Pacific Pests, Pathogens and Weeds - Online edition

Coffee berry borer (118)

Common Name

Coffee berry borer

Scientific Name

Hypothenemus hampei. Previously, it was known as *Crypjalus hampei.* It is a member of the beetle family curculionidae.

Distribution

Asia, Africa, North (Hawaii), South and Central America, the Caribbean, Oceania. It is recorded from Federated States of Micronesia, Fiji (where it is one of the top ten pests), French Polynesia, New Caledonia, Northern Mariana Islands, and Papua New Guinea.

Hosts

Coffea arabica, *Coffea canephora*

Symptoms & Life Cycle

The adults (Photos 1&2) feed and breed inside the berries. Feeding damage, plus the introduction of decay organisms, causes the berries to fall prematurely.

The fertilised female flies to the ripening berries and bores into them, usually through the central disc at the apex. If the endosperm (the part containing starch and other nutrients for the seedling) is still soft the beetle may wait in the fruit for it to become firm, or visit other berries. Eggs are about 0.6 mm long, and are laid in chambers chewed out of the beans; each female produces 30-50 eggs in 2-7 weeks. Eggs hatch within a week or so and the larvae start eating the beans. After about 2 weeks and two moults, the larvae, develop into pupae and 4-9 days later emerge as adults. The entire life cycle is about 4 weeks.

There are about 10 females for every male. Males have short wings and do not fly; they remain in the berries for the 3 months of their lives. Females are fertilized a few days before they leave the berries to find other berries in which to lay their eggs. Some females remain and lay eggs in the same berry. Females live on average 150 days, much longer than the males. Many beetles occur in a single berry, up to 100 (Photo 3).

The adults are black, about 1.5-2.2 mm long by 0.4 mm wide, covered in short stiff hairs. Other noticeable features are short club-shaped antennae, and bristles on the legs that are used for tunnelling through the coffee berries. The females can fly for about 30 minutes; they also swarm, perhaps using updrafts of air to achieve long-distance travel. During times when the crop is low or non-existent, the beetles remain inactive in dry berries on the trees or in those on the ground.

Impact

The damage varies, but berries can be completely destroyed by the adults and larvae so that all that remains is frass or faeces. It is not uncommon for 100% of the berries to be attacked. Further damage occurs if the beans are not properly dried before being stored. Even if only a few of the beans are infested, the damage affects quality, and the beans will be difficult to market (Photo 4).

Photo 1. Adult coffee berry borer, *Hypothenemus hampei*, side view.

Photo 2. Adult *Hypothenemus hampei,* about 1.5-2.2 mm long, showing its relative size to a coffee bean.

Photo 3. The life cycle of the coffee bean borer, *Hypothenemus hampei,* takes place in coffee bean; this photo shows the frass that accumulates as the larvae and adults eat the beans.

Photo 4. Coffee beans damaged by the coffee bean borer, *Hypothenemus hampei*. Even the presence of a few bored beans in a consignment lowers quality and, if the beans are not dried properly, the beetles will continue to breed in storage and increase the damage.

Detection & inspection

Look for brown frass over the holes. Look for holes in beans by rubbing them between the hands to remove the parchment (a skin over the seed). Cut open the berry to find the female in tunnels in the endosperm (the starch deposit in the seed).

Sample as follows, according to age of the trees:

- for every 5000 trees select 30 at random
- select a branch in the middle of a tree, containing 30-100 developing berries
- examine all green berries for coffee berry borer holes
- count the number of green berries and the number with holes
- go to next tree in a zig-zag pattern
- calculate percentage infestation.

In Colombia, more than 2% infestation is sufficient for spraying to be considered. Sampling in this way is carried out monthly. In African countries, recommendations are different, and as follows:

- inspect once per week, from eight to 32 weeks after flowering
- check for infestation - holes at bottom of the berries
- count all berries on at least 3 lower branches of 10 trees per hectare
- calculate percentage infestation

In Africa, a 4-6% average infestation is sufficient for spraying to be considered.

Management

QUARANTINE

It is important that coffee seed imported into countries yet free from the beetle is treated appropriately. Fumigation before entry and inspections should be mandatory. Alternatively, a treatment of minus 15ºC for 48 hours has proven to be acceptable, killing all life stages.

NATURAL ENEMIES

Several wasps (eulophyds and braconids) have been introduced from Africa to Central and South America, and elsewhere, but without noticeable impact (but see below). Ants, predatory beetles and nematodes also occur, but none has sufficient potential to control *Hypothenemus* populations. By contrast, 80% mortality of adults occurs with the fungus, *Beauveria bassiana*, in countries with continuous high humidity.

