

Potato Tuberworm

A Threat for Idaho Potatoes

by Juan Manuel Alvarez, Eric Dotseth, and Phil Nolte

The potato tuberworm, *Phthorimaea operculella* (Zeller), has recently emerged as a potential economic pest of potatoes in the Pacific Northwest. Also known as potato tuber moth, it is an important potato pest on every continent, particularly in tropical and subtropical regions. Two similar species are also called "potato tuber moth": *Tecia solanivora* (Povolny), the Guatemalan potato moth, attacks field and stored potatoes in Central America and northern South America, and *Symmetrischema tangolias*, the Andean potato tuber moth, is considered a serious pest in the Andes.

Phthorimaea operculella has been recorded in California since 1856, and several times over the past two decades it has been recorded in the Columbia Basin of Oregon and Washington. However, it was not a major concern for growers in the Pacific Northwest until 2002, when a field with severe potato tuberworm damage was documented near Hermiston, Oregon. Since then, several more fields in the same region have suffered damage. Milder winters and dry summers during the past few years are probably responsible for extending the potato tuberworm's range northward.

The potato tuberworm had not been recorded in Idaho as of January 2005. This publication summarizes what is known about pest biology, potential damage, and control measures for this species.

Damage

The economic damage caused by *P. operculella* can be significant. Losses of up to 50 percent of the stored crop have been reported in Yemen and Peru; 86 percent in Tunisia, Algeria, and Turkey;



Figure 1: Black tunnels and feeding damage from potato tuberworm. Photo by Jack Kelly Clark

90 percent in Kenya; and 100 percent in India and the Philippines.

The most economically important damage occurs predominantly through the larvae's feeding on the tuber. In the field and in storage facilities, the larvae excavate tunnels throughout the potato tuber, often leaving mounds of frass near the tunnel entrances (figure 1). This damage makes fresh potatoes unmarketable. In addition to their physical damage to the tubers, the tunnels allow the introduction of bacteria and fungi into the tuber.

Larvae of *P. operculella* also damage the foliage by burrowing through the leaf petioles and creating transparent leaf blisters (figure 2). Infested plants can be recognized by the mines the larvae make in the leaves and stems and by the webbing together of adjacent leaves.

Although potato tuberworms are primarily associated with potatoes, they have been observed feeding on other plants. Domesticated plants such as tomatoes, eggplants, peppers, and tobacco and wild solanaceous plants have served as host

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Figure 2. Leaflets damaged by potato tuberworms.
Photo by Jack Kelly Clark

plants for *P. operculella*. A total of 60 plant species have been recorded as its food sources.

Description and Life Cycle

Potato tuberworm adults are dull-colored moths with fringed, elongate wings. The body length is about 0.4 inch, and the wingspan is about 0.5 inch. Adults have a narrow, silver-gray body and grayish-brown wings with small, brown or black markings (figure 3). They are seldom seen because they are active at dusk, but sometimes they can be collected near potato fields during the day. Adults are fast fliers and require a net for capture.

Moth activity correlates with temperature. In the Northern Hemisphere, peak populations of adult *P. operculella* have occurred from May through June in Israel, from June through August in Yemen, and in late summer in the United States.

Tuber moths move between crops and forage up to 0.15 mile to infest tubers or plants. Long distance movement of potato tuberworms is probably due to movement of infested tubers.

The adult female moth lays between 150 and 200 eggs individually on the underside of potato leaves and stems or in the eyes of exposed tubers in the field or in storage. The recently laid eggs are pearly white ovals that become darker as they mature.



Figure 3. Potato tuberworm adult. Photo by Jack Kelly Clark



Figure 4. Potato tuberworm larva. Photo by Jack Kelly Clark

Larvae, also called caterpillars, are only 0.04 to 0.08 inch long when they hatch. As the larvae mature, they grow rapidly and in their fourth and final instar are 0.6 to 0.8 inch long (figure 4). Young larvae are gray or yellow-white with dark brown heads. Mature, healthy larvae are tinged with pink or green. Larvae can be found either on the foliage or in the potato tuber. It is necessary to cut suspicious tubers to carefully check for signs of tuberworm damage and the presence of larvae or pupae.

Larvae pupate in dead potato leaves, in soil, in cull piles, or on stored potato tubers. If these habitats are not available, larvae will seek other protected places for pupation, such as crevices in walls, floors, and crates, or other locations where the temperature is above freezing. Pupae form a silk cocoon overlaid with soil and debris available nearby.

