 30% cheaper freight rates than Australian exporters. However, China faces challenges with pesticide misuse, pollution and environmental degradation (CARD 2005; McKay 2006a).

Australian growers capitalise on market opportunities based on product quality, food safety and environmentally sound production management. Being an island, Australia is free from many exotic pests. Australian producers keep this clean and green image in the export market by firm implementation of quarantine and biosecurity programs. As a result, carrots from Australia have an outstanding reputation for quality and reliability. To maintain this reputation in the export markets, it is important for the industry to be prepared for any exotic pest incursions that may damage this reputation. Food safety and integrity are also key drivers in the domestic and export markets. The focus on a high quality product will counter the strong competition from low cost commodity producing nations such as China.

Plant Health Australia (PHA), in collaboration with the State and Territory governments and the National Vegetable Industry have developed a draft vegetable Industry Biosecurity Plan (IBP). Biosecurity planning provides a mechanism for the carrot industry, government and other relevant stakeholders to actively determine pests, analyse the risks and put in place procedures to reduce the likelihood of pests reaching Australian borders. Biosecurity planning also provides procedures to minimise the impact if a pest incursion occurs.

Ensuring the carrot industry has the capacity to minimise the risk of pests, and to respond effectively to any pest threats is a vital step for the future sustainability and viability of the industry. Through this pre-emptive planning process, the industry will be better placed to maintain and improve market access and reduce the social and economic costs of pest incursions to both growers and the wider community.

Context for pest risk assessment

Horticulture Australia Limited (HAL) is one of the industry members of Plant Health Australia (PHA) in which the Commonwealth, States and selected industries are principle shareholders. Pest Risk Assessments (PRA) and Pest Specific Incursion Management Plans (PSIMP) are recognised as a priority in their strategic plan. PHA members endorsed the cost sharing agreement for the plant industries through the Emergency Plant Pest Response Deed (EPPRD). Under the EPPRD, government and industry signatories will share the eradication cost of any emergency plant pests that are serious threat to Australian plant industries. Accordingly, industry-specific biosecurity plans are being developed for each PHA member with the provision to develop pest-specific contingency plans and risk mitigation (Figure 1).

Carrot rust fly has been identified by PHA as one of the top threats to the Australian carrot industry. Carrot rust fly has been intercepted at the borders, is exotic to Australia and would require significant resources to eradicate if it becomes established. In some organic commercial crops surveyed, carrot rust fly damaged up to 60% of carrot roots (Sivasubramaniam & Wratten unpubl. data). Coppok (1974) reported that in England, 60% of untreated carrots may be damaged if not harvested by early January. Toms (1972) estimated that an average attack resulted in 30% of carrots being rendered unsaleable.

The industry needs not only a thorough understanding of the carrot rust fly but also a consideration of the sources of risk, the probabilities of entry, establishment and spread, their consequences and the overall unrestricted risk. Whilst the Pest Risk Assessment will identify and classify biosecurity risks and provide data to assist in the evaluation and treatment of those risks, a Pest Specific Incursion Management Plan will give clear guidelines on the early detection, incident response and eradication should there be an incursion.

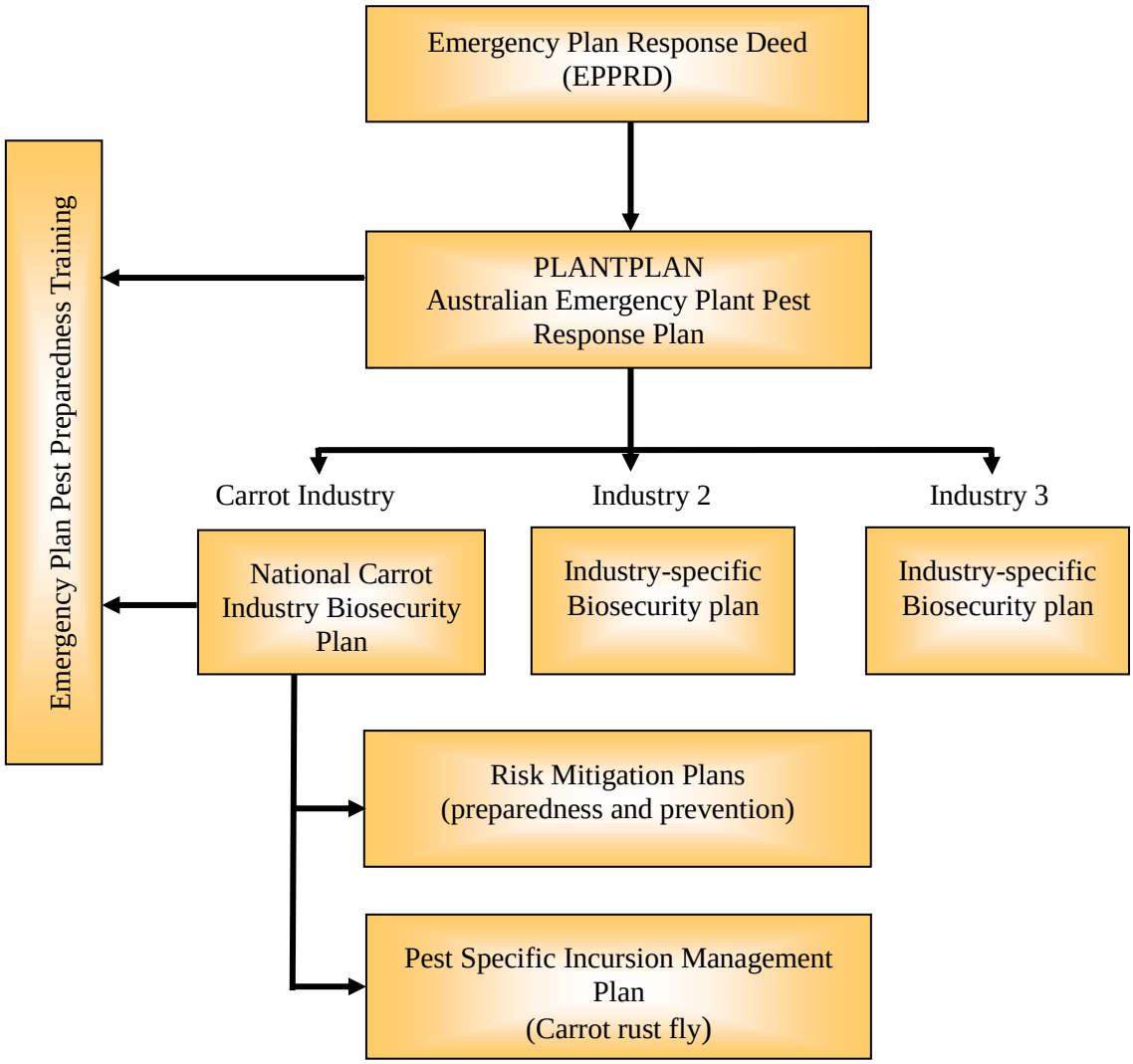

Figure 1. Flowchart shows the relationship of the Pest Risk Assessment and Pest Specific Incursion Management Plans with other components of Emergency Plant Pest Response Deed (EPPRD) (PHA 2007).

Key resource documents used to guide the development of this Pest Risk Assessment were:

- Edwards J, Dawson K, Gardner R, Perrone ST and de Boer RF 2006, Pest Risk Assessment: Late Blight of Potato (*Phytophthora infestans* A2 mating type and exotic strains of A1 mating type), Horticulture Australia Project No PT 04010, Department of Primary Industries, Victoria. 53 pp.
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The preferred methodology for a Pest Risk Assessment described in stage 2 of an Import Risk Assessment involves following steps:

- Pest categorisation.
- Probability of entry, establishment and spread.

- Assessment of consequences.
- Conclusions: estimate of risk.

This allows a systematic approach for the assessment of the risk pose by carrot rust fly in Australia.

The stages to be considered in the entry establishment and spread of the pest are schematically shown in the Figure 2.

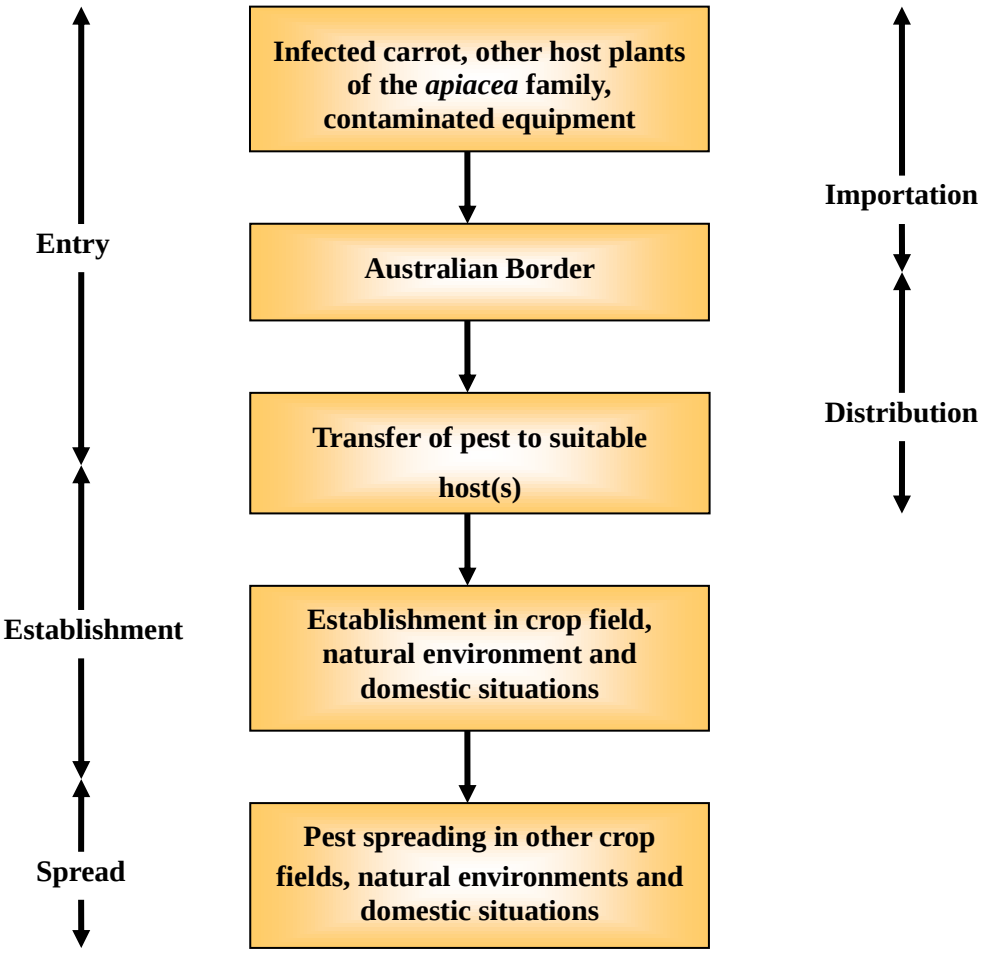

Figure 2. Stages in the entry, establishment and spread of a pest (PHA 2007).

Pest categorisation

Kingdom:	Animalia Linnaeus, 1758
Phylum:	Arthropoda Latreille, 1829
Class:	Insecta Linnaeus, 1758
Order:	Diptera Linnaeus, 1758
Suborder:	Brachycera
Family:	Psilidae
Genus:	Psila
Species	*rosae*
Scientific name:	*Psila rosae* (Fabricius, 1794).

Synonyms or changes in combination or taxonomy

Carrot rust fly was first described in the genus *Musca* by Fabricius (1794) and later removed to the genus Psila. In the Palaearctic Catalogue, it is placed in the genus *Chamaepsila*, previously regarded as a subgenus of *Psila* (Soos 1984). However, Shatalkin (1986) considered that the species should be placed in the genus *Psila*, a combination followed by Iwasa (1991) Thompson and Pont (1994) showed that *Musca rosae* is a preoccupied name and proposed the new name *Chamaepsila hennigi* but there is a submission to the International Commission for Zoological Nomenclature (ICZN) to ensure continued use of the well known name '*Psila rosae*' for Carrot rust fly (Chandler 1998).

Common name

Carrot rust fly (Australasia, USA).

Carrot root fly.

Carrot fly (UK).

Recorded host plants

While the host range of the carrot rust fly seems to be restricted to the Apiaceae family (Appendix 1), the majority of species within this plant family may be considered potential host plants (Degen et al. 1999a; Villeneuve et al. 2007). Ellis (1992) recorded 121 species of Apiaceae hosts. Plant species such as cabbage, beet, endive, chicory, lettuce and potato may be used by the larva if an apiaceous host has been removed and there is nothing else for the larvae to feed upon. However in the field, the female fly will only lay eggs on plants of the Apiaceae family. In the United Kingdom hemlock (*Conium maculatum* L.) is an important wild host (Capinera 2001).

Plant part affected

Leaves: yellowed or dead.

Roots: internal feeding.

Whole plant: plant dead; dieback; internal feeding.

World distribution

Taken from CABI Crop Protection Compendium 2007.

Europe: Austria, Belarus, Belgium, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Hungary, Ireland, Italy, Latvia, Netherlands, Norway, Poland, Portugal, Russia, Slovakia, Spain, Sweden, Switzerland, Ukraine, United Kingdom.

Asia: Georgia, Japan (Hokkaido), Mongolia, Turkey, India.

North America:

Canada Alberta, British Columbia, New Brunswick, Newfoundland, Nova Scotia, Ontario, Prince Edward Island and Quebec

USA California, Colorado, Connecticut, Georgia, Illinois, Maine, Maryland, Massachusetts, Michigan, New Hampshire, New York, Ohio, Oregon, Pennsylvania, Utah, Washington and Wisconsin.

South America: Chile.

Oceania: New Zealand (Smith & Charles 1998). In Australia carrot rust fly has not been recorded but has been intercepted and it is categorised as an exotic plant pest.

Africa South Africa (Myburgh 1988).

Figure 3. World map of carrot production countries ● and carrot rust fly ●
(source: http://www.cabicompendium.org).

Biology

Adult

Carrot rust fly (Figure 4) is slender, shiny, black fly approximately 6-8 mm long, with a 12 mm wing-span. Carrot rust fly has a characteristic reddish head, long yellow legs and iridescent wings. Sex of adults is not easy to distinguish superficially, but the abdomen is more pointed in the female and rather more rounded in the male. Most specimens of carrot rust fly have partly yellow first flagellomere.[1]

Figure 4. Carrot rust fly adult.
(source: http://www.flpa-images.co.uk/bin/flpa).

Egg

Carrot rust fly eggs are white in colour, 0.6-0.7 mm in length; cylindrical and slightly curved, bluntly rounded posteriorly and relatively blunt anteriorly; chorion with longitudinal striations over whole surface; anterior end of egg with an obvious micropyle comprising a round stalk expanded into a circular cap with eight sockets around its circumference.

Larvae

Larvae (maggots) (figure 5) are colourless when hatched with dark mouth-hooks. There are three larval instars (stages) and the fully mature larva is 8-10 mm long and creamy-white to white in colour, tapered to a point at the front and blunt at the rear, with no head capsule. The larvae of carrot rust fly are difficult to identify in the early stages using traditional taxonomic keys because the larvae, as many species of the order *Diptera* do not have many special features for their identification. Suspected larvae can be identified by the key to the family Psilidae in Smith (1989) and Ferrar (1987a) with descriptions of larvae being provided by Ashby and Wright (1946) and Osborne (1961).

[1] Antennae are paired appendages connected to the front-most segments of arthropods, the three basic segments of the typical insect antenna are the scape (base), the pedicel (stem), and finally the flagellum, which often comprises many units known as flagellomeres. The number of flagellomeres can vary greatly, and is often of diagnostic importance.

Figure 5. Carrot rust fly larvae.
(source: http://www.flpa-images.co.uk/bin/flpa).

Pupae

Pupae (Figure 6 & 7) are slender and roughly cylindrical, approximately 5.4 mm long, uniformerly yellow brown colour, anterior end obliquely truncated to produce a flat, anterodorsal plate with a thin, rounded rim around its edge, this plate being the cap that lifts off as the adult emerges. The posterior end tapers and is wrinkled (Ferrar 1987a).

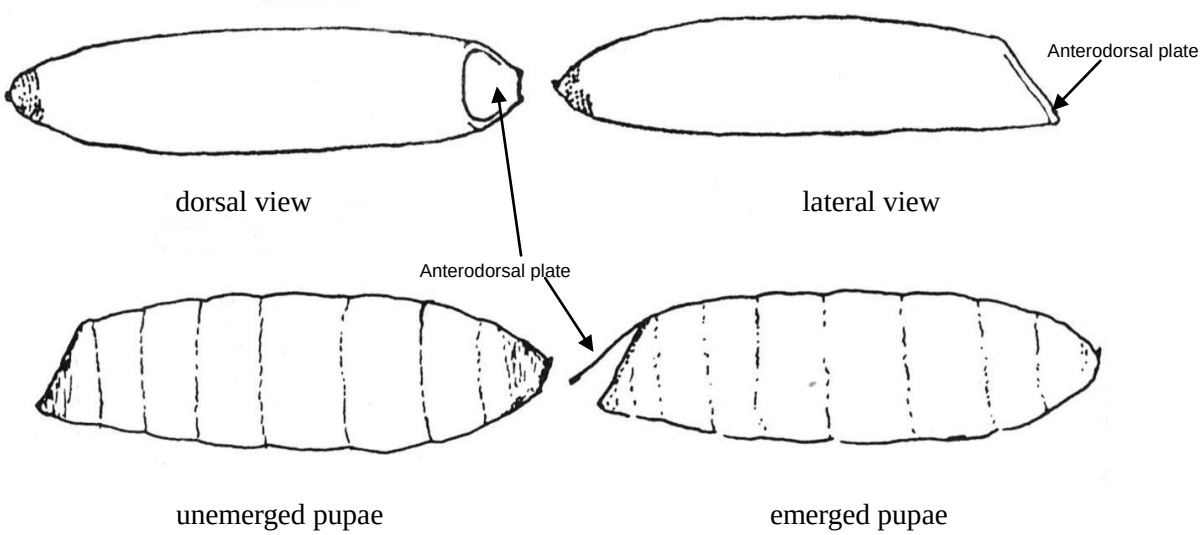

Figure 6. View of carrot rust fly pupae.

Figure 7. Pupae in soil.
(source http://www.inra.fr/internet/Produits).

Similarities to other species

The male genitalia are distinct and while carrot rust fly is apparently confined to plants of the Apiaceae family, the chrysanthemum root fly has only reliably been recorded from chrysanthemum and lettuce but not from plants of the Apiaceae family. Carrot rust fly is closely related to chrysanthemum root fly (*Psila nigricornis* Meigen, 1826). Chrysanthemum root fly have black first flagellomere, but specimens of carrot rust fly with black first flagellomere occur.

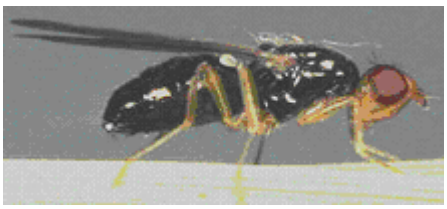

Figure 8. Psila rosae *Psila nigricornis*

(source: http://www. Surecrop.com/Insects vegetable; http://inra.fr/ internet/Produits/).

Similar damage caused by other carrot pests

Carrot rust fly damage to roots is similar to damage caused by carrot mining fly (*Napomyza carotae* Spencer, 1966). Larva of carrot mining fly, mine down through the leaf petiole and tunnel down under the epidermis of the upper root. The mine may become opened like carrot rust fly mines if the root then grows longer.

Carrot rust fly and carrot weevil (*Listronotus oregonensis* Le Conte, 1868) damage may also appear similar in the early stages, but are distinguished easily on mature carrots. Carrot weevil feeding tunnels tend to occur in the

upper third of the root, whilst the narrower and more winding tunnels of carrot rust fly are mainly found in the lower two-thirds of the root. Carrot mining fly and carrot weevil are not found in Australia.

The foliage symptoms of carrot rust fly attack on carrot are similar to the effect of willow carrot aphid (*Cavariella aegopodii* Scopoli, 1763) and carrot motley dwarf virus complex (carrot mottle umbravirus and carrot red leaf luteovirus).Willow carrot aphid is present in Australia (DAWA 2003).

Life cycle

Carrot rust fly is a holometabolous[2] insect with the number of annual generations varying according to the climate. Carrot rust fly overwinters in the soil in the pupal stage. Adults begin to emerge in late April to late May (in the northern hemisphere) in temperate climates and late June in more northern areas. In the southern hemisphere (New Zealand) adults emerge from overwintering puparia in September and are abundant until the following May, depending on heat unit accumulations (about 250 degree-days above 5EC[3]). After emergence the flies live for up to two months. Adults are found on the foliage of host and non host plants in hedges and field margins.

The pre-oviposition period varies from 4 days at 24 °C to 28 days at 9 °C (Stevenson 1981; Finch et al. 1999). Flower feeding is not necessary for the female fly prior to oviposition, but it will increase female life span and the number of eggs laid by individuals. Within four days of emergence, the flies mate in the weedy border of a field, or other favourable sites (Wright & Ashby 1946).

Females move into the edge of carrot crops to oviposit. Each female lays an average of 100 eggs, singly or in groups of two or three (Wright et al. 2005), mostly on or just below the soil surface adjacent to the host plants (Petherbridge et al. 1942).

The eggs hatch in approximately 7 days (in the laboratory, 5 days at 21.5 °C to 25 days at 9 °C) (Stevenson 1981). The egg hatches the emerging larvae rupturing the chorion around micropyle (Ferrar 1987a; Ferrar 1987b).

The emerging larvae feed on the fine roots and later burrow into the taproot to produce a mine. Larger larvae may also feed on the smaller roots of carrot and other Apiaceous crops or weeds. Larvae may move up to 600 mm through the soil. Third instar larvae move away from the root into the surrounding soil and pupate.

[2] Most of the major insect have a typical life cycle which consists of an egg, which hatches into a larva which feeds, moults and grows larger, pupates, then emerges as an adult insect that looks very different from the larva. These insects are often called 'Holometabolous', meaning they undergo a complete (*Holo* = total) change (*metabolous* = metamorphosis or change).

[3] National Oceanic and Atmospheric Administration's National Weather Service Climate Prediction Center (NOAA NWS CPC) issues 3-month temperature outlooks for the United States. These outlooks represent the expected chance for the average 3-month temperature to occur in one of three temperature categories: Above, Near or Below Normal. The categories are based on observations from the present climatological reference period of 1971 through 2000. During this 30-year period, temperatures were in the Below Normal category 1/3 (33.3%) of the time, in the Near Normal category 1/3 (33.3%) of the time, and in the Above Normal category 1/3 (33.3%) of the time. In other words, during 1971-2000, there was an Equal Chance (EC) for the average 3-month temperature to fall in any one of the three categories.).

The time required to complete larval development depends greatly on food availability and soil temperature. Thus, the duration of larval development can range from six weeks to three months depending on the season. If conditions are suitable the larvae may pupate and develop directly into a second generation of flies. However, in northern latitudes either the cooling autumn weather halts development or the third instar larvae undergo facultative diapause[4] with pupation occurring the following spring.

The duration of the pupal stage is also temperature driven and may take from three weeks to several months. Prepupae may aestivate or enter a facultative diapause depending on environmental conditions (McKinlay 1992). Between 800 and 1200 degree-days (DD_3)[5] are required for a complete generation of the carrot rust fly in Canada (British Columbia, Québec and Ontario) (Stevenson 1983; Judd et al. 1985; Boivin 1987).

In New Zealand, adults emerge from overwintering puparia in September, and are abundant until the following May. Eggs are laid from September to May and take 7-14 days to hatch. Larval development takes 4-6 weeks, and the pupal stage lasts 2-4 weeks. A full generation may take 7-12 weeks to complete, which allows up to four generations a year to occur in some parts of the country. Peak flights of carrot rust fly adults in the Auckland area have been recorded in mid October, late December, mid February, and mid April. The insect normally overwinters either as larvae in roots or as pupae in the soil, though a few adults may also survive the winter (Smith & Charles 1998).

Damage

Carrot rust fly is a key pest of carrots (*Daucus carota* L.), and related crops in temperate regions of the world (Berry et al. 1995). Carrot rust flies are oligophagous[6] insects which oviposit in the ground surrounding plants of Apiaceae family (Guerin & Visser 1980; Guerin et al. 1983; Hardman et al. 1990; Degen et al. 1999b). Damage to the crop is caused by larvae chewing into lateral roots resulting in the death of seedlings and young roots. If the seedling survives, carrot roots may be distorted or forked (Hooper 1997).

The first signs of carrot rust fly attack are when the foliage of infested plants turns red or yellow. Seedlings wilt and many die as a result of larval damage to the tap root (Ellis 1999). As the larvae growth, their oral hooks develop enabling them to rasp the tougher and more nutritional cortex of the carrot root. The roots usually survive the attack (Figure 9) but are unmarketable because of the larval mines and associated secondary root infections from fungi and bacteria (Howard et al. 1994).

[4] Facultative diapause, is a physiological state of dormancy of the insect, usually cause by environmental conditions (drought or cold weather).

[5] The total amount of heat required, between the lower and upper thresholds, for an organism to develop from one point to another in its life cycle is calculated in units called degree-days (°D).

[6] Larvae diet is restricted to a few related plants.

Figure 9. Carrot damage (source http://agsyst.wsu.edu).

Heavy levels of infestation and associated levels of fungal infestation may destroy the carrot root. Mining occurs in any portion of the root although Hill (1974) found that the highest proportion of mining occurred in the lower one-third of the root and that there is no apparent limit to the depth of the mining, even roots 30 cm long are damaged to their tips.

Feeding and development site selection

Carrot rust fly may locate their host by a 'sense of smell', as demonstrated by Guerin and Visser (1980) with electroantennogram tests showing responses to green-leaf volatiles, and compounds more specifically characteristic of Apiaceae family. The phenylpropanoid that carrot rust fly is attracted to is called chlorogenic acid which is produced in the epidermis of the carrot root (Cole et al. 1987). Chlorogenic acid is a family of esters formed by caffeic and quinic acids is one of the major product of phenylpropanoid metabolism in vascular plants and is found widespread in plants. Chlorogenic acid is a powerful hydrogen-donating antioxidant that may play an important role in mitigation the effects of oxidative stress in plants (Hulme 1953; Grace et al. 1998). The higher the concentration of chlorogenic acid, the greater the susceptibility of carrots to carrot rust fly damage. The relationship between the yield of marketable roots, chlorogenic acid concentration and previous carrot rust fly damage support the hypothesis that carrot rust fly attack stimulates chlorogenic acid production which in turn encourages further attack (Cole 1985; Cole et al. 1987; Cole et al. 1988).

Pest status

Economic damage caused by carrot rust fly is usually to carrot, parsnip, celery and parsley, but it has much wider host range in related cultivated and wild species of plants of the Apiaceae family. Ellis (1992) recorded 121 species of Apiaceae as hosts plants (Appendix 1). Other plant species may be used by the larva if an apiaceous host has been removed and there is nothing else for the larvae to feed upon, but in the field the female fly will only lay eggs on plants of the Apiaceae family (Capinera 2001).

Management

The host range of the carrot rust fly extends to 121 different plant species, all in the Apiaceae family. Insecticides have limited effectiveness against carrot rust fly due to the behavioural patterns of the pest (Dufault & Coaker 1987). Carrot rust fly females spends most of its time in the periphery of the fields, flying into the field to lay eggs at the base of the carrot plants, and then leaving the field. After hatching, the larva moves down into the soil to feed on the roots and eventually pupates in the soil. When the adult emerges from the pupae, it flies to the periphery of the field. This behavioural pattern leaves limited opportunities for control with insecticides.

The carrot rust fly is commonly controlled in conventionally-grown crops by the application of insecticide granules (phorate or diazinon) in or near the row at the time of sowing (Sivasubramaniam et al. 1999).

There are several cultural control techniques recommended to minimise the extent of damage inflicted on the crop by carrot rust fly. Physical barriers, crop monitoring, crop rotation, late seeding to avoid the damage from the first generation, and avoidance of growing carrots in sheltered areas are the most commonly practiced cultural controls. Commercial growers who use these techniques often have no need for insecticides. However, in home gardens and on farms where crop rotation is limited and where sheltered areas are common, extensive damage by carrot rust fly is inevitable without the protection from insecticides (Hooper 1997).

In Denmark the fungus *Entomophthora muscae* (Zygomycetes: Entomophthorales) (E. Cohn) G. Winter, 1856 is an important mortality factor for adult carrot rust fly in the field. The effect of infection by *E. muscae* on carrot rust fly is the disturbance of the egg-laying behaviour of the female flies, which resulted in abnormal oviposition instead of the normal deposition near the food plants (Eilenberg 1987).

Breeding resistant crops has been highly successful in the control of carrot rust fly. Crosses made between commercial carrot varieties and *Daucus capillifolius* a resistant wild *Daucus* species produced highly resistant ‘carrot-like’ lines. These lines have been developed by seed companies. Prior to this development, the levels of resistance were being raised at about 1% per year, whereas the seed companies raised the levels from 60 to 70 % in less than 3 years (Finch & Collier 2000).

Intercropping with lucerne (*Medicago littoralis* Rohde ex Lois.) as a management strategy for the carrot rust fly was studied in Sweden. Results of these experiments showed that damage caused by carrot rust fly were always lower in intercropping systems (Rämert & Ekbom 1996).

The Agricultural Research Center of Finland introduced a forecasting and warning service to meet the needs for IPM and to allow an effective flow of information between researches, advisers and farmers. The systems use modern information technology such as geographical information systems (GIS) and AGRONET/INTERNET services. Although the service may provide suggestions on control methods, the farmer makes the final

decision about the need of pest control and the choice of control methods (Tiilikkala & Ojanen 1999).

CLIMEX® bioclimatic model

Climate is one of the major factors limiting the distribution of plants and cold-blooded animals. Using climate information, and knowledge about the biology and distribution of a particular species in its original habitat, CLIMEX® enables a rapid, reliable assessment of the risks posed by the introduction of different organisms that can be used to predict locations to which it could spread.

CLIMEX® utilises an Ecoclimatic index (EI) which is a measure of the potential of a given location to support a permanent population of a species. The EI is scaled from 0 to 100, in broad terms; EI of zero (0) indicates that the species is unable to persist at that location. EI values of 1-10 indicate the climatic environment is marginal for the long term survival of the species. EI values of 11-20 indicate the climatic environment will support populations and enable the survival of the species. EI values of >20 indicate highly favourable climatic conditions would exist for the long term survival of the species and the likelihood of ongoing economic impacts. EI values of >50 are usually only found in the relatively stable tropical rainforests ecosystems and the theoretical maximum EI of 100 can only exist in highly controlled growth chambers.

A predictive bioclimatic model has been developed to assess the potential of carrot rust fly establishing in Australia. Carrot rust fly has a world distribution covering mostly template regions. The 'temperate' template provided by CLIMEX® has formed the baseline bioclimatic model in which temperature, moisture and stress parameters were modified according to data sourced from published literature. Stevenson (1983) studied the effects of temperature on various developmental stages of carrot rust fly and reported that adult activity occurred between 10 ^{o}C to 20 ^{o}C with optimal conditions between 17.5 ^{o}C to 20 ^{o}C. Several authors have reported that development of carrot rust fly is favoured by low to moderate temperatures (Whitcomb 1938; McClanahan & Niemczyk 1963). Based on this data, the temperature development parameters has been set to DV0=6, DV1=17.5, DV2=20. Collier and Finch (1996) reported that exposure to temperatures 24 ^{o}C and 26 ^{o}C caused some pupae delayed their development, while exposure to 28 ^{o}C and 30 ^{o}C cause all pupae to delay their development (Glendenning 1946; Collier & Finch 1996).

Mortality of eggs is high at temperatures exceeding 26 ^{o}C, especially in summer. Conditions are more favourable in autumn, but the lower temperatures at that season prolong the period between hatching and entry into the main root of the carrot. As such, a late infestation is not noticed until after some considerable time and may increase greatly in winter crops (Overbeck 1978). According to Overbeck the hatching rate of eggs of the carrot rust fly laid in the soil is influenced mainly by temperature in the upper soil level (Freuler et al. 1988). This data suggests that development is limited to temperatures below 28 °C. therefore DV3 has been set to 26 °C.

To test the validity of the CLIMEX® model, the known distribution of carrot rust fly in Europe. North America, Asia, and New Zealand was compared with the distribution predicted by the model. Though an iterative process, the predicted distribution was replicated to validate the model for carrot rust fly climate suitability throughout Europe, North America, Asia and New Zealand.

Abiotic stress parameters limit the ability of species to survive during unfavourable conditions; inclusion of these parameters may also limit distribution of species. Each of the stress indices are associated with a rate that determines how quickly a particular stress accumulates when conditions are beyond a stress threshold value. Heat stress parameters (TTHS) have been set at 28 with an accumulation rate (THHS) of 0.003. Cold stress parameters (DTCS) have been set at 10 with an accumulation rate (DHCS) of 0.0001. Given that adequate moisture is important for growth and development, a dry stress threshold (SMDS) has been set at 0.2 with an accumulation rate (HDS) of 0.005. Wet stress parameters (SMWS) have been set at 1.5 with an accumulation rate (HWS) of 0.002.

