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Experiences with Cultural Controls for CBB

Content

Summary assessment of criteria for cultural controls for CBB

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.

Summary of use from interviews in production zones with continuous flowering (Colombia)

All the Colombian farmers interviewed are carrying out cultural controls along the lines of the National Coffee Growers' Federation general recommendation for regular and frequent picking and good sanitary controls. These two activities are: Regular Picking (***Recolección)***, i.e. the timely picking of mature berries, fit for sale, and Post-harvest Sanitation ('***Repase***'), collecting ripe, over-ripe and dry berries left on trees after harvest, and those on the ground (if necessary). The two activities are popularly referred to as '***ReRe***'. In many parts of Colombia there are 2 major harvest periods, so a thorough 'repase' clean-up post-harvest will be needed twice a year. Colombian coffee growing is characterised by almost continuous flowering, which means that some berries will be developing and some maturing in each farm at most times of the year. Making sure that the ripe ones are picked regularly, however small the quantity, is important to keep CBB reproduction rates low in the groves by removing the borers multiplying inside ripe berries, as is cleaning out any remaining over-ripe and dried berries after harvest to remove these breeding sites.

Table 1 summarises the controls reported in use. Most farmers interviewed are doing some form of picking every 15 days, and some more frequently. Many highlighted the importance of regular and timely pickings as probably their most important tool for borer IPM, along with good sanitation of left-over berries. 33% of farms are able to manage borer at acceptable levels using only cultural controls (farms A, B and D). These are two small farms, both at high altitude, and one medium sized one. The others will complement these controls with either use of biopesticides (farms, C and I) or occasional insecticide use on infested hotspots (farms, E and G). Farms F and H are in the process of replacing insecticide use with biopesticides.

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It was not possible to obtain data on labour requirements or costs of carrying out ReRes. This was mainly because for much of the year, farmers will be able to sell some or maybe all of the beans collected in this activity. In other words, they are at least partly compensating for the labour collection costs. Two mentioned the pest reduction importance of picking ripe berries even when many are too damaged to sell. Several farms treat all berries from regular, small pickings to kill any borer and prevent them re-infesting the plots. They take care to collect these in covered containers and then either place berries in boiling water for a short while or in sealed containers for 1-2 days so that gases released from the fermentation process kill the borer, before the berries are processed.

It was clear from the interviews that neither small nor large-scale farmers view the labour costs of cultural controls as prohibitive. Rather, they are an essential part of their CBB management strategy and several pointed out that instead of considering them as an increase in production costs, farmers should view them as an investment for good quality coffee. Good cultural controls are fundamental to keeping the pest at acceptable levels and without proper sanitation measures to reduce breeding potential, neither chemical nor biological methods will work effectively. Achieving good picking practices and post-harvest clean-up requires training of workers and close supervision, as well as good farm organisation, planning, monitoring and evaluating how well the tasks have been done. Several large and medium farms motivate their workers by running competitions, rewarding the best work teams and paying a decent daily rate for the task. One farm has developed its own system of intensive sanitary collections around identified hotspot trees, by a specially trained pair of permanent staff, combined with Beauveria applications to the ground. Farm managers and owners recognise that these organisational and workforce logistics cost money but they view the benefits as exceeding the costs, especially when they are able to gain a better price for their coffee or supply more rewarding customers.

Small-scale farmers said it means paying close attention to the groves, using decision making tools, and making sure to carry out tasks at the right time. One smallholder stressed the value of encouraging neighbouring farmers to do timely controls too, in order to prevent borer infesting across farm boundaries.

Several farmers emphasised the importance of regularly renewing trees (every 5, 6 or 7 years) as contributing to borer pest management. Carrying out cultural controls is quicker and easier in plots with trees that are not too tall or dense, helping the farmer to save labour costs, as well as the productivity benefits from rejuvenated trees. The smallholders interviewed were able to afford losing out in the short tem on 3 years' production in renewed plots by growing a variety of other crops for food and for sale and keeping livestock. When cutting down old trees, a large mass of borers will emerge from berries on branches with the disturbance. One farm keeps a couple of centre and border rows of trees intact in felled plots to attract these emerging borers and then applies Beauveria to these 'trap' rows. Another farm makes sure to remove all remaining berries from the trees before they are cut.

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Table 1. Summary of cultural controls reported in use by Colombian farmers interviewed (9 farms)

Farm	Main cultural controls & frequency	Additional info
A small	ReRes every 15-20 days	Bored berries treated with boiling water. Important for neighbouring farms to carry out timely controls too.
B small	ReRes, every 15 days	Renewing trees regularly makes it easier and cheaper to do good ReRe.
C medium	ReRes every 15 days	Pick berries as soon as they ripen and make sure you leave no over-ripe or dried berries on the tree. Renewing groves every 7 years and well-spaced trees allow efficient ReRes.
D medium	ReRes every 10-12 days	
E medium	Picking weekly on the farm	
F large	'to the maximum'	Berries from sanitary pickings collected in plastic pots and covered with greased plastic overnight to trap and kill any CBB emerging as contents heat up.
G small	ReRes, every 15 days	Put all the berries from sanitary pickings into water to drown any CBB inside.
H large	ReRes every 12-14 days	Full clean-up of berries left on trees + those on ground after major & minor harvest periods. Regular renovation of plots, every 5 years, makes CBB control easier and cheaper.
I medium	Regular pickings every 21 days, increased to every 15 days in plots with higher CBB levels. Hotspot sanitary controls every 3-4 weeks after major & minor harvest periods.	Around a hotspot tree and its 6-8 nearest neighbours, all berries collected from ground + any overripe or dry berries on branches. Berries collected from hotspots & 2nd harvest passes put into hermetically sealed barrels for 24 hours to kill any CBB with carbon dioxide released.

Details on cultural controls and farmers' views on labour, costs and tips for good practice are given in Appendix A.

Summary of use from interviews in production zones with defined flowering and one main harvest period (Central America)

Unlike Colombia, green berries are not present year-round in Nicaragua and El Salvador. There is a marked dry season in the months after coffee harvest, when no developing berries are present. When the rainy season starts this triggers a well- defined major flowering although smaller, earlier erratic flowerings may also occur. The main cultural controls used in the region to reduce CBB levels are:

(i) A major clean-up of groves after harvest, to remove any berries left on the trees (mainly over-ripe or dried ones, those missed by the pickers, plus a few late ripening ones) and collect fallen berries. This activity is called ***pepena*** in Spanish

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(or sometimes *repela*). It serves to reduce the number of breeding sites for the borer during the dry season so that in the next season borer population levels are much lower when the new generation of berries reach the 'creamy bean' stage susceptible to attack.

(ii) Collecting any early ripening berries, in one or more picking rounds 1-3 months before harvest. These berries result from early, very minor flowerings and are very often attacked by the borer as they reach the attractive stage. This activity to remove these bored or highly susceptible berries from the grove is known as ***graniteo***. This selective, sanitary picking serves mainly to protect the berries of the main harvest by reducing the number of borers reproducing in the grove and their potential to infest more berries.

