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Banana Moth as a Pest of Coffee

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Banana moth, *Opogona sacchari* (Bojer), is a significant pest of coffee bark tissues and young vertical branches in Hawaii. The moth's larvae feed upon the cambium, vascular system, and pith within the green verticals and on the cambium and phloem beneath the exfoliating bark of the main trunk.

The banana moth is a threat to coffee in Hawaii because its feeding can cause the death or weakening of large numbers of young coffee verticals and can disintegrate large patches of coffee stem bark. Substantial losses in crop yield and overall reductions in the health of coffee plant populations may result.

Significant damage occurred in recent years at some coffee farms in the Kona districts, located from approximately 1200 to 2400 feet elevation. The damage was locally severe and patchy, associated mainly with plants recovering from pruning. Here we describe and document the damage to coffee. We also suggest some integrated pest management practices for coffee farmers to adopt to control the banana moth.

Banana moth biology and ecology

Opogona sacchari has a wide distribution, occurring in the Americas, Africa, and many islands throughout the world. It was accidentally introduced to Hawaii and is known to occur on Oahu and Hawaii. The larvae of *O. sacchari* are generally considered to be scavengers, feeding in dead plant material. In Hawaii they are best known as pests of sugarcane, where they damage the "eyes" (buds) of the plants, but they also attack many ornamental plants. The adult moths are ¾–½ (10–15 mm) long and have grayish-brown wings, each with two small but prominent black spots (Figure 1). When the moths are at rest, their antennae point forward, rather than backward over the wings or next to the abdomen.

The moths lay their tiny eggs into crevices on plants; they hatch after about a week. The newly hatched caterpillars bore into the plant, eventually producing the characteristic frass deposits shown in Figure 2. Fully developed caterpillars removed from their tunnels will be ¾–1⅛ inches (2–3 cm) long and somewhat transparent—it is even possible to see some of their internal organs.

A distinguishing characteristic of the larvae is the presence of brown patches on the top of the caterpillar and dark brown "breathing pores" along the sides of the body. The caterpillars pupate within the plant. Following the emergence of the adult moths from the pupae, empty pupal cases may be observed protruding from the

1. Adult banana moth with empty pupal case. (photos: A. Hara)

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stems of the infested plants. The life cycle is likely to take about 40–45 days under summer conditions in Hawaii. A considerable number of generations per year can be produced.

Early damage by *O. sacchari* is hard to detect because little frass will have been pushed out of the tunnel in the early stages of attack. However, as the hatched caterpillars continue to feed inside the stems, they hollow them out. Thereafter, evidence of their presence will become clear, both because of the presence of frass (Figure 2) and the wilting of young coffee stems.

Where banana moth populations are large and increasing aggressively, attacks can kill coffee verticals and partially disintegrate the bark tissues of the main trunk. Severely affected vertical branches can wilt, collapse, and detach from the trunk (Figure 3). Infested verticals are prone to snapping off during strong winds. Less severely affected branches or branches in early stages of infestation may grow poorly and be structurally weakened.

Foliar re-growth of coffee plants that have been pruned or stumped is particularly susceptible to damage caused by colonization and feeding injury (Figure 4). Egg-bearing female moths are attracted to the wounded coffee stumps. Such plants are weakened by stress and have moist, dead, or dying tissues preferred by the moth for egg-laying. The female banana moth prefers to lay her eggs in necrotic plant tissues and will lay them in wide range of plant species.

Moths are attracted to natural openings in the bark of trunks of pruned coffee. Secondary branches emerge from the primary stem after pruning, and the bark "erupts" to allow the emergence of verticals; a natural opening or hole occurs in the wood to allow the meristematic tissue beneath the bark to emerge and grow through.

Miniscule chambers of decomposing, sloughing bark occur next to the emerging branches. The chambers of necrotic tissue are perfectly suited to protect and nurture the laid and hatching *Opogona* eggs. Females prefer to deposit eggs within these decomposing wounds, or within natural openings in the bark.

The most dangerous egg-laying site for coffee is at the emergence junction between a secondary green stem and an older, woody stem. The hatching larvae are very close to the tender new branch and can easily enter inside. They tunnel up from underneath the emerging branch and into the pith, never having been exposed to predators on the surface of the plant.