For multivoltine[7] insects such as carrot rust fly that enter a facultative diapause, factors that affect diapause are particularly important (Burn & Coaker 1981; Stevenson 1981). Stevenson (1991) found that the capability of carrot rust fly to avert diapause when larvae were exposed to extended periods of low temperature enables development to proceed without diapause when temperatures become favourable for development. Diapuse parameters used with species requiring obligate diapause were not use in this model.

The model was used to predict potential distribution of carrot rust fly in Australia. The predicted distribution indicates there is potential for carrot rust fly to establish in Australia and this may have economic impacts for the Australian carrot industry similar to Europe, North America (Canada, USA) and New Zealand.

The continuous and seasonal growing patterns of carrot production in Australia provide favourable conditions of infestation by carrot rust fly. Locations suitable for carrot rust fly to establish also corresponded to most of the current carrot growing regions in Australia (Figure 10).

The predictive CLIMEX® bioclimatic model suggests that heat and dry stress are detrimental to the survival of carrot rust fly. However, in virtually all instances of commercial horticultural production and home gardening, additional irrigation is applied. The impact irrigation on the long term survival of carrot rust fly at different chosen locations in Australia (Figure 11) was investigated using top up irrigation of 120 mm per month when average natural rainfall does not reach 120 mm. The model predicts that chosen locations will support and enable the survival of carrot rust fly (EI=10-20). The environment suitability of chosen locations in association with irrigation will increase to become optimal for the establishment of the carrot rust fly, thereby having the potential to become an economically

[7] Insects producing several generations per year

important pest should carrot production become established in these areas. The model also predicts that whilst moisture constrains can be overcome, heat stress still limits the overall unfavourableness of the climatic environment within the area of Warwick (Queensland) (EI=0). However, when moisture constraints were removed to a point prior to increases in hot and wet stress interactions, Ecoclimatic indices for Warwick (EI=15) were achieved. These results suggests that carrot rust fly may have the potential to establish in Warwick.

The model also predicts that whilst moisture constrains can be overcome, heat stress still limits the overall unfavourableness of the climatic environment within the area of Warwick (Queensland) (EI=0).

It can be concluded from the model that carrot rust fly has the potential to establish in temperate regions of Australia.

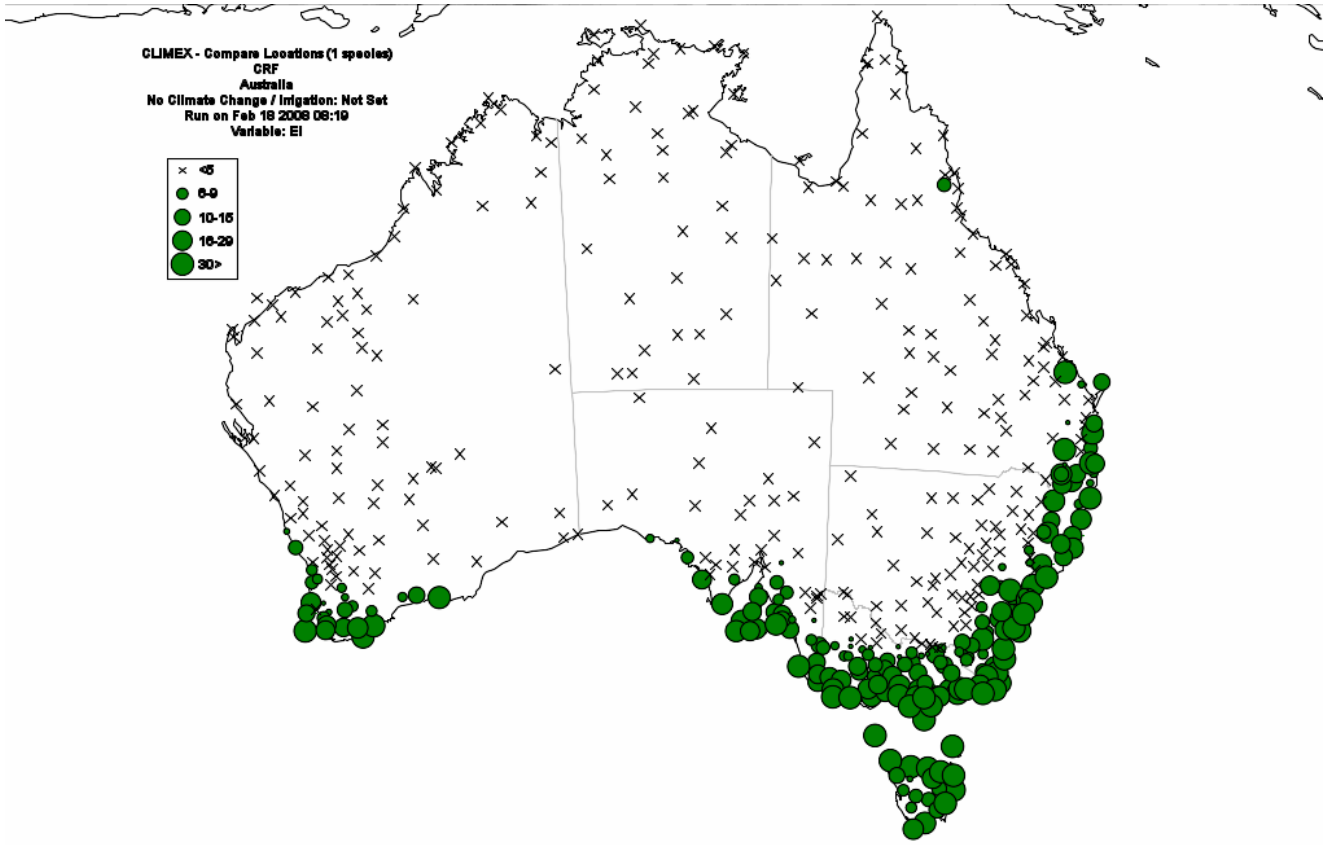

Figure 10. Predicted distribution of carrot rust fly by CLIMEX® in Australia. Green circles indicate the Ecoclimatic Indices (EI). Crosses indicate an EI<5. Smaller circles represent a EI=6-9, medium size circles represent a EI=10-15 and larger circles represent a EI>30. EI values of>20 indicate highly favourable climatic conditions exist for the long term survival of the carrot rust fly and the likelihood of ongoing economic impacts. The suitable locations for carrot rust fly to established corresponded with current carrot growing regions.

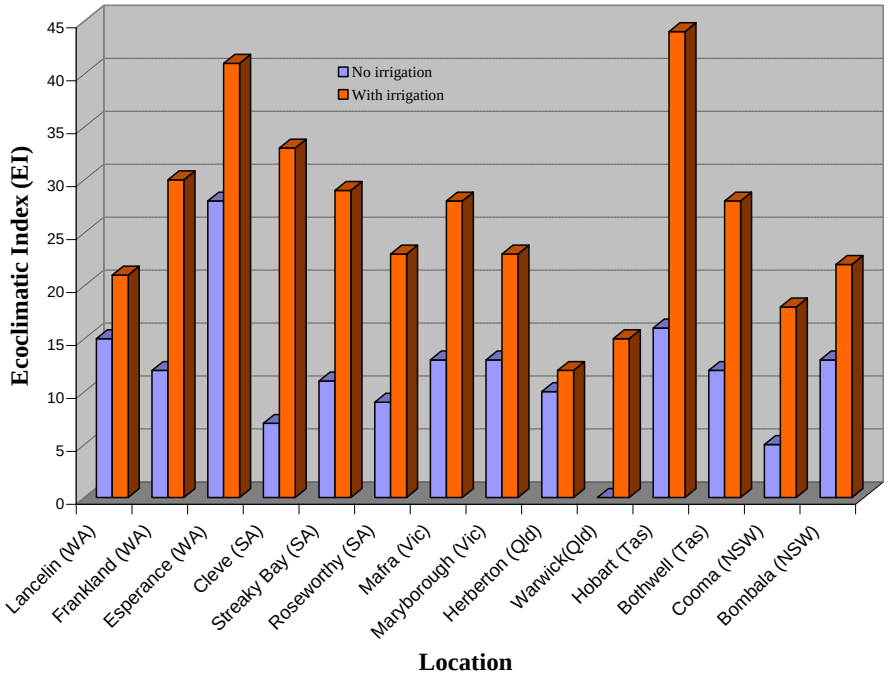

Figure 11. The long term suitability Ecoclimatic Index (EI) for carrot rust fly in association to irrigation to 120 mm/month in-lieu of rainfall to 120mm for Australian locations.

Continuous and seasonal growing patterns of carrot production in Australia favour a potential for carrot rust fly population levels to build up and regions with continuous carrot production are more at risk.

Risk assessment methodology

The methodology used for carrot rust fly risk assessment follows the Guidelines for Import Risk Assessment (BA 2001). The following tables and rules were adapted for use from "Method for development of Pest Risk Reviews, National Strawberry Industry Biosecurity Plan" (PHA 2005), "Import Risk Assessment Report for Apples from New Zealand Part B" (BA 2006), "State Risk Assessment Revised Draft Policy Review for the risk posed by spiraling whitefly (*Aleurodicus dispersus* Russell)" (DAFWA 2007) and "Draft import risk assessment report for fresh Unshu mandarin fruit from Japan" (BA 2008).

The likelihoods of entry, establishment and spread were rated using the risk level ratings in table 1.

Table 1. Generic nomenclature for qualitatively describing likelihoods

Likelihood	Descriptive definition	Indicative probability (P) range
High	The event would be very likely to occur	$0.7 < P \leq 1$
Moderate	The event would occur with an even probability	$0.3 < P \leq 0.7$
Low	The event would be unlikely to occur	$0.05 < P \leq 0.3$
Very low	The event would be very unlikely to occur	$0.001 < P \leq 0.05$
Extremely low	The event would be extremely unlikely to occur	$0.000001 < P \leq 0.001$
Negligible	The event would almost certainly not occur	$0 \leq P \leq 0.000001$

The introduction, establishment and spread potential for each quarantine pest are combined using Table 2 (matrix of rules) to provide the overall probability of introduction, establishment and spread and represents the cumulative likelihood that these events will occur.

Table 2. Matrix of rules for combining descriptive likelihoods

Likelihood 1 \ Likelihood 2	High	Moderate	Low	Very low	Extremely low	Negligible
High	High	Moderate	Low	Very low	Extremely low	Negligible
Moderate		Low	Low	Very low	Extremely low	Negligible
Low			Very low	Very low	Extremely low	Negligible
Very low				Extremely low	Extremely low	Negligible
Extremely low					Negligible	Negligible
Negligible						Negligible

In order to estimate the potential economic importance of the carrot rust fly, information was obtained from areas where the pest occurs. Consideration was given to whether carrot rust fly causes major, minor or no damage; and

whether the damage is frequently or infrequently. The situation in the PRA area was then carefully compared with that in the areas where the carrot rust fly occurs. Case histories concerning comparable pests were also considered. Expert judgement was then used to assess the potential economic consequences should the insect establish and spread in the PRA area.

Economic assessments carried out for carrot rust fly are based on available information regarding each of the *direct* and *indirect* consequences outlined below. It should be noted that in many instances, information regarding the likely consequences of incursions of the identified quarantine pests is often limited. In addition, it is often the case that the consequences of a pest in one country or environment are different to those in another. Given these limitations, the economic assessment has been based on the available information for carrot rust fly or on information obtained for similar pest.

The **direct consequences** considered include:

- Crop losses (yield and grade).
- Control and surveillance measures.
- Environmental effects.

The **indirect consequences** considered include:

- Effects on domestic and export markets - this should include a consideration of any phytosanitary measures imposed by trading partners in the event of a pest incursion.
- Changes to producer costs or input demands.
- Changes to domestic or foreign consumer demand for a product resulting from quality changes.
- Environmental or other undesired effects of control measures.
- Feasibility and cost of eradication or containment.
- Capacity to act as a vector for other pests.
- Resources needed for additional research and advice.
- Social and other effects.

If the pest has no significant economic consequence in the PRA area then it does not satisfy the definition of a quarantine pest and does not need to be considered any further.

In assessing the economic consequences the following nomenclature and criteria are used:

The relevant examples of direct and indirect consequences from ISPM 11 (FAO 2007c) are considered for each of the broad groups (as listed above) and estimates of the consequences are assigned.

The direct and indirect consequences are estimated based on four geographic levels. The terms 'local', 'district', 'regional', 'national' and 'PRA area' are defined as:

Local: An aggregate of households or enterprises (a rural community, a town or a local government area).

District: A geographically or geopolitically associated collection of aggregates (generally a recognised section of a State, or Territory such as Far North Queensland).

Region: A geographically or geopolitically associated collection of districts in a geographic area (generally a State or Territory, although there may be exceptions with larger States such as Western Australia).

National: Australia wide (Australian States and Territories).

PRA area: Australia.

The consequence is described as 'unlikely to be discernible', of 'minor significance', significant' or 'highly significant' (Table 3).

- an '*unlikely to be discernible*' consequence is not usually distinguishable from normal day-to-day variation in the criterion.
- a *consequence* of '*minor significance*' is not expected to threaten economic viability, but would lead to a minor increase in mortality/morbidity or a minor decrease in production. For non-commercial factors, the consequence is not expected to threaten the intrinsic 'value' of the criterion — though the value of the criterion would be considered as 'disturbed'. Effects would generally be reversible.
- a '*significant*' consequence would threaten economic viability through a moderate increase in mortality/morbidity, or a moderate decrease in production. For noncommercial factors, the intrinsic 'value' of the criterion would be considered as significantly diminished or threatened. Effects may not be reversible.
- a '*highly significant*' consequence would threaten economic viability through a large increase in mortality/morbidity, or a large decrease in production. For non-commercial factors, the intrinsic 'value' of the criterion would be considered as severely or irreversibly damaged.

Table 3. Nomenclature for the description of economic consequence

Consequence	Description
Negligible	The impact is unlikely to be discernible by directly affected parties.
Very low	The impact on a given criterion is likely to be minor to directly affected parties. The impact is unlikely to be discernible at any other level.
Low	The impact is likely to be discernible within an affected geographic region and significant to directly affected parties. It is not likely that the impact will be discernible at the State level.
Moderate	The impact is likely to be discernible at a State or Territory level, and significant within affected geographic regions. The impact is likely to be highly significant to directly affected parties.
High	The impact is likely to be significant at a State or Territory level, and highly significant within the affected geographic regions. This classification implies that the impact would be of national concern. However, the effect on economic stability, societal values or social well-being would be limited to a given geographic region.
Extreme	The impact is likely to be highly significant at the national level. This classification implies that the impact would be of significant national concern. Economic stability, societal values or social well-being would be seriously affected in more than one State or Territory.

As with the overall probability of introduction, establishment and spread where the events are combined, the expected loss, or risk, also requires each of the events to occur, i.e. a pest to be introduced, to establish and spread, with the ensuing economic consequences. Therefore risk estimation represents the integration of likelihood and consequence, with the objective of deriving a measure of the expected loss, or 'risk', associated with carrot rust fly (Table 4).

Table 4. Risk estimation matrix

Likelihood of pest entry, establishment and spread	Negligible	Very low	Low	Moderate	High	Extreme
High	Negligible	Very low	Low	Moderate	High	Extreme
Moderate	Negligible	Very low	Low	Moderate	High	Extreme
Low	Negligible	Negligible	Very low	Low	Moderate	Extreme
Very low	Negligible	Negligible	Negligible	Very low	Low	Moderate
Extremely low	Negligible	Negligible	Negligible	Negligible	Very low	Low
Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Very low
	Negligible	**Very low**	**Low**	**Moderate**	**High**	**Extreme**

Consequence of pest entry, establishment and spread

The SPS Agreement article 5 (WTO 1995) defines *appropriate level of sanitary or phytosanitary protection* as the level of protection deemed

appropriate by the member in establishing a sanitary or phytosanitary measure to protect human, animal or plant life or health within its territory.

Economic, environmental and social impacts were assessed individually and were calculated for each four geographic scales: local areas (i.e. rural communities, towns or local government areas), districts (i.e. recognised sections of States), regions (i.e. States) and Australia as a whole (BA 2001).

The overall consequence for carrot rust fly was achieved by combining the qualitative scores (A–G) for each direct and indirect consequence using a series of decision rules. These rules are applied as follows: if the first rule did not apply, the second rule was considered. If the second rule did not apply, the third rule was considered and so on until one of the rules applied.

- Where the consequences of a pest with respect to any direct or indirect criterion are 'G', the overall consequences are considered to be 'extreme'.
- Where the consequences of a pest with respect to more than one criterion are 'F', the overall consequences are considered to be 'extreme'.
- Where the consequences of a pest with respect to a single criterion are 'F' and the consequences of a pest with respect to each remaining criterion are 'E', the overall consequences are considered to be 'extreme'.
- Where the consequences of a pest with respect to a single criterion are 'F' and the consequences of a pest with respect to remaining criteria is not unanimously 'E', the overall consequences are considered to be 'high'.
- Where the consequences of a pest with respect to all criteria are 'E', the overall consequences are considered to be 'high'.
- Where the consequences of a pest with respect to one or more criteria are 'E', the overall consequences are considered to be 'moderate'.
- Where the consequences of a pest with respect to all criteria are 'D', the overall consequences are considered to be 'moderate'.
- Where the consequences of a pest with respect to one or more criteria are 'D', the overall consequences are considered to be 'low'.
- Where the consequences of a pest with respect to all criteria are 'C', the overall consequences are considered to be 'low'.
- Where the consequences of a pest with respect to one or more criteria are 'C', the overall consequences are considered to be 'very low'.
- Where the consequences of a pest with respect to all criteria are 'B', the overall consequences are considered to be 'very low'.
- Where one or more direct or indirect effects are 'B', the overall consequences associated with the outbreak scenario are considered to be 'negligible'.

- Where all direct and indirect effects are 'A', the overall consequences associated with the outbreak scenario are considered to be 'negligible'.

These values were then translated into an 'impact score' (range A-G) according to the guidelines in Table 5.

Table 5. The assessment of local, district, regional and national consequences

Impact score	National	Regional	District	Local
G	Highly significant	Highly significant	Highly significant	Highly significant
F	Significant	Highly significant	Highly significant	Highly significant
E	Minor	Significant	Highly significant	Highly significant
D	Unlikely to be discernible	Minor	Significant	Highly significant
C	Unlikely to be discernible	Unlikely to be discernible	Minor	Significant
B	Unlikely to be discernible	Unlikely to be discernible	Unlikely to be discernible	Minor
A	Unlikely to be discernible	Unlikely to be discernible	Unlikely to be discernible	Unlikely to be discernible

Geographical Level

Assessment of entry, establishment and spread

In the context of the risk posed to Australia, carrot rust fly can be considered a quarantine pest species. The criteria met by carrot rust fly under the International Standards for Phytosanitary Measures is a pest of potential economic importance to the area endangered and not yet present there or present but not widely distributed and being officially controlled. An area being defined as an officially defined country, part of a country or all or parts of several countries (FAO 2007b).

Throughout the development of the pest data sheet the unrestricted risk estimate has been derived taking into account standard quarantine practices for Australia. Basic standards of practice for the production of plant-derived commodities in the exporting area have been considered. Likelihoods and consequences are described using the processes and nomenclature outlined in Import Risk Assessment Handbook (DAFFA 2007).

Probability of entry – Root crop: Carrot

Probability of importation: Moderate

For any pest species that require but can include some or all of its life cycle associated with root and survive storage and transport to the PRA area can have an ambit claim of 'Moderate' probability of importation. This implies that the importation of the pest species into the PRA area would occur with an even probability as per table 1.

Carrot rust fly larvae can be carried as larvae in root crops. The presence of the visible characteristic narrow and winding tunnels of carrot rust fly is mainly found in the lower two-thirds of the carrot root which should be detected during packing house quality control inspection. However in many cases the mining walls will not collapse and the damage may not be

detected. The presence of the adult on the root pathway would be very unlikely to occur as they are highly mobile. Any larvae present in `the root pathway would be likely to survive packing house, storage and transport procedures to Australia. A 'Moderate' probability of importation of carrot rust fly larvae in root is therefore recognised, that is, the event would occur with an even probability.

Probability of distribution: High

When a pest species has the ability to survive on discarded host material and complete its development or is able to find an alternate host to complete its development, has an ambit claim of a 'High' likelihood of distribution to a suitable host, that is the distribution of pest species would be very likely to occur. Larvae of carrot rust fly can survive storage transport and distribution to Australia. Provided the larval stages can be completed development, emergence as adults can occur.

A 'High' probability of distribution of carrot rust fly is therefore recognised that is, the probability that the carrot rust fly will be distributed as a result of the processing, sale or disposal of carrots in Australia and subsequent transference to a suitable host would be very likely to occur from host root crop imported into Australia.

Probability of entry – Carrot crop*: - Moderate*

Probability of establishment

When a pest species is polyphagous[8] and the environmental conditions in the PRA area are suitable for the pest to establish, an ambit claim of 'High' probability of establishment can be proposed, that is, the establishment would be very likely to occur.

Carrot rust fly is oligophagous insect with host species present in the Apiaceae family (USDA 2008). Australia's wide range of climatic conditions along with available carrot (parsley, celery and weeds such as hemlock) cultivation throughout the year will enhance the likelihood of carrot rust fly establishing in Australia.

The CLIMEX® model developed for this Pest Risk Assessment predicts that the natural environmental conditions within Australia will work against the long term survival of carrot rust fly (that is, with an Ecoclimatic index (EI) of well below 30). However, areas at risk to the establishment of carrot rust fly within Australia are mainly the southern coastal areas. Additionally, protected horticultural production such as in glasshouses, has the potential to support carrot rust fly provided their internal environmental conditions are suitable and host plants are present.

A 'Moderate' probability of establishment of carrot rust fly is therefore recognnised, that is, establishment would occur with an even probability in Australia where suitable environmental conditions occur.

Probability of Establishment: - Moderate

[8] Insect that feeds on many species of food plants.

Probability of spread

For any pest species that have well developed dispersal capabilities both independent of host material and in association with host material, an ambit claim of 'High' probability of spread can be proposed, that is, the spread would be very likely to occur.

Carrot rust fly can disperse both independently and in association with host material. Spread independent of host material is facilitated by adult flight, albeit a weak flier, and in association with farm equipment. Carrot rust fly can also be spread in association with host material and as such, long distant dispersal is facilitated by commercial distribution of the host material. As the adult insect has weak flying capabilities, a 'High' probability of spread cannot be justified. A 'Moderate' probability of spread of carrot rust fly is therefore recognised, i.e. spread would occur with an even probability if the pest establishes in Australia where suitable environmental conditions occur.

***Probability of Spread*: -** Moderate

Economic consequences:

The International Standards for Phytosanitary Measures (IPSM No 11) - Pest Risk Analysis for Quarantine Pests including Analysis of Environmental Risks and Living Modified Organisms (FAO 2007c), indicates that the Assessment of economic consequences is made using "*a hypothetical situation where a pest is supposed to have been introduced and to be fully expressing its potential economic consequences (per year) in the PRA area*". This is interpreted as an unabated incursion. However, it is acknowledged that existing control regimes for similar species may impact on this expression. In light of this interpretation, comments on specific impacts are discussed below.

The methodology for assessing economic is outline in table 6

Table 6. Economic consequences of entry, establishment and spread

Criterion	Estimate
Direct consequences	
Plant life or health	**D** — Carrot rust fly can cause direct harm to carrots and a range of economically important horticultural plant species from the Apiaceae family if not adequately controlled. Environmental conditions exist within Australia that are similar to infested areas overseas (USA, Spain France, New Zealand) suggesting that similar impacts to plant life or health would occur. As a result, carrot rust fly is expected to have highly significant consequences at the local level in areas where host crops are commercially grown.
Any other aspects of the environment	**B** — Australia has a significant number of native plant species some of which are listed as endangered species (DECWA 2007). The introduction of exotic species such as carrot rust fly into the natural environment may have the capacity to induce changes in the ecology of susceptible native ecological communities. These changes are expected to be minor at the local level in that ecological changes may be reversible as it would be highly probably that carrot rust fly could be removed from the natural environment.
Indirect consequences	
Eradication, control etc.	**D** — Due to the nature of spread of carrot rust fly an eradication program may be feasible. Successful control regimes overseas are commonly controlled in conventionally-grown crops by the application of insecticide granules (phorate or diazinon) in or near the row at the time of sowing (Sivasubramaniam et al. 1999). To incorporate any modifications to existing cultural practices for the preservation of introduced and natural environment would add to the cost of production. It is expected this could have highly significant consequences at the local level.
Domestic trade	**D** — Carrot rust fly is an exotic pest to Australia. Once established in Australia, the presence of carrot rust fly could restrict interstate trade. Some interstate domestic markets could be lost as infested produce may not meet consumer's expectations of high quality produce. It is expected that the indirect consequences to domestic trade would have highly significant consequences at the local level.
International trade	**D** — International markets could be lost as infested produce may not meet consumer's expectations high quality produce. It is expected that the indirect consequences to international trade would have highly significant consequences at the local level.
Environment	**A** — Insecticides required to control carrot rust fly, if used, are expected to have consequences of minor significance at the local level.

Economic Consequences – all pathways: Low

Risk assessment conclusion

Unrestricted risk estimate summary (Table 7)

***Carrot root*:** Very low

For carrot root grown in regions where carrot rust fly occurs, the basic standards of practice for insect control required for its production would provide an appropriate level of protection for Australia against this pest. As such, any carrot root grown in regions where carrot rust fly is known to occur and transported into Australia would not require additional phytosanitary action undertaken at some point on the pathway to achieve an appropriate level of protection. Currently 600 unit inspection is applied to carrots from New Zealand, the only country exporting carrots to Australia. New Zealand Biosecurity Organism register for imported products carrot rust fly is classified as a non-regulated pest that means carrot rust fly is present in New Zealand.

The Australian Government's policy reflects community expectations and provides for a high standard of quarantine that manages risks to a very low level. It recognises that zero risk stance is impractical as it would mean no tourists, no international travel and no imports (DAFWA 2007). However, as zero risk is not an option and there is a 'Very low' probability of entry, establishment and spread implies that there is some, albeit 'very low' likelihood of an incursion of carrot rust fly occurring. To counter this eventuality, the Industry Biosecurity Plans incorporate Pest Specific Incursion Management Plans to provide a pre-emptive process aimed to eradicate, contain or manage any incursion of carrot rust fly.

Table 7. Unrestricted Risk Assessment Summary

Commodity pathway	Probability of -					Overall probability of entry establishment and spread	Economic consequences	Unrestricted Risk
	Entry Importation x Distribution = Entry			Establishment	Spread			
Carrot root	Moderate	High	Moderate	Moderate	Moderate	Low	Low	Very low

Appendix 1. List of family Apiaceae (host to carrot rust fly)

Species		Weed status	Present in Australia
Scientific name	**Common name**		
Aegopodium podagraria L.	Ashweed,bishop's-weed, goutweed, ground-elder, herb-Gerard	Naturalised, environmental, agricultural, escape, noxious, invasive.	Yes
Aethusa cynapium L.	Fool's-parsley	Escape, invasive.	Yes
Ammi majus L.	Bullwort, false bishop's-weed	Naturalised, environmental, invasive, escape, agricultural.	Yes
Ammi visnaga (L.) Lam. Khella	Lesser bishop's-weed	Naturalised, invasive, escape, agricultural.	Yes
Anethum graveolens L.	Dill, garden dill	Naturalised, invasive, escape, agricultural, environmental.	Yes
Angelica archangelica L.	Angelica, wild parsnip	Agricultural, invasive.	Yes
Angelica archangelica subsp. *archangelica*			No
Angelica archangelica subsp. *litoralis* (Fr.) Thell			No
Angelica laevis J. Gay ex Ave-Lall			No
Angelica sylvestris L.	Wild angelica	Environmental, escape.	Yes
Anthriscus caucalis M. Bieb	Bur chervil	Naturalised, escape, invasive.	Yes
Anthriscus cerefolium (L.) Hoffm.	Chervil, garden chervil	Agricultural, escape, invasive.	Yes
Anthriscus sylvestris (L.) Hoffm.	Cow-parsley, keck, wild chervil	Environmental, escape, noxious.	Yes
Anthriscus sylvestris subsp. *alpina* (Vill.) Gremli			No
Anthriscus sylvestris subsp. *fumarioide*s (Waldst. & Kit.) Spalik			No
Anthriscus sylvestris subsp. *nemorosa* (M. Bieb.) Koso-Pol			No
Anthriscus sylvestris subsp. *sylvestris*			No
Apium graveolens L.	Celery	Naturalised, escape, agricultural, environmental.	Yes
Apium graveolens var. *dulce* (Mill.) Pers.			No

Species		Weed status	Present in Australia
Scientific name	**Common name**		
Apium graveolens var. *graveolens*			No
Apium graveolens var. *lusitanicum* (Mill.) DC. (=*Apium graveolens* var. *graveolens*)			No
Apium graveolens var. *rapaceum* (Mill.) Gaudin			No
Apium graveolens cv. *secalinum* Alef. (=*Apium graveolens* var. *secalinum* (Alef.) Mansf.)			No
Apium graveolens var. *secalinum* (Alef.) Mansf.			No
Apium nodiflorum (L) Lag			No
Apium spp.			No
Astrantia major L.	Astrantia, greater masterwort		No
Astrodaucus littoralis (M. Bieb) Drude Ageomoron			No
Athamanta turbith (L) Brot.			No
Berula erecta (Huds.) Coville	Water parsnip		No
Berula pusilla Fernald (=*Berula erecta* (Huds.) Coville)			No
Berula thunbergii (DC.) H. Wolff (=*Berula erecta* (Huds.) Coville)			No
Bupleurum falcatum L.	Sickle-leaf, hare's ear		No
Bupleurum griffithii hort. (=*Bupleurum rotundifolium* L.)	Hare's-ear		No
Bupleurum praealtum L.			No
Bupleurum tenuissimum L.	Smallest hare's ear		No
Carum buriaticum Turcz			No
Carum carvi L.	Caraway	Environmental, agricultural, escape, noxious.	Yes
Caucalis platycarpos L.			No
Chaerophyllum aureum L.	Golden chervil		No
Chaerophyllum bulbosum L.	Parsnip chervil, chervilturnip-root	Agricultural, escape, invasive.	Yes
Chaerophyllum bulbosum subsp. *prescottii* (DC.) Nyman			No
Chaerophyllum coloratum L.			No
Chaerophyllum hirsutum L.			No
Cicuta virosa L.	Cowbane, water hemlock		No

Species		Weed status	Present in Australia
Scientific name	**Common name**		
Conium maculatum L.	carrot fern, fool's parsley, hemlock	Naturalised, environmental, agricultural, noxious, invasive.	Yes
Coriandrum sativum L.	Chinese-parsley, coriander	Naturalised, invasive, agricultural, escape.	Yes
Crithmum maritimum L.	Rock samphire, sea fennel		No
Cryptotaenia canadensis (L.) DC.	Honewort, white chervil	Environmental, agricultural.	Yes
Daucus capillifolius Gilli			No
Daucus carota L.		Naturalised, invasive, agricultural, escape.	Yes
Daucus carota cv. *atrorubens* Alef. (=*Daucus carota* var. *boissieri* Schweinf.)			No
Daucus carota subsp. *azoricus* Franco			No
Daucus carota var. *boissier*i Schweinf.			No
Daucus carota subsp. c*antabricus* A. Pujadas			No
Daucus carota subsp. *carota*			No
Daucus carota subsp. *commutatus* (Paol.) Thell			No
Daucus carota var. *commutatus* Paol. (=*Daucus carota* subsp. *commutatus* (Paol.) Thell)			No
Daucus carota subsp. *drepanensis* (Arcang.) Heywood			No
Daucus carota subsp. *fontanesii* Thell			No
Daucus carota subsp. *gadecaei* (Rouy & E. G. Camus) Heywood			No
Daucus carota subsp. *gummifer* (Syme) Hook. f.			No
Daucus carota var. *gummifer* Syme (=*Daucus carota* subsp. *gummifer* (Syme) Hook. f.)			No
Daucus carota subsp. *halophilus* (Brot.) A. Pujadas			No
Daucus carota subsp. *hispanicus* (Gouan) Thell			No
Daucus carota subsp. hispidus (Desf. ex Arcang.) Heywood			No

