Growing Coffee without Endosulfan: Comparing IPM methods

CBB is a very complicated pest, which spends much of its life hidden out of reach of chemical or biological insecticides inside the coffee bean, and its population levels, reproduction rate, economic damage and control costs vary widely from year to year, in different regions, and even within the same farm. Blanket recommendations are simply not applicable and IPM methods need fine-tuning to the particular farm situation.

Effective management of this pest relies on combining at least two or more IPM methods, of which the starting point is good cultural controls. The **Farm Case Studies** provide information on how different farmers have developed their own CBB control strategies, in line with their farm enterprise aims and their client demands. Effective CBB management also depends on the economic reward that farmers obtain and the coffee quality requirements of different markets, as well as training and support for farmer organisations.

This comparison of IPM methods is based on the experiences and estimated costs and timings reported by farmers and farm managers interviewed during field visits in Colombia, Nicaragua and El Salvador. It draws on views and data from technical support organisations interviewed and respondents to the project survey, from Latin America, Asia and Africa.

The comparison addresses five key questions or criteria for assessing the pros and cons of different methods for controlling Coffee Berry Borer. These assessment criteria were prioritised by participants at the project stakeholder update workshop held in London in June 2013. More details on each control method as practiced by interviewed farmers are given in the relevant **Field Visit synopses** and in the **Videos**, on control methods used by survey respondents in the **Summaries of Survey Responses** and key points and expert views in the **Key Lessons** and **Workshop summaries**.

The field visits show clearly that it is perfectly possible to manage CBB well without endosulfan, on small and large farms, using safer, IPM methods. They counter the myth that alternatives to endosulfan are always more expensive and demonstrate that considerable reduction in other Highly Hazardous Pesticides can be achieved too. Certification standards, farmer organisations and allied research institutes play a critical role in these changes to more sustainable CBB management. In a time of climate change, which greatly affects CBB levels and predictability, and fluctuating coffee prices, farmers need a better understanding of farm production costs and benefits. There is very little up-to-date information on how much all the measures to control borer cost a particular farm, or how economically worthwhile it may be to improve or change those measures. One recommendation is to set up a network of certified farms to document costs and benefits, take part in practical CBB control research and encourage more farmers to phase out endosulfan and other HHP use.

IPM method criteria	**Cultural Controls based on timely and careful sanitary collections of berries and harvest picking**
How effective is it in controlling CBB?	Can be very effective if done well and at the correct times. 33% of farms interviewed in Colombia and 33% in Central America are able to manage CBB at acceptable levels with only cultural controls. 51% of global survey respondents rated these methods *Very Effective* and 39% as *Reasonably Effective* (including in high CBB pressure zones)

How much does it cost?	Depends partly on whether any of the coffee collected can be sold and recompense part of the labour costs. For sanitary collections, some of the berries will be too damaged to sell. *Colombia*: Regular harvesting of ripe berries every 15 days will generate income. Removal of bored berries before harvest and of remaining green, overripe and dry berries after harvest may produce some 2nd grade beans. *Central America*: Cost for an average 2 rounds of picking early ripening berries (usually bored) = approx. US$38 per ha (at US$5.00 per day). For post-harvest sanitation, most farms allow workers or local people to collect left-over berries to sell as low grade beans, saving the farmer wage costs.
How much labour time does it need?	Labour time is considerable but the results in reducing amount of damaged beans and limiting CBB reproduction in following season are well worth the cost. *Colombia*: full clean-up after harvest = approx. 1.5 days per ha in regularly renewed groves. *Central America*: For removal of early ripening berries, average 3.75 days per ha per round. 1-3 rounds needed. For post-harvest clean-up, approx. 10-12 days per ha?
How easy is it to implement?	Easy as long as workers are supervised and motivated to do a good job. Some farms use special incentives. Small farms can easily do these tasks with family members and/or 1 or 2 part-time workers. Berries collected in sanitary pickings need to be put in boiling water for a few minutes or in a hermetically sealed barrel for 24 hours to kill any borers, before de-pulping.
Does it need much training before it can be used?	Not really. On large farms, it needs careful organisation, planning and supervision. Farms aiming to replace chemical use with more intensive cultural controls and biological products find it is best to have dedicated, trained workers for these tasks.
Other key points	Good cultural controls are the backbone of any effective IPM strategy. No chemical, biological or trapping methods will work well or cost-effectively without grove sanitation. In places or years with medium-high CBB pressure, most farmers will need to complement cultural controls with other methods. Regular tree pruning and renewing plots every 6-7 years makes cultural controls quicker, easier and therefore cheaper.

