



## APPENDIX B

### Thirty Trees Sampling Method for CBB Monitoring

Based on Cenicafé sampling methods [3]

Revised: December 2019 by A.M. Kawabata, S.T. Nakamoto, M. Miyahira and J. Burt

To make management decisions, it is not adequate to simply know that your coffee trees are infested with the coffee berry borer; it is also important to understand what the beetle population is doing on your farm, in terms of population growth and proportion of berries infested. In addition, it is important to understand that berry infestation is not equal to bean damage. This simple sampling method will show you berry-infestation and bean-damage levels, but more importantly, it will show whether the beetle is vulnerable to being killed by spray or not. Sampling may reveal hot spots on your farm and allow you to minimize costs by identifying the most effective times to spray *Beauveria*.

Begin monitoring and sampling about 30 days after your initial flowering, or sooner if there is an increase in CBB activity, as indicated by trap catch or visual observations. Continue monitoring through peak harvest, sampling green berries only. Sample your farm every 2 weeks at the beginning of the season to catch early-season infestations and then at least monthly thereafter. Sample at least 30 trees per 2.5-acre plot. For smaller plots, you may sample a minimum of 12 trees per acre to determine infestation level; however, sampling more trees may provide a more accurate representation of the farm.

Individual farmers may need to adapt these protocols based on their particular situation and needs. For example, if your farm is situated on relatively even terrain or within a single microclimate and your trees are of similar age, under similar management practices, etc., a single sample size of 30 trees might be sufficient for a 3-acre plot. Conversely, you may need to subdivide your farm into smaller plots to address different varieties, tree ages, topographies, areas with shade vs. sun, etc.

#### Materials

- Farm map
- Knife
- Clipboard
- Attached “Thirty Trees Sampling Worksheet”
- Pencil/pen
- Permanent marker
- Container with lid or resealable Ziploc® bag
- Flagging tape or ribbon
- Hand lens, magnifying glass, reading glasses, or other vision aids
- Calculator
- Optional: counter or tally counter



### Step 1: Monitoring the CBB Infestation

Begin monitoring and sampling about 30 days after your initial flowering.  
Get or draw a map of the coffee plot\* to be sampled.

\*Plot can be determined by these factors:

Location, topography, physical features such as roads or gullies

Orchard age or pruning stage

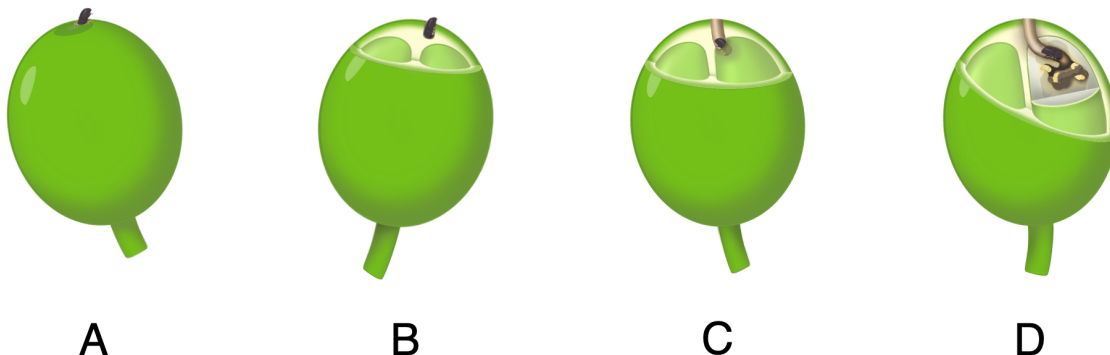
Variety

Kīpuka or microclimate

Management practices (e.g., mechanization, organic vs. conventional, pruning, availability of irrigation)

1. Mark a zigzag pattern on the map to follow as you sample. Choose at least 12 trees per acre or 30 trees per 2.5-acre plot to sample along the zigzag.
2. Begin sampling at tree #1 close to a corner of the coffee plot.
3. Randomly select a lateral branch in the middle of the tree with 30–120 berries.
4. Record the total number of green berries (up to 120 berries) on the branch in column A.
5. Record the number of green berries infested by CBB (berries with a hole) on the branch in column B.
6. Randomly pick 3–4 CBB-infested green berries from the branch (or nearby branches if you cannot find enough on that branch) and place them in the container or bag.
7. Flag any trees observed with high numbers of berries with holes.
8. Record anything noteworthy in column C.
9. Move to the next tree and repeat steps #3–8 until all trees have been sampled.
10. If you sample 30 trees, there should be about 100 infested green berries collected in your container.
11. Proceed to Step 2.

### Step 2: Positions of CBB in Berries Used to Determine Whether to Spray



Created by J. Burt (2019)



In A/B position, the CBB is entering or boring into the fruit, but the endosperm (coffee seed) has not been damaged. In this position, CBB may be controlled by applications of *B. bassiana* and other pesticides or repellants.