The number of generations each year and the length of the life cycle are influenced by temperature. The life cycle can be as short as 2 weeks in summer or as long as 7 months in winter. There are six to eight generations of *P. operculella* in the

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fields of New Zealand during the summer, but probably not more than two in the more temperate climates of North America.

In New Zealand, warmer temperatures allow potato tuberworms to complete their development in 4 to 5 weeks: the eggs hatch in 2 to 6 days, the larvae mature in 16 to 24 days, the pupal stage lasts 6 to 9 days, and the adult females lay eggs 2 to 4 days following emergence. In North Africa the same species completes its life cycle in 3 weeks during the hot season. Two generations of *P. operculella* have been observed in the infested Oregon fields: one in June and the other from mid July through early September.

Tuber storage during the winter months will influence future populations of tuberworms because the pupae will overwinter in tuber storage facilities. The warmer temperatures associated with stored potatoes allow the potato tuberworm to breed year-round. In addition, populations can be maintained in storage sheds because of direct contact between infested and noninfested tubers.

Potato Tuberworm Management

Management in the field

Many cultural practices capable of reducing potato tuberworm populations in the field have been suggested:

- Do not plant infested seed tubers.
- When planning crop rotations, choose potato fields as distant from previous potato plantings as possible.
- Destroy volunteer potato plants in uncultivated lands or other crop fields.

Any effort to reduce the exposure of tubers to egg-laying females or to larvae will reduce crop damage. These insects will not burrow through more than 2 inches of soil to reach the tuber. Therefore, extra hilling to increase soil coverage is encouraged. Furthermore, regular irrigation will reduce the number of soil cracks available for potato tuberworm entrance. Sprinkler irrigation seals the soil and reduces soil cracking better than furrow irrigation.

To reduce exposure time, harvest mature tubers as soon as possible and avoid leaving the tubers on the soil surface or in windrows overnight. Never cover newly dug potatoes with green vines because larvae will migrate from wilting vines to the exposed tubers underneath.

Pheromone traps have been used to monitor adult male moth activity and are commercially available. The University of California IPM pest management guidelines suggest monitoring with pheromone traps and applying insecticides for control when appropriate. For fresh-market potatoes, the guidelines recommend treatment when 15 to 20 moths are captured. The prescribed action thresholds vary according to potato cultivar and field conditions, and if moth activity does not reach the defined action threshold before vine kill, then no treatment is necessary. Because the insect is not present in Idaho, no thresholds exist for Idaho conditions.

Management in storage

Advice for preventing infestations in storage includes detecting the first invading insects. Adult moths could probably be detected early with pheromone traps. Visual spotting of potatoes infested with larvae is more difficult because the insect's tunnels at early stages of infestation are very small and very difficult to see. It is necessary to cut suspicious tubers to carefully check for larvae, pupae, and signs of tuberworm damage.

Eliminating damaged tubers and treating the remainder with insecticide is critical. Only pesticides that are registered for use in storage facilities for the control of this insect pest can be used (see the annually revised *Pacific Northwest Insect Management Handbook* for a list of insecticides). Pyrethroids are effective on potatoes to be used for seed, while biological products such as *Bacillus thuringiensis* and baculovirus are safe on potatoes destined for consumption. Insecticidal control of foliar populations is ineffective when adults immigrate to the storage from nearby infested crops. However, screens placed over potential entry points can serve as barriers to adult moths.

All used sacks and stores should be cleaned of plant residues. Frequently check stored potatoes for signs of rot and insect damage.

Additional resources for management

Although transgenic potato plants are no longer available in the United States, they have proved effective at reducing tuberworm infestations in different parts of the world. High mortality has been found in larvae that fed on tubers and leaves of transgenic potato plants expressing toxin genes from *Bacillus thuringiensis* (Bt). In a choice experiment, larvae showed a preference for the control plant over the transgenic Bt potato plant.

In some insecticide trials that compared the efficacy of different pesticides, such as Bt, the pyrethroid fenvalerate, growth regulators, and botanical extracts, the insecticide Bt was consistently the most effective in killing potato tuberworm larvae. In addition, many insect species such as ladybugs, lacewings, anthocorids, ants, and parasitic wasps are natural enemies of the potato tuberworm. The polyembryonic parasitoid *Copidosoma koehleri* has been used with some success to reduce populations of *P. operculella* in South America.

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