Species		Weed status	Present in Australia
Scientific name	**Common name**		
(=Daucus carota subsp. *fontanesii* Thell)			
Daucus carota subsp. *major* (Vis.) Arcang			No
Daucus carota subsp. *majoricus* A. Pujadas			No
Daucus carota subsp. *maritimus* (Lam.) Batt			No
Daucus carota subsp. *maximus* (Desf.) Ball			No
Daucus carota subsp. *parviflorus* (Desf.) Thell			No
Daucus carota subsp. *rupestris* (Guss.) Heywood			No
Daucus carota subsp. *sativus* (Hoffm.) Arcang			No
Daucus carota var. *sativus* Hoffm.			No
Daucus glochidiatus (Labill.) Fisch. & C. A. Mey			No
Daucus gracilis Steinh			No
Daucus involucratus Sm.			No
Daucus littoralis Sm.			No
Daucus maximus Desf. (=*Daucus carota* subsp. *maximus* (Desf.) Ball)			No
Daucus muricatus (L.) L.			No
Daucus pusillus Michx			No
Eryngium agavifolium Griseb			No
Eryngium agavifolium Griseb			No
Eryngium dichotomum Desf.			No
Eryngium giganteum M. Bieb	Giant sea-holly, miss Willmot's gost	Agricultural.	Yes
Falcaria vulgaris Bernh	Long leaf		No
Eryngium giganteum M. Bieb	Giant sea-holly, miss Willmot's gost	Agricultural.	Yes
Ferula communis L.	Giant fennel	Naturalised.	Yes
Ferula galbaniflua Boiss. & Buhse (=*Ferula gummosa* Boiss)	Gallbanum		No
Ferula gummosa Boiss			No

Species		Weed status	Present in Australia
Scientific name	**Common name**		
Foeniculum vulgare Mill	Fennel	Agricultural, invasive, naturalised, noxious, escape environmental.	Yes
Foeniculum vulgare var. *azoricum* (Mill.) Thell			No
Foeniculum vulgare var. *dulce* (Mill.) Batt			No
Foeniculum vulgare subsp. *piperitum* (Ucria) Cout			No
Foeniculum vulgare var. *vulgare*			No
Grafia golaka (Hacq.) Reichenb			No
Heracleum lehmannianum Bunge			No
Heracleum mantegazzianum Sommier & Levier	Cartwheel flower, giant hogweed	Agricultural, invasive naturalised, noxious, escape, environmental.	Yes
Heracleum sphondylium L.	Meadow parsnip, cow parsnip, hogweed	Escape.	Yes
Heracleum sphondylium subsp. *montanum* (Schleich. ex Gaudin) Briq.			No
Heracleum sphondylium subsp. *sibiricum*			No
Heracleum sphondylium subsp. *sphondylium*			No
Heracleum sphondylium subsp. *ternatum* (Velen.) Brummitt			No
Heracleum sphondylium subsp. *transsilvanicum* (Schur) Brummitt			No
Lagoecia cuminoides L.			No
Laserpitium gallicum L.			No
Laserpitium hispidum Bieb			No
Laserpitium prutenicum L.			No
Levisticum officinale W. D. J. Koch	Lovage	Agricultural, invasive.	Yes
Libanotis buchtormensis (Fisch.) DC.			No
Ligusticum scoticum L.	Beach lovage, Scots lovage		No
Meum athamanticum Jacq.	Garden myrrh, sweet chervil, sweet cicely	Agricultural, escape, invasive.	Yes
Myrrhoides nodosa (L.) Cannon			No

Species		Weed status	Present in Australia
Scientific name	**Common name**		
Oenanthe aquatica (L.) Poir	Fine-leaf water, dropwort, water fennel	Environmental.	Yes
Oenanthe crocata L.	hemlock, water hemlock		No
Oenanthe fistulosa L.			No
Oenanthe fistulosa L.			No
Oenanthe lachenalii C.C.Gmelin			No
Oenanthe peucedanifolia Pollich			No
Oenanthe pimpinelloides L.	Corky-fruit water	Naturalised, environmental.	Yes
Opopanax chironium (L.) Koch	Hercules-all-heal		No
Orlaya daucoides (L.) Greuter			No
Pastinaca sativa L.		*Naturalised, noxious, environmental, agricultural, escape.*	Yes
Pastinaca sativa subsp. *sativa*			No
Pastinaca sativa subsp. *sylvestris* (Mill.) Rouy & E. G. Camus			No
Petroselinum crispum (Mill.) Nyman ex A. W. Hill	Parsley	Naturalised, escape, environmental, agricultural.	Yes
Petroselinum crispum var. *crispum*			No
Petroselinum crispum var. *neapolitanum* Danert			No
Petroselinum crispum var. *tuberosum* (Bernh.) Mart. Crov			No
Petroselinum hortense auct. (=Petroselinum crispum (Mill.) Nyman ex A. W. Hill)			No
Petroselinum sativum Hoffm., nom. nud. (=*Petroselinum crispum* (Mill.) Nyman ex A. W. Hill)			No
Petroselinum segetum (L.) W. D. J. Koch			No
Petroselinum vulgare Lag. (=*Petroselinum crispum* (Mill.) Nyman ex A. W. Hill)			No
Peucedanum alsaticum L.			No
Peucedanum baicalense (I. Redowsky ex Willd.) W. D. J. Koch (=*Kitagawia baicalensis* (I. Redowsky ex Willd.) Pimenov)			No
Peucedanum gallicum Labourr			No

Species		Weed status	Present in Australia
Scientific name	**Common name**		
Pimpinella anisum L.	Anise, sweet cumin	Agricultural.	Yes
Pimpinella major (L) Huds.	Great burnet-saxifrage		No
Pimpinella saxifraga L. - *Pimpinella saxifraga* var. *major* L. (=*Pimpinella major* (L.) Huds.)	Burnet saxifrage, pimpinella	Escape.	No
Pimpinella siifolia Leresche			No
Ridolfia segetum Moris			No
Scandix pecten-veneris L.	Shepherd's needle, venus' comb	Naturalised, escape, environmental.	Yes
Scandix pecten-veneris spp. *Brachycarpa* (Guss.) Thell. Hegi			No
Selinum carvifolia (L.) L.			No
Selinum tenuifolium Salisb. (=*Selinum carvifolia* (L.) L.)			No
Seseli carvifolia L. (=*Selinum carvifolia* (L.) L.)			No
Seseli globiferum Vis.			No
Seseli transcaucasica Schishk			No
Seseli libanotis (L.) W. D. J. Koch			No
Sison amomum L.	Stone-parsley		No
Sium latifolium L.	Great water-parsnip		No
Sium sisarum L.	Skirret, chervis		No
Smyrnium olusatrum L.	Alexanders, black lovage, horse parsley	Agricultural, escape.	Yes
Smyrnium rotundifolium Miller			No
Todaroa montana Brouss. & Hooker			No
Tordylium maximum L.			No
Torilis arvensis (Huds.) Link	Spreading hedge-parsley		No
Torilis arvensis subsp. *arvensis*			No
Torilis arvensis subsp. *elongata* (Hoffmanns. & Link) Cannon			No
Torilis arvensis subsp. *heterophylla* (Guss.) Thell			No
Torilis arvensis subsp. *neglecta* (Spreng.) Thell			No
Torilis arvensis subsp. *purpurea* (Ten.) Hayek (=*Torilis arvensis* subsp. *heterophylla* (Guss.) Thell)			No
Torilis japonica (Houtt.) DC.	Upright hedge-parsley		No

Species		Weed status	Present in Australia
Scientific name	**Common name**		
Torilis nodosa (L.) Gaertn	Knotted hedge-parsley		No
Trinia glauca (L.) Dumort			No
Turgenia latifolia (L.) Hoffm.			No

(CRC 2008; USDA 2008).

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Pest Specific Incursion Management Plan for Carrot Rust Fly (*Psila rosae* Fabricius, 1794)

Marc Poole *et al.*

Department of Agriculture and Food, Western Australia.

Project Number: VG06114

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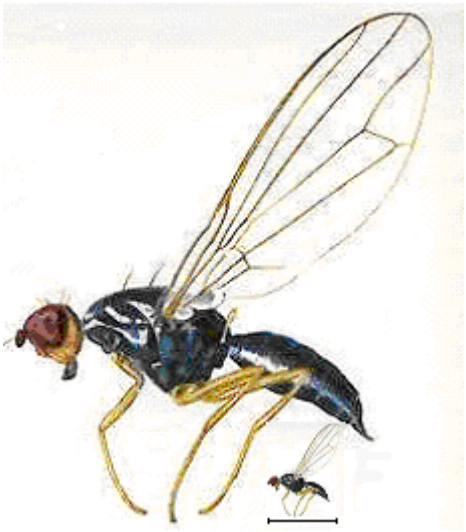
Pest Specific Incursion Management Plan for Carrot Rust Fly (*Psila rosae* Fabricius, 1794)



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VG06114

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Horticulture Australia limited (HAL) Project Number: VG06114

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Project description: Carrot rust fly has been identified by Plant Health Australia as one of the top threats to the Australian carrot industry. In 2007 Horticulture Australia Ltd (HAL) commissioned the Department of Agriculture and Food Government of Western Australia to develop a Pest Specific Incursion Management Plan, a Pest Risk Assessment and a Diagnostic Protocol for carrot rust fly. It is recommended that these documents to be considered a permanent draft documents to be updated regularly as new information becomes available.

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Background

The development of a Pest Specific Incursion Management Plan for the exotic carrot rust fly (*Psila rosae* F.) reflects serious concern by the Australian carrot industry about the economic impact of carrot rust fly should it enter and become established in Australia. As a member of Plant Health Australia, the carrot industry has identified the carrot rust fly as a key emergency plant pest requiring a Specific Incursion Management Plan (Figure 1). This Incursion Management Plan has been prepared, in conjunction with a Pest Risk Assessment and Diagnostic Protocol, as part of Horticulture Australia Project (No: VG06114).

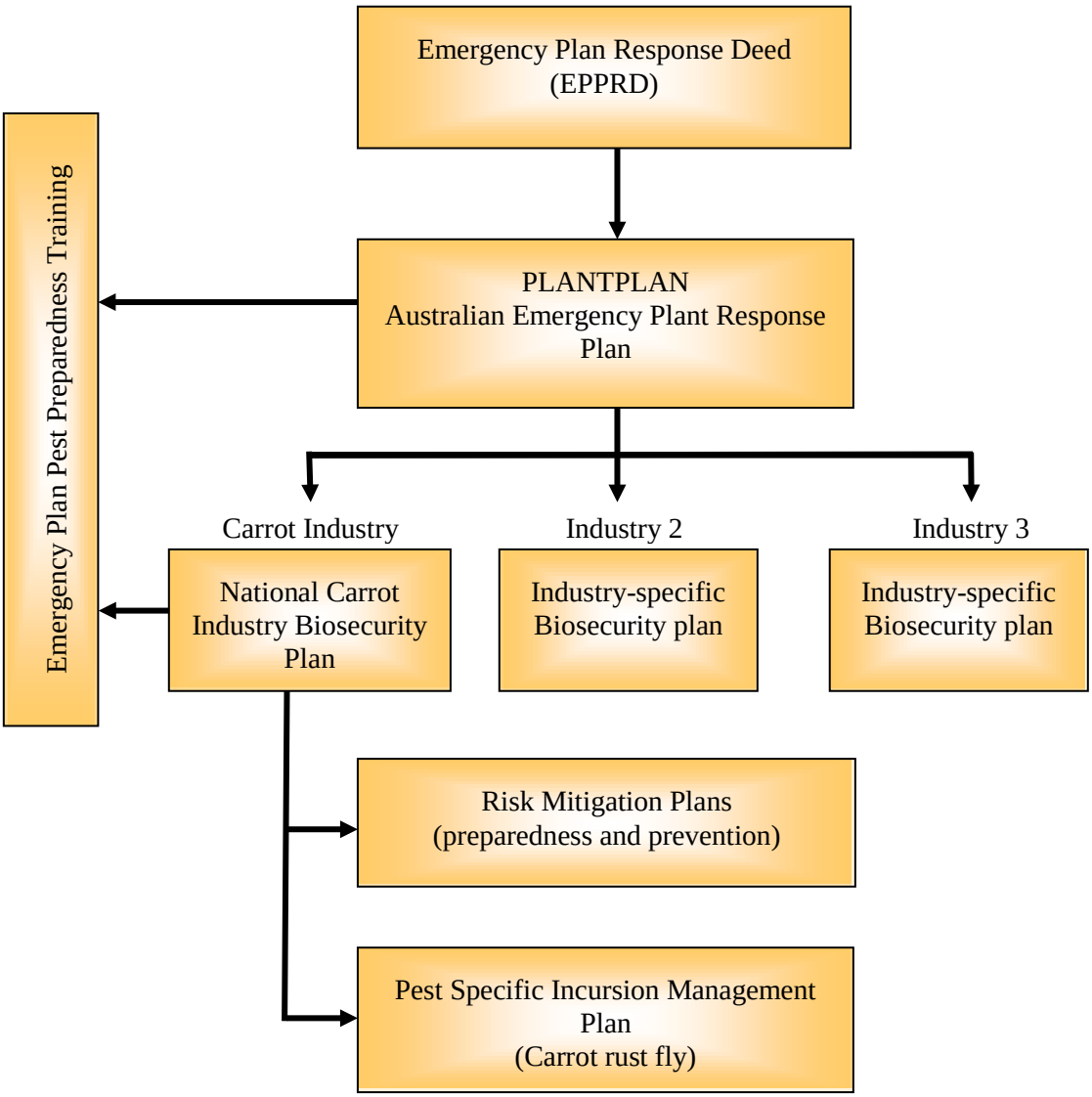

Figure 1. Pest Specific Contingency Plan flowchart and how it fits within the emergency preparedness and response arrangements of the Emergency Plant Pest Response Deed (EPPRD), (PHA 2007).

The management of responses of incursion of exotic plant pests and diseases is the responsibility of the Consultative Committee on Emergency Plant Pests (CCEPP), a technical body that coordinates the response of Commonwealth, State Governments and Plant Health Australia (PHA).

The Consultative Committee on Emergency Plant Pests is chaired by the Chief Plant Protection Officer (CPPO), Department of Agriculture, Forestry and Fisheries (DAFF), Canberra, and makes recommendations on incursion management responses.

Plant Health Australia (PHA) is a public company in which the Commonwealth, States and selected industries are principle shareholders and emergency response to incursions is recognised in its strategic plan as a priority.

In 2002, PHA members endorsed the preparation of a formal cost sharing agreement for the plant industries, the Emergency Plant Pest Response Deed (EPPRD). Under the Emergency Plant Pest Response Deed, government and industry signatories will share the costs of eradicating emergency plant pests that will cause serious economic damage to Australian plant industries. This will reduce delays in the release of funds for eradication efforts and re-imbursements to industry members affected by crop destruction during eradication programs.

PLANTPLAN (PHA 2007) was developed as the generic emergency response plan to guide management of emergency plant pest incursions. Industry-specific biosecurity plans are being developed for each PHA member.

There is provision for pest-specific contingency plans for key emergency plant pest affecting each industry to be developed as appendices of the industry-specific biosecurity plans.

The pest specific incursion management plans are to provide information on the host range, symptoms, biology and epidemiology of the key pest, along with guidelines for general and targeted surveillance programs, diagnosis, and control. They are to be used in conjunction with the emergency response guidelines in PLANTPLAN.

The Australian carrot industry has identified the carrot rust fly as a key emergency pest for their industry, and commissioned the development of this Pest Specific Incursion Management Plan (HAL Project No VG06114).

This pest specific management plan has been developed in consultation with Plant Health Australia, based on guidelines such as:

- PLANTPLAN: Australian Emergency Plant Pest Response Plan (PHA 2007).
- Technical Guidelines for Experts Developing Specific Emergency Plan Pest Incursion Response Plans (Merriman & McKirdy 2005).

There are two basic components to contingency planning:

- Awareness/preparedness which deal with pre-incursion plans.

- Response that deals with post-incursion activities usually associated with eradication or containment.

Awareness aims to enhance the capabilities of stakeholders to recognise the symptoms and understand the biology and spread of the carrot rust fly:

- Increasing the chances of early detection.
- Decreasing risks of illegal importation.
- Maximising opportunities for eradication or containment.

Preparedness is concerned with the establishment of systems and processes, which will enhance the opportunities for early detection. It involves:

- Capitalising on the available knowledge and experience worldwide.
- 'Mining' this information to identify the preferred diagnostic tools and best capabilities for rapid identification of the carrot rust fly.
- Equally important is preparation of detailed plans for:
    - Surveillance.
    - Establishment of quarantine zones and pest free areas.
    - Treatment of affected sites.
    - On-going pest management.
    - On-farm biosecurity.

Response actions are those to be taken following the suspected incursion of carrot rust fly. If an incursion is confirmed, the response may be either eradication or containment.

Introduction

The carrot rust fly (*Psila rosae* F.) is a key insect pest of carrot carrots and related crops of the Apiaceae family (e.g. celeriac, parsnip) in temperate regions of the world.

Damage to carrots is caused by larvae burrowing into the taproot. Young plants wilt and may die, but more often the plants are stunted temporarily and the carrots become bulbous and forked. In addition, fungi and bacteria may invade the damaged tissue and cause severe rot at the crowns of the plants. On parsnips and celery, larvae more commonly are found nearer the crown, and may burrow into the base of leaf stalks (Petherbridge et al. 1942).

Carrot is an important vegetable crop in Australia with industry earning millions of dollars through exports carrots to different countries in South East Asia and the Middle East. Currently, the carrot industry is facing increasing challenges in its export markets from other competing carrots producing countries. However, a focus on high quality product counters competition from low cost commodity producing nations such as China.

Carrot production in Australia is affected by a number of known endemic plant pests and these are relative well managed. Carrot rust fly is exotic to Australia and has been identified as one of the top treats to the Australian carrot industry.

Australian growers capitalise on market opportunities based on product quality, food safety and environmentally sound production (McKay 2006b; McKay 2006a; CARD 2005). Australian producers keep this clean and green image in the export market by firm implementation of quarantine and biosecurity programs.

As a result of these efforts, Australian carrots have achieved an outstanding reputation for quality and reliability. To maintain this reputation in the export markets, it is important for the industry to be prepared for incursion of any exotic pest that may affect this industry. Food safety and integrity are also key drivers in the domestic and export markets.

Plant Health Australia has developed PLANTPLAN, a national set of incursion response guidelines for the plant sector, detailing procedures required and the roles and responsibilities of all parties involved in an incursion response.

Effective preparedness against Emergence Plant Pest (EPP) incursions requires a number of fundamental elements, these include:

- Early detection and confirmation.
- Known reporting lines.
- Contingency plans.
- Agreed decision-making processes
- Coordinated emergency management procedures.

Early detection of carrot rust fly will depend on the ability of different stakeholders to report unusual insect. If an incursion of a carrot rust fly is suspected, the first contact point should be the relevant State Government Officer responsible for plant biosecurity.

At the time of publication, the following list was accurate:

Interstate Quarantine General Enquiries: (Updated July 2008)

- **QLD:** (07) 3404 6990
- **NSW:** (04) 2869 6487
- **ACT:** (02) 6207 2581
- V**IC:** (03) 8371 3500 (Before 3 pm) or (03) 9210 9390 (After 3 pm)
- **TAS:** (03) 6233 4967
- **SA:** 1300 666 010
- **WA:** (08) 9334 1800
- **NT:** (08) 8999 2138

Exotic Plant Pest Hotline 1800 084 881

Emergency Plant Pest Response Deed (EPPRD) and PLANTPLAN

One of the central elements underpinning PLANTPLAN is the Emergency Plant Pest Response Deed.

The Emergency Plant Pest Response Deed is a formal cost sharing agreement covering industry and government funding arrangements for the eradication of Emergency Plant Pests (EPP). This will reduce delays in the release of funds for eradication efforts and reimbursements to industry members affected by crop destruction during eradication programs.

An Emergency Plant Pest response is a complex operation requiring rapid mobilisation of resources and coordination of a diverse team of people. Clear management and coordination systems ensure that those involved in incursion management have a clear understanding of their roles and responsibilities, know who the relevant stakeholder are, and who to contact in each organisation (Figure 2).

In 2004, the National Emergency Preparedness and Response Plan (PLANTPLAN) was developed by Plant Health Australia as a coordinated national response plan primarily concerned with the eradication of Emergency Plant Pests which pose a threat to Australia's agricultural industries (Figure 1).

PLANTPLAN is to be used by all plant industries and government agencies as a guide to management of Emergency Plant Pest incursions. It is included in all Plant Health Australia Industry Biosecurity Plans. The following recommended actions have been aligned as closely as possible to the current version of PLANTPLAN (PHA 2007) but may require modification to suit future versions.

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Plant Health Agency

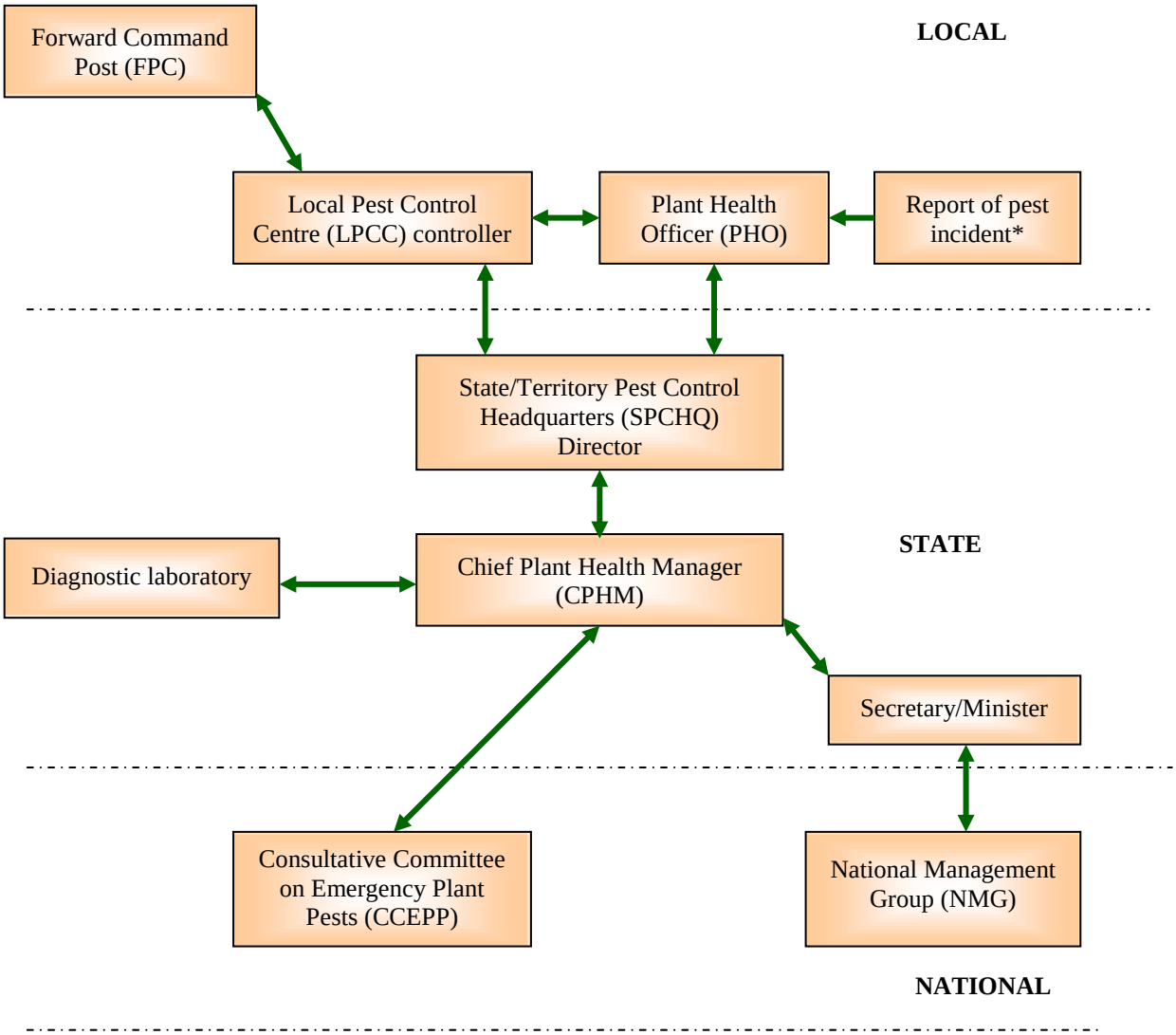

Figure 2. Chain of communication (State/Territory) for coordination of an Emergency Plant Pest.
**NB: A pest report may also be submitted at the state or national level, but will be appropriately directed so that local investigations can proceed.*

A response to an emergency plant pest consists of 4 phases:

- Investigation.
- Alert.
- Operational.
- Stand down.

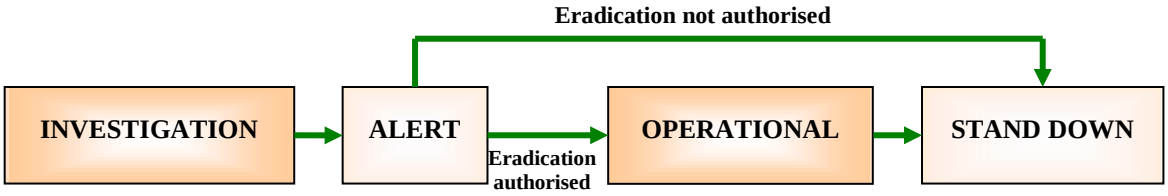

Figure 3. Response to a suspected incursion, based on PLANTPLAN (PHA 2007).

The actions that take place during each phase are listed in Tables 1 – 4 (PHA 2007).

Recommended actions following of an outbreak of carrot rust fly

These recommendations are to guide and assist in decisions that need to be made if an incursion of carrot rust fly has occurred. They identify the issues, actions and responsibilities that may be required during the initial period following a notification of a potential outbreak of carrot rust fly. It is vital that early containment occurs to minimise the spread of a potential outbreak and to maximise the opportunity for eradication.

The plans have been arranged into:

- Stage 1 – Actions that take place while diagnosis is being carried out i.e. pre-confirmation.
- Stage 2 – Actions that take place once the carrot rust fly has been diagnose i.e. post-confirmation.
- Stage 3 – Stand down phase.

It must be stressed that these plans are a guide only, based on information and technologies available at the time of writing this contingency plan.

In the event of an incursion by carrot rust fly, there are important strategies that should be implemented immediately including:

- Surveys and diagnosis of affected areas to map the distribution of the carrot rust fly.
- Pro-active control strategies including roguing and destruction of affected plants.
- Application of insecticide treatments for control of the fly.
- Ongoing monitoring to check status of affected areas after treatments have been applied.

- Long term monitoring and surveillance to confirm ongoing area freedom status for unaffected areas.

Investigation Phase

The Investigation Phase of PLANTPLAN is activated when a report of a suspect Emergency Plant Pest (carrot rust fly) is forwarded to the Australian Government or relevant State/Territory agriculture agency and the detection is investigated. The Chief Plant Health Manager (CPHM) determines the appropriate response at the time. Decisions are needed to ensure that all necessary actions can be taken if the probability of carrot rust fly incursion increases. Refer to table 1 below for a list of actions taken in the Investigation Phase.

Table 1. Actions taken during the Investigation Phase
(**Bold text = Action taken,** Plain text = Party responsible)

State Functions	National Functions	Industry Functions
Report suspect pest Plant Health Officer (PHO), grower, agronomist, researcher, member of the public		**Report suspect pest** (Grower, agronomist)
Identify pest (Diagnostic team)		
Notify Chief Plant Health Manager (CPHM) (Diagnostic team)		
Notify Chief Plant Protection Officer (CPPO) of detection (CPHM)		
Advise Property Owner (CPHM)	**Notify other States/Territories** • CPHMs. • Peak industry body(s). • Plant Health Committee (PHC). • Domestic Quarantine and Market Access Working Group (DQMAWG). • Biosecurity Australia/Australian Quarantine and Inspection Services (BA/AQIS). • CPPO.	
Complete Incursion IncidentReport (Lead Agency(s))	**Convene Consultative Committee on Emergency Plant Pest (CCEPP)** (CPPO)	**Attend CCEPP meeting** (Nominated representative and technical representative)

NB: Some actions may occur simultaneously

Detection

The initial notification of a suspect carrot rust fly incursion will most likely be received by a local agriculture departmental officer or diagnostic laboratory who will report the detection to the Chief Plant Health Manager of the State/Territory agency. The Chief Plant Health Manager will coordinate the collection of all relevant information and investigation of the initial report.

Where there are grounds for suspicion of carrot rust fly, the Chief Plant Health Manager will coordinate:

- Collection of initial details and any urgent trace backs or trace forwards.
- Take immediate steps to limit spread of the carrot rust fly by imposing quarantine measures to restrict the movement of material, people, machinery and equipment into and out of the suspect property or area (in many cases voluntary quarantine will be achievable and is recommended).
- Ensure samples collected are forwarded to an appropriate laboratory that meets the required standards to handle quarantine samples.

If the notification is received via the Exotic Plant Pest Hotline (**1800 084 881**), the report will be handled by staff answering to the Chief Plant Health Manager and the process would be as described above.

Useful preliminary information from the site of detection

All preliminary information that could be useful in identifying and dealing with a suspect carrot rust fly incursion should be documented. Any information that can aid in early diagnosis and help in the adoption of extra precautionary measures will increase the likelihood of eradication. Such information includes:

- Site details – ownership, location, map (latitude and longitude using Global Positioning System (GPS) equipment if available).
- Host plant location – using GPS or it may be possible to clearly mark affected plants.
- Host details – species and/or variety, age and development stage.
- Damage – description of symptoms, part of host affected, percent incidence and percent severity.
- Symptom/specimen photographs – electronic and/or print.
- When and where the suspect carrot rust fly incursion was first noticed.
- Decontamination that may have to be arranged for people, and equipment which have recently left the premises.
- Any other details that could be helpful.

Refer to Appendix 3 for general sampling procedure and Appendix 4 for a Preliminary Information Data Sheet.

Diagnostic team

When there is a suspected carrot rust fly incursion, the Chief Plant Health Manager or State/Territory Pest Control Headquarters Director will arrange for a diagnostic team to be dispatched to the suspect premises.

The diagnostic team must consist of at least two Plant Protection officers for legal and Occupational Health and Safety (OH&S) reasons. A technical expert should be accompanied by a senior state quarantine officer to ensure the sampling protocol and all details associated with the incident are recorded, including the source of planting material and movement of plants, plant products and machinery from the property.

The diagnostic team must ensure that chain of evidence requirements (Appendix 5) for collection of samples are satisfied. This requires that appropriate security measures and documentation procedures are followed at all times. An unbroken chain of evidence must be maintained for results to be admissible in court if need be. Details on protocols for initial diagnosis are provided in Appendix 3.

Internal communication of results

All information pertaining to suspect and confirmed quarantine samples will be treated as confidential and communicated to the Chief Plant Health Manager or equivalent of the lead agency. At this stage the Chief Plant Health Manager will assume sole responsibility as spokesperson.

Notify national authority

Under the Emergency Plant Pest Response Deed, the Chief Plant Health Manager must notify to the chair of Consultative Committee on Emergency Plant Pest within 24 hours of becoming aware of a suspect carrot rust fly incident. An incident is defined in the agreement as the occurrence of a confirmed or reasonably held suspicion of an Emergency Plant Pest.

Notify other State/Territory Agencies, National Authorities and Peak Industry body(s)

The Chief Plant Protection Officer will immediately notify of the detection to:

- Other State/Territory(s) Chief Plant Health Managers.
- Plant Health Australia.
- Members of Plant Health Committee (PHC).
- Domestic Quarantine and Market Access Working Group (DQMAWG).
- Biosecurity Australia (BA).
- Peak Industry body(s).

The Chief Plant Health Manager in the Lead Agency will advise relevant senior industry representatives of the detection.

Emergency Plant Pest Alert

The Chief Plant Health Manager and plant health specialist(s) will develop an Emergency Plant Pest alert using the template provided in Appendix 7.

Advise property owner

If symptoms or the diagnosis indicate the presence of carrot rust fly, the Lead Agency Chief Plant Health Manager will advise the property owner or manager:

- That diagnostic tests have identified a possible carrot rust fly that may require quarantine controls.
- That all staff working on the incident have been instructed to maintain strict confidentiality regarding the event.
- Of the need for cooperation in applying voluntary movement control on plants, plant products and personnel. If cooperation is not offered, the Chief Plant Health Manager should explain that a quarantine order can be placed on the property which imposes mandatory control on the movement of people, plants and equipment.
- Of what will happen in respect of national recommendations on eradication and containment.
- Of any financial arrangements.
- That counselling services can be made available to assist with social, economic or other issues.
- That they will be advised of the outcome of final diagnostic tests.

Initial meeting of the Consultative Committee on Emergency Plant Pest

The Chief Plant Protection Officer will arrange a meeting of the Consultative Committee on Emergency Plant Pests by notifying industry and government representatives by phone, fax or e-mail, as soon as practical.

The Chief Plant Health Manager(s) of the Lead Agency(s) will provide an Incursion Incident Report (Appendix 8) to the Chief Plant Protection Officer prior to the first meeting. It is not expected that all information will be available for this first meeting. However, all available information must be presented.

On consideration of the results of initial analysis of the pest, the Chief Plant Health Manager(s) of the Lead Agency(s) will determine the need to proceed to the Alert Phase.

Alert Phase

The Alert Phase begins when the Chief Plant Health Manager(s) of the Lead Agency(s) declares that based on an initial diagnosis of carrot rust fly, an emergency exists or has the potential to exist. During the Alert Phase the Chief Plant Health Manager(s) of the Lead Agency(s) will

ensure all stakeholders are alerted and key response staff is placed on standby.

