



STATE OF WASHINGTON

## DEPARTMENT OF AGRICULTURE

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### Pest Specimen Identification System and Methods

By Michael W. Klaus, Entomologist, WSDA, Yakima

#### A Diagnostic Aid and System for Arthropod Identification

All arthropod specimens (insects, mites, spiders etc.) must be submitted with a WSDA Pest & Disease (P&D) Sample Form. The WSDA Pest Program in Yakima supports various agricultural commodity exports with the identification of pests of potential quarantine concern. This identification aid is designed to identify some of the common pests of quarantine significance and to separate out some of the common, non-quarantine, pest look-a-likes that WSDA inspectors encounter. [Key characteristics are in blue text.](#) All identifications of quarantine pests of concern must be verified by a qualified WSDA, WSU or USDA Entomologist.

1. a. Specimens from the WSDA Cherry Inspection Program go to 2.a.
1. b. All others go to 3.
2. a. [The larvae \(maggots\) of cherry fruit fly species are 5 to 6 mm \(about .2 in.\) long, cream-colored, and have no legs or visible head. The posterior end is blunt; the anterior or "front" end tapers to a point with two dark mouth hooks.](#) Specimens for the Cherry Inspection Program should arrive in 70-90% ethyl alcohol vials with spill proof caps. **Do not use isopropyl alcohol!** It will dry out and discolor the specimen making identification difficult to impossible. Vials must contain a paper label written only in pencil (ink dissolves in alcohol). The label must have the collector name, warehouse, grower, lot number (or whatever number your inspection protocol requires), sample number, and date

#### *Rhagoletis indifferens* Curran



**Fig. 1.a.**

## Technical Larval Description

Western cherry fruit fly. Body length 5.5–9.5mm (range estimated, LEC coded as small - medium); elongate-cylindrical (?). Integument unsclerotized, entirely whitish to yellowish. Caudal ridge absent. Mature larvae unable to jump.



Fig. 1. b.

**Head.** Head of normal shape. Antenna 2-segmented. Stomal organ: primary lobe rounded, protuberant; number of peg sensilla one (?); peg sensilla unbranched (?); other peg-sensilla-like structures ?. **Stomal region:** secondary lobes absent; **sclerotized stomal guards present (?); number of sclerotized stomal guards 1 (small, blunt)**. Oral ridges present; number of oral ridges 5–13 (short; ?); margins entire (?). Accessory plates absent (?). Elongate, finger-like lobes arising above mandibles absent. Median oral lobe absent or not protruding. Labium broad (?).

*Rhagoletis indifferens*

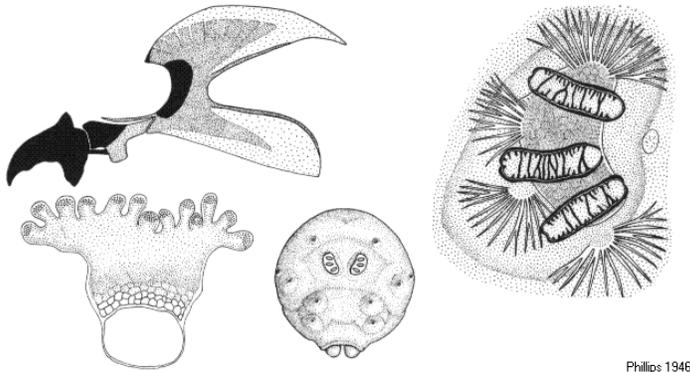


Fig. 1.c.

Note – the image field above includes: a mandible (top left), anterior spiracle (bottom left), caudal spiracles (bottom center) and close-up of caudal spiracles (far right)

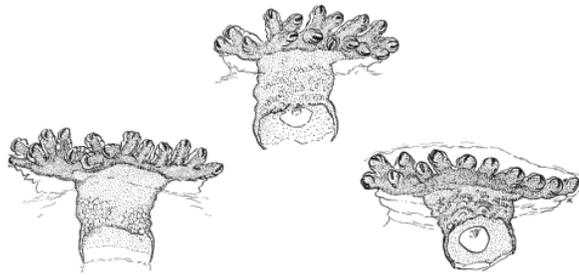
**Cephalopharyngeal skeleton.** Mandibles: subapical teeth absent; base stout, nearly perpendicular to a line from ventral part of base to apex of mandible. Parastomal bars elongate, free from hypopharyngeal sclerite. Dental sclerites apparently absent, not visible in lateral view.