Table 2 summarises the cultural controls reported in use, along with farmers' estimates of labour required and approximate costs per hectare, where obtained. 33% of farmers interviewed are able to manage borer adequately with cultural controls alone (farms, A, B, E and F). These include 1 small sized and 3 medium sized farms. Two of these farms are at high altitude in a low pest pressure area, the other two are in a low-medium pressure area. The majority of farms (67%), however, complement sanitary collections with either use of trapping or application of *Beauveria*, or both.

Both sanitary activities are labour-intensive to carry out well. Clearing as many berries as possible out of the plots after harvest requires the most labour per hectare (estimated 10-14 days per ha) and many farmers avoid the cost of this labour by allowing people to come and collect these *pepena* berries for free. The berries will be a mixture of unripe, overripe and dried berries and the unpulped berries can generally be sold as low-grade coffee to local traders or mills. 72% of farmers interviewed (small and large scale farms) allow either their picking workers and/or local people to collect part or all of the *pepena.* The income generated, while not large, can be an important benefit for workers or poorer people who tend to do this work. It enables farmers to achieve a reasonable clean-up at almost zero cost, requiring just a little supervision, and helps to set good relations between the farmer and the labouring community.

Two of the 12 farms combine 'giving away' the *pepena* with some collection by their workforce when carrying out later tasks post-harvest, such as pruning bushes and tidying up trash. 27% of farmers prefer to pay for *pepena* clean-up because they feel it is done better by their workers. Farmers will pay a standard daily wage for this task, rather than by weight, unless there is a very large amount of coffee left after harvest (if heavy rains, for example, caused many berries to fall). Several mentioned that manual weeding (slashing by machete) a few days beforehand helps workers find fallen berries more easily.

Picking *graniteo* berries is less intensive, although workers need to go carefully row by row, selecting the few ripe or bored berries per tree. Just over half of farmers do 2 rounds of *graniteo*, around a month apart, as the berries from the early flowerings mature. Depending on how climate and altitude affects the coffee production calendar in their zone, some farmers may do three rounds , perhaps combining the last round with the first harvesting round if CBB levels are relatively low, and others find just one is sufficient. As quantities picked in a day are small, this work is usually paid by day rate. Estimates varied widely for labour required, from 0.75 to 7 person/days per ha, averaging 3.75 days per ha per round.

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The first round tends to be quicker as very few berries are ripe yet, which may explain some of the variation in the estimates.

63% of farmers reported putting berries into boiling water in order to kill any borer inside. One farmer buries the berries. Experiences vary on whether any useful beans can be salvaged from *graniteo* pickings. Three farmers said almost all the beans will be useless. Four others explained that some can be dried and carefully selected for sale, or used for home consumption. Most farmers concentrate on removing ripening berries, which are very likely to contain borer, but a few mentioned they also try to remove any green berries bored.

When questioned about labour costs, only two farmers considered *graniteo* as expensive. 63% of farmers felt that the cost of cultural controls was either not a major concern for them or that the task was an essential investment in gaining coffee quality by reducing borer levels. Several explained that the benefits gained in CBB reduction were well worth the cost incurred. One farmer estimated that spraying endosulfan twice would be more expensive than labour costs for sanitary picking. *Graniteo* does require careful supervision and several farmers said they like to check themselves that workers are doing it properly. One export company advises large estates to concentrate on thorough *pepena* collection, while recommending *graniteo* as more suitable for small farms, because large estates cannot recoup their labour costs from *graniteo* picking.

Three of the farmers and both exporters interviewed noted that shade regulation contributes to CBB management and that it is important to avoid too much shade in zones with frequent cloud cover as CBB levels will tend to build up in dense, humid plots with excessive shade. These farmers prune back trees after harvest and/or remove branches from shade trees on a regular basis.

Table 2 Cultural controls reported in use by Central American farmers (12 farms)

Farm	Selective berry removal before harvest *(graniteo)*	Post-harvest removal from trees and ground *(pepena)*
Farm A (medium)	Average 2.85 person/days per ha per round 2 rounds *Approx. cost (at US$5.00-6.00):* US$31 per ha	Needs 16-17 people for several days over 2-3 month period for 11.2ha farm *Approx. cost*: US$65 per ha?
Farm B (medium)	2.85 days per ha per round 2 rounds *Approx. cost (at US$4.17):* US$24 per ha	About 10 person/days per ha Lets locals collect *pepena* to sell *Approx. cost*: none
Farm C (small)	2.84-4.26 days per ha per round 2 rounds *Approx. cost (at US$5.00):* US$35 per ha + food	Lets locals collect *pepena* to sell *Approx. cost*: none

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Farm D (small-medium)	5.6-7.0 person/days per ha per round 2 rounds *Approx. cost (at US$5.00):* US$63 per ha + food	Lets locals collect pepena to sell. (Estimates 14 days per ha if you pay on daily rate) *Approx. cost:* none
Farm E (medium)	7.1 days per ha Pays *graniteo* by volume at a fair price to encourage careful work	Lets coffee pickers collect *pepena* to sell *Approx. cost*: none
Farm F (small)	7 days per ha 1 round *Approx. cost (at US$4.20):* US$29 per ha	Lets workers and locals take most of the last harvest round to sell. Workers then collect any remaining berries when pruning trees. *Approx. cost*: low
Farm G (small-medium)	0.5-1 days per ha per round 2 rounds *Approx. cost (at US$5.00):* U$ 7.50 per ha	Lets coffee pickers collect *pepena* to sell *Approx. cost*: none
Farm H (small)	Carries out *graniteo* *Approx. cost: No info*	No info
Farm J (large)	Pays *graniteo* by day to remove any early maturing berries *Approx. cost: No info*	Lets locals and workers collect *pepena* berries and sell them back to the farm *Approx. cost:* No info
Farm K (small-medium)	1.8 days per ha, removing bored green and ripe berries 1 round only? *Approx. cost (at US$6.25 incl. food provided):* US$11.25 per ha	Pays *pepena* by day if only a few berries remaining, otherwise by volume *Approx. cost:* No info
Farm L (medium)	2.5 days per ha in 1st round, 4 days per ha in 2nd 2 or 3 rounds *Approx. cost (at US$5.00):* US$33 per ha	Lets locals collect fallen berries. Pruning team later collects any berries left on trees. *Approx. cost*: very low
Farm M (small-medium)	2 days per ha 2 rounds *Approx. cost (at US$5.00):* US$20 per ha + food	Pays *pepena* by day *Approx. cost*: No info

Details on cultural controls and farmers' views on labour, costs and tips for good practice are given in Appendix B, along with views from the experience of two exporter companies.

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Summary from on-line survey responses (global)

The majority of respondents (41 of a total 45 responses) mentioned cultural controls, indicating widespread use. Of these, 21 respondents (51%) ranked these methods as 'Very Effective' and 16 (39%) as 'Reasonably Effective', while only one considered them 'Not Very Effective'. Respondents gave no indication that cultural controls are only effective in areas with low or medium CBB pressure- respondents in zones with high or very high pressure also reported good effectiveness.

