Comparison of three years of CBB surveys (2014 to 2012): How are we doing in the war with CBB ?

HC Bittenbender <hcbitt@hawaii.edu>, A.M. Kawabata <andreak@hawaii.edu>, and S.T. Nakamoto <snakamo@hawaii.edu> CTAHR, UHM.

Highlights of 2014 Survey.
This 2014 survey covers the 2013-14 harvest and the 2014 growing season and CBB control tactics used for the 2014-15 harvest season. The Marketable Green Bean Recovery Ratio (MGBRR) for the 2013-14 season as stated by farmers in Question 14 (Q14) of the 2014 survey was 6.2, equal to 19% loss of green bean. The ratio was essentially the same as the 2012-13 and 2011-12 crops. However, farmers who sell cherry (Q15) said processors who sampled for CBB damage estimated 13% cherry damage; a decrease from 26% in 2012 and 22% in 2011. These processors estimated the green bean loss at 20% (MGBRR = 6.3 (Q57)). This is a decrease to 20% from 28% damaged green bean in 2012-13 and 22% in 2011-12. In 2014 54% of farmers thought CBB damage was decreasing, vs. 60% in 2013 and 50% in 2012. **Only 10% thought CBB damage was increasing in 2014**. 63 farmers responded to the 2014 survey vs. 79 farmers in 2013. The survey was sent mid-August 2014, closed in mid-October, and was analyzed in December 2014.

Sanitation.
The slogan "Contain and Kill" means managing all coffee cherry on your farm beginning with the pre-harvest strip picking so that all CBB– adults, larvae, and eggs–in the cherries are destroyed during processing and after stripping all trees of remaining cherry of any age after harvest. Sanitation is the most effective strategy for reducing CBB damage in the current crop and in the following crop.

More farmers are pulping everything picked, including floating cherry and parchment. Less untreated pulping waste is returned to field; instead it is taken to a dump site. Strip picking any cherry at the end of the harvest and treating to kill CBB, has **increased to 75% of farmers who strip at least 90 % of their trees**. **After the 2014-15 season 85% of farmers say all trees will be strip picked.** Only 7% of farms will return untreated processing pulping waste to coffee orchards.

Trapping to determine CBB flying.
2014 trapping (Q27) declined to 32% of farms; in 2013 trap use was 65% and in 2012, 76%. Farmers realize trapping is not an effective control tactic for CBB and there are more effective activities for their efforts.

30 Trees Sampling Method for CBB infestation in cherries.
The 30 Trees Sampling Method for detecting stage of infestation and evaluating the timing and effectiveness of the *Beauveria bassiana* sprays was introduced with workshops in 2012 and 2013. In 2014, 47% used it, an increase over the 17% of farmers in 2013. About 33% sample every 4 and 8 weeks, a decline from 2012 when 50% sampled every 4 weeks and 33% every 3 weeks. This probably reflects the required effort to sample and uncertainty with the method. Nonetheless 45% of farmers plan to use it in the 2015-2016 season.

Spraying commercial preparations of the fungus *Beauveria bassiana*.
Use has increased to 85% from a little more than 80% in 2013. In 2014, 28% began spraying in January and 90% before May. 75% of farmers rated the effectiveness of the fungal sprays as good or very good. 60% spray every 4 weeks and 20% more frequently. 5% use the 30 Trees Sampling Method for scheduling.

Spraying other insecticides to control CBB.
Farmers rate insecticides containing pyrethrins (Evergreen, Pyronyl) and kaolin clay (Surround WP) as very effective.

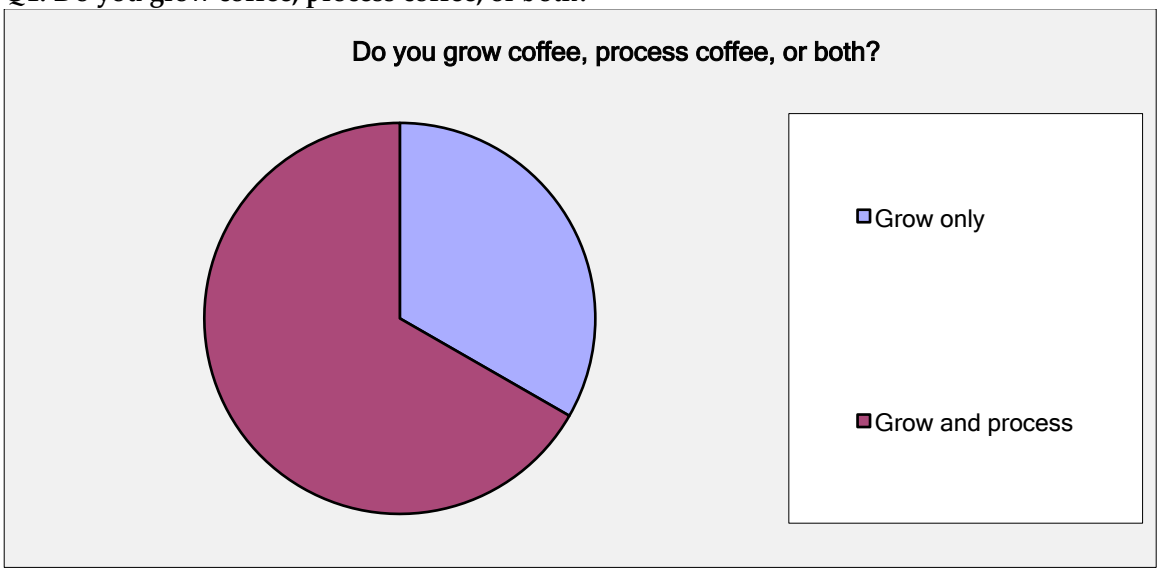
Economic impacts.
About 90% of farmers reported 'much more' or 'somewhat more' costs for producing coffee in 2013-14. Only 35% had 'much more' or 'somewhat more' revenues from coffee in 2013-14. Profitability for the 2013-14 crop was mixed; 29% of farms made no profit, 36% made between 0 and $5,000, and 36% made between $5,000 and $100,000 in profit.

