



## A visual guide to identifying invasive carpophilus beetle damage in almonds: differentiating carpophilus beetle from navel orangeworm and ant damage

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Invasive carpophilus beetle (*Carpophilus truncatus*, Coleoptera: Nitidulidae), was first reported infesting almond and pistachio orchards in the Central Valley of California in 2023. This species has been a significant pest of almonds in Australia over the past decade. In recent years, it has also been reported to cause damage in tree nut orchards in Italy and Argentina. In California, the carpophilus beetle has been found infesting multiple varieties, including Nonpareil, Sonora, Independence, Fritz, Carmel, and Monterey. Within a short period of its establishment in San Joaquin Valley orchards, this pest has caused significant economic loss to the growers.

The Carpophilus beetle is tiny (2.5 mm long). Adult females typically lay eggs on hullsplit nuts, and larvae and adults feed on the kernel directly. In California, both larvae and adult beetles can be found inside the kernels through late fall. They typically overwinter as adults in unharvested leftover nuts, known as "mummy nuts," predominantly in mummies that fall into the ground. In spring, they lay eggs on the mummy nuts on the ground, and larvae feed on them. They likely complete 1 to 2 generations before new adults move to the hullsplit nut.

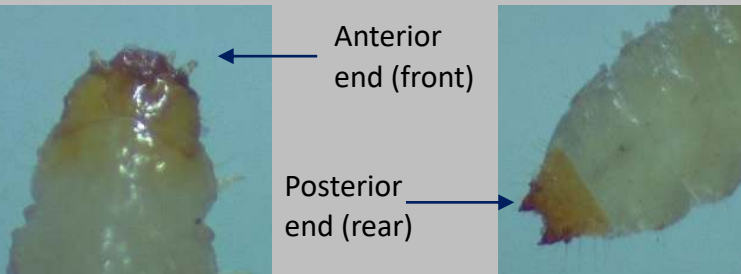
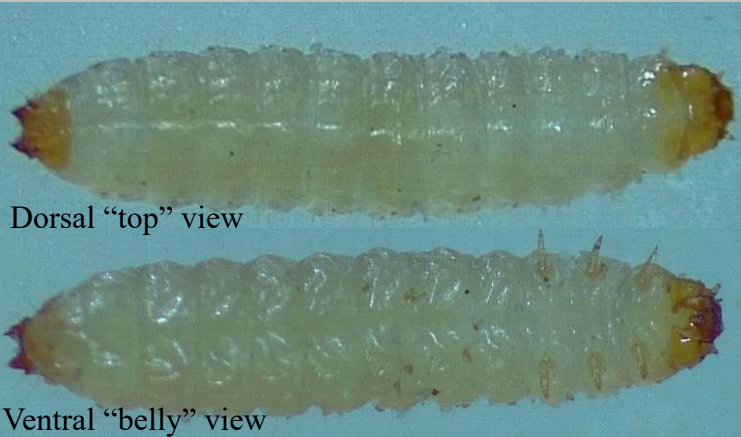
There are no commercial traps or lures for carpophilus beetle in the U.S., though promising pheromone lures are being tested. Nut sampling at hullsplit, damage assessment at harvest, and remnant mummy nut sampling after harvest can help determine the prevalence of this pest. Soft-shelled almond varieties like Nonpareil, Monterey, Sonora, and Independence seem more affected than harder-shelled varieties.

The carpophilus beetle and navel orangeworm (*Amyelois transitella*, Lepidoptera: Pyralidae), are known to attack nuts after hullsplit. These pests may infest nuts separately or coinfect them. Their feeding damage may appear similar, making it crucial to distinguish between them. Multiple species of ants also feed on the almond kernel. This visual guide can aid in recognizing these three major pests and their feeding damage so that appropriate management is implemented.

## Carpophilus beetle



Eggs (size range: 1.5 to 2 mm long) are creamy white.

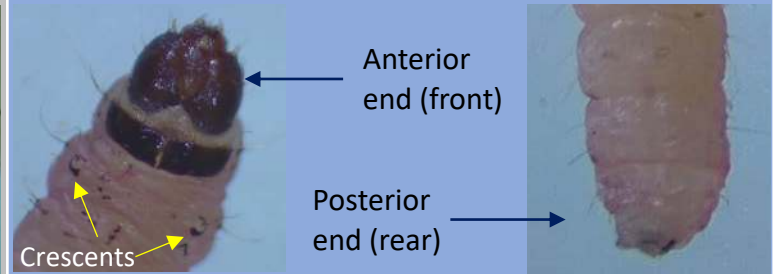
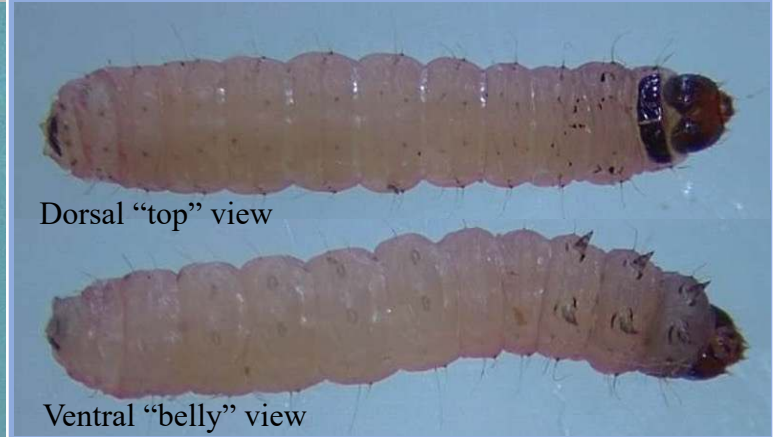