Few details of costs or labour involved were provided and most responses did not specify whether controls were post-harvest clean-ups and/or sanitary pickings before harvest, or other techniques. Several responses combined cultural controls with mechanical or trapping methods, making assessment of the different methods impossible. Labour estimates for cultural controls mainly based on post-harvest clean-up varied hugely from 3 to 20 person/days per ha. Some respondents considered this method expensive due to labour costs, while others considered it a cost-effective investment to achieve good quality beans.

Numerous respondents highlighted the importance of cultural controls and good grove hygiene, irrespective of farm size or coffee production system. With over 82% of those surveyed giving positive feedback on the value of these methods, this confirms expert knowledge and practical field experience that cultural controls (e.g. sanitary berry removal from branches and the ground to reduce CBB breeding sites the following season and/or preventative selective removal of bored berries to protect the coming harvest), form the backbone of effective CBB management.

Hot or boiling water treatment of bored berries to kill any live CBB seems to be fairly common practice, while several mentioned complementary agronomic practices which help make sanitary controls easier and more efficient, such as good tree pruning. In India, use of picking mats placed under the tree (so that any berries dropped during harvesting can be easily seen and collected) is widely promoted. In some Brazilian farms, mechanical removal of fallen berries and trash is carried out by machine after harvest.

Views of experts consulted and issues for consideration

Dr Peter Baker from CABI Bioscience provided feedback on draft project summaries and to specific questions, based on his lengthy experience working in Colombia and elsewhere on CBB IPM:

- CBB is very much a pest problem due to berries left after harvest. These give the borer optimum conditions to reproduce. In dry weather or zones with a prolonged dry season, CBB thrives protected inside dried berries and can produce several generations of offspring inside the same bean. In wetter weather, fallen berries will rot much more quickly and reduce the favourable conditions for CBB breeding and survival. CBB levels will tend to fall after several years with wet weather. Conversely, hotter or drier weather than normal, especially in several seasons running, can send CBB populations rocketing up, even with good cultural controls.

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- Removing berries from the ground after harvest is very important because these are key breeding sites for CBB. BUT this task is also very time-consuming and labour-intensive. What options are there for adapting machinery to help this task? Some years ago CABI tried an adapted leafblower 'vacuum-cleaner' to suck up ground trash and berries, with the aim of CBB control and composting the material but the kit was not robust enough. Some other type of lowish-tech kit may be adaptable now with innovation. Combining some element of mechanised removal with modest sampling of CBB levels in berries on the ground after harvest (to see what level of problem needs to be controlled and where) could be a good option for significantly reducing population levels in the following season.
- What is the relative ratio of CBB control costs to other inputs and in different price scenarios for inputs and coffee? Nobody's really done much research on this. IF lots of green berries are bored, is it cost-effective to do a sanitary collection pre-harvest? No real data from the field to show yes or no. Depends very much on coffee price at harvest and in the following season if you don't control well and lose yield/quality.
- Effect of shade on CBB populations and reproduction is unclear. Academic studies give ambiguous results and no clear conclusions to provide any simple 'messages' applicable to all farmers.

Dr Adán Hernandez from PROCAFE coffee research institute in El Salvador provided information from their research and promotion work.

- Combining good sanitary collection and post-harvest clean-up with alcohol trapping and pruning of coffee and shade trees can greatly reduces borer infestation levels, to well below 2%. Trapping and pruning methods without cultural controls cannot keep CBB % under 6-7%.
- A properly done post-harvest clean-up removes much of the CBB refuge and breeding sites normally found in dried, fallen berries.
- For El Salvador, PROCAFE recommends careful harvesting (Oct-Dec), a very well conducted final harvest collection round (which should cover its labour costs) in Jan-Feb and then a rigorous clean-up of groves afterwards.
- Pruning and shade regulation is very important for effective IPM. Coffee tree pruning post-harvest (Jan-Mar) helps to open up the plots, aiding control of CBB and diseases. Shade trees should be trimmed in May-Jul. The next CBB sanitary control will then be picking of berries ripening (May-Jul) from any early flowerings.

For more details of PROCAFE's recommended CBB IPM strategy, see Dr Hernandez' presentation at the project lessons workshop (in Spanish) and their advisory leaflet on *Triple-Action IPM*, published jointly with French research institute CIRAD (English & Spanish versions). The triple actions refer to:

(1) Branch stripping of all berries after harvest

(2) Use of BROCAP® traps with methanol/ethanol attractant

(3) Careful agronomic practices of pruning coffee and shade trees and grove hygiene.

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Dr Carmenza Góngora from Cenicafe research institute in Colombia has worked on various aspects of CBB IPM (see her presentation at the project lessons workshop for more details):

FNC-Cenicafe publish several advisory leaflets in their *Brocarta* series (Spanish only) relating to cultural controls (see the project List of Useful Resources). Their leaflet *When and how to carry out sanitary controls?* recommends collecting all ripe, overripe and dried berries from trees, and if necessary from the ground, around 2-3 weeks after the last harvest round. In the Colombian coffee climate, this means twice a year, after the major and minor harvest peaks in Nov-Dec and May-Jun respectively.

Good cultural control practices form the foundation of any IPM programme for CBB. Other agronomic practices for coffee productivity are also important to help reduce CBB levels: regular renewal of plots; appropriate planting distance; and integrated management of weeds.

Felling coffee trees in plots to be renewed encourages mass CBB dispersal from the berries towards neighbouring undisturbed plots. Specific control actions are recommended to reduce this dispersal.

Suggestions for follow-up:

- More detailed information on labour requirements and costs of different cultural control measures from farms involved in the project would be useful. Some farms have these very well estimated but most do not. Understanding the cost:benefit ratio under different coffee price conditions would be useful for farmers to see when it makes sense to put more effort into achieving better sanitation controls.

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Appendix A: Details of cultural controls from Colombian farmers interviewed

Farm A. La Divisa (El Aguila municipality**)**(very small farm, high altitude & low CBB pressure. CafeNorte Coop member, Utz certified). Mr Nevardo Restrepo, Owner.

Methods used: Regular picking ('ReRes') and sanitary removal of bored berries (green or ripe)

Frequency: every 15-20 days

Cost aspects: Considers not too difficult or costly to do 'ReRes', with family support and paying for one or two workers. The benefit he gains from good cultural controls is well worth paying for a couple of days' labour each time.

Effectiveness: Has not needed to spray insecticides for CBB control for 15 years, using only monitoring, cultural and physical controls (covering picking baskets). CBB levels have been very low, well under 1%. Farmer is satisfied with this level of control, aided by high altitude of farm.

Treatment and use of berries collected in sanitary picking: bored berries put in buckets of water to drown CBB and prevent it reproducing.

Views and perspectives

- You must take care to harvest the coffee in a very timely way
- You need to make sure that picking and sanitary collection tasks are properly carried out
- All neighbouring farmers in this community carry out timely controls too so no problems with CBB infesting his plots from adjacent farms. Very important to work as a team with family members and with neighbours doing the same controls.
- Monitoring plots to check infestation levels is important.