Are farmers leaving coffee due to CBB?
98% said they are not quitting; 56% of farmers said that no one they knew of were quitting coffee, 42% said they knew between 1 and 4 farmers that were quitting. This is an improvement over 2013 and may indicate increased morale. In 2014, 63% of farms, about the same as 2013 and 2012, have neighbors not trying to control CBB; 54% of farms have border areas with feral or abandoned coffee, similar to 2013 and 2012.

Where do you get CBB information?
Most farmers use multiple sources to get CBB control information.
The most important sources are:
CTAHR workshops 72%,
Talking with other farmers 70%
CTAHR webpage for CBB 66%
Farmer's coffee organization webpage 62%
Farmer's coffee organization workshops 57%
Farmer's coffee organization newsletter 47%

Questions and responses, followed by Bittenbender's comments.

Q1. Do you grow coffee, process coffee, or both?



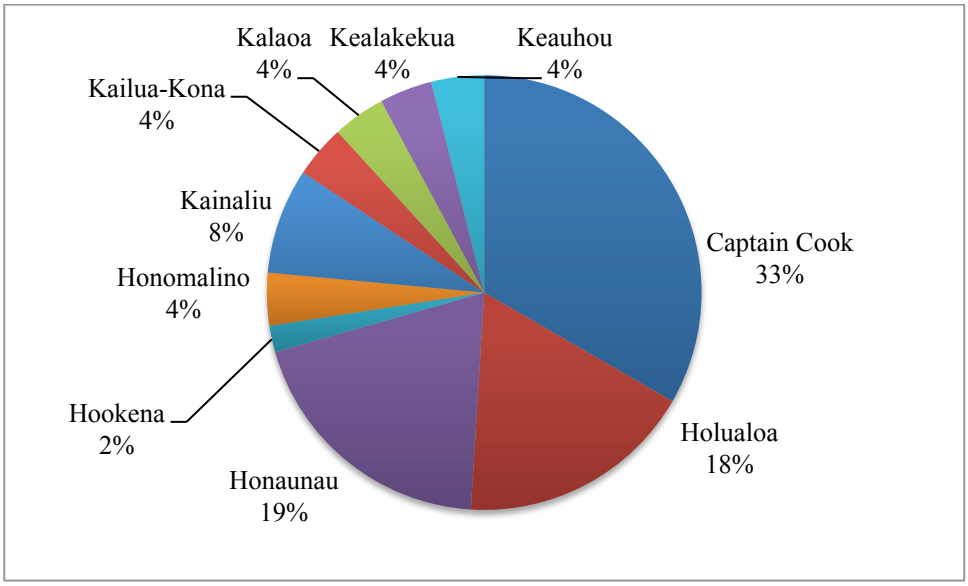
Sixty three farmers responded, 2/3 grow and process. Similar to 2013 and 2012

Q2. Is growing and /or processing coffee your primary occupation?
53% said yes.

Q3. On which island are you farming coffee ?
98% of respondents were on Hawaii island.

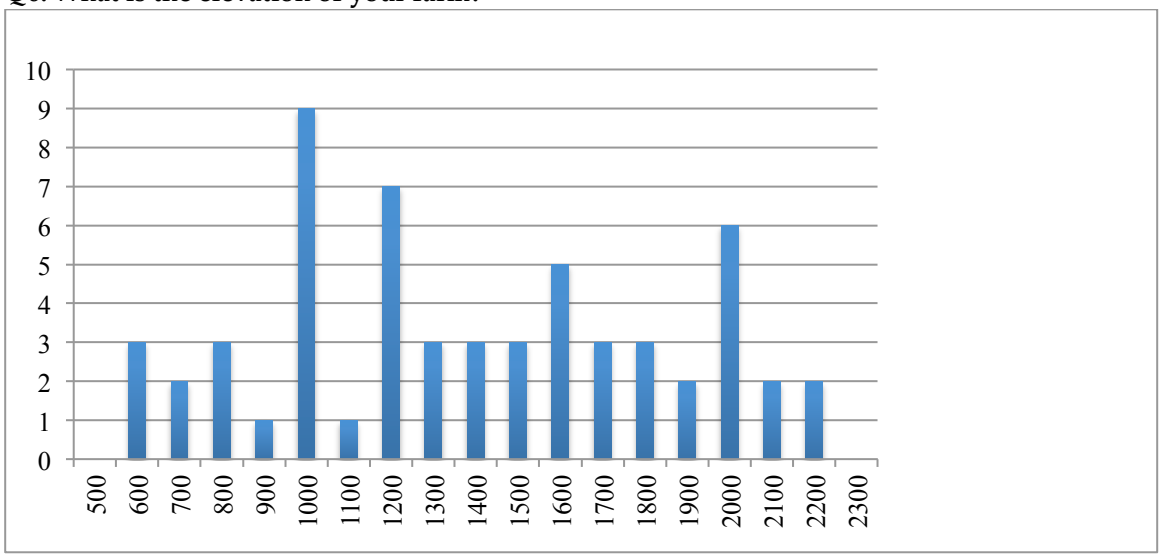
Q4. If you grow coffee on the Big Island, what district do you grow coffee?
90% of farmers were in Kona, 9 % in Kau, and 1 % in Puna.