**Spinules and creeping welts.** Dorsal spinules on segments with an unusual distribution (T3-A6?, very hard to see).

**Caudal segment (a8) and anal lobes.** Sensilla on caudal segment 10 pairs, with at least 7 pairs visible under dissecting microscope (?). Intermediate caudal sensillum I2 obvious (?). Intermediate caudal sensilla I1a&b and I2 on a single tubercle (?). Ventral caudal sensilla obvious, on a papilla or tubercle (?). Anal lobes plainly visible, but not strongly protuberant.

**Anterior spiracles.** Anterior spiracle elevated, margin convex to straight. **Anterior spiracular tubules 7–19 (Blanc & Keifer (1955));** in a single irregular row. See Fig. 1.d.below.

*Rhagoletis indifferens*



Blanc & Keifer 1955

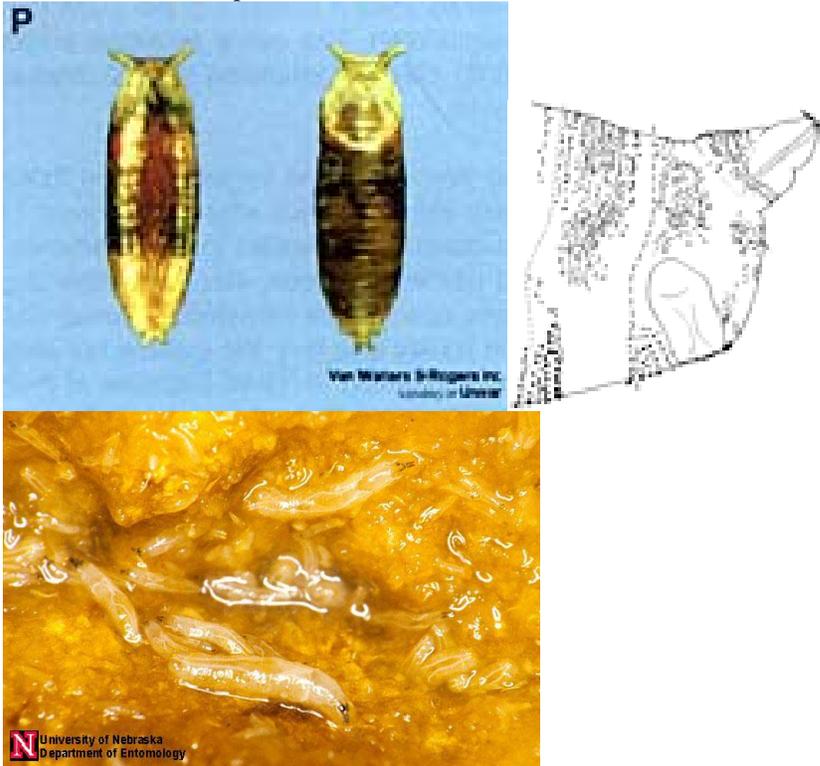
**Fig. 1.d.**

**Posterior spiracles.** Posterior spiracular area not distinctly set off (the look –a-like *Drosophila* sp. larvae have pronounced raised tubes commonly called “tail pipes” by the WSDA F&V Inspectors) from caudal segment. Posterior spiracles: slits 2.8–3.5x longer than wide (avg.~Blanc & Keifer; 3.0–3.2~figure as measured by LEC). Dorsal spiracular processes with numerous trunks arising from a short or semicircular base (long processes). Number of dorsal spiracular processes 11–14 (?). Number of ventral spiracular processes 11–14 (?). Number of lateral spiracular processes 8–12 (?). Area between posterior spiracles smooth. See Fig. 1.c.

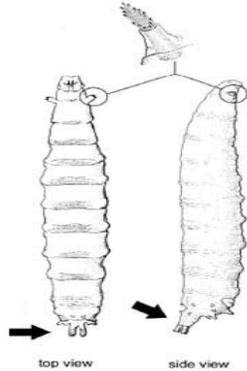
**2. b. If “tailpipes” are present, it is probably *Drosophila*, and not a Cherry Fruit Fly maggot!**

**Caution!**

The smaller, early instar cherry fruit fly larvae can be difficult to distinguish from *Drosophila* sp. larvae to the untrained eye. However, upon close examination the two can be quickly separated by looking for the dramatically raised caudal spiracles (“tailpipes”) found on the *Drosophila*.



