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Challenges Faced by Coffee Growers Establishing an Integrated Pest Management for Coffee Berry Borer in Hawaii



Luis F Aristizábal*

Independent Consultant on IPM, USA

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*Corresponding author: Luis F Aristizábal, Independent Consultant on IPM, PO Box 5579 Kailua-Kona, HI 96745, USA, Email: laristizabal721@gmail.com

Abstract

Lack of knowledge on coffee berry borer (CBB) management, shortage of field workers, high cost of labor and supplies, are key challenges faced by coffee growers in Hawaii trying to establish an integrated pest management program for CBB. The maintenance of high standards of coffee quality is not an easy task for growers due to the presence of CBB.

Keywords: Coffee; Coffee farmers; *Hypothenemus hampei*; Biological control; *Beauveria bassiana*; Cultural practices

Abbreviations: CBB: Coffee berry borer; IPM: Integrated Pest Management

Introduction

Commercial coffee plantations in Hawaii are part of a community heritage tradition dating back more than 170 years ago, especially in Kona District, and still an integral part of Hawaiian Islands economy [1]. Due to their unique agro-ecological conditions and limited production, the Estates Specialty coffees from Kona, and Kau (Districts), Maui, Molokai, Oahu, and Kauai Islands are recognized as one of the best coffee around the world. The wholesale value from cherry production was estimated at US\$ 62.2 million in the 2016/17 harvest [2]. However, the high quality and high prices of Hawaiian coffee is being significantly impacted by a tiny invasive insect pest, the coffee berry borer (CBB), *Hypothenemus hampei* (Ferrari) (Coleoptera: Curculionidae) which was first discovered in Kona in 2010 [3]. Considered as the most damaging insect pest in coffee plantations worldwide, the CBB, bores into developing coffee berries, reducing quality, price of processed coffee, reduces yields, and increasing coffee production costs [4-6]. Coffee growers from Big Island, Oahu, and Maui are facing difficulties to produce "Extra fancy", "Fancy", and "Number one", the three most valuable qualities of Hawaiian coffee due to the CBB.

In order to reduce CBB populations and produce good quality processed coffee to sell, coffee growers need to establish an integrated pest management (IPM) for CBB in their commercial plantations [7,8]. The goal of managing the CBB population is not impossible, but it is not an easy task either. The IPM program for CBB is a concept involving several strategies of control (cultural, biological, physical and chemical), which is supported

by a permanent monitoring of the pest during the coffee season. The cumulative impact of each strategy of control against the CBB, is expected to achieve sufficient control of the pest. Instead of relying on a single strategy of control, the addition of two or more strategies can reduce and regulate the pest until low infestation levels (<3%) are achieved, allowing the production of good quality of coffee. However, to establish an IPM program for CBB coffee growers from Hawaii are facing several challenges, including (lack of knowledge, high cost of supplies, shortage of work staff, and high cost of labor) (Figure 1).



Figure 1: Coffee berry borer (CBB) colonising berries in a coffee tree. Notice small holes making by CBB in already infested berries.

Challenges

Despite efforts by the University of Hawaii extension services [9], the lack of knowledge on integrating the different components of the IPM for CBB, in my personal opinion, is the major challenge facing coffee growers in Hawaii. Attending workshops regarding the management of this pest, is only part of the process for coffee growers to understand the biology of the CBB, its relationship with the coffee tree and with weather conditions, and the different strategies of control recommended. Those are relevant aspects that coffee growers need to incorporate into the IPM program for CBB. The gap between learning and applying IPM recommendations for CBB is large. Through conducting applied research, technicians and coffee growers have the opportunity to learn together how to control the CBB under agro-ecological conditions from Hawaii. Since, there are several micro climates in the Big Island and other islands, the management of CBB varies regionally. For example, in Kona and Kau Districts, the CBB activity (flight and reproduction) are different depending on elevation, weather conditions, and coffee tree physiology (flowering, development of berries and harvest season) [10]. Therefore, the IPM of the CBB needs to be supported by monitoring the pest (conducting the "30-tree sampling plan" and using alcohol-based traps), determining the degree of CBB penetration into berries (AB-CD positions) and identifying "Hot spots" (areas with high infestation in the coffee plantation), in order to determine where application of insecticides and cultural control practices (efficient harvesting) is needed [7,11,12]. In addition, preventing the escape of CBB adults from the wet and dry mill facilities during harvest, is another cultural control practice that needs to be addressed [12].

Most of coffee growers in Hawaii control CBB by calendar applications of *Beauveria bassiana*, an entomopathogenic fungus [11], which is considered the most important natural control of CBB [5,6]. However, the high cost of the commercial formulation of *B. bassiana* make it routine use expensive, since coffee growers may need to apply several times (6-12) during the coffee season. In addition, the efficacy of this insecticide depends of several factors such as activity of CBB and the speed at which the female burrows into the developing coffee berry which determines when the pest is exposed to the fungus. Weather conditions, and coverage during the application is also important [11]. Previously the introduction of *B. bassiana*, was subsidized by the Synergy Hawaii Agriculture Council (SHAC) and currently by the Hawaii Department of Agriculture (HDOA), to help cover the high cost of this entomopathogenic fungus. A positive economic annual benefit of \$947 per farm was estimated with this subsidy [13]. Monthly applications of *B. bassiana* cannot reduce CBB populations if initial infestations are high (>12.6%) and the farm is not cleaned (sanitation) in advance for the coffee season [13]. Applications of *B. bassiana* during the early coffee season (April-July) are more effective than monthly calendar applications. The efficient use of *B. bassiana* requires monitoring CBB populations in the field to determine when and where to apply the fungus, in

this way the effectiveness is increased and cost of applications is reduced, making the IPM for CBB economically feasible [8].

The last two challenges facing by coffee growers in Hawaii are the shortage of work staff, and the high cost of labor. During harvest season many field workers are needed to collect coffee cherries on time (2-3 weeks intervals), a process which also helps eliminate CBB populations. Spanish, Filipino, and Marshallese are the major ethnic backgrounds of field workers that pick coffee in Hawaii. In 2017, The Kohala Center, the Kona Coffee Farmers Associations and Kau Coffee Farmer Cooperative, supported training coffee pickers on how to harvest efficiently. Pre-cleaning (sanitation) before harvest and sanitation at the end of harvest season (strip picking) are two cultural practices that help reduce the buildup of the CBB [9,11]. Despite this progress, many more field workers need to be trained to collect coffee cherries efficiently to minimize CBB population. However, shortage of pickers and high cost of labor (\$10-15/ hour) are two limitations to achieve this goal during harvest season, before the pest causes significant damage. A combination of manual and assisted mechanical harvest helps reduce the high cost of harvest in Hawaii. However, applied research and economic validation need to be addressed on this topic. There are other issues such as feral and abandoned or poor managed coffee plantations, which provides shelter for CBB survival and reproduction a long of year, affecting neighboring plantations; lack of economic liquidity in some cases, is another issue that prevent coffee growers to do farming activities on time, delaying control practices for CBB management.

Conclusion

The CBB is providing a big challenge for the commercial coffee production in Hawaii. Currently, several techniques are needed to adequately control the CBB, and achieve good quality of processed coffee. The best way to do this is for growers to establish an IPM program including monitoring, applications of *B. bassiana*, and cultural control practices. This goal requires understanding the basic biology of the pest and its relationship with the weather and coffee season. In other words, "Monitor CBB populations", and "Make decisions for control actions", only "When and where is needed". Learning by doing could be the best approach for integrating strategies of control, allowing coffee growers to establish an economic and feasible IPM for CBB under Hawaiian agro-ecological conditions.

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