Q5. If you are growing coffee in Kona, select the area closest to your farm.



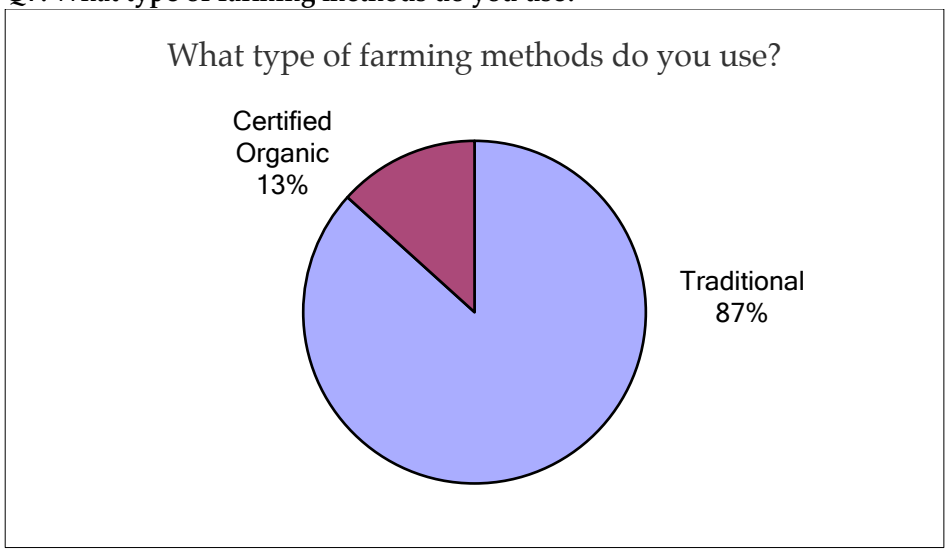
In 2014, as in 2013 and 2012, Kona sites responding in order of largest number of farms were Captain Cook, Holualoa, Honaunau.

Q6. What is the elevation of your farm?



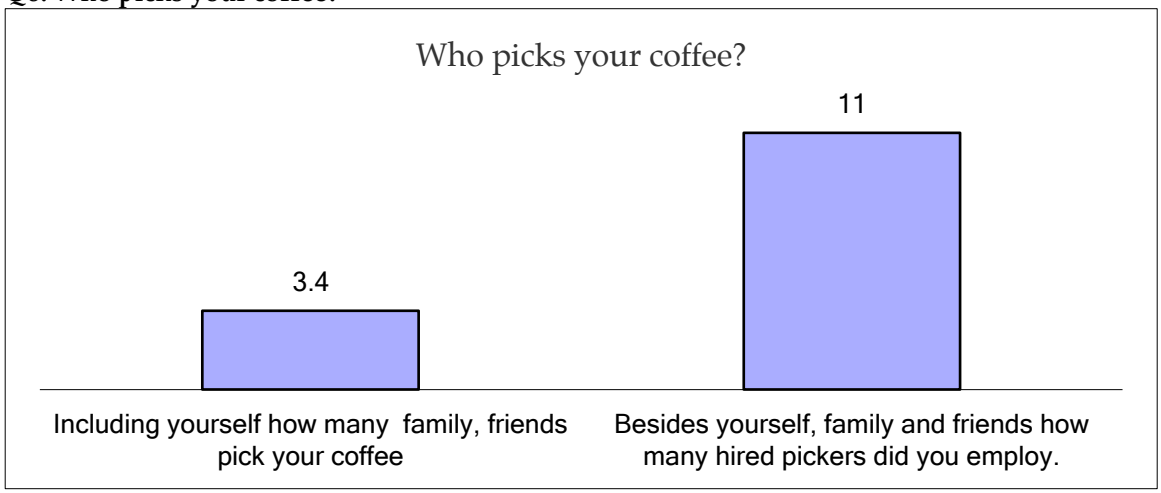
In 2014 majority of responses are farms are between 1000 and 2000 ft elevation, similar to 2013 and 2012.

Q7. What type of farming methods do you use?



In 2014, 87% were traditional and 13% certified organic. Traditional farming methods have increased from 72% in 2012, and 80% in 2013.