The Alert Phase exists while accurate confirmation of the diagnosis is made. The aim of the Alert Phase is to complete a detailed scoping of the incident to determine the extent of the emergency. This in turn will provide the basis for decisions about the type of response required. Refer to table 2 for a list of actions taken during the Alert Phase.

Key issues to be addressed in the Alert Phase include whether the incursion can be effectively contained and eradicated, the potential for the incursion to spread and lead to significant losses to industry, wider economic and trade losses, or environmental consequences. In some emergency situations it may be necessary to move quickly to the Operational Phase and to conduct scoping activities as part of the Operational Phase.

During the Alert Phase the Local Pest Control Centre Controller and managers will be placed on standby.

Table 2. Actions taken during the Alert Phase
(**Bold text = Action taken,** Plain Text = Party responsible)

State functions	National functions	Industry functions
Confirm pest identity (Diagnostic team/international specialists)	**Confirm pest identity** Office of the Chief Plant Protection Officer (OCPPO)	
Adoption of Precautionary measures – state-wide (Lead Agency CPHM)	**Adoption of Precautionary measures – nationally** (DQMAWG)	
Delimiting surveys (Lead Agency)	**Advice National Management Group (NMG)** (CPPO)	
Identify Chemical Strategies (Lead Agency)	**Convene CCEPP** (CCEPP)	
Communicate results, declare incursion (Lead Agency CPHM)	**Declare incursion** (OCPPO)	**Declare incursion** (peak industry body(s))
	Investigate feasibility of eradication (CCEPP)	
	Cost/benefit analysis (CCEPP)	
Prepare EPP Response Plan (Lead Agency(s))	**Prepare EPP Response Plan** (CCEPP)	
	Recommendation to NMG (CCEPP)	
	Authorise eradication, approve EPP Response Plan and cost sharing arrangements (NMG)	

NB: Some actions may occur simultaneously

Confirm diagnosis

To mitigate opportunities for legal action, the initial diagnosis must be confirmed by independent specialists. The independent specialists identified in this Pest Specific Incursion Management Plant include:

Dr. Daniel J. Bickel

Entomology
(Associate Editor, Zootaxa – Diptera, Aschiza & Acalyptratae)
Australian Museum
6 College Street Sydney, NSW 2010. Australia
Telephone: (02) 9320 6347
Fax: (02) 9320 6011
E-mail:dan.bickel@austmus.gov.au
www.australianmuseum.net.au

Dr. Trevor Crosby

(Curator/kaitiaki, N.Z. Arthropod Collection / Ko te Aitanga Pepeke o Aotearoa)
Landcare Research
Private Bag 92 170
AUCKLAND 1142, New Zealand
Tamaki Campus, University of Auckland
231 Morrin Rd, St Johns
Telephone: +64-9-574 4134
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E-mail: crosbyt@LandcareResearch.co.nz
Web page (NZAC information):
http://www.landcareresearch.co.nz/research/biosystematics/invertebrates/nzac
Web page (for Fauna of New Zealand online extracts):
http://www.landcareresearch.co.nz/research/biosystematics/invertebrates/faunaofnz/index.asp

Adoption of precautionary measures

Precautionary measures should be implemented as soon as possible. The Chief Plant Health Manager will put in place appropriate interim quarantine measures on affected properties and will implement procedures to minimise the possible spread of the pest while identification and delimiting surveys are undertaken.

Quarantine measures may include:

- Restrictions on the movement of vehicles, equipment and plant material and products into and off the affected site.
- Interim control or containment measures.
- Establishment of buffer zones around affected properties.

Delimiting surveys to identify Restricted Area (RA) and Control Area (CA)

The Chief Plant Health Manager or State/Territory Pest Control Headquarter (SPCHQ) Director will coordinate initial inspections and surveys of the area to determine the extent of the quarantine zone (both Restricted and Control Areas). Minimum standards for surveillance will be specified by the Consultative Committee on Emergency Plant Pests in order to determine the extent of the incursion with a reasonable degree of confidence.

The Chief Plant Health Manager will coordinate survey teams to conduct trace backs to determine where the carrot rust fly might have come from and trace forward exercises to identify where the carrot rust fly might have spread. Consultation with owners and/or managers of affected properties will be conducted to identify:

- Movement of plant materials/products or other materials that may assist spread of the carrot rust fly.
- Items of equipment shared between properties.
- Personnel or contractors that may have moved from affected to unaffected properties.

Surveys teams will comprise State/Territory agriculture department staff and will be coordinated by experienced entomologists.

Chemical control strategies

The Lead Agency(s) will coordinate an investigation to identify insecticides that may be available to use during eradication or control procedures. This may involve gaining approvals for emergency use of unregistered products or for off-label use of products from the Australian Pesticides and Veterinary Medicines Authority (APVMA). Application forms can be obtained at the APVMA web site at http://www.apvma.gov.au.

General enquiries can be made to the APVMA by phoning (02) 6272 5852.

The Consultative Committee on Emergency Plant Pests will advise the Australian Pesticides and Veterinary Medicines Authority of the emergency and the urgent timelines involved.

Communication of diagnostic tests and declaration of an incursion

Once the carrot rust fly incursion has been confirmed, the Chief Plant Health Manager will notify to the Chief Plant Protection Officer of:

- The details of the site and location of the incursion.
- The details of the pest alert which can be used as the basis for communication with other States/Territories.

The Chief Plant Protection Officer will advise the peak industry body(s) and Plant Health Australia of:

- The details of the carrot rust fly, its biology, methods of spread, impact on plant growth, possible impacts on national and international trade, and control treatments used overseas.
- Prior communication with the owner(s) of the affected property including counselling services.
- The establishment (or proposed establishment) of a quarantine order on the affected property or properties.
- The process of considering opportunities for eradication and containment by the Consultative Committee on Emergency Plant Pests and the National Management Group (NMG).
- The requirement for the affected industry(s) participation as a member of Consultative Committee on Emergency Plant Pests.
- The need to maintain confidentiality.

The Chief Plant Health Manager of the Lead Agency in consultation with the Chief Plant Protection Officer will coordinate the preparation of a draft media release. All possible steps need to be taken to ensure that the location and identity of the property(s) owner(s) is kept confidential. Where a multi-state incursions occur, the Department of Agriculture Fisheries and Forestry (DAFF) will assume the lead role in preparing the media release.

Communications with the media will be restricted to the Chief Plant Protection Officer, a designated media contact within the Lead Agency and the National President or delegate of the peak industry body(s).

The Chief Plant Protection Officer will normally formally declare the detection at a national level concurrently with the Lead Agency after consultation with the Consultative Committee on Emergency Plant Pests. The peak industry body(s) will be prepared to make a statement on behalf of the affected industry(s).

Update Incursion Incident Report

After diagnostic confirmation of carrot rust fly, the Lead Agency will update the Incursion Incident Report. This is required before significant resources can be committed to an eradication program.

The Consultative Committee on Emergency Plant Pests Review

The Consultative Committee on Emergency Plant Pests will meet to review the situation following confirmation of the incident and will initiate a process to collect as much information as possible on the fly, its predicted impact, and the extent of its distribution in Australia to determine if eradication is technically and economically feasible. Accurate information must be accumulated as quickly as possible to ensure the opportunity for eradication is not lost.

The Consultative Committee on Emergency Plant Pests will also consult with the Domestic Quarantine and Market Access Working Group to

develop or modify controls on the movement of potentially affected plant materials out of the control area.

Implement control procedures

Control procedures will be implemented by the affected State/Territory agencies to contain the carrot rust fly incursion while the feasibility of eradication is investigated. The Chief Plant Protection Officer will liaise with the State/Territory Lead Agency to ensure that any response actions are conducted promptly and effectively. Quarantine zones will be established around infected properties and control areas.

Communications strategy

The Department of Agriculture Forestry and Fisheries will coordinate the development of a national communication strategy.

Advise property owner

The Chief Plant Health Manager will advise affected property owners/agencies of the decision to contain the carrot rust fly pending a decision by the National Management Group on whether or not to attempt an eradication program. Affected property owners should be provided with a comprehensive explanation of the intended survey and response action. State/Territory agriculture department staff may discuss owner reimbursement costs with the affected owner, noting that such payments are not guaranteed and are dependent on the National Management Group approving a Response Plan and agreeing to invoke the national cost sharing arrangements provided by the Emergency Plant Pest Response Deed.

Assess international trade impact

The Department of Agriculture Forestry and Fisheries will consider the international trade implications of the carrot rust fly incursion (if any) and notify relevant trading partners of the detection and commence any necessary negotiations for the continuation of trade. The Consultative Committee on Emergency Plant Pests members should be informed of the implications of the pest for export trade of the affected commodity.

Cost/benefit analysis

The Consultative Committee on Emergency Plant Pests will commission a cost/benefit analysis of proposed options to assist decisions on response actions. Analysis will be carried out using an agreed standard procedure (Appendix 11).

Report to the Consultative Committee on Emergency Plant Pests

The Chief Plant Health Manager(s) of the Lead Agency(s) will provide regular progress reports and other information on the carrot rust fly outbreak needed to assess the feasibility of eradication (Appendix 8).

Decision on eradication or alternative action

The Consultative Committee on Emergency Plant Pests will meet to consider the feasibility of carrot rust fly eradication (Appendix 9).

The Lead Agency(s) will provide to the Consultative Committee on Emergency Plant Pests with an updated Incursion Incident Report and any other information that will aid in determining the feasibility of eradicating the carrot rust fly incursion.

The Chairman of the Consultative Committee on Emergency Plant Pests will prepare a preliminary report to the National Management Group to enable the National Management Group to determine whether a Carrot Rust Fly Response Plan is required. The report for the National Management Group will include a recommendation to either:

- Attempt an eradication campaign.
- Continue with a containment program managed by the affected State/ Territory pending further information being obtained.
- Take no further action.

The recommendation to the National Management Group should take into account the carrot rust fly distribution, reliability of diagnostic tests, available control methods, impact on productivity and domestic/international trade, efficacy of control/containment measures and a cost/benefit analysis, among other things.

The carrot rust fly must be identified with a high level of confidence, the response must be technically feasible and a cost/benefit analysis must show that the decision to respond is economically justified.

Preparation of Carrot Rust Fly Incursion Response Plan

If the National Management Group determines that eradication is economically and technically feasible, the Chief Plant Health Manager(s) of the Lead Agency(s) will develop the Carrot Rust Fly Response Plan in consultation with the Consultative Committee on Emergency Plant Pests. Once completed, the Chief Plant Protection Officer will present the report to the National Management Group (Appendix 10).

Approve Carrot Rust Fly Response Plan and cost sharing arrangements

The National Management Group has responsibility for the key decisions relating to the Carrot Rust Fly Response Plan. The National Management Group will make the decision on whether to invoke national cost sharing arrangements to fund the eradication campaign. The government members of National Management Group will also report as necessary to the Primary Industries Ministerial Council (PIMC) in regards to the Carrot Rust Fly Response Plan. The industry representatives of the National Management Group will report to their respective industry boards.

Based on the outcomes of the Alert Phase, either the Operational or Stand Down Phase of PLANTPLAN will be activated.

Operational Phase

The Operational Phase of PLANTPLAN commences once the presence of carrot rust fly is confirmed and the Carrot Rust Fly Response Plan is implemented. The aim of the Operational Phase is to eradicate the carrot rust fly incursion.

The Chief Plant Health Manager(s) in the affected State(s)/Territory(s) implement any eradication procedures agreed to in the Carrot Rust Fly Response Plan. Depending on the extent of the incursion, most States and Territories will have minimal involvement in a Carrot Rust Fly Response Plan, beyond a delimiting survey or supply of expertise or facilities. The Lead Agency(s) plays a major role in implementation. The Lead Agency(s) will coordinate the response under direction from the Consultative Committee on Emergency Plant Pests. The Office of the Chief Plant Protection Officer will coordinate national consultation and decision making as well as any international aspects of the emergency.

The Lead Agency(s) for each State/Territory are listed on the Plant Health Australia web site at http://www.planthealthaustralia.com.au/plantplan

Refer to Table 3 below for a summary of actions that will take place during the Operational Phase.

Table 3 Actions taken during the Operational Phase
(**Bold text = Action taken,** Plain Text = Party responsible)

State functions	National functions	Industry functions
Communicate response strategy to property owner (CPHM)	**Communicate Response** (CPPO)	**Communicate Response** (Peak industry body(s))
Implement EPP Response Plan (Lead Agency)		**Implement EPP Response Plan – publicity and awareness** (Peak industry body(s) assist in implementation of agreed communication strategy)
Provide regular reports and updates to CCEPP (Lead Agency)	**Evaluate eradicate on campaign progress – report to NMG** (CCEPP)	
Down size response activities as appropriate (Lead Agency)		
	Endorse successful eradication/recommend termination of Response Plan (CCEPP)	
	Endorse successful eradication/recommend termination of Response Plan (CCEPP)	
	Decision on eradication/termination (NMG)	

NB: Some actions may occur simultaneously

The primary role of the Lead Agency during an eradication campaign will be to:

- Control or eradicate the carrot rust fly incursion in line with the Consultative Committee on Emergency Plant Pests recommendations and the Carrot Rust Fly Response Plan endorsed by the National Management Group.
- Report regularly to the Consultative Committee on Emergency Plant Pests on the progress of the eradication campaign.
- Prepare budgets.
- Enforce domestic trade restrictions, as recommended by the Domestic Quarantine and Market Access Working Group.
- Negotiate and implement treatments which allow resumption of trade under regulatory controls.

On entering the Operational Phase the State/Territory Pest Control Headquarter will be set up within the Lead Agency(s) to manage the carrot rust fly response. The State/Territory Pest Control Headquarter will evolve from the investigation team and will usually involve the investigation team members plus other members, as necessary.

A Local Pest Control Centre will be set up to manage operational activities in the restricted area. During small scale emergencies the duties of the Local Pest Control Centre may be assumed by the State/Territory Pest Control Headquarter.

Briefings for industry and government

The Office of the Chief Plant Protection Officer, in collaboration with the Chief Plant Health Manager in the affected State/Territory will prepare briefings for Australian Government, State/Territory Governments and Industry. These inform recipients of the recommended Carrot Rust Fly Response Plan, including immediate plans for quarantine action and impacts on industry productivity.

Communicate response strategy to property owner

The Chief Plant Health Manager(s) in the affected State/Territory(s) will advise affected property owners/agencies of the decision by the National Management Group to attempt eradication or any alternative action.

Media brief

Department of Agriculture Forestry and Fisheries will take responsibility for the national coordination of communication issues. As part of the communications strategy, a briefing covering carrot rust fly biology, impact, and safety issues for consumers, and quarantine response arrangements will be developed.

Use of chemicals in an emergency response

Once the Australian Pesticides and Veterinary Medicines Authority has approved the importation and use of an overseas chemical treatment (if applicable) the Lead Agency(s) will have responsibility for determining the quantity of product that will be required and for arranging priority importation if required. Any person who will be involved in the application of the insecticide will need to receive necessary training in order for them to be accredited operators.

The Manager of Chemical Standards (MCS) and State/Territory Pest Control Headquarter Operations Manager will arrange for short course training for suppliers and nominated applicators covering storage, technical information, safety, preparation, application and disposal methods, and roles and responsibilities. The Operations Manager will prepare documentation which identifies trained staff as accredited operators.

The Manager of Chemical Standards and Operations Manager in conjunction with industry experts will develop a communication strategy for the use of chemicals in the Carrot rust fly Response Plan for growers, operators and industry experts.

Implement Carrot Rust Fly Response Plan

The Chief Plant Health Manager(s) of the Lead Agency will be responsible for overall management of the Carrot Rust Fly Response Plan. This includes declaring, in the format required by State/Territory legislation, that a carrot rust fly incursion has occurred and for ensuring that the Operational Phase of PLANTPLAN is implemented.

Progress evaluation

The Lead Agency(s) will provide regular reports (efficiency audit reports and financial audit reports) to the Consultative Committee on Emergency Plant Pests both out of session and within session as agreed by the National Management Group. The Lead Agency(s) will bring all significant developments to the attention of the Consultative Committee on Emergency Plant Pests.

External reviews of the eradication campaign by the Scientific Advisory Panel will take place as determined by the National Management Group.

If key performance indicators agreed by the National Management Group in the Carrot Rust fly Response Plan are not met, the Carrot Rust Fly Response Plan will be reviewed. The review will be managed by the Consultative Committee on Emergency Plant Pests and will take into account any newly gained information that might have contributed to key performance indicators not being met. Cost/benefit factors and operational details will be reviewed to identify inconsistencies with initial predictions. Depending on the outcome, a new Carrot Rust Fly Response Plan may be developed or the response altered to become a pest management program.

A central aspect of a response to a carrot rust fly incursion is that the cost benefits and technical feasibility to attempt and continue eradication. The

Emergency Plant Pest Response Deed specifies an agreed limit on the total cost of an eradication effort. If expenditure on carrot rust fly response reaches 90 per cent of the agreed limit, the National Management Group will meet to review funding arrangements and the continuation of the response.

Downsizing of response

Towards the end of the Operational Phase, activities on infected properties, in the field, and at Local Pest Control Centre(s) and State/Territory Pest Control Headquarter(s) will begin to wind down and will require fewer resources. Managers at all operational levels will need to ensure that resources do not exceed operational requirements. The principles to remember in wind down operations are:

- A written plan must be developed.
- There must be a systematic approach.
- That operations must be official and coordinated by the State/Territory Pest Control Headquarter Director.
- Wind down operations should occur as soon as operational objectives are being achieved, rather than later.

Endorse successful eradication or recommend termination and brief National Management Group

The Lead Agency(s) will obtain endorsement from the Consultative Committee on Emergency Plant Pests that the criteria for successful pest eradication (established at the beginning of the program) have been met. In most eradication programs there will be a minimum period of time between the end of the eradication program and declaration of area freedom.

Pest free area guidelines (guidelines being developed by Plant Health Australia and will be published once formal approval has been obtained) will provide a template for this activity. The Lead Agency(s) together with industry will have carriage of the development of the Pest Area Freedom submission.

The National Management Group will formally declare area freedom based on technical advice from the Consultative Committee on Emergency Plant Pests. Based on the decision by the National Management Group, the Chief Plant Protection Officer will formally announce the decision.

Stand Down Phase

The Stand Down Phase will commence if:

- The Investigation or Alert Phases fail to confirm the presence of carrot rust fly.
- Eradication of a confirmed carrot rust fly is not considered cost/beneficial.
- The National Management Group formally declares that the emergency situation is over.

The Stand Down Phase should involve a review of the outbreak and the initiation of recovery actions (Table 4).

Detection of carrot rust fly incursion is not confirmed

When investigations conducted in the Alert Phase fail to confirm the presence of carrot rust fly, the Chief Plant Health Manager, State/Territory Pest Control Headquarter Director, and Plant Health Officers (PHOs) will notify people and agencies contacted during the Alert Phase that the threat of carrot rust fly incursion no longer exists.

All staff involved will be given the opportunity to discuss any issues that arose during or after the process.

When eradication of carrot rust fly is not considered cost/beneficial

If the eradication of a confirmed carrot rust fly incursion is not considered cost effective, efforts will move to controlling the spread of the fly, investigating long-term control methods and movement restrictions.

The relevant States/Territories will determine the appropriate strategy to be adopted.

Incident termination process

STEP 1

For each carrot rust fly incident that does not progress to a Response Plan, the Consultative Committee on Emergency Plant Pests should provide relevant and reasonable justification and advise the National Management Group either:

- That the incident does not relate to carrot rust fly or
- That the incident does relate to carrot rust fly but
  - The carrot rust fly is not capable of being eradicated or contained.
  - Eradication of the carrot rust fly is not considered cost/beneficial.

STEP 2

The National Management Group should then make their determination. The resolution should include the relevant words from STEP 1 above.

This decision can be made out-of-session.

Note that the composition of the National Management Group and The Consultative Committee on Emergency Plant Pests will usually be different for each Emergency Plant Pest, and thus all relevant parties will need to vote on this for each Emergency Plant Pest (or group of Emergency Plant Pest(s) if there is a common National Management Group).

STEP 3 Any subsequent incidents

A new incident of the same Emergency Plant Pest would again have to be considered against the criteria in the Emergency Plant Pest Response Deed.

When Carrot Rust Fly Response Plan is implemented

Following declaration of a successful eradication or termination of the response due to:

- All documents relating to the incident must be obtained and filed and all data entered into the Information Management System.
- They should include a review of the process with all involved.
- All personnel should be involved in a debrief.
- Outstanding tasks should be handed over to everyday operational positions.

Table 4. Actions taken during the Stand Down Phase
(Bold text = Action taken Plain Text = Party responsible**)**

State functions	National functions	Industry functions
Prepare report for CCEPP and DQMAWG seeking agreement that eradication has been successful (Lead Agency)	**Accept recommendation from CCEPP and declare successful eradication** (NMG)	
Review intra- and interstate quarantine arrangements (DQMAWG/Lead Agency)		
	Notify trading partners (BA/AQIS)	
Provide records of expenditure and reports to PHA (Lead Agency)		
Incident debrief (Lead Agency)	**Incident debrief** (CPPO)	

NB: Some actions may occur simultaneously

Towards the end of the Operational Phase, activities on infected properties, in the field, at the Local Pest Control Centre(s) and State/Territory Pest Control Headquarter(s) will begin to wind down and will necessarily require fewer resources. Managers at all operational levels will need to ensure that resources do not exceed operational requirements. The principles to remember in wind down operations are:

- A written plan must be developed.
- There must be a systematic approach.
- That they must be official and coordinated by the State/Territory Pest Control Headquarter Director once National Management Group has made the decision to terminate the campaign.
- They should occur as soon as operational objectives are being achieved, rather than later.

- They should include a review of the process with all involved.
- All documents relating to the incident must be obtained and filed and all data entered into the Information Management System.
- All personnel should be involved in a debrief.
- Outstanding tasks should be handed over to everyday operational positions.

Review of intra- and interstate quarantine arrangements

If the eradication campaign is unsuccessful or the Carrot Rust Fly Response Plan is terminated prior to completion, the Domestic Quarantine and Market Access Working Group will consider criteria for establishing Pest Free Areas to support national and international trade.

Notify trading partners

If the eradication campaign is successful, the Department of Agriculture Forestry and Fisheries will advise relevant international trading partners and, if necessary, negotiate arrangements to re-instate trade.

Acquittal of funds and program documentation

States and Territories will provide financial audit reports as per the requirements in Section 2.12 (Accounting for a response plan/cost analysis) of the Emergency Plant Pest Response Deed.

Funds will be released to cover costs associated with response activities and the program will be documented allowing for transparent reviews and assessments of the program. At the end of the Operational Phase, the costs of the program will be forwarded to Plant Health Australia along with supporting documentary evidence. Plant Health Australia will then calculate the contributions of affected industry and government parties under the Emergency Plant Pest Response Deed.

Incident debrief

The Chief Plant Protection Officer will coordinate a debriefing one or two weeks after the emergency is over. This will give staff, industry and others involved in the emergency response an opportunity to discuss any issues that arose throughout any phase of the response. It is essential that everyone involved in the response is included in the debriefing process.

Revise PLANTPLAN

Following the outcomes of debriefing, PLANTPLAN may require revision. Any proposed changes and reasons for change should be forwarded to Plant Health Australia.

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Web site www.planthealthaustralia.com.au.

Any proposed changes will be collated and sent to all Plant Health Australia members for endorsement.

Roles and Responsibilities for key players in an Emergency Response

Chief Plant Health Manager

- Oversee the planning and management of the eradication or control campaign in accordance with the relevant legislation, policies, emergency management arrangements and PLANTPLAN strategies and procedures, with due consideration of the economic, commercial and social implications of all actions taken.
- Arrange for urgent plant health matters not connected with the incursion to be dealt with across the State/Territory.
- Ensure that accurate and timely advice is provided to the minister, Consultative Committee on Emergency Plant Pests, the public, all departmental staff, emergency management agencies and industry.
- Assume the role of State/Territory Pest Control Headquarters Director in some emergency responses.

Specific tasks through PLANTPLAN phases

Investigation Phase

Initiate procedures to achieve confirmation of the incident. Specific tasks include:

- Developing a strategy for the disease investigation.
- Appointing a State/Territory Pest Control Headquarter Director.
- Arranging for the collection and submission of samples by the diagnostic team or Plant Health Officer (PHO) to the relevant laboratory.
- Meeting with senior staff to:
  - Define the incident and confirm investigation response.
  - Assess the incident to determine appropriate resource allocations.
- Ensuring the incident is registered on an appropriate Information Management System.
- Briefing stakeholders as appropriate, including:
  - Chief Executive Officer.
  - Minister.
  - Executive.
  - Chief Plant Protection Officer.
  - Property owner(s).

- Allocating resources and assigning a project code.
- Assessing legislative options and legal powers required to institute the controls seen as necessary.
- Planning for field activities.
- Maintaining a suitable response until the incident is fully defined and categorized.
- Determining whether to proceed to the Alert Phase of PLANTPLAN following initial diagnosis of the pest.
- Continuing to provide reports from diagnostic tests to senior management and minister.
- Providing advice, together with the plant health specialist(s), to senior management and minister on when the identity of the causal agent can be confirmed and at what point interim quarantine action should be considered.
- Seeking endorsement from The Consultative Committee on Emergency Plant Pests to proceed with the establishment of quarantine areas.

Alert Phase

Specific tasks include:

- Placing the State/Territory Pest Control Headquarter Director staff on standby.
- Placing the Local Pest Control Centre (LPCC) Controller on standby.
- Activating the State/Territory Pest Control Headquarter.
- Initiate a meeting of the Consultative Committee on Emergency Plant Pests.
- Consulting with the Communications Manager in appointing an interim media spokesperson (Department of Agriculture Forestry and Fisheries).
- Briefing industry and local governments as well as those listed in the Investigation Phase to inform them that PLANTPLAN has entered the Alert Phase.
- Coordinating chemical control, including:
    - Advising the Manager of Chemical Standards (MCS) of the incursion and the requirement for emergency use of non-approved pesticides (if required).
    - Providing the Manager of Chemical Standards with documentation on approved overseas use of actives, application rates and application methods, residues and any offsite issues.
    - Coordinating a submission to the Australian Pesticides and Veterinary medicine Authority (APVMA) including details of the pest alert, relevant overseas data on treatment, and the request for specific pesticide and specific pattern of use.

- Negotiating directly with the Australian Pesticides and Veterinary Medicines Authority to resolve any outstanding issues and communicating proposed guidelines on control of use.
- Under the guidance of the Manager of Chemical Standards, develop the necessary approvals required by State/Territory legislation and the associated audit requirements.

- Directing the State/Territory Pest Control Headquarter Director and Local Pest Control Centre Controller to assess personnel and resources required should the response be elevated to the Operational Phase.
- Notifying the Chief Plant Protection Officer within 24 hours of confirmation of an Emergency Plant Pest.
- Arrange a draft media release by the media unit.
- Ensure the Incursion Incident Report is regularly updated.
- Provide regular reports to the Consultative Committee on Emergency Plant Pests with all relevant information on the detection.
- Direct the Planning Manager to begin preparation of the Emergency Plant Pest Response Plan in accordance with the Emergency Plant Pest Response Deed.
- Ensure that professionally photographed images of the pest/damage are taken (amateur photography is rarely adequate).

Operational Phase

If the presence of carrot rust fly is confirmed and the Carrot Rust Fly Response Plan is approved, the Chief Plant Health Manager will:

- Direct that the Operational Phase of PLANTPLAN be implemented.
- Advise the relevant minister's office and departmental executive management and arrange all necessary legislative matters to initiate the eradication campaign, including:
  - Invoking any necessary regulations.
  - Proclaiming a Restricted Area (RA) and/or a Control Area (CA).
  - Invoking necessary funding arrangements through the treasury department.
- Arrange for supply of chemicals for use in the emergency response by liaising with:
  - Other States/Territories (as necessary) to identify initial quantity of pesticide required.
  - Relevant companies to arrange import within specified timeframes.
  - Australian Pesticides and Veterinary Medicines Authority to approve the importation of the chemical. and issue a permit to use it.

- Ramp up control centres.
- Ensure state employment conditions are satisfied.
- Brief persons and organisations notified under previous phases to advise them that the Operational Phase has been entered and to discuss any further actions required of them.

Stand Down Phase

The Chief Plant Health Manager will consult with the State/Territory Pest Control Headquarter Director to arrange a debrief of all staff who worked in the State/Territory Pest Control Headquarter. Depending on the scale of the response, this may include senior Department Managers and/or Local Pest Control Centre operational staff.

Note: This checklist is provided as a guide and does not contain every action that may be required in responding to an emergency/incident. The checklist is not in any particular order.

State/Territory Pest Control Headquarters (SPCHQ) Director

The State/Territory Pest Control Headquarter Director is responsible for:

- Coordinating the response to the Emergency Plant Pest incursion by the Lead Agency, including all day to day operational matters.
- The State/Territory Pest Control Headquarter Director reports to the Chief Plant Health Manager.
- Manage the eradication/control campaign in accordance with the relevant legislation, policies and PLANTPLAN strategies and procedures with due consideration of the economic, commercial and social implications of all actions taken.
- Manage the State/Territory Pest Control Headquarter.
- Provide accurate and timely advice (often via the Chief Plant Health Manager to the minister, Consultative Committee on Plant Pest Emergency, the public, all departmental staff, emergency management agencies and industry.
- Establish ongoing consultative and reporting arrangements between State/Territory Pest Control Headquarter Director and the Local Pest Control Centre.
- Act as The Chief Plant Health Manager as required.

Specific tasks through PLANTPLAN phases

Investigation Phase

Key tasks in this phase include:

- Evaluating initial reports from the Plant Health Officer.
- Sending the diagnostic team to the Suspected Premises.
- Immediately notifying the Chief Plant Health Manager, both verbally and in writing, of results from all investigations.
- Advising departmental management and relevant laboratory(s):
  - That PLANTPLAN is in the Investigation Phase.
  - Of the nature of the suspected Emergency Plant Pest.
  - Of the location(s) of the Suspected Premise(s).
  - Of any actions required of them.
- Ensuring field staff have taken all necessary steps to limit the spread of the suspected Emergency Plant Pest such as:
  - Restricting product movements into and out of the Suspected Premise by the imposition of quarantine measures.
  - Controlling the movement of people in and out of the Suspected Premise or areas.

- Arranging for decontamination of people, vehicles, machinery that have already left the premises (Appendix 6).
- Quarantining risk enterprises or locations where traces have been identified.

Alert Phase

Specific tasks include:

- Activating the State/Territory Pest Control Headquarter section managers.
- Analysing and evaluating information collected by the Plant Health Officers and ensuring this information is entered into the Information Management System.
- Beginning the preparation of an Incursion Incident Report for submission by the Chief Plant Health Manager to the Consultative Committee on Emergency Plant Pests.
- Initial development of the Emergency Plant Pest Response Plan.
- Developing proposals for personnel and other resource requirements for Local Pest Control Centre operations.
- Overseeing coordination of survey teams to:
  - Conduct initial inspections and surveys of the area to determine the extent of the outbreak.
  - Conduct trace backs to determine where the carrot rust fly might have come from and trace forward exercises to identify where the carrot rust fly might have spread (pest findings outside the affected State are to be referred to the Consultative Committee on Emergency Plant Pests).
  - Undertaking relevant consultation to determine the boundaries for any Risk Areas or Control Areas which may need to be proclaimed if the diagnosis proves positive.
- Preparing documentation/forms for the proclamation of quarantine areas in conjunction with the agencies senior legal officer.
- Notifying relevant persons that PLANTPLAN is in the Alert Phase and providing other details as listed above (all key people who would be involved in operations must ensure that they can be contacted, after hours if necessary, and can locate all plans, procedures and resources).
- Assisting, as required, the Local Pest Control Centre Controller and State/Territory emergency services in selecting a suitable site for the Local Pest Control Centre.

Operational Phase

If the presence of carrot rust fly is confirmed and the Carrot Rust Fly Response Plan approved, the State/Territory Pest Control Headquarter Director will:

- Expand the management of the State/Territory Pest Control Headquarter and appoint personnel to key positions.
- Instruct the Local Pest Control Centre Controller to establish the Local Pest Control Centre and take charge of eradication or control activities in the Restricted Area.
- Advise key departmental staff of the carrot rust fly incursion, the controls and movement restrictions on plants and plant products, vehicles and people and the potential need to provide staff to the Local Pest Control Centre and State/Territory Pest Control Headquarter.
- Liase with the Communications Section to arrange preparation of media releases, including technical information, and initiate press conferences. In some cases joint State/Territory and Australian Government media releases may need to be issued.
- Ensure key contacts (as above) are advised:
  - That PLANTPLAN is in the Operational Phase.
  - Of the nature of the pest (carrot rust fly).
  - Of the location of the Infected Premises.
  - Of the boundaries of the Restricted Areas and Control Areas and conditions that apply therein.
  - Of the location and contact details of the Local Pest Control Centre and State/Territory Pest Control Headquarter.
  - That no visits are to be carried out on premises with susceptible species within the Restricted Area unless permission has been granted by the Local Pest Control Centre Controller.
  - That urgent premises visits may be carried out in the Control Area only by taking full decontamination procedures on entering and leaving all premises.
  - That any suspicions of carrot rust fly must be reported immediately to the Local Pest Control Centre.
  - Of any actions required of them.
  - Of the name of media contacts and key spokespersons.
- Arrange for the appointment (gazettal) of interstate and other appropriate personnel as inspectors under the relevant legislation.
- Arrange for approved valuers to be appointed under the relevant legislation.