Farm B: La Manzanares (small farm**,** high altitude & low CBB pressure, CafeNorte Coop member, Rainforest). Mr Luis Aníbal Suárez, Owner.

Methods used: Regular picking ('ReRes') and sanitary removal of bored berries

Frequency: every 15 days

Cost aspects: Takes around 2 hours to collect 10-15kg of berries. Labour payment for collecting even unsellable berries is necessary to end up with pest-free groves. Costs are recompensed by benefits from low CBB levels in your coffee and no health problems due to pesticide poisoning.

Effectiveness: Has not needed to use insecticides for over 8 years**.** Even under heavy CBB attack in 2012, he managed to keep levels under control by picking every 15 days, even when he could not sell the beans collected.

Treatment and use of berries collected in sanitary picking: berries from some sanitary collections will be useless

Views and perspectives:

- ReRes are the best method, being prepared to do these very regularly.

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- Important to train workers on how to do sanitary collections and check they are doing these properly.
- Good hygiene in the grove is essential.
- He does not want to use dangerous chemicals which can harm wildlife and humans.
- Communal work sharing among 6-8 farm families (taking turns to work together on every farm) promoted by Neumann group is very effective for labour-intensive tasks like picking and nursery preparation.
- Regular renewal of groves (17% of farm each year) is important for many reasons, including pest control. It's much easier and quicker to harvest and do sanitary collections when trees are not too dense or tall.

Farm C: La Divisa (**Buenavista** municipality) (medium farm**,** medium altitude & CBB pressure. Certified Rainforest, Utz, 4C, member of Grupo Cordillerano producer group.). Mr Diofanor Ruiz, Owner.

Methods used: regular picking and sanitary collection; regular renewal of groves, careful monitoring

Frequency: every 15 days for harvesting or sanitary picking

Cost aspects: No details but did not mention cultural control costs being a barrier. Picking needs to be almost constant and very timely.

Effectiveness: Has not used endosulfan for 15 years. Using cultural controls, other IPM methods (application of Beauveria on hotspots when needed) and good grove management, he has been able to eliminate insecticide use for all coffee pests in recent years.

Treatment and use of berries collected in sanitary picking: no details

Views and perspectives:

- Timely and careful action is essential. You need to be picking berries as soon as they ripen and make sure you leave no over-ripe or dried berries on trees.
- Renovating or replanting trees every 7 years is important for good IPM. Regularly renewed and well-spaced trees allows you to do ReRes efficiently in each plot.
- Farms with older trees and where they don't take timely actions will have problems controlling CBB.
- Changing to a more ecological farm system (mixed cropping of coffee with plantain, shade trees, minimal herbicide use, zero insecticide use, mulching and good ground cover) since buying this farm is his specific objective and has helped reduce pest problems.

Farms D and E: Few details obtained from other two Grupo Cordillerano farmers met. Fernando Corrales does ReRes every 10-12 days usually and has not needed to apply chemical or biological products. Jorge Olivares picks weekly on his farm of 30ha, with regular monitoring. When cultural controls alone are not sufficient, he may supplement with very limited chemical application on hotspots.

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Farm F: La Palmera (large estate, medium altitude, high CBB pressure. Member Anserma Coop, Rainforest & Fairtrade certified). Mr Alfonso Gómez, Farm Manager.

Methods used: regular picking and sanitary collections

Frequency: 'to the maximum' i.e. very frequently

Cost aspects: No details

Effectiveness: Very good cultural controls, along with regular applications of Beauveria biopesticide (formerly applications of chlorpyrifos insecticide) achieves 4-5% CBB across this 200ha estate, although some plots at 1-2%. This is a high risk zone and CBB can reach 15% infestation on farms with inadequate controls.

Treatment and use of berries collected in sanitary picking: after harvest passes, collect remaining berries on branches into 5 litre plastic pots and cover with greased plastic to trap and kill any CBB emerging as contents heat up. This practice also serves as measure of how much CBB there is in berries left in a particular plot. Generally, over-ripe and dried berries collected in sanitary picking are unuseable.

Views and perspectives:

- Cultural controls are the most important method. It can be hard to hire workers to do this work, but you need to try and get these controls done as well as possible, especially removing left-over berries. CBB reproduction in fallen berries can be avoided by Beauveria applications to the ground.
- He pays the farm spray team to do sanitary collections in the winter period when they're not spraying and this helps a lot to reduce CBB reproduction.
- You need to organise your harvest and sanitary tasks so that CBB don't get transferred from one plot to another when transporting berries. Important to keep sacks of harvested berries closed tight and use greased covers to trap any borers emerging from left-over berries during collection.
- Maximising cultural controls, with careful monitoring in each plot and supervision of the work.
- It's perfectly possible to control CBB on a large farm without endosulfan, using very good picking and sanitary controls and applying biological products.

Farm G: La Azulita (small farm, lower altitude, high CBB pressure. Fairtrade certified, member of Anserma Co-op). Mr Rafael Henao, Owner.

Methods used: Regular pickings mainly, plus some sanitary collections

Frequency: Every 15 days

Cost aspects: No details but being organised and timely saves you money in the end

Effectiveness: Good regular picking is very effective. With continual ReRes done in a timely way you should be able to keep CBB levels under control for most of the time, without the need for applying insecticide. He is achieving 2-3% on his farm, with some insecticide application.

Treatment and use of berries collected in sanitary picking: put all the berries into water to drown any CBB inside and avoid it breeding further.

Views and perspectives:

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- Picking every 15 days and other tasks in good time, according to the flowering calendar [see Monitoring & Decision-making] and being well organised are all essential.
- The hotter the climate, the easier it is to do regular pickings [as the berries ripen fast].
- Don't spray chemicals when the borer is already inside the bean as the chemical cannot reach them. Instead, you need to remove those berries and put them in water to drown the pest.
- Keeping on top of things, checking and paying attention to detail is important, even for the smallest farm.

Farm H: La Lila, Agrovarsovia Farms (large estate, medium altitude, medium-high CBB pressure. Certified Utz, Rainforest & Fairtrade). Mrs Marlen Sanchez, Mr Arlides Aricapa, Internal Auditor and CBB Control Supervisor respectively.

Methods used: Repeated pickings, well conducted. Thorough sanitary collections across all plots after major harvest periods. Regular renewal of groves. Cropping system with productive shade trees.

Frequency: Regular picking every 12-14 days per plot.

Cost aspects: Full clean-up of berries left on the branches and those on the ground after the major and minor harvest periods is costly, taking around 1.5 person/days per ha and paid by day, not by kilo. Investing in careful monitoring, cultural and biological controls has delivered higher quality coffee with a 3-4% increase in price.

Effectiveness: Although cultural controls alone are not enough in this zone to keep CBB under adequate control for the estate's quality requirements, they are the foundation of CBB integrated management. Neither insecticides nor biopesticides will deliver effective control if the basics of good picking and post-harvest clean-up are not done. Combining cultural and biological controls, with very careful monitoring and planning, CBB levels are now below 2%.