Larvae (size range: 1 to 5 mm long) are creamy-white with a brownish head and two brownish projections at the end of the abdomen.

## Navel orangeworm



Eggs (size range: 0.5 to 1 mm long) are flat and oval. Initially white then turn pink.



Larvae (size range: 1 to 19 mm) can be reddish-orange or pinkish-orange to creamy white color with a dark brown head. Has a distinct crescent-shaped mark on each side of the second thoracic segment behind the head.



Mature larva of navel orangeworm (NOW) is 3 to 4 times bigger than carpophilus beetle (CB) mature larva.



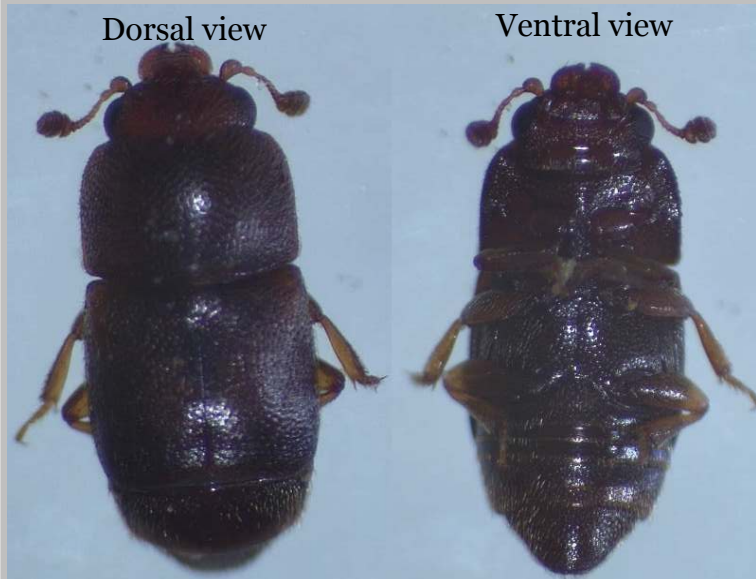
## Carpophilus beetle



Pupa is small (3.5 mm long) and whitish. Carpophilus beetles likely pupate in soil on the orchard floor.

Dorsal view

Ventral view



The adult carpophilus beetle is 2 to 3 mm long, black, or dark brownish. The beetle wings are truncated, exposing the abdomen at the end.



Carpophilus beetle attacks the nuts. Both adults and larvae feed on the kernel and cause damage.

## Navel orangeworm



Pupa (size range: 7.25 to 12 mm long) are dark brown and generally covered with a whitish silken cocoon. Navel orangeworm pupates in the nuts.



Silken cocoon



The adult navel orangeworm is 9 to 10 mm long, gray-brown, with an irregular black pattern on its forewings. Its head has a snout-like projection.



Navel orangeworm attacks hullsplit nuts. Larvae feed on the kernel and cause damage.



## Carpophilus beetle

## Navel orangeworm

### Damage at harvest

The carpophilus beetle and larva feed on the nutmeat, leaving the kernel skin intact or with minimal damage. The damage is characterized by fine powdery frass and nutmeat, a white-creamy color with some webbing. Large numbers (>10) of adults and larvae per nut.



The navel orangeworm larva feeds on nut meat and scrapes off the skin. The damage is characterized by thicker frass and silky webbing entangled with a darker brownish appearance. The frass pellets are much bigger. Only larvae are present, and usually 1 to 3 larvae per nut.



### Overwintering

Adults are found in tree mummies in late fall to early winter. However, during the winter, most adults are found in ground mummies.



Advanced stage of larvae overwinter in both tree and ground mummies.





# Additional Pest/Crop Damage Differences

Carpophilus beetle



Creamy color nutmeat remnants mixed with the fine-powdery frass.

Ants



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More superficial damage or the entire nutmeat is cleared out, leaving only the skin (pellicle) or clear white powder (loose) without frass and webbing.

Damage signs difference: The color of the powdery feeding signs produced by carpophilus beetle depends on the host (nut).