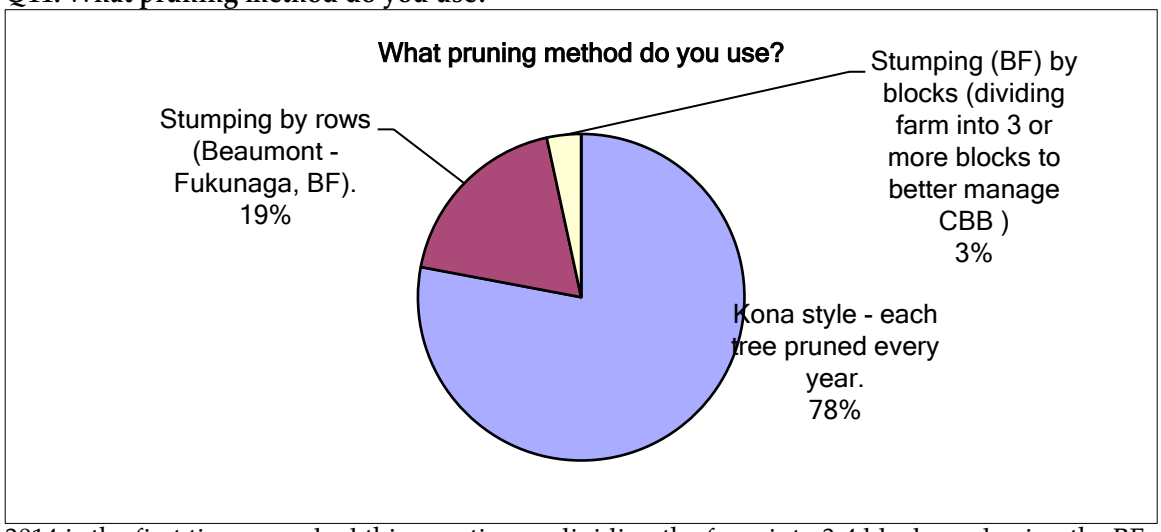
Q8. Who picks your coffee?



In 2014, an average farm had 3.4 family and friends picking and 11 hired pickers.

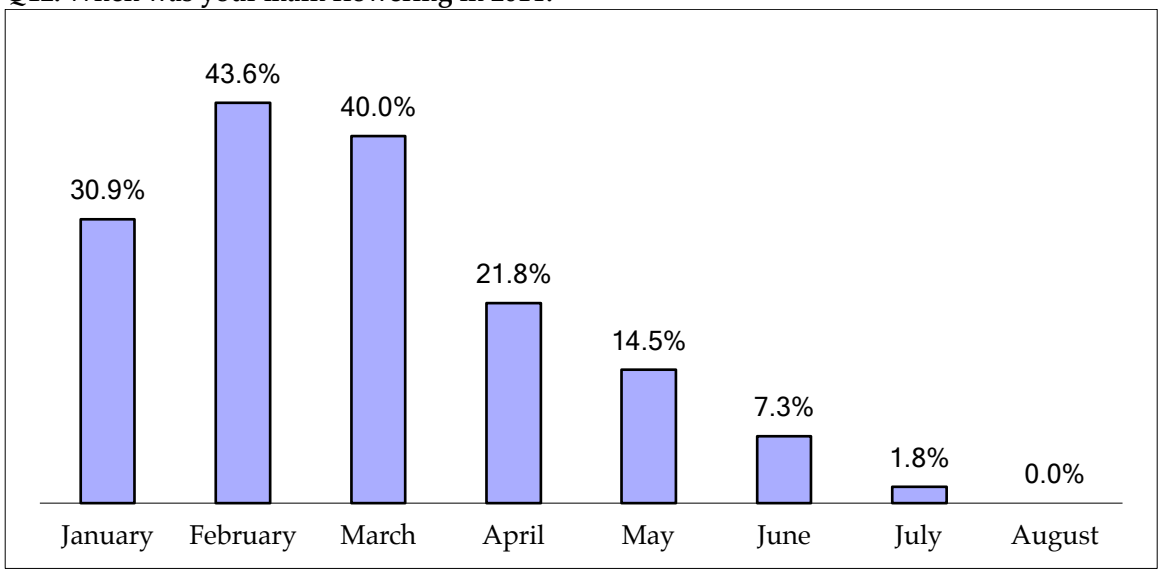
Q9 & 10. How big is your coffee farm? What is your tree spacing?
In 2014, the average size farm of respondents was 8.5 acres with trees spaced 6 feet in row and 9.5 feet between rows. This an increase in size and spacing from 2013 when average size of respondents was 5.4 acres and average tree spacing was 7 x 8.4 ft indicating a shift in the farmers who respond to the survey.

Q11. What pruning method do you use?



2014 is the first time we asked this question as dividing the farm into 3-4 blocks and using the BF or stump pruning in one block a year – not every other row - improves CBB management. Most farms still prune in the Kona style but 22% are stump pruning.

Q12. When was your main flowering in 2014?



February and March 2014 were the main flowering months in Kona; in 2013 it was later in March and April.