Treatment and use of berries collected in sanitary picking: 2nd grade berries dried under sealed conditions to trap any CBB emerging.

Views and perspectives:

- The most important control method for CBB is really good picking practices, so no ripe, over-ripe or dried berries are left on the trees.
- Paying workers a fair price will motivate them to pick well.
- Workers need training how to pick properly and do sanitary collection. Staff need to understand when and why things might be going wrong in a particular plot.
- Careful auditing of all farm tasks, especially picking, is essential. They appoint a field supervisor for every 15-20 pickers, to check they are doing it properly. If more than 5% of berries remain on the trees or ground in a specific plot, workers go through the plot again to collect them.
- Regular renovation of plots, every 5 years, makes CBB control easier and cheaper as incidence levels tend to be lower on young trees and it's easier to hire workers to pick and clean amongst smaller, less dense bushes.
- When cutting back groves to renovate trees, they leave a line of trees intact along the borders and plot centre to trap any CBB migrating when the trees are cut. These trees then sprayed with Beauveria.

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- Some workers used to throw any green berries they picked accidentally during harvesting back into the plots. You must eradicate that bad habit!
- Thinking only about the immediate costs of control methods is the wrong approach. You need to consider the cost:benefit. Cultural controls are best seen as an investment for quality, rather than an increase in your production costs.
- Productive shade from bananas and plantain along grove borders helps reduce the high temperatures that encourage rapid CBB reproduction in this zone.

Farm I: Las Brisas (médium farm, médium altitude, médium-high CBB pressure. Member of Risaralda co-op, certified Fairtrade, Utz, Rainforest, 4C). Mr Guillermo Londoño, Owner, and Mr Juan Pablo Salguero, Farm Manager.

Methods used: Regular picking, with rigorous sanitary collections around identified hotspots (trees with > 5 bored berries from sampling). Around a hotspot tree and its 6-8 nearest neighbours, all berries collected from the ground and any overripe or dry berries on the branches.

Frequency: Regular pickings every 21 days, increased to every 15 days in plots with higher CBB levels. Hotspot sanitary controls every 3-4 weeks after major and minor harvest periods.

Cost aspects: Investment in careful picking and hotspot controls delivers benefits in terms of better coffee quality and higher price. He can now meet demanding speciality client requirements for quality coffee produced under environment-friendly conditions.

Effectiveness: Has not needed to apply insecticide for 10 years using this ecological system based on intensive sanitary controls, careful and frequent monitoring and application of Beauveria around hotspots. This system has achieved 1.5% levels even in recent high CBB attack season, compared to 18% infestation when he first took over this farm.

Treatment and use of berries collected in sanitary picking: Berries collected from hotspots and from second harvest passes are collected in lidded containers and put into hermetically sealed barrels for 24 hours. As berry fermentation starts, carbon dioxide gases released kill any CBB inside or emerging. Many of these berries can then be processed and sold as 2nd grade beans.

Views and perspectives:

- Outside main picking seasons, farm runs a competition for workers with prizes for those who can collect the most dried berries. These berries often left behind so motivating workers to collect them achieves excellent sanitary control in each plot.
- Hotspot control conducted by two young women trained and paid daily, rather than volume rate, to incentivise them to do this work carefully. They use containers lidded with greased plastic to capture any CBB emerging.
- Keeping CBB levels low benefits workers financially as they pick a heavier weight from pest-free berries for the same effort.
- You need dedicated and well-trained farm manager, foremen and pickers. It's best to train a few permanent staff to do the intensive controls.
- When cutting back groves to renovate trees, they first collect all the green and developing berries, to prevent CBB migrating to infest nearby plots when the trees are cut.
- Good controls necessary at pulping and processing stations to prevent CBB re-infesting from pulp or collection containers.

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Appendix B: Details of cultural controls from Central American farmers and exporters interviewed

Farm A: La Herencia, Nicaragua (medium farm, medium-high altitude, medium CBB pressure. Member of CONFOP service co-op, Rainforest certified). Mr David Pérez, Owner.

Methods used: sanitary removal post-harvest (*pepena*) and pre-harvest selective removal of bored early ripe berries (*graniteo*)

Frequency: 2 rounds *graniteo* Jul-Sep (2 rounds necessary to avoid removing any useable beans). Then a thorough sanitary control (fallen berries and any left on trees) during 2-3 months after harvest.

Cost aspects: Pays daily rate, rather than volume rate, for both '*graniteo*' and '*pepena*', currently US$5.25 equivalent per day. [For his 11ha farm approx. US$40.5 total in graniteo labour, = US$3.67 per ha] *Pepena* is costly but necessary, taking at least 20 person/days. *Graniteo* is quicker and more economical, taking 0.28-0.42 person day/ha. Cultural controls are rather expensive and slow but they give good control.

Effectiveness: With good cultural controls alone, he achieves coffee with 2%, or maximum 2.5%, bored beans in a zone where CBB levels can rise to >5% if not controlled. He has managed to keep CBB below 2.5% for 11 years using this system.

Treatment and use of berries collected in sanitary picking: Only bored early ripe berries collected in *graniteo* and put in boiling water to kill CBB. *Pepena* beans can be used for home consumption but *graniteo* beans usually too damaged for use.

Views and perspectives:

- *Graniteo* requires careful and slow work, picking branch by branch. He may offer workers a slightly higher daily rate, to motivate them to do the job well. The aim is to prevent CBB reproducing in these early ripening berries and damaging the future harvest.
- Only does full sanitary clean-up once after the main harvest period, requires 15-18 people per day for several days on a farm of his size (11ha). Too expensive in labour terms to do this after each harvest round.
- To make sanitary control easier, does manual slashing of weeds just beforehand, leaving the cut material for a couple of days to rot or dry up and then people can spot the fallen berries more easily.
- Important to supervise *pepena* task very well, he thinks it best to check this personally rather than rely on a foreman.
- In 2012 due to very low coffee prices and difficult economic situation (made worse by severe coffee rust attack in many farms), he adapted his usual tactic of paying workers to clean up groves and instead 'gave away' the *pepena* coffee, i.e. allowed local people to collect fallen and remaining berries on branches. They can then sell these or use them for home consumption. He benefits from getting CBB removed from his groves and poorer people locally benefited as they were desperate to earn some income.
- It might be more expensive using cultural controls compared with chemical control but he considers it important not to harm his health or his children. Cultural controls may not be 100% effective but he is achieving good control.
- In first *graniteo* pass, each worker probably only collects 2.3-4.5kg berries, in 2nd pass, probably 6.8-9.0kg as more berries are maturing.

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Farm B: La Naranja, Nicaragua (medium farm, medium-high altitude, medium CBB pressure. Member of CONFOP service co-op, certified Rainforest, formerly organic). Mr Ulíses Pérez, Owner.

Methods used: sanitary removal post-harvest (*pepena*) and pre-harvest selective removal of bored early ripe berries (*graniteo*). Separates bored floating beans after pulping and puts them in boiling water to kill any live CBB.