Criteria	**Biological Control based on *Beauveria* fungus biopesticide**
How effective is it in controlling CBB?	Can be useful as part of an IPM strategy IF a good quality product is applied with care and at the right time. 44% of farms interviewed in Colombia and 31% in Central America are currently using *Beauveria* products. 32% of global survey respondents rated biopesticide use *Very Effective* and 37% as *Reasonably Effective* (including in high CBB pressure zones)
How much does it cost?	Not very different from insecticide application cost. *Colombia*: Approx. US$10-37 per application of commercial product per ha + labour. Lowest cost is similar to the cheapest chlorpyrifos product. *Central America*: Approx. US$7-11 per application of semi-commercial product (rice with spores) per ha + labour. Cost similar to or a little less than endosulfan.

How much labour time does it need?	Labour time similar to mixing and applying any insecticide. Semi-commercial products need spores to be washed off rice and filtered before adding to the spray tank. Labour time for monitoring CBB incidence levels and assessing whether borers are within reach of biopesticide contact should also be included.
How easy is it to implement?	Semi-commercial products (rice with spores) have short shelf-life of a few days if unrefrigerated so should be applied as soon as possible and not stored or transported at high temperature. As with insecticides, *Beauveria* applications will not kill borers already within the bean so careful timing of application based on field assessment is needed. Semi-commercial products best applied early or late in the day to protect spores from UV light, unless groves are shaded or weather cloudy. Fully commercial products usually contain UV protectants. Fungicides applied close in time to *Beauveria* applications will kill the spores. Separate spray equipment should be used to avoid contamination. Semi-commercial products not widely available and may need to be ordered direct from technical support organisation or farmer co-operative.
Does it need much training before it can be used?	Farmers must understand how applying living fungal spores differs from spraying a chemical. Advice, and preferably an individual or group training session, is needed to explain how to store, use and evaluate *Beauveria* products. Farmers are often best convinced by seeing biopesticide use in practice on an experienced user's farm.
Other key points	Good cultural controls are the backbone of any effective IPM strategy. Biopesticides will not work well or cost-effectively without grove sanitation. Farmers need to understand that *Beauveria* does not immediately kill CBB but takes several days to infect and kill the insect. Regular applications can increase background levels of *Beauveria* in the grove, providing some level of longer-term control, especially in cooler, shady and humid conditions. Some large farms have successfully reduced or replaced chemical use with regular *Beauveria* applications plus improved cultural controls.

Criteria	**Physical Control based on traps with methanol-ethanol attractant**
How effective is it in controlling CBB?	Can capture large numbers of emerging CBB adults and reduce attack rate and reproduction on the new season berries BUT only in regions with a defined 'off' or dry season when no developing berries are present in the grove for several weeks. 46% of farms interviewed in Central America are using methanol traps since 2011 with very satisfactory results. 22% of Colombian farms use traps but only for monitoring borer flight periods or for capturing CBB at processing stations. 26% of global survey respondents rated trap use *Very Effective* and 32% as *Reasonably Effective*.
How much does it cost?	Much cheaper than insecticide application cost if home-made trap type (empty, plastic bottles), rather than commercial type, used. *Central America*: Alcohol attractant + dispenser approx. US$0.29-0.60 each, equivalent to