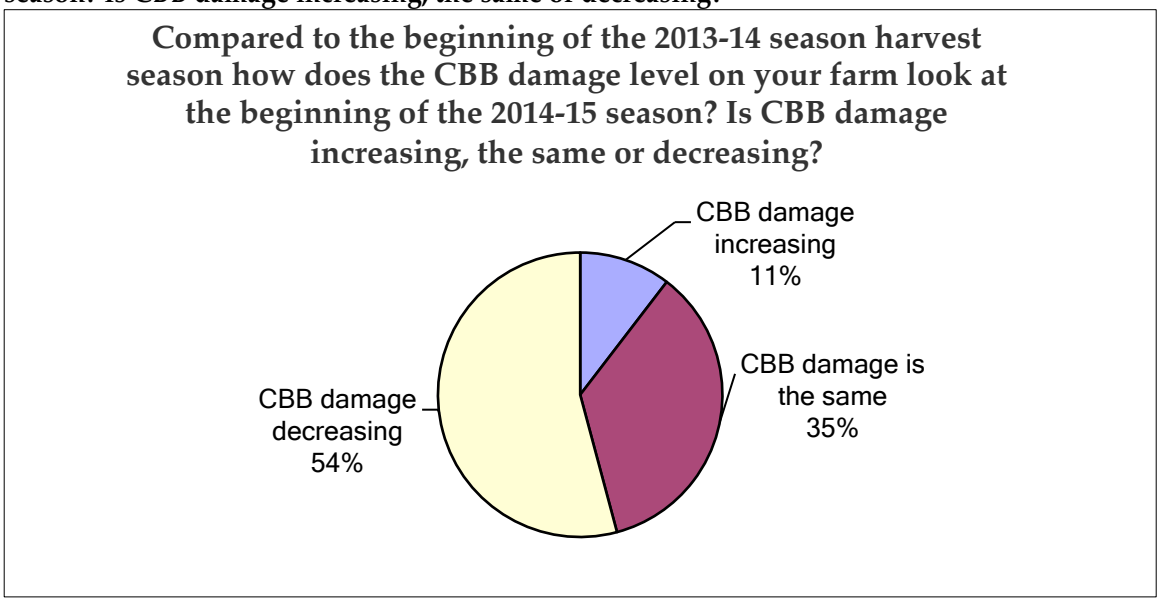
Q13. Did you have CBB on your farm in the 2013-14 season?
94% reported yes, for 2104 and 2013. In 2012, 78% and in 2011, 56% farmers had CBB.

Q14. What was the 2013-14 season's marketable green bean recovery ratio (MGBRR)? This is calculated as cherry weight divided by marketable green bean weight.
The adjusted average MGBRR reported by farmers who processed their coffee for 2013-14 was 6.2, equivalent to 19% green bean damage. For 2012-13 and 2011-12, the MGBRR was 6.3 or 20% green bean loss. However, in 2014 several farmers had difficulty in answering the question. Damage appears to have peaked.

Q15. If you sell only cherry but your buyer samples your cherry and tells you the percent CBB damage please list all the damage percents given to you for the 2013-2014 season.
Farmers who sold cherry to processors reported a decrease in CBB damages to 13% cherry loss in 2013-14. 2012-13 and 2011-10 cherry damages were 26% and 22%, respectively. This also suggests that CBB damage has peaked.

Q57. Cherry buyers.
They said in 2014 that the 2013-14 cherry crop purchased had an estimated MGBRR of 6.3 or 20% green bean damage. The 2012-13 crop MGBRR was 6.9 or 28% damage, the 2011-12 damage they reported was 22%. This also suggests that CBB has peaked and is declining. Note processor volume was not factored into the calculations.

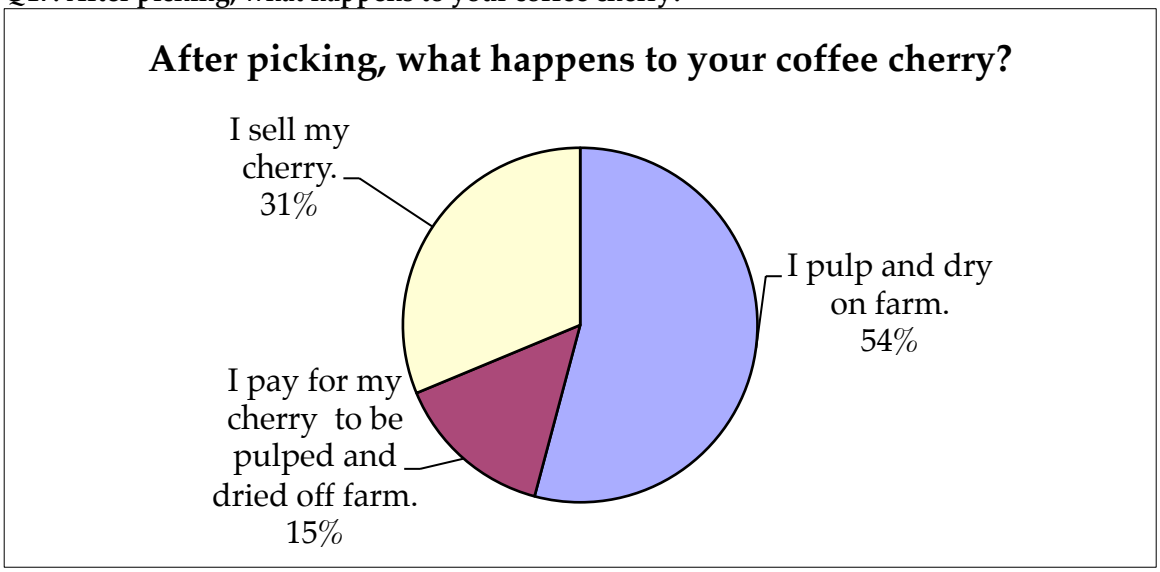
Q16. Compared to early 2013-14 season, how does the CBB damage level on your farm look early in the 2014-15 season? Is CBB damage increasing, the same or decreasing?