In C/D position (inside the endosperm or coffee seed), CBB females and progeny (larvae) have already damaged the bean. Neither *B. bassiana* nor chemical insecticides can effectively control CBB in the C/D position; CBB may only be controlled by field-sanitation methods like manual collection of infested green, ripe, over-ripe and raisin berries.

Dissect your collected green berries. Determine and tally A/B and C/D positions of CBB on the attached “Thirty Trees Sampling Worksheet.” Be careful not to kill the beetle while opening the berry, as determining whether the beetle is alive or dead is very important.

Complete all calculations on the worksheet.

- % infestation
- % A/B
- % C/D

Based on your calculations, proceed to make a decision to spray or not to spray.

### Step 3: Decision-Making

The timing of *Beauveria* sprays may vary greatly from farm to farm. It is better to control CBB early in the season than fight a larger population later.

Table 1 on page 23 is an example provided to aid in pesticide application decision-making. This sample table demonstrates how a farmer would decide which CBB infestation level of the entire field would trigger pesticide applications.

In this example, when % A/B alive and % infestation intersect to exceed 1, then the farmer would consider spraying. When the intersection exceeds 20, the farmer may have lost the opportunity to control CBB. If % C/D is high, the farmer may need to review their spray techniques and program and alter them for greater effectiveness. Farmers should establish their own spray thresholds based on their individual situations.

### Thirty Trees Sampling Worksheet: Percent Infestation by CBB

Date: ..... Farm: .....

Plot # or ID: ..... Evaluator: .....

Branch	Column A: # of Green Berries	Column B: # of Infested Berries	Column C: Notes
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
<b>Total</b>	Column A Total:	Column B Total:	

### Tally of CBB from Dissected Berries

A/B Alive:	A/B Absent:
A/B Dead:	C/D:
Total # of Dissected Berries =	

### Calculations Used to Determine When to Spray

$$\% \text{ infestation} = \frac{\text{Column B Total:}}{\text{Column A Total:}} \times 100 = \boxed{\phantom{000}}$$
  

$$\% \text{ A/B alive} = \frac{\text{A/B Alive Tally:}}{\text{Dissected Berry Total:}} \times 100 = \boxed{\phantom{000}}$$
  

$$\% \text{ C/D} = \frac{\text{C/D Tally:}}{\text{Dissected Berry Total:}} \times 100 = \boxed{\phantom{000}}$$

Table 1. Example of Percent Live CBB in the A/B Position for Spray Determination

		% A/B Alive																			
		0	1%	2%	3%	4%	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%
% infestation	1%	0.01	0.02	0.03	0.04	0.05	0.1	0.15	0.2	0.25	0.3	0.35	0.4	0.45	0.5	0.55	0.6	0.65	0.7	0.75	
	2%	0.02	0.04	0.06	0.08	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	
	3%	0.03	0.06	0.09	0.12	0.15	0.3	0.45	0.6	0.75	0.9	1.05	1.2	1.35	1.5	1.65	1.8	1.95	2.1	2.25	
	4%	0.04	0.08	0.12	0.16	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2	2.2	2.4	2.6	2.8	3	
	5%	0.05	0.1	0.15	0.2	0.25	0.5	0.75	1	1.25	1.5	1.75	2	2.25	2.5	2.75	3	3.25	3.5	3.75	
	10%	0.1	0.2	0.3	0.4	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7	7.5	
	15%	0.15	0.3	0.45	0.6	0.75	1.5	2.25	3	3.75	4.5	5.25	6	6.75	7.5	8.25	9	9.75	10.5	11.25	
	20%	0.2	0.4	0.6	0.8	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
	25%	0.25	0.5	0.75	1	1.25	2.5	3.75	5	6.25	7.5	8.75	10	11.25	12.5	13.75	15	16.25	17.5	18.75	
	30%	0.3	0.6	0.9	1.2	1.5	3	4.5	6	7.5	9	10.5	12	13.5	15	16.5	18	19.5	21	22.5	
	35%	0.35	0.7	1.05	1.4	1.75	3.5	5.25	7	8.75	10.5	12.25	14	15.75	17.5	19.25	21	22.75	24.5	26.25	
40%	0.4	0.8	1.2	1.6	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30		
45%	0.45	0.9	1.35	1.8	2.25	4.5	6.75	9	11.25	13.5	15.75	18	20.25	22.5	24.75	27	29.25	31.5	33.75		
50%	0.5	1	1.5	2	2.5	5	7.5	10	12.5	15	17.5	20	22.5	25	27.5	30	32.5	35	37.5		
		=0-0.99 – Spraying not recommended; will cost more than the expected value of coffee saved from CBB																			
		=1-1.99-Consider spraying, especially early in the season																			
		=2-4.99 – Especially early in the season, this is a critical level to start spraying to avoid economic loss.																			
		=5-9.99 – You are starting to lose money due to CBB damage. Losses will be greater if you don't spray.																			
		=10-19.99 – You are losing money due to CBB damage, but you may still want to spray.																			
		=>20 – Processors may reject your harvest. The value of your harvest may not cover picking cost, so consider focusing on your next crop (i.e. strip pick, stump prune)																			