	US$ 5-13 per ha for home-made traps, at recommended densities. Commercial traps cost US$2-4 each, incl. attractant. On large farms, trapping costs US$14-20 per ha for trap + labour, compared to US$ 70-84 for standard 2 applications of endosulfan (product + labour only)
How much labour time does it need?	Labour includes making traps from empty plastic bottles, inserting attractant, placing in grove. Then checking traps every 2-3 weeks to empty water and dead insects and refill dispenser if necessary. Approx. 1-1.5 days per ha for trap production, placement & checking.
How easy is it to implement?	Very easy once farmer and workers have been shown how to manage the traps. Much less arduous and much safer work than handling pesticides. Methanol and ethanol are not available for public retail due to ingestion hazard so attractant dispensers can only be obtained from technical support organisation or farmer co-operative. Supplies must be stored out of reach of children or alcoholics. Empty 1-3 litre plastic drinks bottles easily collected and trap construction requires only simple tools and materials.
Does it need much training before it can be used?	Not really. Farmers quickly understand the idea and will adapt trap density and distribution, e.g. to increase coverage in CBB hotspots or next to abandoned plots. Use of traps to monitor CBB flight patterns and estimate numbers requires some training on use and interpretation of results.
Other key points	Good cultural controls are the backbone of any effective IPM strategy. Traps will not work well or cost-effectively without grove sanitation. If post-harvest clean-up is poorly done, traps may be insufficient to keep CBB population levels under control at the start of the following season. CBB females will always prefer developing berries to the attractant so the traps won't work for mass capture if green berries are already present. Traps must be placed in plots before CBB females start to emerge (at the start of the rainy season in Central America) and at the correct height (around 90cm) to target CBB flying up from berries on the ground. Several farms have successfully reduced or eliminated endosulfan use by adding trapping to cultural controls in the last 3 years.

Criteria	**Other physical controls**
How effective is it in controlling CBB?	These include: closing or covering sacks of berries at field collection points and pulping station, often with plastic smeared with grease or oil, to capture adults emerging from harvested berries; plastic or other smooth lining to delivery bins at pulping machine (so no borers trapped in crevices to escape later); filters on waste pipes to capture any live adults in pulp; trap trees or greased plastic sheets near processing station and pulp pit to capture any flying adults. Paths between plots, field weighing points and pulping/processing stations often have high levels of CBB. These methods can help reduce numbers of CBB escaping from picked berries or pulp and reduce re-infestation of other plots. 77% of Colombian farms interviewed are using some form of physical methods at processing stations and during picking.
How much does	No cost info but methods require very little expenditure. Small farms can easily afford

it cost?	plastic coverings.
How much labour time does it need?	A little for initial installation of filters, coverings, etc. and minimal maintenance.
How easy is it to implement?	Very easy.
Does it need much training before it can be used?	No. Farmers can easily learn the techniques from illustrated leaflets. May require some worker instruction and supervision as part of good picking practices.
Other key points	Not a major control method but farms aiming to minimise CBB damage, especially if reducing chemical control, highlight the usefulness of these small measures to stop preventable CBB movement from one site to another during normal operations. Maybe of more importance in regions with continuous pickings and frequent movement of bored berries.