IPM (integrated pest management) for coffee berry borer includes sampling/monitoring, cultural practices, use of *Beauvaria bassiana*, post-harvest control, and release of parasitoids. In Mexico, organic coffee production uses *Beauveria bassiana*, the parasitic wasps *Prorops nasuta*, *Phymastichus coffea*, and *Cephalonomia stephanoderis*, attractant traps, removing dried berries from the bushes to interrupt the pest's life cycle, and neem. The traps contain methyl or ethyl alcohol or a mixture of methanol and ethanol at 3:1.

CULTURAL CONTROL

The main methods of control are collection of ripe and over-ripe berries before and after harvest, post-harvest sanitation, and pesticides. Collection of berries from the ground is not always recommended because labour is either unavailable or costs make production uneconomic.

During growth:

- Pick berries as they ripen, increasing to every 2-3 weeks in 'hot-spots'.
- Collect blackened berries from the ground or bushes - those decayed by fungal infections and beetles - and burn them. The aim is to leave less than five ripe, over-ripe or raisin berries per tree.
- Alternatively, do the following for 3 months to break the life cycle:
    - Remove all berries from the bushes (and ground depending on labour availability and costs) after harvest, and continually remove young berries. This method works best where there is a single flowering period and short harvesting season.
- Check with local authorities to find out if parasitoids are important; if they are, do the following:
    - Pick all ripe berries at least every 2 weeks (more often, if practical).
    - Leave fallen berries as reservoir for parasitoids (where numbers fallen are low).
    - Increase shade (there may be more predators where shade is present, but this is variable and needs to be checked locally). Common shade trees are *Alnus*, *Calliandra*, and *Leucaena*.
- Maintain healthy trees using correct type and amounts of fertilizer, control of weeds, and pruning.

After harvest:

- Prune bushes after harvest: (i) remove branches on which berries are too high to reach (keep bushes about 2 m high); (ii) cut out dead or dying branches; and (iii) keep stems to maximum of four. Stumping is also recommended when trees are old, yield has declined, or they are too tall to harvest easily.
- Do not leave any berries on the bushes, remove them, and also pick up fallen berries, boil and bury them.
- Destroy bushes in abandoned plantations, as they are sources of infestation.
- Processing facilities should be aware of measures to take to prevent beetles from escaping back into production areas, including use of traps.

RESISTANT VARIETIES

Differences exist between *Coffea* species and between varieties of *Coffea arabica* and *Coffea canephora*, but are probably not sufficient as a basis for developing resistant varieties.

CHEMICAL CONTROL

Insecticides are effective if applied early when the female is in the entry tunnel, but not later when berries are mature and the female has penetrated the endosperm. Fallen berries are particularly difficult to treat. Pirimiphos-methyl is recommended. (*Note that endosulfan previously used extensively in Central and South America is banned under the Stockholm Convention, April 2011.*) Fenthion has also been de-registered by Australian Pesticides and Veterinary Medicines Authority. In Hawaii and South America, a commercial preparation of *Beauveria* (the GHA strain) is used. Sprays are recommended when monitoring shows that 'hot-spots' have more than 2% infestation.

When using a pesticide, always wear protective clothing and follow the instructions on the product label, such as dosage, timing of application, and pre-harvest interval. **Recommendations will vary with the crop and system of cultivation. Expert advice on the most appropriate pesticides to use should always be sought from local agricultural authorities.**

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Information from Waterhouse DF, Norris KR (1989) *Hypothenemus hampei* (Ferrari). *Biological Control Pacific Prospects - Supplement 1.* ACIAR Monograph No. 12. Inprint Limited, Brisbane; and Evaluation of non-chemical alternatives to endosulfan (2012) UNEP/POPS/POPRC.8?INF/14/Rev.1. UN/UNEP; and Aristizabal LF, *et al.* (2017) Integrated pest management of coffee berry borer in Hawaii and Puerto Rico: Current status and prospects. Insects 8(4): 123. (doi: 10.3390/insects8040123); and from Aristizabal LF, *et al.* (2016) Integrated pest management of coffee berry borer: strategies from Latin America that could be useful for coffee farmers in Hawaii. Insects 7(1). 24pp. (http://www.mdpi.com/2075-4450/7/1/6). Photos 1&2 Walker, K. (2007) coffee berry borer *(Hypothenemus hampei).* PaDIL - http://www.padil.gov.au. Photo 2 Peggy Greb, USDA, ARS. Photo 3 Save Kona coffee! Fighting the coffee berry borer. (https://marcoinkona.com/save-kona-coffee-fighting-the-coffee-berry-borer//). Photo 4 Forest and Kim Star. Coffee Berry Borer parchment seeds with damage sample at Kula Community Centre, Maui, Hawaii. (https://www.flickr.com/photos/starr-environmental/32087834650/).

Produced with support from the Australian Centre for International Agricultural Research under project PC/2010/090: *Strengthening integrated crop management research in the Pacific Islands in support of sustainable intensification of high-value crop production*, implemented by the University of Queensland and the Secretariat of the Pacific Community.

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