Frequency: 2 rounds *graniteo* to remove early ripening berries containing CBB, in Jul-Aug and again in Oct. Pepena done in Jan-Feb after harvest, mainly to remove berries left on ground.

Cost aspects: 2 workers can easily pick *graniteo* berries in 0.7ha, i.e**.** 2.85 person/days per ha, paid at US$4.17 per day. [For his 21ha farm, approx. US$500 total for two graniteo rounds, approx. US$24 per ha for cultural controls]. This work is fairly quick as only a few trees will be showing ripe berries. *Pepena* clean-up would requires 9.94-11.36 person days per ha but he 'gives away' *pepena* coffee to his workers or local people, i.e. does not have to pay the labour costs.

Effectiveness: These cultural controls work well and he has not needed to use other controls, e.g. methanol trapping. His farm has a very low level of CBB damage using these controls and has not suffered bean rejections for quality defects.

Treatment and use of berries collected in sanitary picking: all early ripening berries picked for *graniteo* as they are very likely to be bored, then put in boiling water to kill pest. Beans collected in pepena are not the best quality coffee but not the worst either.

Views and perspectives:

- *Graniteo* is the first task in CBB management, important to remove borer breeding populations.
- If there are a lot of early ripening berries in a particular season, due to significant early flowering, he may pay *graniteo* by volume.
- *Pepena* sanitary clean-up very important to prevent surviving CBB infesting developing berries of the next season. There will be many fallen berries dropped by pickers during harvest, or as a result of rain or natural ageing.
- It's best to keep an eye on people collecting pepena to make sure they're doing it well and collecting from the entire plot, but you don't need to supervise them all day long.
- It benefits local people to collect *pepena* because they can sell the unprocessed berries for a reasonable income, especially if their family members help out. For him it makes more sense economically to let them take these berries and remove CBB from his groves. Some farmers are too mean to do this but they've not done the sums to see that paying for this labour is more expensive.

Farm C: La Consentida, Nicaragua (small farm, medium altitude, medium CBB pressure. Local co-op member, organic & Fairtrade certified). Mrs Maritza Colindres, Owner.

Methods used: sanitary removal post-harvest (*pepena*) and pre-harvest selective removal of bored early ripe berries (*graniteo*).

Frequency: 2 rounds of *graniteo* in late Jul and early Oct, removing ripe berries from early flowering-most will be bored.

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Cost aspects: *Graniteo* needs 2.84-4.26 person/days per ha for good collection, carefully selecting the berries. This is not a major expense if using family labour alone. For hiring 1-2 workers, it costs US$5.00 per day + their food. [for her farm of 2.8ha would cost approx. US$99 + food, i.e. US$35 per ha]. She allows local landless people to collect *pepena*, i.e. does not incur labour costs.

Effectiveness: These cultural controls along with application of *Beauveria* once a year work really well on her farm to keep CBB around 2%. Farms that don't invest in proper cultural controls can easily reach 10% CBB levels.

Treatment and use of berries collected in sanitary picking: Ripe bored berries from *graniteo* put in boiling water to kill pest. These beans normally too damaged for sale but you can sometimes keep clean halves for your own consumption if % infestation level is not too high.

Views and perspectives:

- *Graniteo* important to keep the pest from spreading. She thinks that each borer can produce up to 60 new ones, so imagine how many beans will be deteriorating if you let those borers reproduce.
- In difficult economic years like 2012 and 2013, many small farms cannot afford chemicals or biological products so must rely on manual methods.
- Farmers have to understand that they will never eradicate this pest, you have to learn to live with it to some extent.
- Restrictions on child labour under certified schemes now makes it difficult to use family labour for *graniteo*, as your children would lose 1-2 days of school to take part.
- She always permits her picking workers to stay to collect pepena, along with some local people. Sometimes they get a very rewarding pepena, if it's been very rainy and lots of berries have fallen. They might collect up to 9kg per day which they can sell to the traders and this income helps poorer families to buy rice and sugar.
- Some farmers don't like giving away *pepena*, they say the berries aren't worth collecting or they don't want people damaging their trees. She's never had problems as long as you make sure one of your family or a permanent worker is around to do a little supervision.
- If all coffee farmers carried out good cultural practices that would really help control borer, not totally, but minimising the damage. In 2009-2010 there were plots round here with levels of up to 10%- that's far too high and harms neighbouring farms. So it's very important for all the neighbours to do the cultural controls, this is the best method to prevent the pest reproducing. You need to begin yourself and hope others will follow your good practices. Doing good *graniteo* protects your plots and maybe those of neighbours, it's a responsibility.

Farm D: Gracias a Dios, Nicaragua (small-medium farm, lowish altitude, medium CBB pressure. Local co-op member, organic & Fairtrade certified). Mr Eriberto Altamirano, Owner.

Methods used: sanitary removal post-harvest (*pepena*) and pre-harvest selective removal of bored early ripe berries (*graniteo*).

Frequency: 2 rounds of *graniteo*.

Cost aspects: *Graniteo* needs 5.6-7.0 person/days per ha, at cost of US$5.00 per day + food. [for his farm of 8ha would cost approx. US$480 + food, i.e. US$60 per ha]. He usually allows locals to collect *pepena*, unless there is a lot of coffee remaining on the floor. Estimates around 14 days per ha to collect pepena well, paid on a daily rate.

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Effectiveness: These cultural controls, along with two applications of *Beauveria* per season, keep CBB levels below 3% on his farm. With poorly managed farms, levels can easily reach 5%.

Farm E: Los Planes, Nicaragua (medium farm, high altitude, low CBB pressure. Local co-op member, Fairtrade certified). Mr Rodolfo Lago, Owner.

Methods used: *pepena* post-harvest, *graniteo* and shade regulation

Frequency: 1-2 rounds *graniteo* before harvest + thorough *pepena* after harvest

Cost aspects: He lets his workers take all the *pepena* berries and sell or use for their family. For graniteo, he generally pays a little more per volume than the usual harvesting rate but with very poor coffee price this year, he had to pay less for the 1st graniteo round. Estimates *graniteo* takes 7 person/days per ha and pays *US1.25 per 9kg can collected.*

Effectiveness: Has never used insecticides for CBB control, main control tactic is *pepena* after harvest and good picking practices, plus some *graniteo*. Only once received price penalty for bored beans in 2004, an outbreak year when some of his beans reached 7-8% levels.

Shade regulation: at this altitude (1600m) and frequent cloud cover it's important not to have too much shade as this is where CBB thrives. He replaced very large trees and those that lose all their leaves in the dry season and replaced them with more manageable species where you can easily prune back a few branches, without damaging the coffee bushes.

