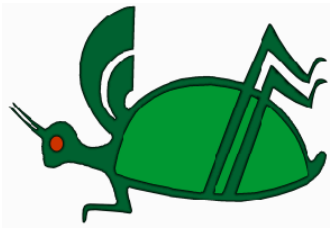
ABSTRACTS
COFFEE BERRY BORER



"INVASIVE SPECIES OF THE PACIFIC REGION"

PACIFIC BRANCH
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Invaded! Implications of Coffee Berry Borer in Hawaii and Prospects for its Management

THE COFFEE BERRY BORER: AN OVERVIEW

Fernando E. Vega

USDA, ARS, Beltsville, MD 20705

The genus *Coffea* (Rubiaceae) comprises 103 species, but only two of these are commercially traded: *C. arabica* and *C. canephora* (also known as robusta). Coffee is grown in more than 10 million hectares in over 80 developing countries and ca. 20 million families depend on this plant for their subsistence. Among the hundreds of insect that attack coffee, the coffee berry borer, *Hypothenemus hampei* (Coleoptera: Curculionidae: Scolytinae), is considered to be the most important throughout the world. Adult females bore a hole in the coffee berry, where they deposit their eggs; upon hatching, larvae feed on the coffee seeds inside the berry, thus reducing yield and quality of the marketable product. The insect spends most of its life inside the coffee berry, making it extremely difficult to control. Various biological control agents have been reported as natural enemies of the coffee berry borer, including parasitoids, predators, nematodes, and fungal entomopathogens. A novel strategy based on the use of fungal entomopathogens as fungal endophytes was recently attempted. Even though ants and birds have been reported to prey on the insect, they are not considered important mortality factors. Jaramillo et al. (2010) reported on the black thrips, *Karnyothrips flavipes* (Phlaeothripidae), as a predator of egg and larvae of the coffee berry borer in Kenya. The thrips has been reported in Hawaii. The specific cues used by the coffee berry borer to localize the berry have not been elucidated; their identification could be a great improvement over the current use of the ethanol:methanol attractants.

DETECTION, RAPID RESPONSE, AND CONTAINMENT OF COFFEE BERRY BORER, A NEW THREAT TO COFFEE PRODUCTION IN HAWAII

Neil Reimer

Hawaii Department of Agriculture, 1428 S. King St., Honolulu, HI

The coffee berry borer (CBB), *Hypothenemus hampei*, is a major pest of coffee production throughout the world. King Kalakaua imposed a quarantine in 1888 to keep this and other coffee pests out of the Kingdom of Hawaii. The quarantine has been in effect throughout the 122 years since then and has ensured that Hawaii was one of the few coffee production areas in the world that was free of this pest, until now. CBB was detected in the Kona area of Hawaii in September 2010. Upon detection, a statewide delimiting survey was initiated. Results to date demonstrated that CBB is restricted to the Kona area of the Big Island. An intrastate quarantine was implemented to prevent its movement out of the infested Kona area into other coffee growing regions in the state. Pest management options applicable to Hawaii conditions are being researched and used to decrease population levels in the infested area.

INDUSTRY RESPONSE AND IMPLEMENTATION TO COFFEE BERRY BORER IN HAWAII

Dan Kuhn

P.O. Box 250, Kualapu'u, HI 96757

Hawaii-grown coffee is an industry of over 800 coffee farmers with an estimated value of over 27 million dollars annually. The industry is represented by five organizations including a statewide organization and several smaller regional organizations. The discovery of coffee berry borer in Kona resulted in an immediate need to organize the industry to be able to disseminate information about the pest, develop comprehensive plans to delimit, control and manage the pest and establish a framework with state officials and the research community. Some of the activities that were undertaken to facilitate communication were initiation of meeting with the growers, the
establishment of a coffee berry borer task force made up of growers, processors, Hawaii department of agriculture and the various state and federal research entities. Within the task force
an executive committee, scientific advisory panel and legislative outreach subcommittees were formed. Activities performed on behalf of the task force included, a quarantine to prevent the spread of CBB, field days to inform growers on CBB, a bill in the legislature requesting funds to deal with the CBB problem and a pamphlet on CBB for tourists. While coffee berry borer represents a concern for the industry, close collaboration between the industry, governments and research entities will hopefully establish measure that will help mitigate the pest.

COFFEE BERRY BORER: SCRAMBLING FOR ANSWERS IN HAWAII'S UNIQUE AGRO-ECOSYSTEMS.