Criteria	**Chemical Controls**
How effective is it in controlling CBB?	Can be very effective if a recommended insecticide for CBB is applied correctly and at the right time to kill borers before they enter the bean. But farmers also report ineffective applications and if rain occurs shortly after spraying, a repeat application may be needed. 44% of Colombian farms interviewed are using insecticides (mainly chlorpyrifos) as part of their CBB control. 50% of Central American non-organic farmers interviewed have used endosulfan in the last 5-8 years. 38% of global survey respondents rated chemical use *Very Effective* and 38% as *Reasonably Effective*.
How much does it cost?	Not necessarily cheaper than other methods, especially if full costs of spray equipment, maintenance, personal protective equipment and medical checks for spray teams on large farms taken into consideration. Calendar-based spraying without sampling for CBB levels or position risks wasting money on unnecessary application. *Colombia*: Approx. US$10 in product + US$22 in labour per ha on a large farm for one application of chlorpyrifos. Conventional farms may make 2-3 general applications per season. Certified farms only apply on hotspots, sometimes only once per season. *Central America*: Approx. US$7-15 in product depending on dose + US$20 in labour per ha on a large farm for one application of endosulfan. Conventional farms may apply 2-3 times per season. Small farms can find chemical use unaffordable.
How much labour time does it need?	*Colombia*: Approx. 2-3 person/days per ha on large farms for mixing and spraying. *Central America*: Approx. 1.5 person/days per ha on medium farms and 4.25 days per ha on large farms for mixing and spraying. Labour time for monitoring CBB incidence levels to assess need for control and assessing whether borers are within chemical contact should also be included.
How easy is it to implement?	Easy in terms of farmers and workers already familiar with spraying procedures. Not always easy to identify precise time for effective targeting of CBB or for organising

	spray operations in time over a large farm. Manual work of carrying 20 litre sprayers is hard and risky when using hazardous pesticides, even with protective clothing. Certification standards require considerable efforts in pesticide storage, recordkeeping, handling and disposal procedures.
Does it need much training before it can be used?	For well-timed and effective application, farmers and workers need training in monitoring techniques and proper application methods. For reduced risk pesticide handling, workers and managers require training and procedures need supervision.
Other key points	Experience and/or fear of poisoning workers or family members using endosulfan or other hazardous insecticides is a frequent reason cited by farmers to reduce or eliminate pesticide use. Others are concerns to avoid harm to wildlife and the environment and to comply with certification requirements. Over 50% of non-organic certified farmers interviewed in Colombia and Central America are not using insecticides for CBB. Several farms have greatly reduced or eliminated insecticide use in recent years, using a combination of IPM methods, while maintaining or even improving coffee quality.

Criteria	**Monitoring & Decision-making**
How effective is it in controlling CBB?	Not a control method in itself but highly important in achieving effective CBB management, especially in medium-high pressure zones. Farmers will not be able to control CBB cost-effectively if they don't know: (a) If CBB levels are high enough in a particular season to warrant extra control (b) Where CBB hotspots are in their plots (c) Whether borers can be reached by chemical or biopesticide contact or already out of reach inside the bean 89% of Colombian farms sample their plots at least once a season to assess % CBB levels. 77% record dates of flowering episodes to forecast when CBB controls may be needed on the new berries. 55% of Colombian farms assess borer position within the berries. Only 23 % of Central American farms sample to assess CBB % levels but almost all visit plots to identify hotspots.
How much does it cost?	None or very little in equipment. Labour effort in good monitoring is recompensed by gains from borer damage reduction and quality. Trained CBB pest scouts can be hired at US$4 per ha in some parts of Colombia.
How much labour time does it need?	May take a trained person 2-4 hours per 1 ha plot to sample 30 trees to estimate % CBB levels and then dissect 100 bored berries to assess borer position. Little time needed to observe and record flowering episodes or to get an idea of CBB hotspots in plots (can be incorporated into ordinary plot visits or field operations).
How easy is it to implement?	Colombian recommended monitoring is quite easy once farmer or worker trained, thanks to useful data recording calendars, field notebooks and guidance leaflets. Monitoring plots every 2-4 weeks helps large farms keep careful check on CBB population patterns and evaluate success of control actions for very well-organised management, especially if aiming to reduce chemical control.
Does it need much training before it can be used?	Farmers, managers and certain workers need to be trained, with practical demonstrations and some follow-up support till they become confident. Careful monitoring can be done by farmers without secondary education and irrespective of farm size.
Other key points	Most important in regions with continual berry development or highly unpredictable flowering patterns and CBB behaviour. Farmer experiences of ineffective spraying probably most often due to badly timed application, i.e. too late to prevent CBB damaging beans.