Stand Down Phase

Key tasks are to:

- Close the State/Territory Pest Control Headquarter.
- Ensure all records relating to the Emergency Plant Pest response are held securely so they are available for future retrieval.

- In consultation with the Chief Plant Protection Officer arrange a debrief for all staff who worked in the State/Territory Pest Control Headquarter (depending on the scale of the response this may include senior department managers and/or staff from the Local Pest Control Centre).

Note: This checklist is provided as a guide and does not contain every action that may be required in responding to an emergency/incident. The checklist is not in any particular order.

Local Pest Control Centre (LPCC) Controller

- Develop a detailed program for eradication, control and surveillance activities within the Restricted Area and other areas as defined by the Chief Plant Health Manager in accordance with PLANTPLAN and/or with plans determined by the Chief Plant Health Manager.
- On approval from the Chief Plant Health Manager, implement and manage the campaign in the Restricted Area (and other areas as defined) including task analysis, priority setting and resource estimation and allocation.
- Ensure that the State/Territory Pest Control Headquarter Director is advised of the progress of the program.
- Ensure that activities are technically sound, lawful and cost-effective.
- Ensure effective management of staff and resources (physical and financial).
- Monitor the progress of the campaign and obtain authorisation from State/Territory Pest Control Headquarter Director for modifications as required.
- Maintain contact with emergency service organisations, industry, the local media and relevant government departments.

Specific tasks through PLANTPLAN phases

Alert Phase

The Local Pest Control Centre Controller is activated by the Chief Plant Health Manager early in the Alert Phase. Specific tasks include:

- Coordinating the identification of likely Local Pest Control Centre sites.
- Determining likely personnel requirements.
- Ensuring relevant personnel are put on standby and the Local Pest Control Centre is scaled up to a level commensurate with the level of suspicion regarding the Emergency Plant Pest detection.

Operational Phase

If the presence of carrot rust fly is confirmed and the Carrot rust fly Response Plan approved, the Local Pest Control Centre Controller will:

- Coordinate establishment of the Local Pest Control Centre.
- Ensure an incident action plan is developed for field operations (both short term and longer term).
- Ensure State/Territory Pest Control Headquarter Director is kept up-to-date on field operations.
- Ensure an initial briefing is given to:
  - Other local managers within the department that have responsibilities inside the Restricted Area.
  - Local government (Shire Secretary).

- Appropriate industry contacts for those in the Restricted Area.
- Risk enterprise managers.

- Ensure plant health consultants, departmental district staff and key industry contacts in the affected area are advised:
  - That PLANTPLAN is in the Operational Phase.
  - Of the nature of the Emergency Plant Pest (carrot rust fly).
  - Of the location(s) of the Infected Properties.
  - Of the boundaries of the Restricted Area and Control Area and conditions that apply therein.
  - Of the contact details for the Local Pest Control Centre.
  - That no visits are carried out on properties with susceptible species within the Restricted Area unless permission has been granted by the Local Pest Control Centre Controller.
  - That any suspicions of the carrot rust fly incursion must be reported immediately to the Local Pest Control Centre and the person reporting must remain on the premises until permission is given by the Local Pest Control Centre Controller or Operations Manager or Plant Health Investigations Manager to leave.
  - Of the contacts for all media enquiries.

The Local Pest Control Centre Controller will also need to liaise with the State/Territory Pest Control Headquarter Director regarding:

- The declaration of the Restricted Area and Control Area and conditions, including produce standstill arrangements that apply in these areas.
- The contact details of the Local Pest Control Centre and State/Territory Pest Control Headquarter.
- Resource requirements and their supply (personnel and equipment).
- Any urgent tracings on and off the Infected Premises that need to be referred to the State/Territory Pest Control Headquarter.

Stand Down Phase

Key tasks are to:

- Close the Local Pest Control Centre.
- Ensure all records relating to the Emergency Plant Pest Response are held securely so they are available for future retrieval.
- In consultation with the Chief Plant Protection Officer arrange a debrief for all staff who worked in the Local Pest Control Centre (depending on the scale of the response this may include senior department managers and/or staff from the State/Territory Pest Control Headquarter).

Note: This checklist is provided as a guide and does not contain every action that may be required in responding to an emergency/incident. The checklist is not in any particular order.

Plant Health Officer (PHO)

Specific tasks through PLANTPLAN phases

Investigation Phase

Where there are grounds for suspicion of carrot rust fly incursion, the Plant Health Officer should notify the Chief Plant Health Manager of the notification, details of the premises and then:

- Check to ensure adequate supplies are carried in their vehicle (Appendix 6).
- Notify office staff where possible of intended actions and request that the investigation be kept confidential.
- Proceed to the suspected property(s).
- Examine affected plants.
- Discuss the details of the suspected carrot rust fly and the actions that will be taken with the property owner/manager.
- Notify the Chief Plant Health Manager of the outcome of the investigation and provide verbal details and ensure the following details are entered in the Information Management System:
    - The name, address and phone number of the property owner/manager.
    - The nature of the pest suspected.
    - The exact location of the suspected case(s).
    - Findings from the examination of affected plants.
    - The need for a diagnostic team to re-examine the case.
    - The need (or otherwise) for quarantine.
    - The property identification code (unique property identifier or GPS).
- Determine the need for:
    - Any urgent tracings.
    - Other assistance.
    - Decontamination procedures that may need to be arranged for people, produce, vehicles or machinery that have recently left the property (Appendix 6).

Alert Phase

In addition to the actions listed above, where there is a high level of suspicion of carrot rust fly incursion, the Plant Health Officer should:

- Quarantine or arrange for quarantine of the premises to stop the movement of plants, produce and other objects into and out of the suspect property.

- Serve or arrange to have the owner or manager served with a notice of quarantine.
- Restrict the movement of people and plants within the property.
- Arrange for boundaries to be secured so that only one gate, which can be controlled, is left as an entrance to the premises.
- Ensure they are readily contactable by phone or other appropriate means.

When the diagnostic team (if requested) arrives at the Suspected Premise, the Plant Health Officer must arrange for plants showing the full range of symptoms to be presented for examination.

Before leaving the suspected infestation(s), the Plant Health Officer should ensure procedures are in place to allow personal/family movement on and off the property for essential purposes.

When leaving the property, ensure full decontamination procedures are followed (Appendix 6).

Operational Phase

At the suspected infestation, the Plant Health Officer or delegate must act as site supervisor until relieved and consult with and liaise with the owner/manager to plan infected property(s) activities to ensure owner/manager involvement in the process. This may include:

- Reinforce the provisions of quarantine and ensure adequate property security.
- Implementing appropriate decontamination procedures (Appendix 6).
- Provide advice to the Local Pest Control Centre (or the State/Territory Pest Control Headquarter if necessary) on the resource requirements for preliminary but urgent, destruction and disposal of infected and risk plants and produce and contaminated materials.
- Make a preliminary assessment of suitable destruction procedures and locations.
- Maintain records and an accurate inventory of plants and produce for valuation purposes.
- Ensuring communications from the Local Pest Control Centre are facilitated.
- Advising the Local Pest Control Centre (or State/Territory Pest Control Headquarter if necessary) of further urgent tracings and priority nearby properties which should be visited.
- Ensuring the welfare of the personnel on the property by ensuring their short-term needs for food and other requirements are met.

Note: This checklist is provided as a guide and does not contain every action that may be required in responding to an emergency/incident. The checklist is not in any particular order.

Diagnostic Team

People collecting samples must be appropriately trained in sampling and packaging techniques and appropriate safety and decontamination procedures.

- Collect appropriate samples to ensure that a diagnosis can be made as quickly as possible.
- Ensure samples are securely packaged and transported under appropriate guidelines and protocols (Appendix 3).
- Assist with the visual evaluation of affected plants.
- Obtain an independent diagnosis.
- Ensure that chain of evidence requirements for collection of samples are satisfied (Appendix 5) – an unbroken chain of evidence must be maintained for results to be admissible in a court of law so appropriate security measures and documentation procedures must be followed at all times.
- Lodge specimens with recognised Entomology collections.

Generally the State/Territory Plant Headquarter Director will oversee the formation of the diagnostic team. The team should be briefed on:

- The name of the owner or manager of the affected property.
- The location of the suspect infestation.
- The details of the suspect pest and preliminary findings.
- Specific actions required of them.
- Quarantine and decontamination requirements for entry to and departure from the Suspected Premises (Appendix 6).
- Arrangements for the dispatch of samples for laboratory examination (Appendix 3).
- Communication arrangements.

The diagnostic team should ensure they have a clean vehicle and the following equipment:

- Adequate protective clothing, overalls, rubber boots, hats and appropriate decontamination kit.
- A previously prepared Emergency Plant Pest diagnostic kit (Appendix 3).
- Mobile communications equipment (if appropriate).
- Relevant containers and paperwork for packaging biological specimens (Appendix 3).
- Appropriate maps.

Upon arrival at the suspected infestation the diagnostic team should:

- Leave the vehicle outside the property.

- Change into protective clothing and leave street clothes in the car.
- Disinfect boots and waterproof clothing before entering the premises.
- Conduct examinations and collect samples and additional information as required.
- Ensure representative plants of each species are examined.
- Report the detection of pathological signs, pest presence and significant epidemiological information to the Chief Plant Health Manager or State/Territory Pest Control Headquarter Director
- Pack samples in sealed containers that can be effectively disinfected off the property.
- Decontaminate themselves and equipment on departure.
- Place protective clothing in sealed bags for further decontamination.
- Dispatch samples to the appropriate diagnostic laboratory approved by the Chief Plant Health Manager.
- Report findings of the investigations, including an assessment of the probability of an Emergency Plant Pest to the Chief Plant Health Manager.

Industry Representatives

Industry representatives will fulfill a number of roles at different levels, namely:

- Industry Liaison Coordinator (ILC) in the State/Territory Pest Control Headquarter.
- Industry Liaison Officer (ILO) at the regional level in the Local Pest Control Centre.
- National technical representative on the Consultative Committee on Emergency Plant Pests.
- National representatives at the National Management Group level.

Industry Liaison Coordinator

Key activities include:

- Preparing comprehensive advice on the affected State/Territory industry, including advice on its size, distribution, sources of supply, marketing practices, industry organisations and all other factors which may affect the eradication/control program.
- Providing advice on the practicality and other economic consequences of actions proposed for eradication/control purposes.
- Providing advice on plans for handling potentially contaminated material, including identifying the steps required to pick up, handle, process and distribute this material and limit the spread of infection.
- Consulting with other State/Territory industry contacts about the campaign and acting as a focus for contact with national peak industry body(s).
- Consulting with the Industry Liaison Officer at the regional Local Pest Control Centre level and the Consultative Committee on Emergency Plant Pests and National Management Group industry representatives on a regular basis.

Industry Liaison Officer (ILO)

Key activities include:

- Preparing comprehensive advice on the affected local industry, including advice on its size, distribution, sources of supply, marketing practices, industry organisations and all other factors which may affect the eradication/control program.
- Providing advice on the practicality and other economic consequences of actions proposed for eradication/control purposes.
- Providing advice on plans for handling potentially contaminated material, including identifying the steps required to pick up, handle, process and distribute this material and limit the spread of infection.
- Consulting with other local industry contacts about the campaign and acting as a focus for contact with the local industry.
- Briefing the State/Territory Industry Liaison Coordinator and the Consultative Committee on Emergency Plant Pests representative on a daily basis.

National Management Group industry representatives will be involved in national decision-making and will undertake their role according to carrot rust fly training.

Industry representatives on the Consultative Committee on Emergency Plant Pests will make recommendations about the technical feasibility of Carrot rust fly Response Plan.

Table 5. Initial Stage: Pre-confirmation of carrot rust fly

Days after initial notification	Issue	Responsibility	Action
Stage 1: **Day 1**	Notification of suspected carrot rust fly	Government field Officers, Industry field Staff Consultants Growers	● Collect information from growers on extent of symptoms, how long they have been present, insecticides and other treatments used. ● Hold specimens under secure conditions (Appendix 2). ● Arrange collection and dispatch of samples by express courier to appropriate diagnostic labs. ● Alert diagnostic laboratory(s).
Stage 1: **Initiate by Day 1 - 4**	Examination of plant symptoms, presence, of the fly and alerting appropriate authorities	Diagnostic Laboratories	● Check leaf, tap root, small roots (radicles), of the plant, confirm identification of the fly. ● Alert Chief Plant Health Manager (State) and contact national experts in regard to further identification.
	Establishment of interim quarantine Phase 1. Create response team and State Pest Control Headquarters (SPCHQ)	Chief Plant Health Manager (State)	● If the growers have already sprayed insecticides several times without success, the Chief Plant Health Manager (State) should consider establishing an interim quarantine on the affected property.
	Communication	Chief Plant Health Manager (State)	● Advise property owner and the Chief Plant Protection Officer (CPPO). ● Communicate the need to maintain confidentiality.
	Emergency use of insecticides/or herbicides on the contaminated field	Chief Plant Health Manager (State)	● Consider using herbicides to destroy the hotspot in the infected field and using insecticides to treat the rest of the field. ● Consider applying insecticides to crops on nearby

Table 5. Initial Stage: Pre-confirmation of carrot rust fly

Days after initial notification	Issue	Responsibility	Action
			properties. ● Liaise with Australian Pesticides & Veterinary Medicine Authority (APVMA) for emergency approval and / or import of additional insecticides. ● Advise State Chemical Standards of the potential for increased demand for insecticides.
Stage 1: **Initiate by Day 2-4**	Implement delimiting survey	Chief Plant Health Manager (State)	● Experienced entomologist and quarantine personnel to survey associated and neighbouring properties. ● Record samples and field site details. ● Send new samples to diagnostic laboratories.
	Establishment of interim quarantine Phase 2	The Chief Plant Health Manager (State)	● Establish interim quarantine on property. ● Inform and counsel owners of property under interim quarantine. ● Commence planning for establishment of official quarantine zones and additional field surveys in other carrot growing districts.
	Database systems	State Pest Control Headquarters	● Develop appropriate systems for recording survey and sample details for data entry and retrieval. ● Develop information packages for users.
	Information for management and industry	State Pest Control Headquarters	● Update Senior Management at the State level, the Chief Plant Protection Officer, and selected carrot industry leaders (including organic producers).

Table 5. Initial Stage: Pre-confirmation of carrot rust fly

Days after initial notification	Issue	Responsibility	Action
			● Prepare briefings for Government and Industry leaders. ● Communicate the need to maintain confidentiality.
	Interim funding	Chief Plant Health Manager (State) Executive State Department of Agriculture	● Develop an interim budget for quarantine action until cost sharing arrangements are approved.
	Chemical control Strategies	State Pest Control Headquarters	● Confirm approvals for temporary registration (APVMA) and emergency use of insecticides (State Agencies). ● Apply new preventive insecticide programs to nearby properties in the same district.
	Media liaison	Department of Agriculture Fisheries and Forestry (DAFF)	● Respond to requests from media and avoid disclosing site location until the outbreak is confirmed.
	Contact Australian and overseas experts, arrange visits	State technical advisors	● Established experts to be contacted.

Table 6. Second Stage: Confirmation of carrot rust fly

Time	Issue	Responsibility	Action
Stage 2: **Day 5**	Communication of new information on detection of the carrot rust fly (when available)	State Pest Control Headquarters	**Negative result: The fly is not carrot rust fly** ● Suspend operations. ● Remove quarantine on property. ● Inform Senior management, CPPO and industry leaders. ● Cancel international experts. **Positive result: The fly is carrot rust fly** ● Implement new insecticide programs. ● Begin surveying within 5 km radius surrounding the out-break. ● Define high risk quarantine zones (consider controlling movement of plant material, soil, implementing on-farm biosecurity measures and restricting movement of machinery). ● Consider implementation of a 10 km risk zone around infested properties. ● Inform property owner/agencies of new results, arrange professional counselling. ● Prepare briefings for the State carrot industry leaders, Senior Management and CPPO on latest results. ● The organic vegetable industry will have to be taken into consideration when implementing any chemical management plans.

Table 6. Second Stage: Confirmation of carrot rust fly

Time	Issue	Responsibility	Action
Stage 2: **Initiate by day 5**	Assemble survey teams	State Pest Control Headquarters	● Provide details of outbreak and briefings to leaders, assemble survey teams and associated resources. ● Communicate the need to maintain confidentiality.
	Information for State and Commonwealth governments	CPPO, State Pest Control Headquarters	● Convene meeting of Consultative Committee on Exotic Plant Pests and Diseases (CCEPPD), circulate summaries and maps of the outbreak situation. ● Confirm proposed arrangements for overseas experts if needed.
	Implementation of official quarantine surveys	State Pest Control Headquarters	Assemble and brief quarantine alert teams, commence survey and sampling protocols. ● Adhere to strict hygiene protocols (Appendix 6). ● Map symptoms at affected sites. ● Trace back/forward to identify properties at risk. ● Review and adjust quarantine zones. ● Diagnostic testing of samples from survey.
	Implementation of official survey to confirm pest free areas	State Pest Control Headquarters	● Plan and commence targeted surveillance of production districts not implicated in the initial outbreak to confirm their area of freedom for national and international trading issues. ● Adhere to strict hygiene protocols.
	Decisions: ■ Eradication or containment	Consultative Committee on Emergency Plant Pests (CCEPP) including industry	● Results of diagnostic, distribution of the carrot rust fly. ● Consensus on establishment of the area of the quarantine zone.

Table 6. Second Stage: Confirmation of carrot rust fly

Time	Issue	Responsibility	Action
	■ Funding for eradication ■ Controls on national and international trade ■ Compensation ■ Communication	representatives and Domestic Quarantine & Market Access Working Group (DQMAWG)	● Confirmation of either initial eradication or containment strategies. ● Cost benefit analysis of proposed action to assist decision on cost sharing. ● Impact on international trade. ● Planning and implementation of initial intra - and interstate controls on movement of carrots. ● Commissioning of survey to define pest free production areas. ● Briefing papers for Primary Industries Standing Committee (PISC) and Plant Health Australia (PHA) incorporating approvals for initial cost sharing (pending consensus on eradication) and arrangements for compensation (consultation with PHA). ● Establish, contact and organize visit by overseas specialists if need be. ● The organic vegetable industry will have to be taken into consideration when implementing any chemical management plans.
Stage 2: **Initiate by Day 6**	Communication of response strategy to property owner	State Pest Control Headquarters	● Affected properties owner(s)/producer(s) advised of decision to eradicate or contain. ● Comprehensive explanation of intended survey and response action. ● Option of marketing carrot and arrangements for compensation.

Table 6. Second Stage: Confirmation of carrot rust fly

Time	Issue	Responsibility	Action
	Briefings for State and Commonwealth government	Chief Plant Health Manager (State) CPHM	● Synchronised briefings for State and Commonwealth Government, PHA, incorporating recommended Government response.
	Briefing for Industry	Chief Plant Health Manager (State) CPHM	Briefings for carrot industry representatives on: ● Current situation particularly immediate plans for quarantine action (survey, destruction, insecticide treatments, movement controls). ● Impact on national and international trade.
	Information for media	Chief Plant Health Manager (State) State Pest Control Headquarters	● Development and release of briefing for media covering carrot rust fly, impact, quarantine response, safety issues and consumers.
	Confirm plan for eradication response (killing of infected crop and adjacent buffers)	State Pest Control Headquarters	Carrot growing districts and other host plants: ● Collect plants and destroy on quarantine approved sites. ● Spray with new insecticide program as a preventive measure. ●The organic vegetable industry will have to be taken into consideration when implementing any chemical management plans. Home gardens: ● Destroy all infested plants, bag and carefully remove for disposals at approved refuse site.

Table 6. Second Stage: Confirmation of carrot rust fly

Time	Issue	Responsibility	Action
			● Disinfestation of equipment and machinery.
OR containment response			
	Containment response (selective removal of hot spot, treatment of neighbouring crops)	State Pest Control Headquarters	● Arrange machinery for spraying and harvesting of infected plants and their destruction (on quarantine approved sites). ● The organic vegetable industry will have to be taken into consideration when implementing any chemical management plans.
	Media briefing	State Pest Control Headquarter	● Preparation of briefing for media on eradication protocol including technical justification.
Stage 2: **Initiate by Day 7**	Review infrastructure, facilities and operations	State Pest Control Headquarters	● Review arrangements for courier, labelling systems for samples and data processing, databasing and data retrieval. ● Refine operational and resourcing of the quarantine measures. ● Confirm Headquarters for management of operation. ● Develop and refine financial management system. ● Provide daily briefings for overseas experts. ● Summarise available information for meeting of CCEPP. ● Visit properties to review field operations. ● Maintain professional counselling for owners of affected properties.

Table 6. Second Stage: Confirmation of carrot rust fly

Time	Issue	Responsibility	Action
	Program for arrival of overseas experts if need be	Chief Plant Health Manager (State)	● Review of diagnostic results, of plant eradication, containment, and of survey protocols. ● Meet with government, industry representatives, and CCEPP. ● Provide report and recommendations.
Stage 2: Initiate by Day 7	Prepare data for Primary Industry Standing Committee (PISC) paper for discussion by CCEPP	Chief Plant Health Manager (State/Territory)	Summarise: ● The number of infested properties and the number of not surveyed properties. ● The survey on pest free areas. ● The progress of eradication/containment action. ● The budget. ● Trade restrictions. ● The Information on cost benefit analysis.
Stage 2: Day 8	Draft PISC paper Chief Plant Protection Officer	Plant Health Manager (State)	● Circulation to CCEPP and Domestic Quarantine and Market Access Working Group.
Stage 2:Initiate by Day 9	Further diagnostic results	Chief Plant Health Manager (State)	● Summaries results of comprehensive diagnostic tests forwarded to CPPO and CCEPP. ● if positive proceed as planned. ● if negative proceed to wind back.
	Third meeting of CCEPP	CCEPP and Domestic	● Consider the latest diagnostic results and the extent of quarantine zones.

Table 6. Second Stage: Confirmation of carrot rust fly

Time	Issue	Responsibility	Action
		Quarantine & Market Access Working Group	● Consider recommendations from cost benefit analysis. ● Consider issues for establishment of Pest Free Areas for national trade. ● Report on impact on international trade. ● Consider PISC paper, especially cost sharing recommendations. ● Ensure communication with PHA. ● Develop paper for peak industry. ● Recommend options for compensating growers.
Stage 2: **Initiate by Day 10**	Implementation of recommendations from CCEPP	CPPO Chief Plant Health Manager (State)	● PISC paper circulated to States. ● Conference call of Domestic Quarantine and Market Access Working Group to consider development of protocols for interstate trade. ● Meeting convened with industry to advise on situation and future action.
Stage 2: **Initiate by Day 11**	On going implementation of program	State Pest Control Headquarters Industry body	Bi-weekly meeting of State Pest Control Headquarters to review the following: ● On going surveying and trace-backs. ● Diagnostic results. ● Re-inspection of quarantine zones. ● Movement control of carrots, other host plants, machinery and staff.

Table 6. Second Stage: Confirmation of carrot rust fly

Time	Issue	Responsibility	Action
			● Communication to government, industry and media. ● Compensation issues. ● Trouble shooting. ● Financial management. ● Headquarters inspection. ● Counselling.

Table 7. Final Stage: Stand Down

Issue	Responsibility	Action
Report to CCEPP and DQMAWG	State Pest Control Headquarters Industry body	● Prepare a report CCEPP and DQMAWG seeking agreement that the program has been successful.
Review intra- and interstate quarantine arrangements	DQMAWG and State Pest Control Headquarters	● Review and adjust quarantine zones.
Incident debrief	CPPO, State Pest Control Headquarters	● Convene meeting of Consultative Committee on Exotic Plant Pests and Diseases (CCEPPD), circulate summaries and maps of the outbreak situation. ● Confirm proposed arrangements for overseas experts if needed.
Implementation of long term control measures	DQMAWG and Industry bodies	Meeting of DQMAWG and Industry bodies to review the following: ● On going surveying. ● Areas of Freedom. ● Trade Barriers. ● Chemical Strategies. ● Management Strategies.

Table 8 Government Contacts

STATE AND TERRITORY: the Domestic Quarantine and Market Access Working Group (DQMAWG)	
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CERTIFICATION SERVICES WORKING GROUP	
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Risk Mitigation Measures, Quarantine Zones and Movement Controls

National Quarantine Review

Import conditions for carrots

Fresh and unprocessed carrots are considered high risk and are permitted entry into Australia under strict import conditions.

These conditions include:

- Issuing of import permits prior to importation.
- Inspection regimes prior to importation which check for freedom from live insects, fly, disease symptoms, contaminant seeds, soil and other debris prior to arrival in Australia.
- Appropriate plant packaging material.

Currently, as a standard procedure, there is a 600-unit inspection for carrots from New Zealand, the only country exporting carrots to Australia.

Additional information on the most up-to-date import conditions for carrots is available on the AQIS web site (www.aqis.gov.au).

Import conditions for agricultural machinery

- For new agricultural machinery there are no restrictions to import into Australia
- Second-hand agricultural machinery including used spare parts, can only be imported into Australia from Canada.

  An import permit is required.

  In the permit should include a history of the machinery's use over the past three years and a phytosanitary certificate issued by the Canadian agricultural authorities, certifying that the machine is clean and of Canadian origin.

  There is a specific list of inspection points on each machine which must meet criteria before the permit is issued. A similar inspection is conducted on arrival of the machinery and/or parts in Australia.

  Entry will be denied should the machinery and parts fail any of the risk criteria. If the machinery is considered unsatisfactory, it will be re-exported.

  Additional information on the most up-to-date import conditions is available on the AQIS web site (www.aqis.gov.au).

Potential entry pathways for carrots and other host plants

Carrots entering Australia other than by the methods described above is an illegal import and if detected, action will be taken.

The quarantine barrier program that screens arrivals from overseas, both by air and sea, is by far the largest AQIS activity. Since 2001, the Australian Government, through AQIS, has dramatically increased quarantine intervention programs which include new detection procedures and methods. The program delivers levels of inspection between 80% and 100% of all arrivals, depending on arrival loadings. Screening methods include:

- Arrival declarations- this is a legal document that is signed by every one on arrival and sets up the non-compliance penalty system.
- Targeted flight - flights arriving from some destinations are considered high risks and 100% inspection applies.
- Passenger profiling - people who have defaulted on quarantine requirements in the past are targeted for inspection.
- Sniffer dogs - trained to detect animal and plant material in luggage and on the people.
- X-ray - all luggage and packages may be subjected to screening on arrival.
- Visual inspection all luggage and packages may be subjected to open inspection on arrival.

Other potential entry pathways for carrot rust fly are on illegal carrots carried across by boat traffic between northern Australia and Indonesia and PNG. It is particularly important for the travelling farming community to comply with all requirements and requests from our quarantine authorities.

Diagnostic testing capabilities

The need to develop diagnostic capabilities and training programs in carrot rust fly identification for departmental staff is a priority to improve the diagnostic capabilities.

The development of standard protocols for identification of carrot rust fly for incursion purposes, and the third party providers of technical information to industry stake-holders within all States and Territories are important.

It will then be possible to implement simple, on-farm protocols for the identification of carrot rust fly. To support this national initiative, additional funding must be made available for the overseas training of a suitable specialist.

Pre-incursion national surveys

Surveys enhance prospects for early detection, minimise costs of eradication. And they are necessary to meet the treaty obligations of the World Trade Organization (WTO) SPS agreement with respect to the area freedom status of Australia.

With the specific climatic conditions required for carrot rust fly to occur, and of the limited occurrence of the pest in carrot districts of Australia a national survey is considered to be too costly for the likely return to industry and government. A more cost-effective approach would be to concentrate on the areas of the country where outbreaks are more likely to occur.

Carrot and other host growing property owners/managers, non-commercial growers and the community can assist in reporting new or unusual animals, diseases, insects and weeds. Sample kits and identification aids for exotic threats are required for use by commercial growers and agri-business.

State/Territory Review

Quarantine justification

All States and Territories have quarantine legislation in place to control the import of plant material and to manage incursions if and when necessary. The Domestic Quarantine and Market Access Working Group (Table 3) meets regularly to review responses to specific pest threats and incursions and to develop acceptable additional legislative controls or required changes to legislation for individual States and Territories.

Treatment response

Insecticides are already registered in Australia for the treatment of the existing pests in carrots and other host plants. There is however a need to develop a suitable program for the use of insecticidal treatments which would inhibit the potential development of carrot rust fly (protective program).

In order to be better prepared for any outbreak, it would be prudent to make application to the appropriate National and State bodies on behalf of the national carrot industry, for label extensions. Label extensions would allow for prompt, effective action should carrot rust fly be detected. These extensions should:

- Firstly, include insecticides that are registered in Australia, but not registered for use on carrots.
- Secondly, insecticide that are registered for use on carrot, but not for carrot rust fly control.

These latter insecticides have proven effective in overseas treatments of carrot rust fly.

On-farm biosecurity/hygiene plan

The greatest risk of spreading pests between properties is when propagation material, people, machinery and equipment move from farm to farm and from region to region.

It is the responsibility of the owner/manager of each property to ensure these risks are minimised. It is in the interests of the industry to encourage and manage risk at the farm level, as this will reduce the probability of an incursion and increase the probability of early detection. This should in turn reduce the likelihood of a costly incident response, thereby reducing costs to government, industry and the community. An on-farm biosecurity plan presents guidelines for general issues related to carrot and other host plants hygiene management.

Another generic on-farm biosecurity plan to minimise the risk of the introduction and spread of any pest and diseases has been published by HortGuard for the carrot industry in Western Australia. On-farm biosecurity/hygiene should be incorporated into routine operations of all farm owners and their staff.

The following issues are specific to carrot rust fly and should be added to any carrot grower's farm hygiene plan:

- Knowledge of the occurrence of carrot rust fly and its relevance to particular paddocks of a property and district.
- The ability to accurately diagnose carrot rust fly and access to late printed information.
- The training of staff in on-farm monitoring for suspect carrot rust fly infestations in all areas of the farm.
- Understanding of control strategies related to the use of particular insecticide regimes.
- Ensuring that all staff are adequately trained in the correct use of insecticides and in the maintenance of equipment and records.
- Confidence in the reporting of chemical treatment program to the authorities and level of support/compliance to associated quarantine issues.
- Willingness to undertake regular farm inspections.

Quarantine Action Responses

Availability of control methods

The available control methods for carrot rust fly outbreaks are listed below and all or some of these methods may be deployed:

- Quarantine and removal controls.
- Elimination of the source by the destruction of infested plants and host plants within a determined buffer zone.
- Insecticide treatments for the containment of the pest.
- Decontamination of all machinery, vehicles, tools, bins and personnel.
- Long term rotations for host plant material on infested sites.
- Soil treatments.

Course of action

The extent of the quarantine actions taken will depend on the location of the outbreak to the carrot production areas of any State or Territory while the suggested quarantine action radii are based on overseas experience in attempts to control the spread of carrot rust fly.

Climatic events that are associated with carrot rust fly infestations and spread in Australia are less adequate than those which occur overseas. These factors may be considered by industry and government when reviewing the quarantine radii for outbreaks of carrot rust fly.

There is a need to demonstrate an active approach to containment and/or eradication to protect and maintain current market access for carrot exported from Australia.

Proposed quarantine action radii and response following detection of carrot rust fly

- Immediate quarantine of the affected property by an authorized inspector under the appropriate State/Territory Plant Protection Act.
- Declare the “quarantine area” within 20 km of the detection site, restricting movement of host material and other implements, appliances and other things that have been in contact with the host material within and out of the quarantine area without approval from an authorized officer.
- Delimiting surveys within the 20 km quarantine area concentrating on movement tracing from the infested and associated properties.
- Delimiting surveys within the carrot production areas of the State or Territory.
- Implement new insecticide programs on all growing crops within the quarantine zone.

- Harvesting and destruction plants at an approved site from infested properties.
- Consider implementing long term crop rotations.
- Restrict soil movement from properties.

Home gardens

The treatment and removal of affected host plants from home gardens will need to be considered especially those of farm field staff associated with affected properties:

- Affected carrot and other host plants will need to be removed, bagged, sealed and transported for destruction at an approved disposal site.
- Check compost heaps for root regrowth and remove if necessary.
- The application of insecticide treatments should be applied to unaffected hosts in gardens of associated staff as a preventive measure.
- Community and local council gardens should be inspected for affected hosts and removal if necessary.
- Bags of plant material should be transported in sealed trucks to approved sites.
- Replacement produce to home occupiers should be considered by industry and government.