Russell H. Messing

University of Hawaii at Manoa, Kauai Agricultural Research Center,
7370 Kuamoo Rd, Kapaa, HI 96746

Since coffee berry borer was first detected in Hawaii several months ago, researchers have been scrambling to find ways to help growers and processors mitigate damage and economic loss in one of the state's major agricultural commodities. As CBB is a well-known pest from coffee-growing areas around the world, the advice from experienced scientists in other regions was "*don't re-invent the wheel*." However, the existing published literature is far from clear on several major issues regarding CBB biology, including methods of trapping and the existence of alternate host plants. Also, from both ecological and an economic perspectives, Hawaii's coffee industry is unique; and the role that CBB (and its natural enemies) will play in our system may differ from that in other areas. Several preliminary lines of research have been opened to investigate CBB biology in the context of Kona agro-ecosystems; their possible contribution to integrated control is discussed.

TRAPPING IN COFFEE BERRY BORER MANAGEMENT

Mark G. Wright

Department of Plant and Environmental Protection Sciences, University of Hawaii,
3050 Maile Way, Honolulu, HI 96822.
Email: markwrig@hawaii.edu

Research on the use of trapping systems and different attractants in coffee berry borer (*Hypothenemus hampei*) management is reviewed. Methanol / ethanol mixes are the most effective attractants, compared with kairomone sources such as coffee berries, ground green coffee and caffeine. In South America, minimal numbers of coffee berry borer are trapped outside of coffee plantations. Trap type, trap placement and beetle phenology have investigated. It suggested that 22 traps per hectare would provide effective mass trapping in coffee plantations in Colombia. Some researchers propose that stringent sanitation combined with mass trapping can reduce coffee berry borer losses by 90%.

A VIEW FROM THE TRENCHES: A KONA COFFEE FARMER'S PERSPECTIVE ON THE INVASION

Suzanne Shriner

Lions Gate Farms, 84-5079 Mamalahoa Highway, Honaunau Hawaii

Hawaii is the only state in the US that grows coffee. Until the discovery of Coffee Berry Borer (CBB), *Hypothenemus hampei*, in Kona, it was also one of the last pest-free coffee regions in the world. In September 2010, the seasonal harvest had begun when the pest was identified. With the crop rolling in, nearly 30% of farms began to report moderate-to-severe damage to the specialty Kona coffee crop. As news quickly spread, farmers, scientists and government officials scrambled to come to terms with the changed reality. Growers who had never heard of "Integrated Pest Management" found themselves attempting to implement alien techniques. Access to scientific journals and worldwide industry practices was limited as the primary documents were in Spanish. And to compound all these issues, the only effective pesticide *Beauveria bassiana*, was illegal. As we prepare for the 2011 growing season, we are still attempting to grasp the true cost of the beetle. Will we be able to minimize crop damage effectively? How will we balance added labor and monetary costs? And what will happen to the stellar reputation of Kona coffee?

BEAUVERIA OR OTHER FUNGI: TOOLS TO MANAGE COFFEE BERRY BORER, NOT MAGIC BULLETS

Stefan T. Jaronski

USDA ARS NPARL, 1500 N. Central Ave., Sidney MT 59270

The insect pathogenic fungi, especially *Beauveria bassiana* and *Metarhizium anisopliae*, have undergone much development as biological insecticides (mycoinsecticides) in recent years. Of the 110 fungus products on the worldwide market, 79% represent these two species. Several *Beauveria*-based products are used in Latin America for control of Coffee Berry Borer (CBB), and there has been considerable recent interest in Puerto Rico and Hawaii about using this fungus to halt the invasion of CBB. These fungi can be effective, but are not "magic bullets." They have limitations and must be used carefully and knowledgeably, within an integrated management system, to extract maximum value. In my talk I will cover basic biology and ecology of *Beauveria* as they affect efficacy and considerations in its use against insects, esp. CBB.

PROSPECTS FOR AREA-WIDE MANAGEMENT OF CBB IN HAWAII

Eric Jang

USDA-ARS, USPBARC, 64 Nowelo St. Hilo, Hawaii 96720

Initial perspectives from coffee growers, processors and even consumers at the news that coffee berry borer (CBB) had been found in "kona" coffee ranged from fear that Hawaii-grown coffee was dead to thoughts that through eradication the coffee could be again made CBB-free. These initial reactions to the news of invasive species is predictable and has followed similar reactions by growers and the public to the introduction of light brown apple moth and glassy wing sharpshooter into California. Interestingly, Hawaii is not the first place to get CBB and in fact is one of the last coffee-growing areas to be invaded by this pest. Luckily, this has resulted in a significant body of information being developed world-wide on the biology, and management of this beetle.