54% of farmers felt it was decreasing, same as 2013 and more than in 2012's 51%. In 2011, only 13% felt damage was decreasing. Again, damage appears to have peaked.

Sanitation.

Q17. After picking, what happens to your coffee cherry?

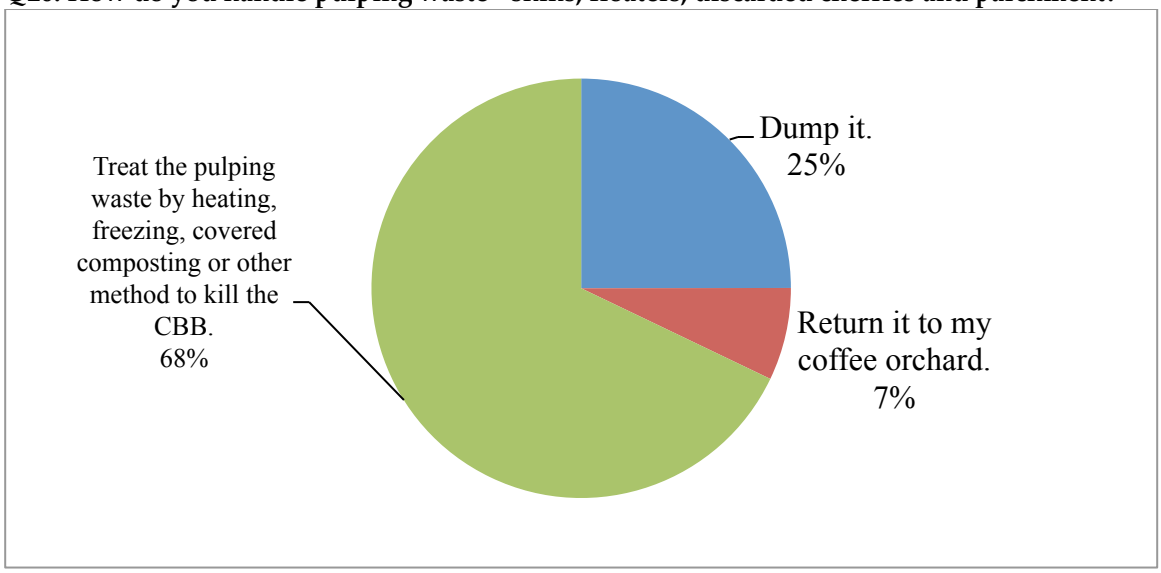


In the 2013-14 season, cherry selling decreased to 31% vs. 43% in 2012-13 season; otherwise, the distribution was similar for the past 2 seasons.

Q18. When you pulp, what happens to the floater cherries?
In 2014, 46% of farm processors pulped everything that was harvested vs. 30% in 2013 and 42% in 2012. 54% discarded floater cherries in 2014; 70% in 2013, 58% in 2012, and 60% in 2011. CTAHR recommends pulping everything, even floaters, as one bean may be undamaged, so could be recovered.

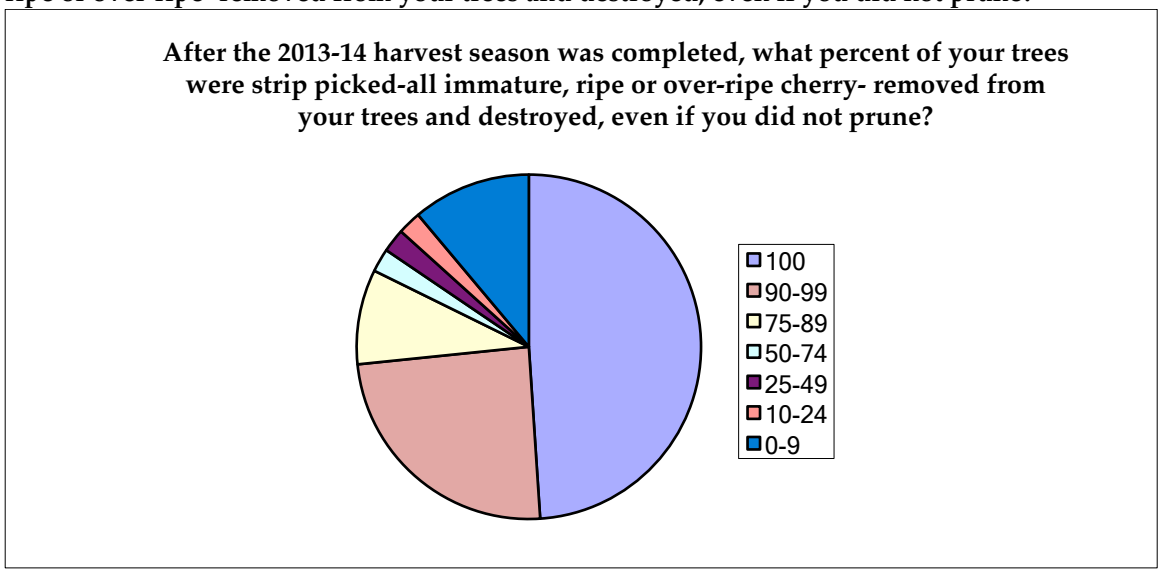
Q19. After pulping do you process all parchment coffee or do you discard floating parchment coffee without processing?
More farmer-processors process floating parchment. In 2014, 77% discarded floating parchment, vs. 90% in 2013, 81% in 2012, and 79% in 2011.