Recommendations

The recommendations for minimising the chances of carrot rust fly entering and becoming established in Australia and minimising the damage to industry if this were to happen are as follows:

- Increase awareness of quarantine recommendations for growers travelling overseas.
- Apply for label extensions on current insecticides not registered for carrot rust fly and apply for registration of new chemicals that are currently being use overseas.
- Consider funding support for crop eradication if an incursion was to occur.
- Increase diagnostic capability within Australia for more rapid identification of carrot rust fly.
- Industry to review quarantine action plans and surveys on a regular basis.

Technical Information for Planning Surveys

Adults emerge from overwintering puparia in September in New Zealand and are abundant until the following May. Females lay their eggs on or near the crowns of young carrots. Eggs are laid from September to May and take 7-14 days to hatch. Larval development takes 4-6 weeks, and the pupal stage lasts 2-4 weeks. A full generation may thus take 7-12 weeks to complete, which allows up to four generations a year to occur in some parts of the country. Peak flights of carrot rust fly adults in the Auckland area have been recorded in mid October, late December, mid February, and mid April. The insect normally overwinters either as larvae in roots or as pupae in the soil, though a few adults may survive the winter too (Smith & Charles 1998).

Dispersal

Natural

Adults are weak fliers, but wind does appear to play a role in their dispersal. Finch and Collier (2004) described a method for studying the neighbourhood (dispersal) movement of pest insects. The method has been developed using the carrot fly (*Psila rosae* Fab.) as the experimental insect. This method suggested that when carrot rust flies move to find new crops, the population moves about 100 m/day. The findings also indicated that, provided carrot flies are well-established in the locality and the weather remains favourable at the times of year critical for larval establishment (Finch & Vincent 1996), then it is possible to buildup a large carrot fly population in just 3 years.

Humans

There is considerable risk of the species being carried as larvae in root crops. There is also the possibility of transferring pupae in infested soil.

Recommended survey methods after a detection of a carrot rust fly

The systematic approach to crop survey methods will form the practical basis for locating the extent of the incursion, while equally important defining the remaining pest free areas.

Three survey intensities set out below are considered necessary to adequately cover these important factors:

- For contact premises within the 5 km Control Area (CA) and of the infested site and associated properties beyond the CA considering trace back/forward material and machinery movement.
- Beyond the 5 km CA and within 20 km of the incursion designed as delimiting and area freedom surveys.
- Beyond 20 km of incursions and designated as area freedom surveys.

Surveys must be robust and designed to meet the international guidelines as described in

- The International Sanitary and Phytosanitary Measure (ISPM 6. 1997) - Guidelines for surveillance (FAO 2007a).
- The International Sanitary and Phytosanitary Measure (ISPM 4. 1995) - Requirements for the establishment of pest free areas (FAO 2007b).

International Sanitary and Phytosanitary Measures are developed by the International Plant Protection Convention (IPPC) and recognised by members of the World Trade Organisation (WTO).

By using this international process market access may well be protected.

Proposed survey criteria

All carrot paddocks and other host crops within 5 km of a site infected with carrot rust fly and associated properties beyond 5 km from an infected site including farm staff home gardens.

Survey to include visual inspection of:

- All carrot and other host plants paddocks.
- Carrot and other host plants cull heaps or dumps.
- Plants in greenhouse crops

All carrot paddocks and other host crops between 5 and 20 km of a site infected with carrot rust fly

Survey to include visual inspection of:

- All carrot and other host plants paddocks.
- Carrot and other host plants cull heaps or dumps.
- Plants in greenhouse crops.

All carrot paddocks and other host crops beyond 20 km of a site infected with carrot rust fly other carrot districts of the State or Territory

Survey to include visual inspection of:

- All carrot and other host plants paddocks.
- Plants for all paddocks less than 4 ha **or** every 20 rows for paddocks greater than 4 ha.
- Carrot other host plants cull heaps or dumps.

Control treatments

The host range of the carrot rust fly extends to 121 different plant species, all in the Apiaceae family. Insecticides have limited effectiveness against carrot rust fly, due to the behavioural patterns of the pest (Dufault & Coaker 1987). Carrot rust fly females spends most of their time in the periphery of the fields, flying into the field to lay eggs at the base of the carrot plants, and then leaving the field. After hatching, the larva moves down into the soil to feed on the carrot and eventually pupates in the soil. When the adult emerges from the pupal case, it flies to the periphery of the field. This behavioural pattern leaves only limited opportunities for control with insecticides. The pest is commonly controlled in conventionally-grown crops by the application of insecticide granules (phorate or diazinon) in or near the row at the time of sowing (Sivasubramaniam et al. 1999).

Several insecticides are used (overseas) for control of carrot rust fly including 1st generation pyrethroids (e.g. cyfluthrin, pyrethrin and tefluthrin (Force)), seed treatment carbofuran (eg Yaltox, Rampart), or carbosulfan (eg Marshal) to give initial control. Control can also be achieved by the use of lambdacyhalothrin (Hallmark, Hero) just prior to adult emergence and continued while necessary, or until the permitted number of applications have been made. In general, pyrethroids do not appear to be effective against eggs and larvae, but do reduce adult populations with continual broadcast spraying.

There are various cultural control techniques recommended to minimize the extent of damage inflicted on the crop by carrot rust fly.

- Physical barriers, crop monitoring, crop rotation, late seeding to avoid the damage from the first generation, and avoidance of growing carrots in sheltered areas are the most commonly practiced cultural controls. Commercial growers who use these techniques often have no need for insecticides. However, in home gardens and on farms where crop rotation is limited and where sheltered areas are common, extensive damage by carrot rust fly is inevitable without the protection from insecticides (Hooper 1997).
- In Denmark the fungus *Entomophthora muscae* (Zygomycetes: Entomophthorales) (E. Cohn) G. Winter, 1856 is an important mortality factor for adult carrot rust fly in the field. The effect of infection by *E. muscae* on carrot rust fly is the disturbance of the egg-laying behaviour of the female flies, which resulted in abnormal oviposition instead of the normal deposition near the food plants (Eilenberg 1987).

- Breeding resistant crops has been highly successful in the control of carrot rust fly. Crosses made between commercial carrot varieties and *Daucus capillifolius*, a resistant wild *Daucus* species produced highly resistant 'carrot-like' lines. These lines have been developed by seed companies. Prior to this development, the levels of resistance were being raised at Wellesbourne (Horticulture Research International, Wellesbourne, Warwick, UK) by about 1% per year, whereas the seed companies raised the levels from 60 to 70 % in less than 3 year (Finch & Collier 2000).
- Intercropping with lucerne (*Medicago littoralis* Rohde ex Lois.) as a management strategy for carrot rust fly was studied in Sweden. Results of these experiments showed that damage caused by carrot rust fly were always lower in intercropping systems (Rämert & Ekbom 1996).
- The Agricultural Research Center of Finland has introduce a forecasting and warning service to meet the needs for IPM and to allow an effective flow of information between researches, advisers and farmers. The systems use modern information technology such as geographical information systems (GIS) and AGRONET/INTERNET services. Although the service may provide suggestions on control methods, the farmer makes the final decision about the need of pest control and the choice of control methods (Tiilikkala & Ojanen 1999). The carrot rust fly is a major pest of carrots, but also may infest parsnips, turnips, parsley, and celery. Hemlock, a related weed species, is known to be a host plant also. Damage to carrots is caused by larvae burrowing into the taproot. Young plants wilt and may die, but more often the plants are stunted temporarily and the carrots become bulbous and forked. In addition, fungi and bacteria may invade the damaged tissue and cause severe rot at the crowns of the plants. On parsnips and celery, larvae more commonly are found nearer the crown, and may burrow into the base of leaf stalks.

Availability of carrot rust fly insecticides in Australia

No insecticides are registered for carrot rust fly control in Australia, due the nature of the pest (exotic pest). But a number of insecticides used for control carrot rust fly overseas are registered in Australia include Temik (a.i. Aldicarb), Dupont Vydate (a.i. Oxamyl), Nemacur (a.i. Fenamiphos), Telone (a.i. 1-3,Dichloropropene), Basamit (a.i. Dazomet) and Furadan®100G (a.i. 100 g/kg of Carbofuran).

Insecticides such as Thimet® 100G Systemic granular insecticide (a.i. 100 g/kg of Phorate), Umet®100G systemic soil granular insecticide (a.i. 100 g/Kg of Phorate), Umet®100G systemic soil granular insecticide (a.i. 100 g/Kg of Phorate), Zeemet® 200G systemic soil granular insecticide (a.i. 200g/Kg of Phorate), Nufar Thimet® 100 G and Nufar Thimet® 200G Systemic granular insecticides (a.i. 100 and 200g/kg of Phorate) have on their lebels a recommendation for carrot fly in all states of Australia.

Marshal® 250ec insecticide (a.i. 250 g/L of Carbosulfan), Diazol® 800 (a.i. 800 g/L of Diazinon), Barmac Diazinon® Insecticide (a.i. 800 g/L of Carbosulfan are used overseas to control carrot rust fly.

Destruction of affected crops

Where it is decreed that a crop affected with a carrot rust fly must be destroyed. The crop should be harvested and deep-buried at an approved burial site. Strict hygiene protocols must be followed.

Macerate or mash with heavy equipment, then deep bury at an approved site. Strict hygiene protocols must be adhered to.

Clean all equipment and clothing that has been in the field thoroughly, ensuring that the water is contained and can be treated with a disinfectant after cleaning is complete.

An infected crop

In the initial stage of an incursion response (pre-confirmation), all infected carrots should be rapidly destroyed with a fast-acting herbicide and the surrounding crop(s) protected with insecticide. If the diagnosis is positive (post-confirmation), the whole crop and a 150 m buffer zone of adjacent carrot crops should be destroyed rapidly with herbicide. This should be followed with harvesting and deep burial of the tubers at an approved site. Soil movement must be minimised, and strict hygiene protocols adhered to.

Appendix 1: Farm Biosecurity/Hygiene.

General

- The general risk of spreading pests and diseases on potato farms is when propagation material, people, machinery and equipment move from property to property and region to region.
- It is the responsibility of the owner/manager to ensure biosecurity standards are undertaken on the property to reduce individual property risk.
- Each property to undertake a biosecurity/quarantine education and training program for their employees and related personnel.
- Each property to undertake an effective monitoring/pest management program.
- Each property to erect informative signs at the entrance of the property that outline basic biosecurity requirements.
- Each property to report suspect plants/pests/diseases to the Department of Agriculture of their respective State/Territories for identification. Failure to do so may lead to imposition of a fine under the various Plant Protection Acts in the State/Territories.
- Vehicle movement around the property is to be to a minimum (especially when the soil is wet).
- Include farm biosecurity in quality assurance systems.

Importation of carrot material

Carrot plant material must be brought into Australia through quarantine. Failure to do so jeopardises the industry and may lead to prosecution under the Plant Diseases Act of States and Territories.

State carrot material

Purchase carrot seed material that has been grown and prepared with the aim of minimising the spread risk of pests and diseases to the area.

Carrot Industry Biosecurity Plan

Carrots are often moved from one region to another. Some guidelines to minimise pest and disease spread are:

- The property from which produce is to be taken and transported to another property or region for processing should maintain an effective monitoring/pest management program..
- All properties supplying produce should have access to high-pressure wash down facilities associated with a concrete or tarmac pad. It is preferable that this facility be located on the property. If the facility is not on the property then it should be in close proximity to the property

and definitely within the region from where the produce is being supplied.

- When new pest and disease outbreaks are likely all waste emanating from the produce, should not be disposed of in the growing area but should be taken to a site at least 100m from the nearest carrot plant.
- All waste emanating from the produce may alternatively be hot composted.
- Trailers, crates and bins must be cleaned of all soil and vegetable matter before being taken onto a property. They should also be cleaned to remove soil if they are transporting produce to another property or region.
- The water and soil from cleaning should not go into the property or the property irrigation water supply but away from the property and irrigation water supply.
- To avoid a chemical residue issue all property personnel undertaking spraying activities should complete the "Farmcare – chemical user's course" http://www.atpl.net.au/2/itemdetail.aspx?piid=10688. All property spray operations should be recorded into a spray diary and accompany each consignment of produce. All properties should contact their local re-seller, chemical company, or the Department of Agriculture if they are unsure about chemical residues.

People movement

- All persons entering the property should have a clear view of the informative signs to the entrance of the property that outline the property's basic biosecurity requirements (e.g. not to wander through the plants without prior approval).
- All visitors to the property should park their cars in an area designated specifically for this purpose or remain on farm roadways.
- All employees should have a designated parking area.
- All employees should be transported around the property in vehicles based permanently on the property.
- All visitors and employees should be made aware of the importance on ensuring their footwear and clothing are free from any 'loose' dirt and vegetable matter if they have been amongst the plants before leaving the property.
- All properties should provide washdown facilities (e.g. scrubbing brushes and footbaths) for persons entering or exiting the property.
- The water and soil from this wash down facility should not go into the property or the property's irrigation water supply, but away from the property and irrigation water supply.

Machinery and equipment (AQIS)

There are some restrictions imposed on machinery and equipment from interstate or overseas. If there is any uncertainty contact, Australian Quarantine and Inspection Services for information on importing machinery and spare parts into Australia
Phone: +61 2 6272 3933
(http://www.daffa.gov.au/aqis).

- Small items of equipment (e.g. hand post hole rammers) should be cleaned of all soil and vegetable matter before being taken into and leaving a property.
- All equipment and tools used on a property should be washed down with high pressure to remove soil and vegetative matter on a concrete or tarmac pad before the truck leaves the property. If there is no wash down facility on the property then it should be in close proximity to the property and definitely within the region from where the machinery and equipment is being moved.
- Water from the wash down should not go into the property or the property irrigation water supply but away from the property and irrigation water supply.
- All property owners/managers should visually inspect machinery or equipment before it comes into their property to ensure it is in accordance with their biosecurity standards and access should be denied if it is not in accordance with their standards.

Appendix 2: Laboratory Standards

These laboratory standards are designed for laboratories dealing with Emergency Plant Pests (EPP) during an emergency response.

Communication during an emergency response

During an emergency response, the following lines of communication will be used by laboratories and control centres. Results from initial and confirmatory diagnostic tests may only be disclosed to the Chief Plant Health Manager (CPHM) of the Lead Agency.

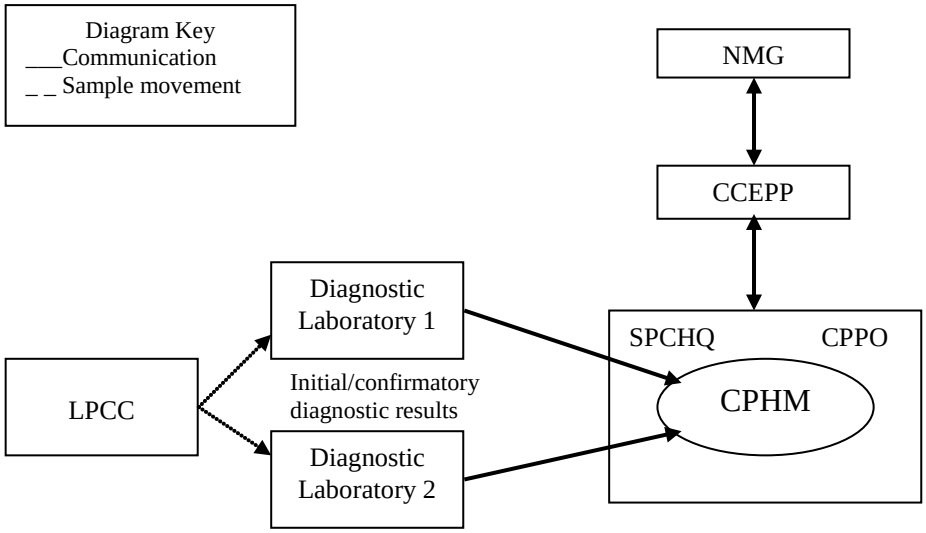

Figure 1 - Lines of communication for diagnostic laboratories during an emergency response.
**__Note__: Only the CPHM and CPPO will have contact with the media and public (i.e. growers, industry etc.).*

Acronism used in the figure 1

CCEPP	Consultative Committee on Emergency Plant Pest
CPHM	Chief Plant Health Manager
CPPO	Chief Plant Protection Officer
LPCC	Local Pest Control Centre
NMG	National Management Group
SPCHQ	State/Territory Plant Headquarter

Standard operating procedures

It is essential that each laboratory has documented standard procedures that ensure biological security during normal operation. Manuals containing these procedures should be readily accessible to all laboratory staff at all times. These standard procedures form a sound basis for any special measures required during the carrot rust fly outbreak.

Basic standards for laboratories

Laboratories handling suspected carrot rust fly samples will be either Class 5.2 (Quarantine Containment Level 2) Quarantine Approved Premises (QAP), as appropriate to the pest in question.

Quarantine Containment Level 2 (5.2 Class) laboratories are used for work on biological materials including micro-organisms, animals and plants (and their products) that pose a risk of causing disease in animals, plants and humans, but are unlikely to be a serious hazard to facility workers, the community, livestock, or the environment. The facility must include all laboratory design and construction requirements to meet PC2 status as specified in Australian/New Zealand Standard™ 2243.2:2002 and 2982.1:1997.

Prior to commencing any work in the laboratory remove all non-essential equipment, this will decrease the amount of equipment requiring decontamination at the end of the emergency.

Laboratory equipment and facilities

In line with AS/NSZ 2243.3:2002 3.1 production of aerosols and spread of infectious agents and fungal spores must be minimised during use, routine cleaning and decontamination of:

- Biosafety cabinets (use in accordance with Australian Standard)
- Centrifuges
- Sonicators
- Pipettes

Clean-up and decontamination of spills, or after accidents must also be carried out to ensure no spread of infectious agents.

There should be routine cleaning and decontamination of benches after use, and routine cleaning and decontamination at the end of each day.

An appropriate selection of disinfectants should be made balancing broad-spectrum activity (oxidising agents, aldehydes) against convenience for routine use (alcohols).

Disinfectant use on different surfaces (stainless steel, laminates, paintwork, concrete or tiles) should be specified. For further details refer Appendix 7.

Waste handling, sterilisation and disposal

Waste must be handled in accordance with the protocols as per the Quarantine Approved Premises Criteria 5.2. For specific waste handling, sterilisation or disposal methods for carrot rust fly please refer to the diagnostic protocols for carrot rust fly (if available).

Safe specimen handling

Procedures for the safe handling of specimens for transport from the field to the laboratory are specified in Protocols for Collecting and Dispatching Samples (Appendix 3). This includes details on unpacking and handling of specimens in the receiving areas. For transfer of samples within the laboratory and between buildings the following protocols should be followed:

- All suspect quarantine samples should be held in primary, sealed impermeable containers which have quarantine labels and sample details clearly attached.
- Quarantine samples should be transported between labs and buildings in secondary dedicated lockable quarantine boxes or eskies each with appropriate signage.
- Interior and exterior surfaces of the secondary quarantine containers should be surface sterilised against the pest of concern using the protocols in Appendix 6.
- Primary containers which have held quarantine samples will be autoclaved or disposed of according to AQIS requirements.

Protective clothing

Personal protective equipment (PPE) requirements specified in the Australian/New Zealand StandardTM 2243.2:2002 and 2982.1:1997 for PC2 and PC3 laboratories should be adhered to. Standard laboratory procedures should specify:

- The nature and requirement for use of protective clothing in laboratory areas.
- Instructions to remove protective clothing prior to leaving the laboratory. Preferably in a specified area or air lock.
- The type of PPE required for different classes of agents and levels of work being done with such agents.
- Decontamination procedures for PPE.
- Exit protocols for PPE from quarantine areas will ensure that carrot rust fly will be contained within the facility.

Training

Training should include:

- Instruction in handling the insect to be diagnosed.

- Instruction in using PPE.
- Induction training of new staff and visitors in safe operating practices.
- Operation of equipment.
- Occupational health and safety issues.
- Instruction in waste disposal.
- Assessment of competency.

The laboratory supervisor should be responsible for ongoing assessment of staff competency.

Control of access to and movements within the laboratory

The number of people allowed access to the laboratory should be effectively controlled. Refer to Quarantine Approved Premises Criteria 5.2. A log of every person entering an area and records of training given during a carrot rust fly incursion should be kept (both as legal defence and as a matter of good practice).

Recording of data from diagnostic tests

- Results from diagnostic tests must record the unique sample ID number.
- Data should be entered in an approved database or data recording system.
- Slide specimens, photographic records of gels, and host symptoms from tests, records from automatic analysis (fatty acid) sequence information should be incorporated into the database.
- All relevant data should be linked to the sample and to those who entered the data.
- Results should be entered into the database by approved staff, checked for transposition errors and verified by the specialist.
- Release of results will follow the protocol for reporting Emergency Plant Pests (Appendix 7).

Appendix 3: Sampling Procedures and Protocols for Transport, Diagnosis and Confirmation of Emergency Plant Pest (EPP).

Correct identification is central to effective control of pests and diseases and for the detection of new emergency plant pests which have penetrated our quarantine barrier.

Documented procedures (as outlined below) should be followed for the collection of suspect material to ensure samples taken are appropriate for diagnostic tests.

The diagnostic and survey teams will be responsible for collection of infected material and/or samples of the organism.

The following generic guidelines should be followed in order to collect, package and transport samples.

A State/Territory officer appointed by the Chief Plant Health Manager (CPHM) (or nominated representative) will be responsible for collection of infected material and or samples of the organism. The procedures detailed here should be adopted.

Field sampling kits standard kit (i.e. absolutely necessary)

The Standard Kit includes equipment that may be required for the investigation of a suspected emergency plant pest by the diagnostic or survey teams.

- Global Position System (GPS).
- Esky or sturdy, sealable plastic crate.
- Sample containers of varying sizes (e.g. 20 ml and 50 ml).
- Disposable gloves.
- Disposable overalls.
- Bleach (e.g. domestic use with 4 - 5% available Chlorine).
- A solution containing dimethyl sulphoxide, disodium ethylenediamine-tetraacetic acid (EDTA), and saturated Sodium Chloride (NaCl) (DESS solution) (for fly sample storage).
- Trowel.
- Spade or coring tube for sampling soil.
- Sealable plastic bags of suitable micron thickness for samples and disposing of Personal Protective Equipment (PPE).
- Large, strong plastic bags for sealing contaminated equipment such as boots or spades (strong garbage bags are OK for this).
- Washable boots i.e. rubber boots.
- Adhesive labels (either pre-prepared with bar code/unique ID or handwritten in field).

- Evidence tape (tamperproof).
- Permanent markers.
- Digital camera.
- Pencils/pens.
- Book or sample sheets for recording details of site and samples.
- Soap.
- Paper towels.
- Water (sufficient for washing hands).
- Baby wipes for cleansing hands and face.
- Brightly coloured ribbon.

Additional equipment for the advanced kit:

- 70% Ethanol in spray bottle.
- Bucket (for disinfecting tools).
- Plastic containers for sample storage.
- Trays/crates (for disinfecting equipment).
- Quarantine tape.
- Water (sufficient to wash hands and equipment).
- Magnifying glass.
- Masks and other PPE if dealing with chemicals.

It is suggested that all the above items should be efficiently stored in a large toolbox for easy access.

Additional basic equipment for collecting insect samples

- Variety of vials with internal seals e.g. 20 mm, 70 mm.
- McCartney bottles.
- Soft tweezers.
- Reasonably fine scissors.
- Secateurs.
- Alcohol 75%.
- Very fine brush e.g. size 0 – 000.
- Rigid tweezers.
- Larger plastic jars.
- Paper bags.
- Fine forceps.

- Pocket knife.

It is suggested that all the above items should be efficiently stored in a large toolbox for easy access.

STEP 1: Collecting samples

General

- Complete a sample submission form at time of sampling (include details such as host, plant parts affected, location (GPS coordinates), date of sampling, property owner, contact details and any other relevant information). Hold a copy of details with duplicate sample.
- Sterilise any implements with a sterilant (eg 70% v/v ethanol or 0.5% v/v available chlorine solution, as appropriate) prior to and after each sampling.
- If considered to be a root problem include soil and crown (lower stem) tissues with root samples.
- It is essential that the time between sampling and dispatch of the sample for identification be kept to a minimum.
- When sampling a suspected EPP do not drive from paddock to paddock when sampling as this increases the potential for spread of the EPP.
- If possible, sample from perceived area of minimal damage to perceived area of high damage within a field/orchard and on individual plant.

Insect samples

In most instances insect specimens should be sent dead and preserved in a manner required by the laboratory.

- As soon as a fly has been collected it should be quickly killed or fixed and handled in a way that keeps it clean and undamaged until it can be permanent preserved. Most adult flies are killed dry, in killing bottles or tubes. Killing bottles are usually charged with either Cyanide or a liquid killing agent (Ethyl acetate).
- Collect soil material samples in strong plastic bags, and label them clearly and systematically.
- Leave insect larvae (maggots) in the roots as this will help to preserve them. Include loosely crumpled facial tissues or similar in the bottom of containers to help prevent damage to fragile insects and absorb any free fluids.
- Place the specimens in a plastic or glass vial or small jar, or in a crush-proof box with tissues.
- Where possible it is advisable to collect a large number of specimens of all life stages. Collection of different life stages can assist in diagnosis.

- Collect specimens in duplicate that are clean and in good condition i.e. complete with appendages such as antennae, wings and legs.
- Place the specimens in a plastic or glass vial or small jar, or in a crush-proof box with tissues.

Record, where is possible:

- The crop and cultivar.
- The sampling date.
- The farmer owner name.
- The location (GPS coordinates if possible).
- If sending soft bodied insects (e.g. larvae), place specimen in 65% ethyl-alcohol 35% water (use methylated spirits) and completely fill the container. NOTE: A limited amount of alcohol is permitted to be posted by Australia Post under the International Air Transport Association's "Dangerous Goods Regulations". Methylated spirits will destroy insect samples and should not be used where live samples are required.
- Retain and store a spare sample in a secure location, cool and dark.

STEP 2: Sample labelling instructions

- For samples taken at the Infected Premise (IP) or Contact Premise (CP) refer to Appendix 5 – Chain of Evidence for labelling and sample sealing instructions.
- Label each sample clearly using an alcohol-proof marker.
- Key list the samples and label each sample clearly.
- Secure labels to the outside (and if appropriate to the inside) of the sample bag or container for insect pest and pathogen samples. A label should also be included in the bag in case the outer label is destroyed.

STEP 3: Selection of laboratory and confirmation of mailing arrangements

- The Chief Plant Health Manager will select the preferred laboratory and scientist for sample diagnosis.
- If the laboratory is interstate, it will be necessary to seek appropriate permits from interstate Chief Plant Health Managers.
- If the laboratory is overseas, it will be necessary to seek appropriate permits from the appropriate authority.
- The quarantine officer or Chief Plant Health Manager will confirm with the Manager of the diagnostic laboratory that they are prepared to accept the sample(s). The Manager of the diagnostic laboratory will also confirm the mailing address and arrangements for consignment and receipt of samples, including packaging requirements.

STEP 4: Packing of samples for surface and air transport

According to the International Air Transport Association (IATA) *Dangerous Goods Regulations 2005*, infectious substances such as plant pathogens are now classed as Dangerous Goods and must be packed in accordance with Packing Instruction 650. In addition persons packing samples will have to be trained by IATA in order to send samples by air. At least one person in each outreach will need to be accredited by IATA for packaging of dangerous goods.

Biological substances for surface transport within Australia should be packaged according to the Australian Standard *DR 05023: Packaging for surface transport of biological material that may cause disease in humans, animals and plants* (currently in draft form).

General

- Include a covering note to the diagnostic facility outlining that the sample is a suspect exotic pest, and if possible, indicate what you suspect the pest to be.
- Include the sample submission form in a separate plastic bag.
- Label the package with:
  - The recipient's name, address and telephone number.
  - The sender's name, address and telephone number.
  - 'Urgent – Diagnostic sample. Keep cool'
- Pack the samples securely using the following procedures:

Insect Samples

- Place the sealed bag/envelope (containing the sample/receptacle) into a small sturdy box, i.e. made out of rigid cardboard, tin or light wood or plastic.
- Fill the remaining space in the box with at least 100 mm of padding (foam chips, crumpled paper, bubble wrap etc) to prevent the sample/receptacle from moving about inside the box during transit. Ensure the lid is secured.
- Wrap the box securely in packing paper.

STEP 5: Despatching Sample

Interstate

- Check if there are any interstate quarantine regulations that need to be complied with should a sample be sent interstate. ENSURE APPROPRIATE PERMITS ARE OBTAINED. (Permits asking authorisation for movement of exotic pest into the state should direct to the members of the Domestic Quarantine and Market Access Working Group (DQMAWG) States/territories (See Government contacts Table 8).

- Notify the diagnostician that that a suspect emergency plant pest is being sent to the laboratory and the estimated time of arrival.
- Choose the most reliable and fastest method of despatching the sample.
- If you expect a delay of more than 2 days in sending samples, store sample under appropriate conditions prior to sending.
- Ensure samples are sent directly to the chosen diagnostician/laboratory. Do not send samples to postal boxes.
- Attach consignment notice to outside of package.
- In the event of delays store samples in refrigerator or cool dry place, unless specified in specific protocol.

Samples must either be despatched to the diagnostic facility by a courier provider which ensures overnight or same day delivery of package with on arrival signature receipt or the sample can be hand delivered to the diagnostic facility. Remember to keep samples cool and out of direct sunlight.

International

- Include an explanatory letter from Chief Plant Health Manager arrangements need to be made depending on the condition of the samples this may require re-sampling.
- The lead agency Chief Plant Health Manager will notify Australian Quarantine and Inspection Service (AQIS) of the intended movement of a suspect emergency plant pest.
- Movement permits will be obtained for transfer within the state/interstate to the port and for export to the receiving country.
- The Lead Agency Chief Plant Health Manager will confirm international courier arrangements and any special quarantine requirements of the importing country.

STEP 6: Receiving the package

When the diagnostic laboratory receives the package, the diagnostician will, in a timely fashion (in keeping with ISO/IEC 17025:2005 which specifies the general requirements for the competence to carry out tests and/or calibrations, including sampling. It covers testing and calibration performed using standard methods, non-standard methods, and laboratory-developed methods).

- Only open the package in a room that complies with appropriate quarantine containment facility requirements.
- Retain packaging until its disposal is approved by AQIS.
- Check the condition of the plant/pest to determine if it is suitable for testing.

- Note and record the integrity of the sample on the sample submission form.
- Notify the Chief Plant Health Manager of the Lead Agency that the sample has been received.
- Notify the Chief Plant Health Manager in the agency in their State/Territory that the sample has been received.
- Keep consignment form and details.
- Record consignment note number, courier details and accession number on the sample sheet and in an appropriate database.

Protocol for initial diagnosis of suspect Carrot Rust Fly

Initial examination will be carried out by an experienced general diagnostician (entomologist) within the Agricultural Department in the State/Territory in which the sample was obtained. Once an initial examination has been undertaken a specialist will be engaged to carry out diagnosis.

Examination of symptoms by Lead Agency Diagnostic Laboratory

- Samples will be allocated a unique sample ID number.
- This number should be recorded on a confidential database.
- The package should be opened by an experienced general diagnostician.
- The general diagnostician should examine sample for decision on diagnostic pathway.
- Once initial examination has been completed, the sample will be kept in a tamperproof container following chain of evidence protocols (Appendix 5).
- The diagnostician will observe decontamination protocols detailed in Appendix 6 (remove lab coat, for sterilisation, wash hands, disinfect instruments and area) after the initial inspection.
- A specialist will be engaged for more detailed examination.

Note: if the laboratory is interstate the Chief Plant Health Manager will provide details and seek assistance from the counterpart Chief Plant Health Manager.

- When initial examination indicates a high likelihood of an Emergency Plant Pest, the diagnostician may decide to sample again and proceed with confirmatory testing.
- The sample will be forwarded from the Lead Agency Chief Plant Health Manager to the specialist with an explanatory letter, observing consignment protocols (see Despatching Samples step 5).

Initial diagnosis by specialist

Samples for initial diagnosis are to be given the highest priority.

- The specialist should ensure they maintain the biosecurity of the sample.
- Diagnosis should be carried out within a secure containment facility (QC2).
- Where there is a high possibility of an emergency plant pest and where diagnostic tests may take a long time the specialist should run tests to exclude endemic pests that may cause similar symptoms.
- The specialist should follow diagnostic standards (if available).
- Digital images of symptoms and other features should be recorded.
- Initial conclusion on diagnosis should be conveyed to the Manager of Diagnostics and Chief Plant Health Manager of the Lead Agency (test results may only be disclosed to the Chief Plant Health Manager).
- Once diagnosis has been completed the sample should be returned to the secure labelled quarantine container.
- The specialist should preserve all physical evidence (e.g. slides, DNA etc) in a manner which supports the initial diagnosis.
- The specialist will keep records of where the sample is stored and label appropriately.
- The specialist will observe decontamination protocols listed in Appendix 6.
- The diagnostic laboratory will provide the results of diagnosis to the Lead Agency Chief Plant Health Manager.

Confirming diagnosis

Refer PLANTPLAN section 2.1.3.