***Drosophila suzukii***



size: 3rd instar max 3.5mm

***Rhagoletis* sp.**



size: 3rd instar 5 - 7.5mm

**Fig. 2.a.**

*Drosophila* sp. caudal spiracles aka “tailpipes” (left, dorsal view, right lateral view, middle photo is larvae in decaying fruit, bottom view is a comparison with Tephritid larvae).

Currently, characteristics for positively identifying *Drosophila suzukii* larvae are not known. Lab rearing to the adult stage may be an option for certain protocols. If specific *Drosophila* species identification is required, then live *Drosophila* larval specimens will be required.

### Other look-a-likes

Other look-a-likes rarely encountered by cherry inspectors include: sap beetle larvae, and various Lepidoptera larvae. Larvae of both of these Orders will usually have very distinct legs and/or prolegs.

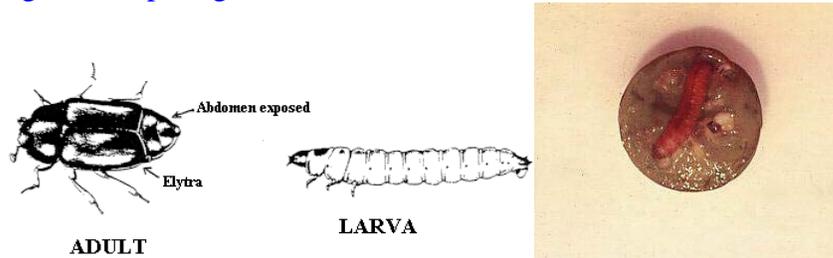


Fig. 2. b. left and center, Sap Beetle adult and larva. right, cherry fruitworm

System and Methods Aid for Pest Specimen Identification

### Stone Fruit Specimens from Samples for Export to Mexico or British Columbia, Canada

3. a. Stone Fruits Infesting Specimens. The main pests of concern here are Oriental Fruit Moth (OFM). Walnut Husk Fly (WHF) and Codling Moth (CM) rarely infest stone fruit in Washington. If the specimen is a caterpillar type larvae go to 4. a.



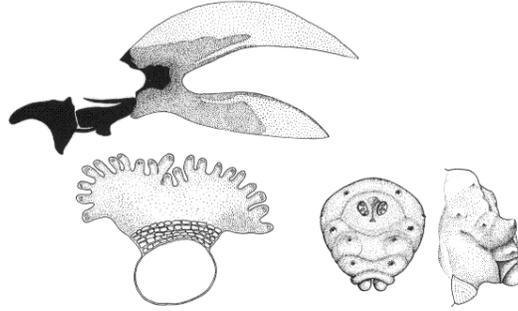
Fig. 3. a. Oriental Fruit Moth larva

- 3.b. If the specimen is a maggot, it is probably Walnut Husk Fly. Maggots of this fly are sometimes found in late peach varieties. This is rarely found in Washington. New research has shown that WCFF can infest apricots in Washington. This has only been recorded in non-commercial fruit situations and is considered to be a recent and rare occurrence.



Fig. 3. b. WHF Maggot

*Rhagoletis completa*



Phillips 1946

Fig. 3. c. WHF larva mandibles, prothoracic spiracle and caudal spiracles

System and Methods Aid for Pest Specimen Identification

- 4. a. Larva is caterpillar – like with distinct head and legs and/or prolegs --- codling moth (CM), OFM, LAW, Peach Twig Borer (PTB) or other Lepidoptera larva.



Fig. 4.a. Lepidoptera larva

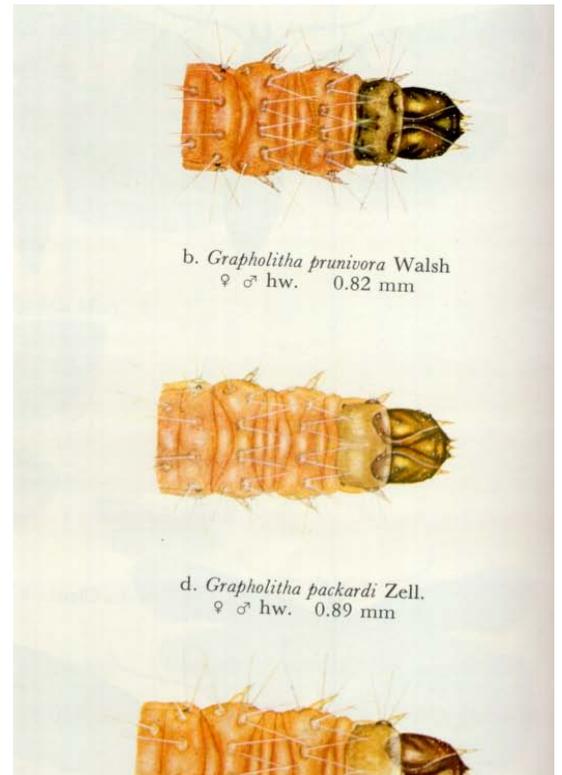
**Lesser Appleworm *Grapholitha prunivora* Walsh (0.82mm)**