Q20. How do you handle pulping waste - skins, floaters, discarded cherries and parchment?



In 2014, farmers slightly decreased the treatment of pulping waste to 68% from 76% in 2013. Dumping the pulp waste increased as did returning to orchard. This may reflect that farmers deem pulping waste less hazardous.

Q21. After the 2013-14 harvest season was completed, what percent of your trees did you have all cherry- immature, ripe or over-ripe- removed from your trees and destroyed, even if you did not prune?



After the 2013-14 season 75% farmers increased strip picking to 90% or more trees, a significant increase over 2012-13!
Q22: After the 2014-15 season 85% of farmers indicate they will strip pick everything vs. 4% who won't. This is great improvement over previous seasons.

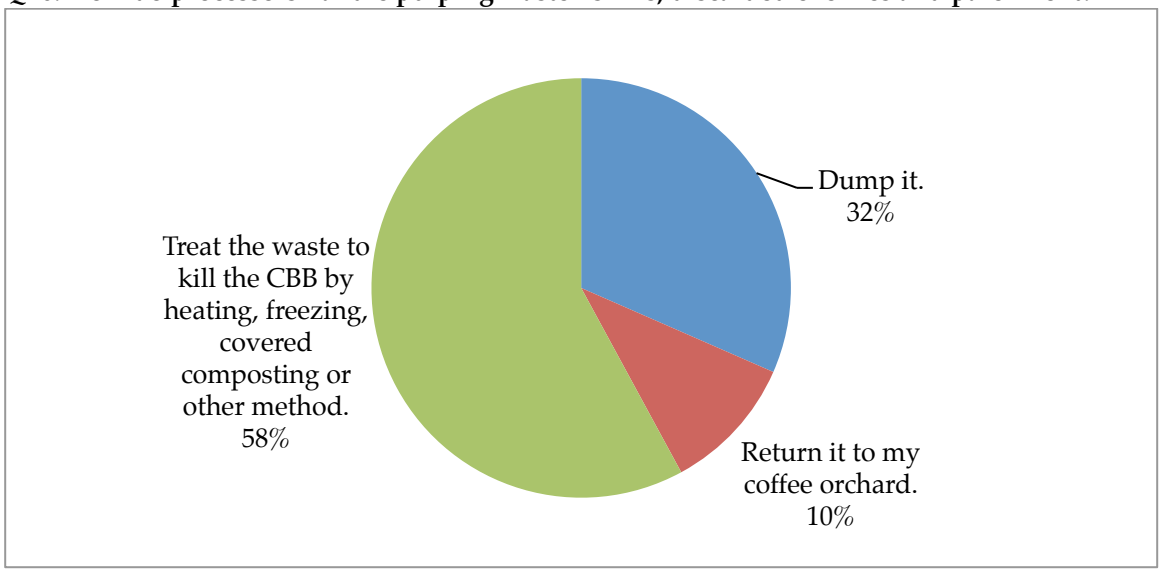
Q23. What is your most effective sanitation tactic for your farm?
Besides strip picking, other methods of sanitation mentioned by farmers in decreasing effectiveness are: Pulp all cherry harvested, Treat all pulping waste to kill CBB, Contain and kill CBB in wet and dry mill areas, Harvest more frequently, Pre-harvest strip pick. A slight change from 2013.

Questions for wet millers.

Q24. When you pulp, what happens to the floater cherries?
In 2014, 50% pulped everything; an increase from 33% in 2013. This percentage should be increased to save undamaged green bean.

Q25. After pulping do you process all parchment coffee or do you discard floating parchment coffee without processing?
In 2014, only 67% discarded floating parchment. This is a welcomed decline from 95% in 2013 and 86% in 2012.

Q26. How do processors handle pulping waste - skins, discarded cherries and parchment?