Views and perspectives:

- You need to take care to pick the first *graniteo* round before bored berries start to split or fall to the ground or you will get problems of borer reproducing on the floor.
- You won't get far if you pay workers to do the *pepena*, as it's little to earn [by volume] so they won't put much effort in. But when they know all they collect is for them, then they'll collect much more and the farmer benefits too.
- You need to supervise harvest teams closely because the pickers will always drop some berries, so make sure they don't leave them there but collect them up. You've got to talk to the people and tell them not to let any fall and then you let them take the pepena, as much as they can collect. It's economic as you don't need to pay and the workers benefit too.
- You need to check after harvest when you weed in May-Jun between rows and along paths that no berries are still hiding there. Rainy weather before harvest can cause many berries to fall, so you need to get the pickers to collect these otherwise you're generating borer problems.
- To help *pepena* collection and other farm tasks, he does two manual weedings with machete in May-Jun, then again Nov. He also burns off weeds, using glyphosate herbicide, on his renewed groves or where the land was used before for maize growing, which tend to become very weedy.
- You need to keep an eye on harvest workers to avoid any from deliberately dropping berries to collect later in *pepena*. Foremen need to follow behind workers and keep a check. He generally gets long-time local pickers staying on for *pepena* and they are conscientious. You may need to win over people by offering them e.g. 18-20kg worth of green berries in *pepena* to sell. It's supervising carefully but also giving people respect and benefits.
- Borer tends to be worse in traditional groves where the farmer doesn't really do anything, just a bit of weeding, and in organic ones. Farms that don't regulate the shade are where

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populations will breed in this zone. It can be problematic if you have an old-fashioned neighbour that doesn't maintain his plots properly.

Farm F: La Ilusión, Nicaragua (small farm, high altitude, low CBB pressure. Co-op member, organic and Fairtrade certified). Mr Rogelio Villareyna, Owner.

Methods used: sanitary removal post-harvest (*pepena*) and pre-harvest selective removal of bored early ripe berries (*graniteo*). Good picking practices. Shade regulation.

Frequency: one *graniteo* round, about 1 month before harvest. This serves as both a sanitary control and an initial picking.

Cost aspects: Labour required for *graniteo* depends on berry load in a specific season. If it's fairly high load, you need 3 persons for 5 days to do this collection in his 2.1ha plots, i.e. approx. 7 days per ha. Pays this by day, not volume, because workers will collect only 4.5-7 kg each day, it's mainly a cleaning operation but he usually is able to sell part of this coffee. Pays US$4.2 per day excl. food.

He often allows locals and workers to take berries from the last harvesting round (*repela*) as part of his clean-up.

Effectiveness: With careful cultural controls, he doesn't get much CBB problem in this zone, except in one heavy attack season 5 years ago. He managed to prevent too much damage in that attack by applying *Beauveria*.

Treatment and use of berries collected in sanitary picking: You need to take much care in very first harvest picking (*graniteo*) when first berries are ripening and look to see if it's bored at all. If so, then put all those berries to boil to kill CBB.

Views and perspectives:

- In the last harvest pass (*repela*) you need to make sure no berries left on trees and definitely not on ground. Those berries left on the ground will become serious CBB breeding sites.
- He does *pepena* with is 2 regular workers at the same time as post-harvest bush pruning, collecting any berries they notice on trees and any left on ground . It's part of starting the new coffee cycle, coppicing some trees, clearing out branches and other trash.
- You need to be doing preventative controls. Once coffee is very badly infested with CBB there's not much you can do for that harvest.
- You have to carefully select the coffee you deliver to the mill as they reject coffee if >7% defects.

Farm G: Santo Domingo, El Salvador (small farm, low altitude, high CBB pressure. Member local co-op, organic certified). Mr Antonio Gómez, Owner.

Methods used: sanitary removal post-harvest (*pepena*) and pre-harvest selective removal of bored early ripe berries (*graniteo*).

Frequency: Two *graniteo* rounds, timed when early berries are ripening. *Pepena* clean-up after harvest.

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Cost aspects: Doesn't see *graniteo* labour as costly as his area is very small, just 1 -2 person/days for his farm (2.1ha), i.e. approx. 0.5-0.95 days per ha. Allows local people to collect *pepena* berries so he has no labour costs for that clean-up.

Effectiveness: With 1-2 *Beauveria* applications each season and cultural controls he has CBB reasonably well controlled although incidence has risen this year.

Treatment and use of berries collected in sanitary picking: Best to bury *graniteo* berries as it's humid here and they will rot quickly. You can't sell beans from *graniteo* as they're all damaged.

Views and perspectives:

- In this zone there are lots of organic farms but these are not certified. The problem with this situation is that some neighbouring plots aren't tended at all and CBB will multiply there and soon cross into your farm.

Farm H: El Cerrito, El Salvador (small farm, low altitude, high CBB pressure. Member local co-op, organic certified). Mrs Maria Josefina Ruiz, Owner.

No details except that they do *graniteo*.

Farm J: Belmont estate, El Salvador (large farm, medium altitude, medium-high CBB pressure. Rainforest certified). Mr Abelino Escobar, Farm Manager.

Methods used: sanitary removal post-harvest (*pepena*) and pre-harvest selective removal of bored early ripe berries (*graniteo*).

Frequency: one *graniteo* round usually, if early flowerings produce significant numbers of early ripening berries.

Cost aspects: Pay *graniteo* at daily wage rate, to collect small quantities (20-30kg) of early berries, ripe or green bored. Doesn't see labour costs as a concern. Prefers to buy back *pepena* berries collected by workers and some local people. Likewise for the last harvest pass, of 2nd grade berries, it's better to buy these back, rather than pay workers to collect them as they will always leave some in the plot. Buying the berries encourages people to collect many more and the farm benefits from getting rid of CBB from the groves and obtains more coffee to sell.

Effectiveness: With trapping and cultural controls he has managed to maintain very low levels of CBB in their beans, despite no longer using endosulfan. Estate has never received a defects report from mill (issued when defects, including CBB damage, exceed 1% beans) even when CBB levels were reaching 10% in this zone.

Treatment and use of berries collected in sanitary picking: *Graniteo* berries put in boiling water to kill CBB. Too risky just to bury these berries.

Views and perspectives:

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- No *graniteo* needed in 2013 season due to heavy attacks of coffee rust in 2012. On trees that lost their leaves due to this disease, berries didn't develop properly and there was no early flowering this year so ripening is very uniform.

Farm K: San Jose, Nicaragua (small-medium farm, lowish altitude, medium CBB pressure. Member local co-op affiliated to SOPPEXCCA co-op, Fairtrade certified). Mrs Francisca Gutierrez, Owner.

Methods used: sanitary removal post-harvest (*pepena*) and pre-harvest selective removal of bored early ripe berries (*graniteo*).

Frequency: only mentioned one *graniteo* round

Cost aspects: Estimates 10 person days in *graniteo* for her farm of 5.6ha, i.e. 1.8 days/ha, at daily rate of US$6.25 incl. food. Considers this quite a lot of money. She pays workers to collect *pepena*, at same daily rate, if it's very few berries around, or by volume if there is a lot to pick up.

Effectiveness: No details for cultural controls alone, but with traps in use too she is now satisfied with CBB controls and levels are fairly low on her farm.

Treatment and use of berries collected in sanitary picking: Will dry *graniteo* berries and sell any undamaged or slightly damaged beans.