LAW is not reported in peaches, apricots or nectarines. Anal Comb present



**Cherry Fruitworm *Grapholitha packardi* Zeller (0.89mm)**

CFW only has peach reported as a possible host. Anal comb present

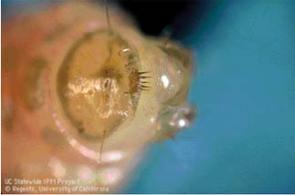




**Oriental Fruit Moth *Grapholitha molesta* Busck (1.11mm)**

OFM is found in stone fruit, but is rare in apples in Washington State.

Anal comb present.



**Codling Moth *Cydia pomonella* Linnaeus (1.65mm)**

CM has no anal comb. CM is rare in stone fruits in Washington State.

**System and Methods Aid for Pest Specimen Identification**

4. **b.** Larva not as in 4.a. above. **Mid-mature and Mature larva with distinct alternating light and dark banding.** – Peach Twig Borer.

Peach Twig Borer is the most common pest of Washington Stone fruits submitted by WSDA inspectors.



**Fig. 4. b. Peach Twig Borer Larva**

## Pests Causing Similar Damage



- Peach Twig Borer - 1st instar hard to tell from OFM!

**Fig. 4. c. First Instar Peach Twig Borer Larva**

### System and Methods Aid for Pest Specimen Identification

## PTB - Anal Comb



- PTB larvae also have an anal comb, so an anal comb alone does not mean you have OFM
- PTB anal comb has 6 teeth

**Fig. 4. d. PTB Anal Comb**



**Fig. 4. e. PTB larval damage to peach**

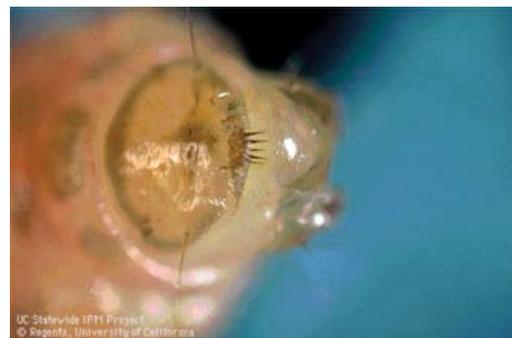
PTB damage is usually located on the stem end of the fruit. The larvae tend to prefer to hide under a leaf as they feed on the fruit.

System and Methods Aid for Pest Specimen Identification

**Pome Fruit Specimens from Samples for Export to Mexico or British Columbia, Canada**



**Fig. 5. a. Codling Moth larva**



**Fig. 5. b. OFM Larva (CM has no anal comb)**

5. a. Codling Moth - Just-hatched larvae are very small-about 2 mm long and 0.5mm in diameter. At this stage, the head is almost twice as wide as the body. When the larvae are young and boring into the fruit, they are pale yellow. [The full-grown codling moth larva can be distinguished from.....](#)

5. b. ... Oriental fruit moth and lesser appleworm larvae found in fruit, by the **absence** of the chitinous protuberance on the end of the abdomen called the **anal comb**.



**Fig. 5. c. – Codling Moth larva in apple**

System and Methods Aid for Pest Specimen Identification

5. c. Maggot-like specimens without distinct legs or head - probably AM.



**Fig. 5.d. Apple Maggot larvae**

Apple Maggot larvae have never been detected in Washington State commercial apples. Report any such suspicious AM larvae to a WSDA Entomologist!

The following attachment is intended for use by the WSDA Commodity Inspection Personnel to guide them in the proper handling of specimens encountered during the inspection process. It may be useful to periodically resend this memo as a reminder of the proper procedures.