The hatching moth larvae are whitish caterpillars that feed on the tender green tissues just beneath the

2. *Left:* Granular, light-brown frass produced by the banana moth caterpillar larvae at the base of young coffee vertical branches. *Right:* The damaged branch is easily detached. The black circle of dead tissue is evident around the perimeter of the branch; it indicates where banana moth larvae were feeding. In this case, larvae did not penetrate the center of the stem and did not create a tunnel; the larvae caused structural damage that weakened but did not kill the vertical.

3. Wilting and collapse of newly emerged vertical branch on a recently pruned coffee plant. A banana moth larva was feeding within a tunnel in the affected vertical, having hatched from an egg laid near the base of the stem where it emerged through the woody tissue of the trunk.

woody surface of coffee stems. They also feed within young, non-woody coffee verticals (Figure 6). Larvae feed and create tunnels up to three inches long within the young stem. This effectively severs the vascular system and interrupts the flow of water to the branch. Wilting and collapse quickly follow. Although banana moths can attack plants at all stages of development, significant damage to bearing or desired coffee verticals occurs during their first year of re-growth after pruning. Secondary damage occurs to coffee plants as other invasive organisms, including insects and fungi, replace the maturing banana moth larvae.

A reliable indicator of banana moth populations is the presence of the characteristic piles and elongated mounds of light-brown frass that accumulate copiously on coffee stumps and on debris (Figure 7).

Banana moth integrated pest management

Manage the banana moth on coffee with on-time, integrated management actions. Following are suggested tactics.

Accurate diagnosis and assessment

Coffee verticals are susceptible to a number of significant pests, and an accurate diagnosis of the cause is essential. Contact the UH-CTAHR Cooperative Extension Service for assistance in pest identification and for an evaluation of damage. Learn to recognize the frass and damage caused by this insect. Learn to recognize the larval stage of the banana moth. Scout coffee fields on a regular basis for damage, and keep systematic records of your observations. To detect the banana moth, look for signs of frass being pushed out of stems, and gently bend stems by hand (severely infested stems will tend to collapse under pressure and break, rather than bending evenly).

Field sanitation

Remove pruned coffee branches and trimmings from fields and destroy them immediately. Chipping the woody material, for example, can destroy larvae embedded within and remove the material as a source of

4. Granular, light-brown frass of the banana moth larvae on the coffee bark surface indicates the location of their feeding sites under the bark on stumped coffee plants. The newly emerging vertical branches are highly susceptible to damage, and those in the photo at left are under attack. The wounds created by pruning can attract the gravid moth females to lay eggs.

5. Banana moth frass at the intersection of vertical branch and the main coffee trunk. The base of the vertical branch shows a blackening from larval feeding. When the lateral branch is pulled away it separates from the trunk easily, and the burrowing hole of the moth becomes visible. Banana moth larvae tunnel inside the lateral branch to about three inches or more. This is sufficient damage to cause the wilting, collapse and death of the vertical branch.

attraction for egg-laying banana moths (a beneficial byproduct is mulch). Banana moth populations can develop on pruned coffee materials that are left on the ground and in the field within coffee rows (Figure 6).

Spray pruned plants with Bt or pyrethrin

Drench the bark and the newly emerging verticals with applications of *Bacillus thuringiensis* (Bt) shortly after pruning and periodically thereafter as needed to achieve economic control. Proper spray timing is important to achieve best results. It probably is not necessary to spray Bt on plants which have not been pruned recently. For established infestations of the banana moth, supplement the use of Bt with pyrethrin sprays, which are useful as contact insecticides.

Selection of pruning method

More damage has been reported at farms using the Beaumont-Fukunaga pruning method than using the Kona style of pruning. However, more information on this is needed.

6. Banana moth caterpillar in tunnel within young coffee vertical.

Minimize plant stress (maintain plant vigor)

Plants that suffer from nutritional deficiency, root problems, nematodes, drought, or physical or chemical injuries may recover slowly after severe pruning; vertical branches that do not re-grow vigorously are not as tolerant of banana moth feeding injury.

Remove suckers

Side branches emerging from coffee-bearing verticals can harbor larvae of the banana moth. Populations of the moth can be reduced by timely, periodic removal and destruction of unwanted, infested suckers from these plants.

7. Rows of coffee plants were pruned at a coffee farm in 2002 with the Beaumont-Fukunaga method, stumping. The severed coffee foliage was discarded on the ground, between plants within rows. In the following months, banana moths fed on the discarded materials, as evidenced by the large amounts of the characteristic frass which accumulated on them and the presence of banana moth larvae embedded within them.