For confirmatory diagnosis Chain of Evidence protocols described in Appendix 5 should be observed at all times to ensure the integrity of samples.

Confirmation of diagnosis

- The Consultative Committee on Emergency Plant Pest will select a second national laboratory for independent confirmation of the result.

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- The Lead Agency Chief Plant Health Manager will confirm that the diagnostic laboratory is accredited for quarantine samples will process the current sample and confirm the essential requirement for confidentiality (test results may only be disclosed to the Chief Plant Health Manager).

Note: If the diagnostic laboratory is interstate, the Chief Plant Health Manager will provide details and seek assistance from the Chief Plant Health Manager in that state/territory. Movement Permits will be obtained for interstate transfer.

- The sample will be forwarded under strict quarantine conditions from the Lead Agency Chief Plant Health Manager to the diagnostician with an explanatory letter, observing consignment protocols (see Despatching Samples, step 5).
- The Lead Agency Chief Plant Health Manager will negotiate any financial transaction for the proposed work and confirm pathway for confidential reporting of results.

Requirement for overseas expert

- Needs to be established prior, in the event that a second national laboratory cannot be located, the local specialist will identify the requirement for an overseas expert to assist with diagnosis (where appropriate).

Note: Selection criteria should cover availability, ease of communication and industry links.

- The Lead Agency Chief Plant Health Manager and local specialist will engage the overseas expert by teleconference to confirm arrangements for consignment of samples, payments and confidential reporting of results.

- The Lead Agency Chief Plant Health Manager will arrange for the consignment of samples to the overseas expert (see protocol for consignment of samples Appendix 3). The package should include explanatory letter from Chief Plant Health Manager confirming arrangements. Depending on the condition of samples this may necessitate resampling.
- The lead agency Chief Plant Health Manager to notify AQIS of the proposed movement of samples.
- Office of the Chief Plant Protection Officer will coordinate to obtain movement permits for transfer within the State/Interstate to the port and for export to the receiving country (Permits asking authorisation for movement of exotic pest into the state/Interstate should directed to the Office of the Chief Plant Protection Officer).
- The Lead Agency Chief Plant Health Manager will confirm international courier arrangements and any special quarantine requirements of the importing country.
- The Lead Agency Chief Plant Health Manager and specialist will discuss by phone with overseas expert, the preferred diagnostic tests for isolation and identification of the target.
- The specialist will arrange for import of ELISA kits, DNA, special chemicals, fixed specimens and any other specific requirements.
- The local specialist will send high quality digital images of carrot rust fly.

Diagnostic and recording protocols for samples from surveys to confirm Infested and Pest Free Areas.

The Chief Plant Health Manager will liaise with the specialist to design guides for sampling and field monitoring teams. The guides will include:

- Digital images to assist recognition of symptoms/damage/life stages.
- Specific sampling protocol for affected plants, which assists the selection of infected material including any “cryptic” symptoms on certain plant parts or cultivars.
- Sampling protocol for fly species including GPS trapping grid, and protocol for species which are sensitive to lures.

The Chief Plant Health Manager will liaise with the specialist to design guides for diagnosis of samples from surveys for other diagnosticians that will be processing samples. The guides will include:

- Validated tests (with quick turn around time) for isolation of carrot rust fly.
- Ensure quarantine accredited receiving room for sample examination and diagnostic laboratories for isolation and characterisation of organisms.

- Design hardcopy recording system of results for each sample including dedicated sample number and GPS readings.
- Develop a Quality Assurance (QA) system for checking veracity of results.

Training diagnosticians and technical staff

A specialist technical working group will be required to plan and implement training protocols for diagnostic laboratories covering:

- Methods of selecting samples from plants to maximise detection of the pest.
- Methods of sorting and identifying pests caught in “lure” traps.
- The selected tests for isolation and identification of flies.
- Methods of recording information relating to a case.
- The requirements for Quality Assurance systems to check all technical aspects of the tests, interpretation of results and transposition errors.

Appendix 4: Preliminary Information Data Sheet

Date: / /
Subject
Site Details:
Ownership:
Location:
Map (latitude and longitude):
GPS identifier:
Host plant location (clearly mark plant if necessary):
Host details
Species and variety:
Age:
Developmental stage:
Damage
Description of symptoms:
Part of host affected:
Percent incidence:
Percent severity:
Details of when and where the pest was first noticed
Records of product movement on and off detection site
Symptoms/photographs
Further details or comments

Appendix 5: Chain of Evidence

In the event that a grower or other person takes legal action against the Lead Agency a demonstrable chain of custody and record of evidence from the time of sampling until trial is essential for evidence to stand up in court. The samples taken from the Infected Premises (IP) and Contact Premises (CP) are likely to be one of the most important forms of evidence for the Lead Agencies and the courts. Protocols are therefore required to maintain confidence in the integrity of the samples and their value as evidence.

The Lead Agencies must be able to ensure:

- The collection of the samples is authorised by law.
- The samples collected come from the Infected Premises or Contact Premises.
- The persons collecting the samples have appropriate training and experience.
- The samples are properly identified, recorded, stored and handled between the time of collection and trial.

In order to maintain continuity of evidence, diagnostic and survey teams and diagnostic laboratory staff should follow these protocols when collecting and handling Emergency Plant Pest samples. Chain of Evidence protocols do not have to be followed for samples from general surveys. Chain of evidence protocols will be reviewed as part of the annual review of PLANTPLAN to ensure the protocols are relevant and reflect best industry practice.

Collection of the samples is authorised by law

If a sample is to be used as evidence, the Lead Agencies must ensure that the persons collecting the sample are authorised to do so by law. If the collection of the sample is not authorised, a court may refuse to accept the sample as evidence or, if accepted, accord it little or no weight.

Samples collected come from the Infected Premises or Contact Premises

The person or persons collecting the sample must be able to establish that the samples were collected from the Infected Premises or Contact Premises. To help establish that the samples were collected from the Infected Premises or Contact Premises and how the samples were collected, the person or persons collecting the samples should make a written record of collection at the time the sample is collected. It would be appropriate for those persons to mark the point or points of collection on a map of the Infected Premises or Contact Premises and to photograph the scene.

Persons collecting the samples have appropriate training and experience

The training and experience of persons collecting samples is vital. The chain of evidence is only as good as the people who operate it and there are risks throughout the collection process of things going wrong: people misidentifying a sample or compromising its integrity, or making an error in its analysis or misinterpreting results. Lead Agencies must ensure that everyone involved in the collection process is trained and competent to collect, store and handle samples. In addition persons packing samples will have to be trained by IATA if samples are to be sent samples by air.

Samples are properly identified, recorded, stored and handled between the time of collection and trial.

Chain of evidence protocols should be followed for all samples taken from Infected Premises or Contact Premises. Appropriate handling, documentation procedures and security measures are required when collecting and handling samples to preserve the integrity of the evidence. It is considered best practice if all samples submitted have uniquely numbered seals affixed to them for continuity and security.

The written record should be sufficiently detailed to:

- Permit the Lead Agency to call witnesses who could explain how the sample was collected, identified, stored and handled between the time of collection and trial.
- Permit another expert to be able to identify what has been done to a particular sample and to independently assess the Lead Agency's findings.

The diagnostic or sampling team will complete a Sample Submission Form at the time of sampling. This will form the Evidence Register. Sample Submission Forms will be supplied by the laboratory to which the samples are being sent.

Of the original sample, the specialist will use a sub-sample for diagnostics and store the remainder of the sample as a reference sample. The reference sample will follow chain of evidence protocols. The sub-sample used for diagnostics will be tracked by normal laboratory procedures.

All material held by the agency which is relevant to the incursion should be treated as evidence until no longer required for the investigation and/or prosecution.

Marking the exhibit

The diagnostic team (or other person collecting samples) will allocate each sample container with a unique identifier so that each sample can be easily tracked within the laboratory system.

Note: Each tamperproof seal will carry a unique number which can be the basis of it passing through the laboratory. The method of marking the sample will rest with the person in charge of the diagnostic team. however

this should be consistent across the emergency response. Marking should be difficult to remove and appropriate to the surface. A label should be included within the audit bag/container in case outer label is accidentally destroyed.

The identifier shall be retained throughout the life of the item in the laboratory and shall not be reused at any subsequent time.

Exhibit labels

Sample ID and tracking of samples within the laboratory is a vital issue. Sample tracking must occur through the Evidence Register but also may occur on the sample label (as below). The amount of detail in the example label below may only be necessary for the first sub-sample.

Sample Continuity Label				
Sample ID No.				
Bag No:		*All samples obtained are grouped together and placed in bags or containers. These are then sequentially numbered*		
Handed to:	**1**	**ON:**	/ /	am/pm
	2	**ON**	/ /	am/pm
	3	**ON**	/ /	am/pm
	4	**ON**	/ /	am/pm

Figure 1 – Sample exhibit label.

Sealing of Items

All evidence must be stored in appropriate tamperproof audit bags/containers that are properly sealed with a tamperproof seal. Sealing an exhibit within an audit bag/container may reduce the opportunity for allegations of impropriety being made against investigators and enhances credibility. Occasional exceptions (e.g. for very large or wet items) may be made, and this shall be recorded in the case file. A container is properly sealed only if its contents cannot readily escape or become contaminated and only if entering the container results in obvious damage to the container or seal. Containers must be closed or items covered, during storage, to prevent accidental loss or contamination. When a long break is expected in the examination of an item, the item must be sealed with a tamperproof seal to prevent contamination. Containers are designed to prevent illegal entry, not prevent entry per se.

Containers shall be resealed using a tamperproof seal after the examination is complete.

Evidence labels or evidence tape used to seal containers must be initialled or signed to record the person sealing the item, and must be dated with the date the item was sealed.

In circumstances where an audit bag/container is to be re-opened, the investigator responsible for sealing should consent and be present when the bag is re-opened. If this is not feasible, an independent person should be present to verify the contents of the audit bag at the time that the bag is re-opened. A written record should be made in relation to the opening of an audit bag/container and placed in the Evidence Register.

The record should include:

- Time, date and place that the bag/container was opened.
- Name of the person opening the bag/container.
- Name of the independent witness.
- Reason the bag/container was opened.
- Full description of the contents of the bag/container.
- Verification that the contents of the bag/container are as recorded on the property seizure record.
- What occurred to the contents of the bag/container.

Evidence Register

Once the investigating officer/specialist takes possession of the sample, the following procedures must occur immediately.

- The sample must be recorded in the Evidence Register and allocated a sample number. The information in the Evidence Register should include the full details as recorded specimen advice.
- Any subsequent movements of the sample must be recorded in the Evidence Register. This must include the date, the name and signature of the person taking the evidence, the reason and the destination.
- A designated person must maintain the Evidence Register. The nominated person should monitor and maintain the Evidence Register and the storage area. This person needs to have appropriate authority.

The Evidence Register shall provide a comprehensive record of each evidence transfer over which the laboratory has control.

- For transfer of items out of the laboratory:
    - Samples shall be recorded on an appropriate specimen advice sheet, along with a copy of the original specimen advice the name of the delivering person, the name (printed) and the signature of the accepting person, and the date and time of transfer. Sample transfer will be recorded.
- For transfers of evidence items in and out of the section

- The unique identifier of the evidence item, the name of the delivering person, the name of the accepting person, and the date and time of the transfer shall be recorded on the item examination sheet and in the Evidence Register.

Receipt of sample

Upon receipt of sample into the laboratory, the receiving scientist must ensure that:

- Sample packaging must be retained until AQIS and/or the Lead Agency approves its disposal.

Note: Responsibility will depend upon the quarantine status of the sample.

- A complete description of testing requirements from the Lead Agency Chief Plant Health Manager is documented and understood. This shall be evidenced by completion of a Sample Submission form.
- Any abnormalities or incorrect sample collection or preservation practices are noted in writing.
    - Where there is any doubt as to the suitability of a sample for test or examination, or when an item does not conform to the description provided, or the test/examination is not specified in sufficient detail, the Lead Agency shall be consulted for further instructions before proceeding. A written record must be made of any further instructions received from the client, at any point in the diagnostic process.

Note: Where it is clear that the sampling procedures were so inadequate that this could fundamentally compromise the results, then the receiving officer may reject the samples, using his or her professional judgement. Where samples were obviously collected or stored incorrectly, this should be clearly stated on the final report to the client.

- Samples submitted are to be examined for the pest in question.
- All items are sealed in accordance with “Sealing of Items” procedure.
    - If not already adequately sealed, the samples must be sealed by the submitting officer or the receiving scientist at the time the evidence items are accepted.
- The section has the capability to perform the work requested.
    - Any requests for diagnostic service which are not provided by the section shall be rejected, or accepted only if there is a danger that the evidence samples may deteriorate, and on the clear understanding that the section will limit its role to the referral of the samples to another service provider, on the Lead Agency’s behalf.
- The Receipt of Sample procedure is followed.

Storage of samples and documents

Samples and documents must be securely stored in a physically safe area with appropriate restrictions on access.

Movement of samples and documents

Samples and documents must be accessible only by designated or authorised officers. It is advisable that samples or documents be removed only for specified purposes, such as:

- Registration.
- Initial examination and assessment.
- Identification processes.
- Imaging.
- Photocopying.
- Hearing or trial.
- Answer subpoena.
- Where it is impractical to examine sample or document in the confines of the storage area.
- Disposal.

The removal of the sample must be noted in the Evidence Register in accordance with this Appendix.

Protection of Items

All samples must be protected from loss, cross transfer, contamination and/or deleterious change.

Samples shall be stored under controlled environmental conditions when not in the process of being examined. Appropriate conditions include:

- A cold room with restricted access.
- Other suitable condition to preserve plant tissue and pest.

Non destructive tests Should be utilised wherever practicable. When destructive tests are used, up to ¼ of the substance may be used in pre-DNA testing. After the completion of all testing at least ¼ of any substance should remain. This is to allow possible re-testing by an independent laboratory. This may not be useful in all situations, for example citrus canker, and may need alternative options.

Samples shall be collected from evidence items so as to maintain evidence integrity. Instruments shall be sterilised before and after each sample is removed, or separate disposable instruments shall be used to take each sample. Appropriate outer garments, including disposable gloves, shall be used.

Evidence Retention and Disposal

After the completion of testing, all evidence must be returned to the Lead Agency Chief Plant Health Manager, except where listed for retention below.

a) Retention of sub samples, records, photographs, DNA extracts and samples and other items shall be retained indefinitely in the following circumstances:

- To be made available for further diagnosis.
- Where the evidential material is likely to be of significant value in the future (e.g. where court proceedings have not yet taken place).
- As reference material to diagnosis made.
- To assist with future incursions of the pest.

The retained material shall be sealed and stored in accordance with this appendix.

b) Destruction of Samples shall be only on written authority from the Lead Agency CPHM. Waste disposal will be by AQIS approved method or Chief Plant Health Manager approved equivalent.

Note: Responsibility will depend upon quarantine status of the sample (managed under Australian Government or State/Territory Government legislation).

Prior to issuing any such instruction, the Lead Agency Chief Plant Health Manager must ensure that:

- Any decision he/she makes is not in conflict with any Court Order.
- All potential claimants have been afforded an opportunity to lodge a claim for the items/goods/documents.

When authority to destroy is received, the specialist shall:

- Remove, or make illegible, any feature that might allow the identification of any person involved in the case.
- Dispose of the item appropriately (autoclaving or incineration etc). and record the name and signature of the person destroying the items.

The method and date of destruction and a reference to the authority received in the Evidence Register.

Appendix 6: Disinfestation and Decontamination

Should eradication be considered feasible, the first priorities will be destruction of the carrot rust fly. This will often involve treatment and removal of all infected plants, including a buffer zone around infected plants. Plants will need to be deep buried or burned.

Eradication is dependant on two fundamental principles:

1. Stopping the multiplication of the carrot rust fly on infected plants.

2. Preventing contact between susceptible plants and the carrot rust fly.

This can be achieved by:

- Restricting the spread of carrot rust fly on hosts, plants and contaminated equipment through quarantine and movement controls.
- Eliminating sources of inoculum by removal, disposal and destruction of infected plants.
- Application of treatments to restrict secondary spread of carrot rust fly.
- Decontamination of premises, vehicles, equipment and materials.

Destruction of Infected Plants

A campaign to eradicate carrot rust fly may require the destruction of all infected plants and the destruction of all susceptible host species within a defined distance of the infected plants. Once authority is granted to destroy infected plants then the following guidelines are followed:

1. Prior to destruction, infected plants and plants suspected of harbouring carrot rust fly may require treatment. This may include all symptomless hosts within a buffer zone around infected plants (10 km).
2. Where possible, all infected plants shall be harvested and deep buried at an approved burial sites.
3. All susceptible hosts within the buffer zone of an infected plant will be destroyed, with symptomless plants being destroyed before the infected plants are handled.
4. When it becomes necessary to remove infected plants rather than destroying them where they are growing or are located, the infected plants are to be placed in plastic bags or plastic lined containers, and transported to an approved site for burial or incineration.
5. Prior to leaving the Infected Premises all personnel and equipment are decontaminated according to the guidelines provided in this chapter.
6. Following the disposal of infected plants, bags and/or bin liners, containers and all other equipment and vehicles that has or may have come in contact with the infected plants shall be decontaminated.
7. Any remnants of plants left in the ground will be treated to prevent regrowth.

Organisation of destruction

Planning is essential to ensure the destruction task is carried out efficiently and is not impeded by lack of resources. An action plan should be drawn up in consultation with the owner or his/her agent and other departmental officers. The following procedures should be followed.

- Consult with the Infected Premises Operation Team (IPOT) site supervisor and property owner/manager to establish:
  - Property layout, facilities and equipment.
  - The number, species and location of plants to be destroyed.
  - The destruction technique to be used.
  - The time-frame for commencement and completion of plant destruction.
- Advise the Infected Premises Operation Team site supervisor of immediate resources needed to prepare for destruction of plants.
- Consult with the Officer In Charge (OIC) of the disposal team, determine the disposal method and site to be used and, if necessary, identify centrally located disposal sites as close as practicable to the site of destruction.
- Provide the Infected Premises Operation Team site supervisor with a concise written plan for approval, including:
  - Destruction method(s).
  - Destruction site(s).
  - Order of destruction.
  - Personnel required.
  - Facilities and equipment needed.
- Details of the destruction operation should be included on a diagram of the Infected Premises.
- Confirm that the Infected Premises Operation Team site supervisor possesses a complete inventory of all plants to be destroyed on the property. All crops should be valued before destruction.
- When there is a delay in reaching agreement on valuation with the owner or his/her agent, authority to destroy should be sought from the Local Pest Control Centre (LPCC) Controller.
- Brief the destruction teams then supervise and coordinate their activities. Ensure that:
  - Destruction facilities, methods and working conditions are consistent with personal safety.
  - Destruction teams receive adequate rest and meal breaks.
- Make every effort to avoid damage to property. Any damage that does occur must be drawn to the attention of the owner/manager, recorded

and reported promptly to the Infected Premises Operation Team site supervisor.

- Check all destruction against the authorised inventory to ensure that all variations are accounted for and that all susceptible plants scheduled to be destroyed on that day have in fact been destroyed.
- Provide the Infected Premises Operation Team site supervisor with a situation report at the end of each day.
- Advise the Infected Premises Operation Team site supervisor of resource requirements for the next 48 hours.
- Advise the Infected Premises Operation Team site supervisor immediately destruction has been completed so that other tasks, e.g. disinfection, can be started without delay.

Decontamination (General)

Decontamination practices are aimed at restricting the movement of, and destruction of infectious agents such as bacteria, viruses, fungi, phytoplasma, flys, mites and insects from growing media, water, equipment, tools or any surfaces. Thorough decontamination involves close cooperation between property owners and all personnel involved in the cleaning and disinfection procedures.

In order to eliminate Emergency Plant Pests from clothing, vehicles, tools or the environment, there must be a good understanding of the general properties of each infectious agent and the ways they may persist in the environment and infect other plants. Importance is placed on the adoption of the basic microbiological principles of isolation of the source of infection and decontamination of personnel, equipment, vehicles and sites. The most important initial information is the presumptive identification of the Emergency Plant Pest involved. Once established, the basic properties of the agent must be considered. What are the epidemiological characteristics of the spread? Has transmission occurred by aerosol spread, soil and water, close contact or insect vectors? Depending on the pest, different decontamination procedures and disinfectants are likely to be used for different sites on the IP and adjacent properties.

General Guidelines

1. Only recommended materials are to be used when conducting decontamination procedures, and should be applied according to the product label.
2. Survey and eradication personnel must follow decontamination procedures during all survey and eradication activities. (Personal safety precautions must be followed at all times).
3. Movement of all personnel, vehicles and equipment within and out of declared quarantine areas must be minimised as much as is practically possible.
4. Properties are not to be entered for inspection by any inspector who has been on any known Infected Premises within the predetermined exclusion period.
5. Generally, the inspection of an Infected Premises shall be the only survey activity scheduled for these inspectors during any one day. Before surveys of an Infected Premises, effort should be made to inspect the apparently Emergency Plant Pests - free areas prior to inspecting the area surrounding infected plants.
6. Inspectors must refrain from touching host plants during any inspection except to examine or collect suspicious-looking symptoms.
7. During an outbreak, the affected industry should adopt routine hygiene and decontamination practices to help reduce the possible spread of the Emergency Plant Pests.

The natural processes of time, dehydration, warm temperature and sunlight will also greatly assist the decontamination operation and should be considered in planning.

Prior to commencing decontamination of any surface, determine if the chosen decontamination procedure is likely to spread the disease.

Pressure steam sterilisation (autoclaving) is the most reliable means of decontamination.

However, this method can not be used in all situations.

For larger surfaces and spaces and for heat labile materials or equipment, chemical disinfection is often the only practical method of decontamination. Where time permits, heat-labile materials and equipment may be sterilised by gaseous chemicals such as ethylene oxide or ionizing radiation.

Susceptibility of microorganisms

Microorganisms vary in their susceptibility to chemical disinfectants. Lipid containing viruses and the vegetative forms of bacteria are relatively susceptible. Fungi, acid-fast bacteria and non-lipid-containing viruses are less susceptible while bacterial spores are resistant to many chemical disinfectants.

Types of disinfectants

Chemical disinfectants are available under a range of trade names. Refer below for examples of some broad spectrum disinfectants that are effective against a range of micro organisms, including some sporicidal activity:

- Halogens e.g. chlorine and iodine.
- Aldehydes e.g. formaldehyde and glutaraldehyde.
- Oxidising agents e.g. peracetic acid, peroxygen biocide and hydrogen peroxide.

Chemical disinfectants with a more limited antimicrobial spectrum include:

- Alcohols e.g. ethyl and isopropyl alcohols.
- Phenolics.
- Quaternary ammonium compounds.
- Chlorhexidine.
- Acids and alkalis.

Factors affecting disinfectant activity

Variables which may affect the action of chemical disinfectants include:

- Concentration and formulation of the disinfectant
- Effective period of contact.
- Temperature.
- pH.
- Relative humidity.
- Inactivation by organic matter or cellulosic and synthetic material.

Choice of disinfectant

The choice of chemical disinfectant often represents a compromise between the requirement for a broad antimicrobial spectrum, the limitations imposed by the situation or type of materials being disinfected, and any disadvantages of particular disinfectants.

A chemical disinfectant which is suitable for a particular purpose or situation depends not only on the types of micro organisms likely to be present but also on the control or provision of the conditions that can promote its effectiveness in the situation. Other properties of the disinfectant also need to be considered, such as possible corrosive, bleaching or staining effects and its flammability. In addition, the effect it can have on personnel as a toxic irritant, any sensitising action and its carcinogenic potential need to be taken into account.

A risk assessment needs to be undertaken before deployment of any disinfectant.

The least toxic disinfectant should always be selected when there are a number of disinfectants known to be effective against the pest/pathogen.

Material Safety Data Sheets (MSDS) should be ready available for any chemical disinfectant used in the workplace. A request for the relevant MSDS should automatically accompany the initial order for materials. MSDS provide information on the identity, physical characteristics, potential health hazards and precautions to be taken for safe storage, use and disposal of chemicals. The laboratory supervisor should ensure that all persons have access to MSDS for the substances that are used in the workplace and that these are read and understood by those concerned. MSDS, as obtained from suppliers, should not be altered although additional information can be appended and clearly marked as such.

For further information on the properties of commonly used disinfectants, refer to Appendix E of Australian and New Zealand Standard™ Safety in Laboratories Part 3: Microbiological aspects and containment facilities.

Below is a Summary Table. 1

Table 1- Chemical agents which can be used for Emergency Plant Pests disinfection

Site or equipment	Routine or preferred method or usage	Acceptable alternative
Benches and surfaces (not obviously contaminated)	Alcohols e.g. 70% *w/w* (= 80% *v/v*) ethyl or 60-70% *v/v*.	Synthetic phenolics[1]
Biological safety cabinet (BSC) work surfaces	Synthetic phenolics[1] after bacteriological work or Iodophor[2] or other disinfectant according to the pathogen being handled.	For BSC with capture hoods, glutaraldehyde[3]+ (with cabinet fan operating).
BSC before servicing or testing	Formaldehyde vapour	
Centrifuge rotor or sealable bucket after leakage or breakage	Chemical disinfection not the preferred method. Pressure steam sterilise at 121 °C for 15 min recommended.	Glutaraldehyde[3] + (see note below) for 10 min *or* synthetic phenolics[1] for bacterial spills for 10 min (see note below).
Centrifuge bowl after leakage or breakage	Gluteraldehyde[3] + for 10 min (swabbed twice within the 10 minute period then wiped with water).	Synthetic phenolics[1] for bacterial spills for 10 min.
Discard containers (pipette jars)	Chlorine disinfectant at 2000 – 2500 ppm (0.2 – 0.25%), freshly prepared and changed daily.	Synthetic phenolics[1] for bacteriological work (changed weekly) *or* detergent with pressure steam sterilising for viral work.
Equipment surfaces before services or testing	Surfaces disinfected according to manufacturer's instructions.	Alcohol (80% *v/v* ethyl or 60 – 70% *v/v* isopropyl) except when its flammability poses a hazard *or* glutaraldehyde+ then water.
Hand disinfection	Chlorohexidine (0.5 – 4% *w/v*) in alcoholic formulations for 2 min	Isopropyl (60 – 70% *v/v*) or ethyl alcohol (80% *v/v*) with emollients or Povidone-iodine (075 – 1% av I) for 2 min
Hygienic handwash	Chlorhexidine (4% *w/v*) in detergent formulation (or alcoholic formulations) for 15 sec	Detergent cleansers or soap for 15sec
Spills of bacterial cultures	Synthetic phenolics[1] (unaffected by organic load) for 10 min.	High concentration chlorine or Iodophor[2] for 10 min.

1 Dilute according to manufacturer's instructions
2 Iodophor a water-soluble material that releases free iodine when in solution
3 Glutaraldehyde as 2% *w/v* activated aqueous or 2% *w/v* glycol-complexed formulations

For details on the best disinfectants to use for a certain Emergency Plant Pest, refer to the diagnostic protocol (if available).

Please Note: Concern has been raised about the use of Gluteraldehyde in the decontamination of laboratory equipment, especially biological safety cabinets which circulate air back into the laboratory environment, as Gulteraldehyde can cause a strong immunological reaction in some individuals whereby repeated exposures can lead to severe reactions.

Contamination of disinfectants

Working solutions of disinfectants should be frequently replaced by freshly prepared dilutions from stock solutions. This applies particularly to those disinfectants which are subject to inactivation by organic or other materials, loss of stability or significant dilution through the introduction of wet instruments. Otherwise, the inactivated, exhausted or diluted disinfectants may become contaminated and may even support the growth of contaminants. The containers or dispensers used should also be emptied and decontaminated between batches and not merely 'topped up'.

General safety precautions

- First aid boxes must be available on every Infected Premises or where hazardous chemicals are being used.
- It is essential to brief workers and the property owner on safety aspects before commencing operations, including the potentially harmful effects of chemicals on the environment, animals and humans.
- The usage of any chemical or equipment should conform to the manufacturer's instructions and safety standards.
- All officers and workers must carry out their duties in accordance with current health and safety legislation.
- All accidents which require medical attention, however small, must be logged with details reported back to the Local Pest Control Centre.

Disinfection Procedures

Some insects and plant pathogens may travel almost unseen in mud or lodged in nooks and crannies on machinery, vehicles and other equipment. The first priority is to ensure no personnel, vehicles or equipment leaves the Infected Premises without thorough decontamination. The Infected Premises site supervisor must ensure effective property decontamination, including decontamination of all people, equipment and vehicles.

Personal Decontamination

The following procedures are to be complied with by all survey, eradication and other personnel who may be exposed to an Emergency Plant Pests during the course of their duties.

This includes:

- All people who move out of infected, contact and suspect premises.
- Personnel who take suspect samples and all personnel involved in eradication activities.
- All persons who are required to decontaminate themselves will disinfect hands, arms and any other parts of the body that have contacted any part of the infected/ infested crop and surrounding vegetation, plus any clothing, shoes and small personal items (pens, hand lens, glasses, pocket-knives, etc.) that have come into direct or

indirect contact with plant material suspected of carrying an Emergency Plant Pests.

Decontamination of personnel will be conducted with the aid of approved products. The aim of personal decontamination is to safely remove any contamination of the body or clothing. The process minimises the risk of spreading the Emergency Plant Pests to uncontaminated areas.

Personal Protective Equipment

Standard dress requirements recommended to improve the effectiveness of decontamination procedures are:

- Globes.
- Overalls.
- Goggles.
- Gumboots.
- Mouth cover (when dealing with certain pathogens mouth cover may be necessary to prevent disease/illness).
- Eye wear/breathing equipment (may be needed for certain containment procedures e.g. fumigating).

Prior to exiting the Infected Premises all Personal Protective Equipment should be removed. Disposable items should be double bagged in heavy gauge plastic garbage bags, the outside of the bag disinfected and sealed with quarantine tape and deep-buried or burnt on site. If items are to be removed from the Infected Premises, the bag should be taken back to the laboratory and autoclaved for the recommended time at the recommended temperature.

If the person is returning to site the next day any non-disposable items such as hat, gloves, boots and overalls can remain on site. Items to be taken off the property should be disinfected on site or double-bagged, sealed with quarantine tape, the outside of the bag disinfected and then autoclaved for the recommended time at the recommended temperature.

Personal and small tool wash equipment

Portable wash baths are recommended for use when travelling in vehicles for washing footwear and small tools. Wash baths can be made from a fish box (or other suitably sized plastic box) fitted with an open weave plastic doormat, a scrubbing brush, a pair of safety gloves, glasses, detergent or disinfectant, and a container of clean water.

Small tools & portable footbaths washdown procedures

1. The wash bath should be located just outside the infected area or at the departure point for the vehicle.
2. Remove all loose mud and dirt from the object to be cleaned.
3. Use the recommended safety equipment if washing with a disinfectant (e.g. safety gloves and glasses).

4. Part fill the wash bath with clean water (a depth of about 4 cm is adequate for boot washing). Mix a solution of detergent or disinfectant as required.
5. Clean boots, gaiters and equipment with the scrubbing brush.
6. Waste detergent and disinfectant must be kept and disposed of in accordance with AQIS standards.
7. A final rinse or wipe with disinfectant or methylated spirits can be used for sterilisation of scientific equipment.

Vehicle & Machinery Decontamination

Many industries have, or are developing, standard operating procedures for vehicle and machinery washdown. Consult your industry code of practice or environmental management system for determining the washdown requirements that apply.

It is advisable to washdown machinery after:

- Operating in an area affected by a pest that is under containment.
- Transporting soil known to be infected with a plant pest.

or before:

- Moving machinery out of a local area of operation.
- Moving machinery between properties.

For general cleaning procedures the following standard applies:

- Remove cover plates etc.
- No clods of dirt or loose soil should be present after washdown.
- Radiator grills and the interior of vehicles should be free of accumulations of seed and other plant material.

Note that some machinery, such as harvesting equipment, cannot be washed with water because of potential damage to sensitive electronic equipment. Always consult and comply with the manufacturer's recommended cleaning method.

Cleaning and inspection should be undertaken in accordance with the general vehicle/equipment washdown procedure.

These standards will need to be modified to control specific Emergency Plant Pests. For instance, particular disinfectants may need to be applied and greater attention to soil accumulations behind protective plates and covers required.

Where field wash down is a regular practice facilities should be obtained and carried for the purpose. Large commercial wash units are available, though in many instances small self-assembled systems will be adequate. In industries that use bushfire slip-on units, these are ideal, allowing more flexible choice of washdown sites. Small fire pumps or portable high pressure wash units are suitable. A shovel, crow bar and stiff brush are also required. Farm workshops should also have suitable wash down

equipment. Where a blowdown only is required, compressors or portable blower vacs may be used along with a small brush.