Views and perspectives:

- It's no use being an absent owner- you need to keep an eye on the workers and she sometimes picks *graniteo* with them too. There are good, responsible workers who do their job well but you always need to check on them.
- *Graniteo* takes quite some time to do properly, to make sure no ripening berries left to cause pest problems for the main harvest.

Farm L: Hermanos López, Nicaragua (medium farm, medium altitude, medium CBB pressure. Local co-op member affiliated to SOPPEXCCA co-op, Fairtrade certified). Mr Bernardo López, Owner.

Methods used: sanitary removal post-harvest (*pepena*) and pre-harvest selective removal of bored early ripe berries (*graniteo*). Shade regulation

Frequency: 3 *graniteo* rounds, Aug, Sep and Oct. Collect ripe, ripening and any green bored berries.

Cost aspects: Uses 3 workers for *graniteo*, 1st round takes 50 person/days for his farm of 19.6ha, i.e. 2.5 days per ha, at US$5.00 per day + food. 2nd round has more berries ripening so needs 80 person/days, i.e. 4 days per ha. 3rd round is heavier still and needs 10-15 workers but those berries will have very little infestation and should be good quality. Does not consider *graniteo* expensive or very time-consuming and it's cheaper than cost of spraying endosulfan over his 20ha. He always allows locals to collect *pepena* for free and his workers do a further collection of any berries remaining at pruning time, i.e. almost no additional labour cost.

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Effectiveness: Very good results now with careful *graniteo* and use of traps. CBB levels well under 5% on his farm and he's not been penalised for coffee quality since he started intensive cultural controls and more recently trapping.

Treatment and use of berries collected in sanitary picking: Puts *graniteo* berries in boiling water to kill pest. Some of the damaged berries will have clean half beans so he dries these and keeps them to sell later when traders are buying poor quality coffee at harvest end so he can get a little income from these. After locals take the *pepena* his workers carrying out coffee pruning collect any fallen and remaining berries they notice and spread these to dry on racks in the sun. Dry season heat will kill most of the borer in these berries and they can be processed and sold.

Views and perspectives:

- Only started doing thorough *graniteo* 5 years ago after his farm first suffered CBB problems, which cost him in price reduction. Very important to collect these in good time to reduce borer breeding and prevent it from moving onto healthy developing berries. You mustn't let those early ripening bored berries fall to the ground or you get real problems later. Two careful rounds should mean you start harvest season with little infestation.
- You must put the effort in of boiling water treatment, otherwise you may end up re-infesting plots.
- *Graniteo* needs careful work as the berries are scattered, workers have to walk around to find them, you need to provide food, and they'll only be collecting a few kg in a day. It seems at the time that *graniteo* is costing you a lot but if you look at the figures, that small amount of coffee removed will mean fewer berries affected in the next month or at harvest. You need to realise in the end you don't lose out paying this labour cost as you're avoiding too much damage later on.
- Pepena is very cheap. When there's a lot of coffee left the people benefit a lot, they can get almost US$8.00 for a day's picking sometimes. Some farmers don't like to give away the *pepena*, they pay somebody half rate to collect it, but he finds it better to allow local people to get the benefit directly, even in plots where a lot falls to the ground. Very occasionally a few workers may deliberately drop berries during harvesting or even hide some to collect for themselves later under *pepena*, so he has given them a warning and had to dismiss a couple.
- Shade regulation in this cloudy zone is important, you should keep shade limited to 50-60%.
- If all farmers undertook better manual practices, CBB levels would be lower in general and everybody would benefit. Abandoned or poorly managed plots just breed lots more of the pest.

Farm M: Linda Vista, Nicaragua (small-medium farm, medium altitude, medium CBB pressure. Local co-op member, affiliated to SOPPEXCCA co-op, Fairtrade certified). Mr Henry Zelaya, Owner.

Methods used: sanitary removal post-harvest (*pepena*) and pre-harvest selective removal of bored early ripe berries (*graniteo*).

Frequency: 2 *graniteo* rounds, according to when berries ripen from early flowerings. Remove all mature berries and any bored green ones.

Cost aspects: Estimates each *graniteo* round takes 4 person days for his 8.4ha farm, i.e. around 2 days per ha. Pays daily rate of US$5.00 + food. Considers these costs an investment in his favour because the costs are very low compared with the damage that CBB can cause. He pays workers daily rate for pepena collection.

This document has been developed in the framework of the project ***Growing Coffee without Endosulfan***, funded by the **Sustainable Coffee Program powered by IDH**, the **FAO** and the **ISEAL Alliance**, and implemented by the **Pesticide Action Network (PAN) UK** and the **4C Association**. (© 2014)

Effectiveness: Combining traps + cultural controls he's been able to reduce CBB levels by a good percentage.

Treatment and use of berries collected in sanitary picking: He boils then buries *graniteo* berries to prevent CBB spreading. Most of them are useless but a few individual beans might be ok. You can go through them after drying and pick a few out, but it's very little.

Views and perspectives:

- If a farmers lets this pest do what it likes, without spending on controls, he risks losing the harvest. You need to supervise workers well so they'll carry out good work during *graniteo*.
- He prefers to pay for sanitary collection after harvest, rather than let locals collect these, as he finds this more effective. Because it's only a few berries remaining, people don't see it as profitable and they won't put much time in. It's better to pay them to do a good job of it.
- He does manual weeding beforehand to achieve a good *pepena*. He doesn't use herbicides because they're expensive and it's not recommended to use them in the dry season because they will dry out the soil too much.

Organisation A: Exportadora Atlántica, Jinotega, Nicaragua (traders working with ECOM and providing technical advice to their suppliers). Mr Dorwin Tellez Jarquin, Technical Officer.

Pepena is their main recommendation for larger farms, especially when heavy rains or other factors cause many berries to fall off the trees. It's important to do a very good final harvest pass, to remove as many berries as possible at that stage.

For small farmers they recommend *graniteo* especially when they're doing their harvest estimation counts. Larger farms are often at higher altitude so tend to have less CBB incidence. *Graniteo* is more difficult for larger farms as it is labour intensive and cannot compensate for the labour cost.

They also recommend shade regulation, use of traps and regular monitoring for CBB incidence.

Organisation B: COEX estates & exporters, El Salvador (4C member and sell coffee from several supplier farms certified under Rainforest and Starbucks). Mr René Fontan, Head of Agriculture.

Methods used: Good cultural controls for all the coffee cycle: good harvest collection; pruning of shade trees, then manual weeding, and *pepena* clean-up.

Cost aspects: No details. Allow workers who do the pruning to then collect *pepena* berries so estate incurs no labour cost for that task.

Effectiveness: Good cultural controls, use of traps and 1-2 Beauveria applications per season is providing good control on their estates, keeping CBB levels below 2%.

Views and perspectives:

- Predicts higher CBB levels in many zones in 2013 due to heavy attack of coffee rust in 2012, which meant many berries fell prematurely. With low coffee prices, fewer people asked to collect *pepena* berries so this could mean more breeding sites for CBB if left uncontrolled.

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