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## DEPARTMENT OF AGRICULTURE

21 North First Avenue, Suite 103, Yakima WA 98902 • (509) 225-2609

July 25, 2006

TO: Jim Quigley, WSDA Commodity Inspection Division

FROM: Michael W. Klaus, Pest Biologist II

RE: Review of Specimen Submission Guidelines for Plant Protection Division Pest Identification

### **WSDA Plant Protection Division Procedures for Arthropod Specimen Collection, Handling, Identification and Record Keeping**

Please follow the following procedure key for handling specimens detected during the inspection process:

1. a. Plant Diseases (mold, fungi, bacteria etc.) – Submit to the WSDA Plant Pathologist
1. b. Arthropods (insects, mites, spiders etc.) submit with a WSDA Pest & Disease (P&D) Sample Form. Go to 2 below.
2. a. Specimens for the Cherry Inspection Program must be submitted in 70-90% ethyl alcohol vials with spill proof caps. **Do not use isopropyl alcohol!** It will dry out and discolor the specimen making identification difficult to impossible. Vials must contain a paper label written only in pencil (ink dissolves in alcohol). The label must have the collector name, warehouse, grower, lot number (or whatever number your inspection protocol requires), sample number, and date.
2. b. Other specimens (including specimens for USDA Export Programs) shall be submitted with a WSDA Pest and Disease Sample Form and handled as described in 3. below.
3. a. Live (including diapausing pupae or cocoons) shall be submitted in labeled, crush-proof vials or canisters. Specimens found attached to or within fruit shall be left intact and carefully packaged to ensure survival of specimen. Please keep the specimen cool and out of sunlight for possible rearing. (Sometimes the larvae grow enough in the time it takes to ship it to us to allow for easier identification.)

Many larvae are difficult or impossible to identify in the early instars and rearing may be necessary for identification to the species level. This is especially true for the Oriental Fruit Moth larval identifications. If you are not sure if the specimen is dead, treat it as a live specimen. The entomologist can make the live/dead determination in the lab. Please note on the P&D that the specimen appeared to be alive when it was submitted.

3. b. If the specimen is dead, check your export work plan, you may not need to submit it. Other dead specimens shall be submitted according to number 4 below.
4. a. Soft-bodied specimens (mites, spiders, larvae, aphids, moths, butterflies, flies, gnats and aphids) shall be submitted as in 2.a. above.
4. b. Hard-bodied specimens (beetles, and ants) shall be packaged in dry vials or other containers that prevent crushing.

We realize that sometimes specimens do not make it through the packinghouse processes in very good shape and we will do our best to make identifications. Most samples are coming into lab in good shape in proper containers, with labels etc. However, we have seen several samples where either the proper procedures are not being followed or were not known. Please send this memo out to all field offices to remind them of the proper procedures. Help us to help you better serve Washington State Agriculture!

**Currently, characteristics for positively identifying *Drosophila suzukii* larvae are not known. Lab rearing to the adult stage may be an option for certain protocols. If specific *Drosophila* species identification is required, then live *Drosophila* larval specimens will be required.**

### **Suggested Methods for Small, Live Specimens**

Many larvae are difficult or impossible to identify in the early instars and rearing may be necessary for identification to the species level. This is especially true for suspected Oriental Fruit Moth larval identifications. If you are not sure if the specimen is dead, treat it as a live specimen. The entomologist can make the live/dead determination in the lab. Please note on the P&D that the specimen appeared to be alive when it was submitted. If alive, the entomologist can attempt to rear it out to a larger instar and sometimes even to the adult stage.

Always submit your specimens with a WSDA Pest and Disease Sample Form and include information as to which program the sample is for, i.e. California Cherry Master Permit, Mexico Protocol, Cherry System Approach for Japan etc.

You may also try keying out your specimen at the following link.

<http://www.hortnet.co.nz/key/keys/damkey2/fruits/frtdam.htm>

or:

<http://www.faculty.ucr.edu/~legneref/bckey/insect2.key.htm>

or

## Acknowledgements

Images for this identification aid are based on a joint WSDA & WSU training presentation for stone fruit cutter certification. Many of the images used in that presentation came from WSU, USDA/ARS, UC-IPM and the Clemson insect image galleries made public for educational purposes. Please do not copy or redistribute the images without their permission.

Clemson University - USDA Cooperative Extension Slide Series, [www.insectimages.org](http://www.insectimages.org)

University California, Davis - [UC-IPM Online Guidelines for OFM](#)

United States Dept. of Agriculture/Agric. Research Service - [ARS Image Gallery](#)

Updated April 24, 2011