Selecting a field washdown site

Field washdown will be required to contain Emergency Plant Pests to a particular area or where machinery is moved directly between field sites. Always consult the landholder in selecting a washdown site, consideration should be given to:

- Setting the washdown at the edge, or nearby, any areas where pests need to be contained, choose sites where the land slopes back into an infested area or an adjacent area not susceptible to the problem.
- Ensuring run-off will not enter any watercourse or waterbody, a buffer of at least 30 m is desirable.
- Avoiding sensitive vegetation or wildlife habitat e.g. remnant native vegetation and threatened species sites.
- Selecting mud-free sites (e.g. well grassed, gravel, bark or timber corded) which are gently sloped to drain effluent away from the washdown area. Run off water from the contaminated area *must not* flow to the clean area. If no adequate drainage is available, a pit must be dug as soon as heavy machinery arrives, to ensure no effluent escapes beyond the decontamination site.
- Allow adequate space to move tracked vehicles.
- Potential hazards, e.g. powerlines.

Low loaders are not a suitable platform for washing machinery.

Where there will be large quantities of effluent or there is a risk of extensive run-off, the washdown area should be bunded and a sump constructed to safely dispose of the effluent. Take particular care where the effluent is likely to be contaminated with oils.

Mark or record washdown sites for subsequent monitoring.

General vehicle/equipment washdown procedure

Note: Do NOT apply water to harvesters or other equipment that may be damaged by water.

1. Locate washdown site and prepare the surface or construct bunding as required.
2. Safely park the vehicle free of any hazards (e.g. electrical), ensure the engine is off and the vehicle is immobilised.
3. Look over the vehicle, inside and out, for where dirt, plant material including seeds are lodged. Pay attention to the underside, radiators, spare tyres, foot wells and bumper bars.
4. Remove any guards, covers or plates if required being careful of any parts that may cause injury.
5. Knock off large clods of mud, use a crow bar if required and sweep out the cabin.

6. Cleaning using disinfectant/soap and water with brushing to dislodge encrusted dirt and organic matter is preferable to washing with strong water streams.

Caustic soda should not be used on paintwork.

7. If using high temperature steam, wet equipment prior to cleaning to prevent Emergency Plant Pest being forced into the air.
8. Clean down with a high pressure hose and stiff brush/crowbar. Use only freshwater if washing down in the field.
9. Start with the underside of the vehicle, wheel arches, wheels (including spare). Next do the sides, radiator, tray, bumper bars etc and finally upper body. Some vehicles may need to be moved during washdown e.g. tracked machinery.
10. Clean any associated implements e.g. buckets.
11. Check there is no loose soil or plant material that could be readily dislodged or removed.
12. In wash bays, steam treat or rinse off vehicle with clean water.
13. All washdown water should be captured for disinfection and disposal.

If using deep burial site, contact AQIS for approved burial site and procedures

Phone (02) 6272 3933
www.aqis.gov.au

Equipment Checklist

Use these checklists as a guide only. The equipment will vary with specific circumstances.

Personal equipment

Cap or hairnet	
Gumboots	
Cotton or disposable overalls	
Torch and batteries	
Gloves – disposable	
Goggles	
Short-handled scrubbing brush	
Boot tray or bucket	
Heavy duty plastic garbage bags	
Spare underclothes	

Decontamination site — Infected Premises or Contact Premises

2 plastic ground sheets (10 m x 10 m)	
50 m hessian sacking	
Star pickets	
Caravan and portable shower units	
50 m of 20 mm rope	
6 x 200 L drums	
Fibreglass water tanks to 2500 L	
Water supply	
Pumps eg Southern Cross or Davey Firefighting units	
Hoses (spray attachments)	
Disinfectant supplies (citric acid or sodium carbonate) as appropriate	
Hand brushes – short and long handle	
Boot trays	
Buckets	
Heavy duty plastic garbage bags	
Spare overalls	

Property decontamination

Water supply	
Portable pumps, eg Southern Cross, firefighting pumps	
Polypipe 50 mm	
Fittings for pipe	
Hoses	
High pressure industrial pumps and lances	
Fibreglass water tanks of sizes up to 2500 L	
200 L drums	
Universal indicator strips	
Appropriate disinfectant	
Flame guns and fuel	
Fuel for pumps and engines	

Generators	
Arc lamps	
Electric lead and connectors	
Mechanical diggers	
Bulldozers	
Tractor and trailers	
Front-end loaders	
Vehicle-mounted boom spray	
Shovels	
Brooms	
Forks	
Crowbars	
Hand tools	
Plastic sheeting	
20 L containers (metal)	
Industrial gloves	
Respirators	
Perspex face shields	
Back pack sprays	

Vehicle decontamination

Water supply and tanks for storage	
Buckets	
Detergent and brushes	
Disinfectants	
Sponges	
Tools for dismantling floor – shovels, hand brushes, scrapers	
Fire fighting pump	
High pressure pump	
Fuel for pump engines	
Perspex face shields	
Personal equipment	

Appendix 7: Emergency Plant Pest Alert Template

The Emergency Plant Pest Alert will be used in briefing government, industry and the media on the details of the incursion. The information included in the Pest Alert will vary depending on the incursion and its intended audience. It is particularly important that the Pest Alert provides the media with general information on the outbreak which cannot easily be misinterpreted and does not disclose the identity of property owners. Images of publication quality of the disease/pest/damage should be obtained and included with the Pest Alert.

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Agriculture Western Australia

Carrot rust fly *Psila rosae*

Exotic threat to Western Australia

By John Botha, Darryl Hardie and Greg Power, Hortguard™ Initiative AGWEST

Background

Carrot rust fly was probably introduced into North America, South Africa and New Zealand from Europe. There is a considerable risk of the species being transported as larvae in root crops, especially to other temperate countries like Australia. This reinforces the need for thorough quarantine measures to remain in place. For further information on WA quarantine regulations for this pest please refer to the Carrot Industry Protection Plan and Reference Manual, or contact Agriculture Western Australia's Quarantine Entomologist, Mike Grimm, on (08) 93683752.

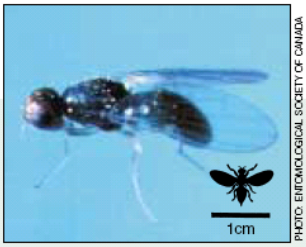


PHOTO: ENTOMOLOGICAL SOCIETY OF CANADA

ADULT CARROT RUST FLY

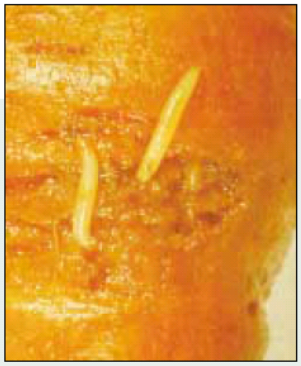
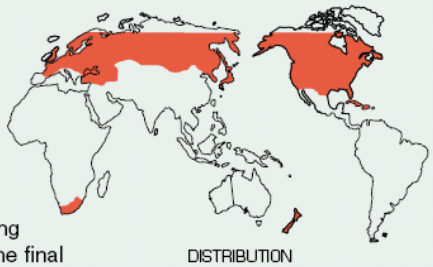


PHOTO: ENTOMOLOGICAL SOCIETY OF CANADA

LARVAE FEEDING ON CARROT ROOT

Potential impact

Carrot rust fly reproduces successfully in South Africa as well as the carrot districts in warmer parts of the North Island of New Zealand. It is likely that the pest would flourish in the cooler areas of south-western Western Australia.



DISTRIBUTION

Carrot rust fly is a severe pest of carrots, killing many seedlings early in the year or making the final crop unsaleable due to the level of larval mines, secondary rots and the uneven size of root development.

Plants affected

Major hosts
Daucus carota (carrot), *Pastinaca sativa* (parsnip), *Apium graveolens* (celery), *Petroselinum crispum* (parsley), *Levisticum officinale* (lovage), *Apium graveolens* var. *rapaceum* (celeriac).

Minor hosts
Anethum graveolens (dill), *Foeniculum vulgare* (fennel, which frequently occurs as a roadside weed in WA), *Anthriscus cerefolium* (chervil), *Carum carvi* (caraway), *Coriandrum sativum* (coriander).

Wild hosts
Conium maculatum (poison hemlock, which is naturalised but not common in the Perth region).


PHOTO: ENTOMOLOGICAL SOCIETY OF CANADA
PUPAE OF CARROT RUST FLY

Season of occurrence

Adult flies emerge from overwintering cocoons in spring, and females lay their eggs on or near the crowns of young carrots. The eggs hatch after about ten days, and the maggots feed for up to 7 weeks before pupating in the soil. There can be two or three generations per year depending on climatic conditions.


PHOTO: BEJO ZADEN HOLLAND
DAMAGE TO CARROT

Mode of spread:

Natural
Adults are weak fliers, but wind does appear to play a role in their dispersal.

Human aided
There is considerable risk of the species being carried as larvae in root crops. There is also the possibility of transferring pupae in infested soil.

Symptoms

The larvae feed on the roots of young and mature plants. Symptoms include partial dieback with yellowing, or the whole plant can turn brown and die due to internal feeding.

In carrots the young plants are attacked on the taproots and may die, leaving gaps in the crop. Larger carrot plants are attacked at the base of the taproot and lower down, showing irregular brown channels under the surface, from which the creamy-white larva (maggot) can be extracted. Where damage to plants is severe, the leaves become reddish and the plant may die, particularly if stressed from dry conditions.

In parsnips the damage is similar to that on carrots, but usually it is confined to the top 15 cm of the root.

In celery the larvae bore into the roots, crown and petioles, resulting in yellowing of the leaves and a reduction in growth or death of young plants.

In parsley the larvae live in the surface of the taproot and in the lateral roots.

Appendix 8: Incursion Incident Report

Pest:	Common and scientific name
Host:	Name of host plant
Location:	Locality, city, state/territory
Detection date:	Date
Detected by:	Organisation

Detection details

Detail the following:

- Date of incursion.
- Who made the detection.
- What was detected.
- What was the method of detection.
- On what host was the detection made on.
- Where was it detected.
- What was the extent of the outbreak (geographic and severity).
- Is this detection considered a first record of an incursion.
- Confirmation of identity and details.

Description and effect

Detail as many of the following factors as possible (where known):

- Worldwide distribution.
- Host range (listed generally).
- The effect on the hosts.
- Potential economic cost.
- Potential for establishment.
- How the pest is spread.
- Available control methods.

Response to date

Detail any actions taken place to date, including:

- Treatment or destruction of host material and/or products.
- Establishment of quarantine zones and/or restrictions.
- Trace back and trace forward analysis.
- Media releases issued.

Appendix 9: Eradication or Alternative Action

Assumptions

In making a decision on eradication or alternative action, some assumptions may need to be made, including:

- The diagnosis (especially strain identification), biology, dispersal and host range information is correct.
- Effective control treatments have been identified and are available.
- The cost/benefit analysis developed by ABARE is accepted as an accurate economic risk assessment summary.
- Survey data represents a realistic and up-to-date summary of the distribution of the incursion for risk management decisions.

Factors favouring eradication	*Factors favouring alternative action*
● Cost/benefit analysis shows significant economic loss to industry or the community if the organism establishes.	● Cost/benefit analysis shows relatively low economic or environmental impact if the organism establishes.
● Physical barriers and/or discontinuity of hosts between production districts.	● Major areas of continuous production of host plants.
● Cost effective control difficult to achieve (e.g. limited availability of protectant or curative treatments).	● Cost effective control strategies available.
● The generation time, population dynamics and dispersal of the organism favour more restricted spread and distribution.	● Short generation times, potential for rapid population growth and long distance dispersal lead to rapid establishment and spread.
● Pest biocontrol agents not known or recorded in Australia.	● Widespread populations of known pest biocontrol agents present in Australia.
● Vectors discontinuous and can be effectively controlled.	● Vectors unknown, continuous or difficult to control.
● Outbreak(s) few and confined.	● Outbreaks numerous and widely dispersed.
● Trace back information indicates few opportunities for secondary spread.	● Trace back information indicates extensive opportunities for secondary spread.
● Weather records show unfavourable conditions for pest development.	● Weather records show optimum conditions for pest development.
● Ease of access to outbreak site and location of alternate hosts.	● Terrain difficult and/or problems accessing and locating host plants.

Appendix 10: Generic Elements of an Emergency Plant Pest (EPP) Response Plan

Structure and content of an EPP Response Plan

The following guide to the structure and content of an EPP Response Plan is taken from Schedule 4 of Version 9 of the Emergency Plan Response Deed (EPPRD). Development of the Emergency Plant Pest Response Plan should be commenced as soon as possible following confirmation of the incident.

The subheadings may be regarded as a checklist to aid in the development of the Emergency Plant Pest Response Plan. The Emergency Plant Pest Response Plan may not necessarily need to refer to all matters referred to in the subheadings. The amount of detail will depend on the nature and extent of the Emergency Plant Pest response, and the stage of the response.

However, an EPP Response Plan submitted for initial approval by the National Management Group (NMG) must address all of the following major headings shown in bold type. Other components may be developed, and their approval sought, in accordance with a timetable agreed by the Consultative committee on Plant Pest (CCEPP).

Status report on suspect Emergency Plant Pest

Pest details:

- Name of pest: common and scientific.

Affected host:

- Affected plant: name (common and botanical).

Diagnostic details:

- How was pest detection confirmed? Date, laboratory and methods used for sample diagnosis.
- Details of other laboratories sample was sent to for simultaneous testing.

Description and effect:

- The effect on the plant when infested. The potential economic cost.

Extent of incident:

- The geographic area and severity – for example, minor outbreak, 1 property of 500 ha no other properties in the vicinity or major outbreak, 5 properties of around 3000 ha in total, many other properties in the vicinity.
- Include maps if available.
- Delimitation survey results from neighbouring properties.

Host range and epidemiology:

- Spread potential and establishment potential.

- Natural and possible hosts.
- Current geographic distribution.
- Details of current eradication programs worldwide.
- Previous detections in Australia.

Availability of control methods:

- Can the pest be controlled (treatments/resistance)?
- Whether Australian Pesticides and Veterinary Medicines Authority (APVMA) emergency use permits are necessary/have been obtained.

Course of action:

- Suggested methodology to eradicate an incursion.
- If contingency plan is available these protocols should be followed. Where the emergency response plan differs from the contingency plan approval must be obtained from the National Management Group.
- Quarantine of the affected area - areas under quarantine.
- Declaration of pest quarantine area (PQA). When the declaration of pest quarantine area was declared, any amendments since declaration.
- Quarantine and movement controls - Date and details of notice. Any amendments to notice.
- Destruction and disposal of affected material.
- Delimiting surveys.
- Details of host-state surveys carried out within and outside the declaration of pest quarantine area.

Publicity:

Is the media involved? if so, how? Will the issue become public, and if so, when?

Awareness of the outbreak:

- Has a communications plan been developed?

Key messages.

Key communications during the outbreak:

- types of communication.
- media releases, web-based updates, posters, fact sheets.
- where media enquires are directed.

Feasibility of eradication on technical and/or economic grounds

- Feasibility of eradication given the specifics of the outbreak.

Proposed response activities (eradication strategies)

Destruction of plant material:

- Details of destruction methods, refer to contingency plan if appropriate.
- Legislation.

Destruction procedures for all infected plants and host plants within the quarantine area:

- Any disposal issues.

Quarantine and movement controls on plants, plant products, people, machinery and other items including details of the:

- Movement of plants and plant products, appliance and other things into, within and out of Infected Premises and the Quarantine Zone.
- Movement of plants and plant products, equipment and other things into, within and out of the pest quarantine area
- Movement of host material outside the pest quarantine area,
    - Restricted Area (RA).
    - Control Area (CA).

Decontamination and farm clean-up procedures

Diagnosis, tracing and surveillance

Diagnostics:

Key steps in diagnosing the pest.

- Tracing:
    - Tracefoward/traceback procedures.
- Surveillance:
    - Details of the surveillance plan, frequency of surveys.
    - Maps.
    - Estimated period required to monitor eradication.
- Liaison:
    - Between State/Territory and private laboratories.
- Resources for surveillance and laboratory testing.
    - Diagnostics.
    - Surveillance and tracing staffing.

Zoning

- Details of zones involved in the emergency eg destruction zone, quarantine zone, buffer zone, restricted zone and the control zone.

Destruction strategy:

- Destruction protocols.
- Priorities.

- Processing of plants, and plant products, including by-products and waste.
- End-use of any processed plants and plant products.

Situation Reports production and dissemination

- Consultative Committee on Emergency Plant Pest will meet (quarterly) to review progress
- Progress reports circulated to National Management Group and Consultative Committee on Emergency Plant Pest.

International notifications (DAFF responsibility)

Indicative budget (to be provided for each proposed response activity)

Staffing:

Permanent staff (including accreditation to National Emergency Plant Pest Preparedness Competency Standards).

- Include number of staff (Full Time Employment) required to undertake activities associated with the response plan.
- Number of staff required to be specifically recruited.
- Volunteers/emergency services personnel.

Operating:

- Breakdown categories as far as possible.
- Non-labour budget in the key activity areas of:
    - Program management.
    - Destruction and disposal.
    - Surveillance and tracing.
    - Quarantine and movement control.
    - Information management.
    - Scientific support.
    - Communication and industry liaison.
- Cost sharing budget estimates.

Capital

Owner Reimbursement Costs

Public Relations

Industry and community liaison

Lead responsibility for liaison with media

Local Pest Control Centre:

- Include diagrams of management structure.

Local Pest Control Centre site

Equipment

Operations:

- Diagnostic investigations.
- Restricted Area movement and security.
- Infected Premises operations.
- Other field operations.

Planning:

- Epidemiology/ecology/taxonomy.
- Public relations.
- Technical specialists.
- Liaison.

Logistics:

- Induction for incoming staff.
- Administration (accommodation, meals, transport etc).
- Emergency services liaison.

Infected Premise Operation Teams

Forward Command Team (FCP) (if necessary)

Industry Liaison

State Pest Control Headquarters:

- Include diagrams of management structure.

Structure, management and staffing

Planning:

- Legal support.
- Epidemiology/ecology, taxonomic and other specialist support.

Operations:

- Tracing, surveillance, movement controls and destruction.
- Mapping and information management.

Logistics:

- Administration.
- Emergency services liaison.

Communications

Industry Liaison

Information systems and management

- Software to assist the management of Emergency Plant Pest information.

- Control centres information management:
    - Message forms and log sheets.
    - Files
    - Personnel.
    - Information boards.
    - Staff information briefings.

Additional research and information needs

Accounting procedures

Monitoring of cost effectiveness of Emergency Plant Pest Response Plan:

- Program objectives and milestones.
- Progress report, financial summary reports.
- Groups or committees set up to oversee the response.

Appendix 11: Identifying Costs/Benefits

The costs of an eradication campaign usually reflect the direct costs associated with implementing and running the program, and the benefits represent the direct savings in costs that would otherwise be incurred if the program was not implemented (there may also be secondary costs and benefits that occur as indirect flow-on effects of the program).

These costs and benefits are valued in dollar terms to enable the comparison of diverse positive and negative impacts of a program. Potential costs and benefits are listed below.

Direct costs:

- Surveys/monitoring.
- Research and diagnostics.
- Expert consultation.
- Equipment/machinery and vehicles.
- Materials and application of chemicals (herbicides or insecticides).
- Maintenance of facilities.
- Awareness/education programs and public relations.
- Salaries.
- Travel.
- Legal fees.
- Data management.
- Contracting and/or other administrative costs incurred by plant health services.
- Loss of product quality.
- Marketing, handling and processing.

Secondary costs:

- Costs of detecting and eradicating a pest at low population levels.
- Likelihood of reintroductions.
- Possible adverse effects of eradication programs on human health, non-target species, food and the environment.
- Costs to affected grower(s) including loss of income, reduced value of personal/business assets, costs incurred as a result of possible quarantine restrictions and/or impacts on lifestyle.

Direct benefits:

- Preventing yield loss in host crops.
- Saving growers the cost of additional controls (e.g. insecticides) for the pest.

- Eliminating economic losses to Australia due to market access restriction.
- Eliminating economic losses to Australia due to removal of quarantine restrictions.
- Eliminating costs to growers incurred as a result of disinfestation of host produce for the domestic market.

Secondary benefits:

- Minimising to private gardens, parks, nature strips, or uncultivated land.
- Minimising additional research and development costs.
- Preventing risks to human health.
- Eliminating structural adjustment costs in the affected industry.
- Eliminating costs to associated sectors.
- Preventing negative impacts on the work/leisure environment and employment options.

Estimating benefits

The measurement of benefits is highly dependent upon the ability to predict what impact the carrot rust fly would have if it was not controlled.

Data on the impact that the pest has had in countries where it is established is useful but not definitive. Introduced pests may behave differently in a new environment compared with their original environment.

Information on the impact of the pest overseas must be reassessed to take into account Australian conditions, such as differences in:

- Climate.
- Cultivar susceptibility.
- Range of potential host plants.
- Presence/absence of vectors.
- Spray regimes.
- Potential to adapt to its new environment (based on its known geographic range).

In some cases software application packages may be used to model the potential distribution.

Template for Cost/Benefit Analysis

This template is still being developed. Plant Health Australia will consult with relevant members regarding the finalisation of this section of PLANTPLAN.

The costs of an eradication campaign usually reflect the direct costs associated with implementing and running the program, and the benefits

represent the direct savings in costs that would otherwise be incurred if the program was not implemented (there may also be secondary costs and benefits that occur as indirect flow-on effects of the program). These costs and benefits are valued in dollar terms to enable the comparison of diverse positive and negative impacts of a program. Potential costs and benefits are listed below.

Direct costs:

- Surveys/monitoring.
- Research and diagnostics.
- Expert consultation.
- Equipment/machinery and vehicles.
- Materials and application of chemicals (herbicides or pesticides).
- Maintenance of facilities.
- Awareness/education programs and public relations.
- Salaries.
- Travel.
- Legal fees.
- Data management.
- Contracting and/or other administrative costs incurred by plant health services.
- Loss of product quality.
- Marketing, handling and processing.

Secondary costs:

- Costs of detecting and eradicating a pest at low population levels.
- Likelihood of reintroductions.
- Possible adverse effects of eradication programs on human health, non-target species, food and the environment.
- Costs to affected grower(s) including loss of income, reduced value of personal/business assets, costs incurred as a result of possible quarantine restrictions and/or impacts on lifestyle.

Direct benefits:

- Preventing yield loss in host crops.
- Eliminating growers the cost of additional controls (e.g. insecticides) for the pest.
- Eliminating economic losses to Australia due to market access restriction.
- Eliminating economic losses to Australia due to removal of quarantine restrictions.

- Eliminating costs to growers incurred as a result of disinfestation of host produce for the domestic market.

Secondary benefits:

- Eliminating damage to private gardens, parks, nature strips, or uncultivated land.
- Minimising additional research and development costs.
- Preventing risks to human health.
- Eliminating structural adjustment costs in the affected industry.
- Eliminating costs to associated sectors.
- Preventing negative impacts on the work/leisure environment and employment options.

Estimating benefits

The measurement of benefits is highly dependent upon the ability to predict what impact the Emergency Plant Pest would have if it was not controlled. Data on the impact that the pest has had in countries where it is established is useful but not definitive. Introduced pests may behave differently in a new environment compared with their original environment. Information on the impact of the pest overseas must be reassessed to take into account Australian conditions, such as differences in:

- Climate.
- Cultivar susceptibility.
- Range of potential host plants.
- Presence/absence of vectors.
- Spray regimes.
- Potential to adapt to its new environment (based on its known geographic range).

In some cases software application packages may be used to model the potential distribution and density of the pest. For example, CLIMEX is a dynamic simulation model that enables the prediction of the potential distribution of an introduced species based on temperature, relative humidity and rainfall. These simulations can help to identify the major production regions in Australia that are climatically suitable for a pest but, as for all modelling programs, the outcomes will only be as robust as the data on which they are based.
A good understanding of the industry(s) under threat in Australia is also needed to estimate the likely impact of the pest. Consider:

- Hosts at risk.
- Location of major/minor production areas.
- Varieties grown (and their susceptibility to the pest).

- Production figures (value and volume).
- Trade figures (export markets – both international and domestic).
- Phytosanitary measures applied to imports.

Acronyms

APVMA	Australian Pesticides and Veterinary Medicines Authority
AQIS	Australian Quarantine and Inspection Service
BA	Biosecurity Australia
CA	Control Area
CCEPP	Consultative Committee on Emergency Plant Pests
CPHM	Chief Plant Health Manager
CPPO	Chief Plant Protection Officer
DAFF	Australian Government – Department of Agriculture, Fisheries and Forestry
DAFFEMPLAN	DAFF Emergency Management Plan
DQMAWG	Domestic Quarantine and Market Access Working Group
EMA	Emergency Management Australia
EPP	Emergency Plant Pest
EPPRD	Emergency Plant Pest Response Deed
FCP	Forward Command Post
GPS	Global Positioning System
IBP	Industry Biosecurity Plan
ILO	Industry Liaison Officer
IP	Infected Premises
IPO	Infected Premises Operations
IPOT	Infested Premises Operations Team
IPPC	International Plant Protection Convention
LPCC	Local Pest Control Centre
MCS	Manager of Chemical Standards
MPR	Media and Public Relations
NIMTG	National Information Managers Technical Group
NMG	National Management Group
NPCHQ	National Pest Control Headquarters
OCPPO	Office of the Chief Plant Protection Officer
OH&S	Occupational Health and Safety
PHA	Plant Health Australia
PHC	Plant Health Committee
PHO	Plant Health Officer
PIHC	Primary Industries Health Committee
PIMC	Primary Industries Ministerial Council
PISC	Primary Industries Standing Committee
QA	Quality Assurance
RA	Restricted Area
SAP	Scientific Advisory Panel
SES	State Emergency Service
SP	Suspect Premises
SPCHQ	State/Territory Pest Control Headquarters

Glossary

Accredited laboratory	Criteria for accreditation of laboratories involved in EPP responses are currently being developed by PHA.
Biosecurity	Protection from risks posed by EPPs through actions such as exclusion, eradication, and control.
Categorisation Group	The Categorisation Group is a group convened to advise on the categorisation, re-categorisation or removal from the categorised list of a EPPs from EPPRD.
Chief Plant Health Manager	The plant health manager of each state/territory plant health authority that has prime responsibility for plant pest control in that state or territory.
Chief Plant Protection Officer	The Chief Plant Protection Officer is responsible for undertaking national coordination and emergency management of plant health issues. The Office of the Chief Plant Protection Officer is an operating unit within the Australian Government Department of Agriculture, Fisheries and Forestry.
Consultative Committee on Emergency Plant Pests	The CCEPP is the key technical coordinating body providing the link between the Australian Government, state/territory Governments, Industry, PHA and NMG for EPP incursions. The CCEPP makes recommendations to the NMG on incursion management response. For further details of the responsibilities and composition of the CCEPP refer Schedule 8 of the Government and Plant Industry Cost Sharing Deed in respect of Emergency Plant Pest Responses.
Contact Premises	Premises (or locality) containing susceptible host plants which are known to have been in direct or indirect contact with an infected premises.
Containment	Restriction of an incursion to a limited area, perhaps with quarantine measures enforced in order to prevent further spread. Containment may be an adjunct to or an approach used in an eradication campaign.
Control Area (CA)	A CA will be imposed around the RA and will include all SPs. The purpose of the CA is

	to regulate movement of susceptible plant species for as long as is necessary to complete trace back and epidemiological studies. Movement controls will apply and the area will be surveyed regularly. Once the limits of the disease have been confidently defined, the CA boundaries and movement restrictions will be reduced or removed.
Cost sharing	Cost Sharing is the process of Government and Industry Parties proportional funding of the shared costs arising from the implementation of an EPP Response Plan.
Diagnostic laboratory	Laboratory used for identification or confirmation of a suspected EPP.
Diagnostic team	Team of personnel sent to investigate and collect samples when there is suspicion of an EPP.
Domestic Quarantine and Market Access Working Group	The Domestic Quarantine and Market Access Working Group is a subordinate committee of the Plant Health Committee. It works collaboratively with other committees on market access issues/arrangements.
Emergency Plant Pest	As defined in the EPPRD, an Emergency Plant Pest or EPP is a Plant Pest that is included in Schedule 13 or which is determined by the Categorisation Group to meet one or more of the following criteria: It is a known exotic Plant Pest the economic consequences of an occurrence of which would be economically or otherwise harmful for Australia, and for which it is considered to be in the regional and national interest to be free of the Plant Pest. It is a variant form of an established Plant Pest which can be distinguished by appropriate investigative and diagnostic methods and which, if established in Australia, would have a regional and national impact. It is a serious Plant Pest of unknown or uncertain origin which may, on the evidence available at the time, be an entirely new Plant Pest or one not listed in Schedule 13 and which if established in Australia is considered likely to have an adverse economic impact regionally and nationally. It is a Plant Pest of potential economic importance to the area endangered thereby and not yet present there or widely distributed and being officially controlled, but is occurring in such a fulminant outbreak form, that an emergency response is required

	to ensure that there is not either a large scale epidemic of regional and national significance or serious loss of market access. For further details refer to the EPPRD.
Emergency Plant Pest Response Deed	The proposed Government and Plant Industry Cost Sharing Deed in respect of Emergency Plant Pest Responses.
Emergency Plant Pest Response Plan	A plan for undertaking a response to an EPP that is developed by a state or territory CPHM and endorsed by the CCEPP and the NMG and which is subject to cost sharing in accordance with the EPPRD.
Eradication	Eradication is the permanent elimination of the EPP from the ecosystem which, in practice, means that it can no longer be detected by recommended methods of survey and diagnosis.
Establishment	Perpetuation, for the foreseeable future, of a pest within an area after entry.
Evidence register **Incident Action Plan**	A daily written plan detailing the day's activities, against which the situation reports are prepared by the LPCC Controller.
Incident Definition Phase	The investigation period following formal notification to the CCEPP of an incident.
Incursion	The detection of a pest which qualifies as an Emergency Plant Pest in the EPPRD.
Industry	Any industry member of PHA who is a signatory to the EPPRD.
Industry Representative	An appropriately accredited person who represents each Industry Party at the NMG, CCEPP or Categorisation Group.
Infected Premises	Premises (or locality) at which the EPP is confirmed or presumed to exist.
Infected Premises Operations Team	Carry out control and/or eradication procedures at the Infected Premises, managed by the Operations Manager of the LPCC.
Lead Agency	The state(s) or territory(s) which are responsible for leading the conduct of an EPP Response Plan. Usually the state/territory in which the EPP was first detected.
Local Pest Control Centre	A local emergency operations centre responsible for the command and control of

	field operations in a defined area. Generally the LPCC would be close to the RA. Refer to Control Centres Management, Section 3.3
LPCC Controller	Appointed by the CPHM. The LPCC Controller manages the operational activities of the eradication/control of EPPs in the LPCC‟s area of responsibility.
Manager of Chemical Standards	Person with responsibility for sourcing and managing emergency registration of chemicals.
National Management Group	A group which will approve or not approve the invoking of cost sharing following advice from the CCEPP of an appropriate EPP Response Plan and which will manage, on behalf of the affected parties, the national policy and resourcing needs of an EPP Response Plan.
Owner reimbursement costs	Valuation principles for the destruction of crops or other assets during the conduct of an EPP Response Plan as included in the EPPRD.
Peak industry body	Organisation representing an Industry and which is a member of PHA and signatory to the EPPRD.
Plant Pest	As per the EPPRD, Plant Pest means any species, biotype or strain of invertebrate pest or pathogen injurious to plants or plant health provided that it is discrete, identifiable and genetically stable, but excludes Genetically Modified Organisms.
Pest free area	An area in which a specific pest is known not to occur as demonstrated by scientific evidence and in which, where appropriate, this condition is being officially maintained.
Plant Health Officer	Officers with powers delegated under state/territory plant health legislation.
Quarantine	Compulsory or voluntary restraints upon activities on an affected property imposed as part of an EPP Response Plan and in accordance with relevant state/territory plant health legislation to prevent the spread of an EPP(s). Includes restrictions on access to and removal of plants from an affected property, and movement controls on plants, plant products, people, machinery and other items except as approved in accordance with the

	EPP Response Plan.
Restricted Area	A relatively small area (compared to CA) around infected premises and SPs that is subject to intense surveillance and movement controls. Movement out of the area will, in general, be prohibited, while movement into the RA would only be by permit. Multiple RAs may exist within one CA.
Sample Submission Form	Form obtained from the diagnostic laboratory which is to be filled out by the diagnostic team when collecting samples. The Sample Submission Form will form part of the exhibit register for samples taken from Infected Premises or Contact Premises.
Scientific Advisory Panel	A panel of experts that may be appointed by the CCEPP to evaluate, based on scientifically-based decision making processes, the progress of an eradication campaign.
State/Territory Pest Control Headquarters	The emergency operations centre that directs the pest control operations to be undertaken across the state/territory. Refer to Control Centres Management, Section 3.2
State/Territory Pest Control Headquarters Director	Under the authority of the CPHM, directs key activities during the emergency response.
Surveillance	A systematic examination and testing of plants or an area to determine the presence or absence of an EPP
Suspect Premises	Premises (or locality) containing plants which may have been exposed to an EPP and which will be subject to quarantine and intense surveillance.
Tracing	The process of locating plants, plant material, persons, or other items that may be implicated in the spread of an EPP.

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