From a practical and research perspective, CBB control will require a concerted area-wideapproach similar to the recent successful program on tephritid fruit flies here in Hawaii. Areawide approaches are becoming more widespread as farm-by-farm has proven elusive. Sustainable management will require groups of growers in an area to apply measures such as sanitation, trapping, chemical controls, biological controls and postharvest measures to successfully deal with this pest. Knowledge of the specific parameters under which these measures will be effective will need to be refined for Hawaii-specific conditions. However management of this pest is possible if the area-wide approach is implemented.

SCOLYTINAE (COLYOPTERA: CURCULIONIDAE) ATTACKING COFFEE BERRIES IN HAWAI'I

Elsie G. Burbano and Mark G. Wright

University of Hawaii, Department of Plant and Environmental Protection Sciences
3050 Maile Way, Honolulu, HI 96822

Coffee in Hawaii is grown from sea level to 762 meters elevation, and the largest contiguous area of production is in the North and South Kona district of the Island of Hawaii. There are 830 coffee farms recorded in the state of Hawaii with 6,300 acres harvested, 790 of which are located on the island of Hawaii with 2,900 acres harvested annually. Forty coffee farms are located on other major Hawaiian islands (Honolulu, Kauai and Maui), with 3,400 acres harvested and these contribute significantly to the total value of Hawaii's coffee production. The black twig borer, *Xylosandrus compactus,* is an ambrosia beetle that has been reported in Hawaii since 1960 and attacks branches of more than 200 plant species, including coffee. This beetle was found recently for the first time boring coffee berries. Female beetle entry holes were observed close to the blossom area or the side of the berry. Beetles reached the endosperm and caused damage without making galleries or ovipositing. The coffee berry borer, *Hypothenemus hampei* is the most aggressive coffee pest in the world and reported in Hawaii in August, 2010, from the South Kona area. Comparisons of the biology, behavior and management of these beetles are discussed.

FROM AFRICA WITH LOVE

Juliana Jaramillo[1] and James D. Harwood[2]

[1]International Centre of Insect Physiology and Ecology, PO Box 30772-00100, Nairobi, Kenya
[2]Department of Entomology, University of Kentucky, Lexington KY 40546, USA

Coffee (mainly *Coffea arabica* and *C. canephora*) is the world's most valuable tropical export crop, on which more than 100 million people in these regions depend for their livelihood. However, the yield of coffee beans is severely affected by its main pest, the coffee berry borer *Hypothenemus hampei* (Curculionidae). Infestation levels can be as high as 90%, and annual losses worldwide exceed US $500 million. The origin of *Hypothenemus hampei* is still unknown, but it was first described in 1867 in France feeding on dry coffee beans of unknown origin. Subsequently, *H. hampei* has spread to all coffee producing countries worldwide except China and Nepal. The most recent accidental introduction was reported in the Kona area of Hawaii. Here we report on an extensive multidisciplinary 5 year-long study in East Africa, which objective is to trace back the origins of the pest and understand its biology, ecology and biological control in its native range. Novel alternatives to manage the pest are discussed. Additionally, recent research developing molecular approaches to study predator-prey interactions in coffee will be discussed, and the utility of the approaches highlighted in relation to understanding the dynamics of coffee berry borer biological control in Hawaii.

COFFEE BERRY BORER IN HAWAII

Bernarr R. Kumashiro, Neil J. Reimer, and Janis N. Garcia

Hawaii Department of Agriculture, 1428 South King Street, Honolulu, HI

The Coffee Berry Borer (CBB), *Hypothenemus hampei* (Ferrari), is a major pest in coffee-growing regions throughout the world. It bores through the berry and attacks the bean, rendering it unsuitable for market. CBB was first detected in Hawaii in late August 2010 in the Kona area on Hawaii Island, where world-premier coffee is grown. The initial identification was made by Hawaii systematists, and the final determination was made by the USDA Systematic Entomology Laboratory. Since this was a pest of known economic importance, the National Plant Diagnostic Network Standard Operating Procedure for: APHIS-PPQ Pest of Concern was utilized to enhance rapid identification and notification. Following a delimiting survey, an interim quarantine was instituted on December 2, 2010 for Hawaii Island. In a collaborative effort, staff from the Hawaii Department of Agriculture and other government agencies are working together to develop methods to control CBB and to assist farmers in mitigating the effects that CBB may have on coffee crops.