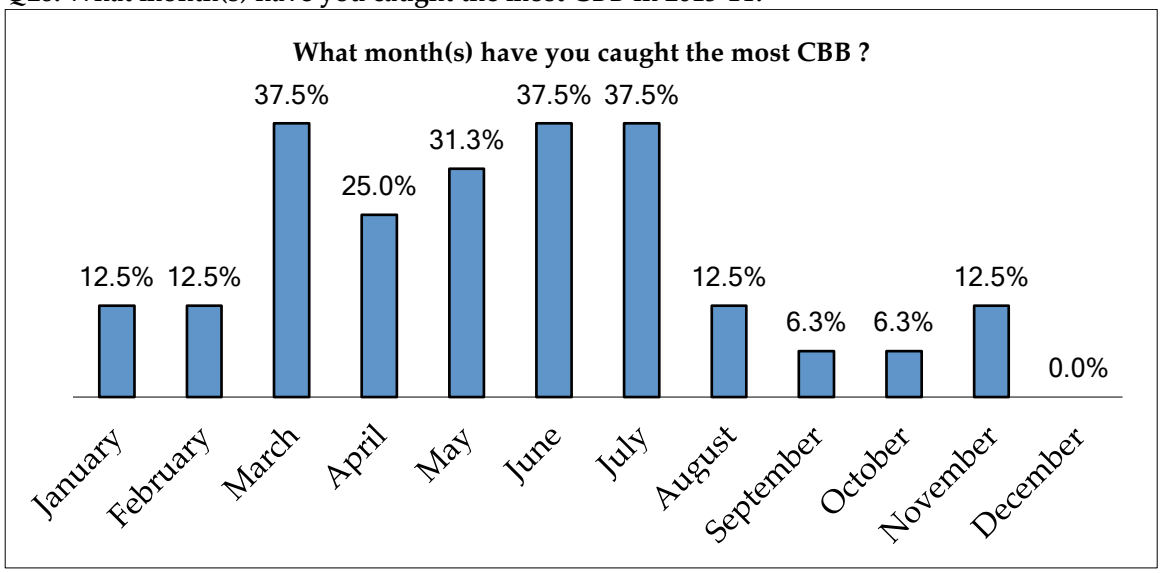


In 2014, processor treatment of pulping waste declined to 58% (2013 63% vs. 71% of wet mills in 2012). Dumping increased to 32% from 26% in 2013. Fewer return it to their orchards. Mill waste containers should be sealed to prevent CBB escape when transported to the dump. It is preferable to treat mill waste to kill CBB before it leaves the mill. But likely, this has become a burden.

Use of CBB Traps by Farmers.

Q27. Did you use traps baited with methanol and ethanol to monitor CBB this 2014-15 season?
In 2014, trap use declined significantly to 32% from 65% in 2013 and 76% in 2012. Farmers are investing time in other, more effective activities.

Q28. What month(s) have you caught the most CBB in 2013-14?

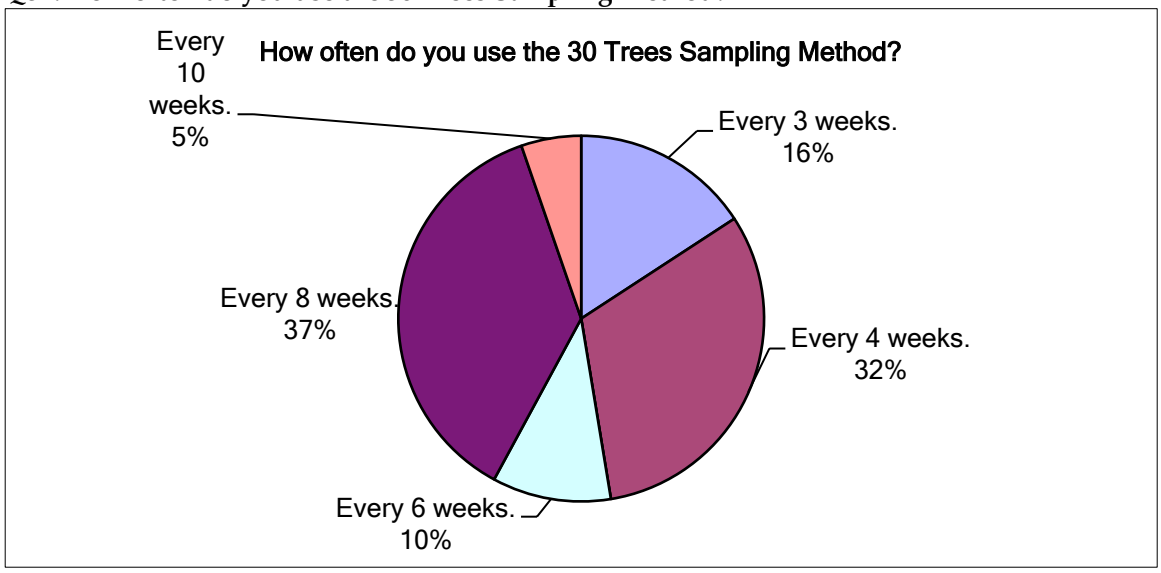


In 2013-14 most CBB were trapped in March, May, June and July. This is a longer period reflecting the experience of farmers in Kau. Previous years, most CBB were trapped in March and April.

Q29. Are you using the 30 Trees Sampling Method for CBB monitoring ?
In 2014, 47% of farms used the 30 Trees Sampling Method; an increase from 17% of farms in 2013 the first year it was used.

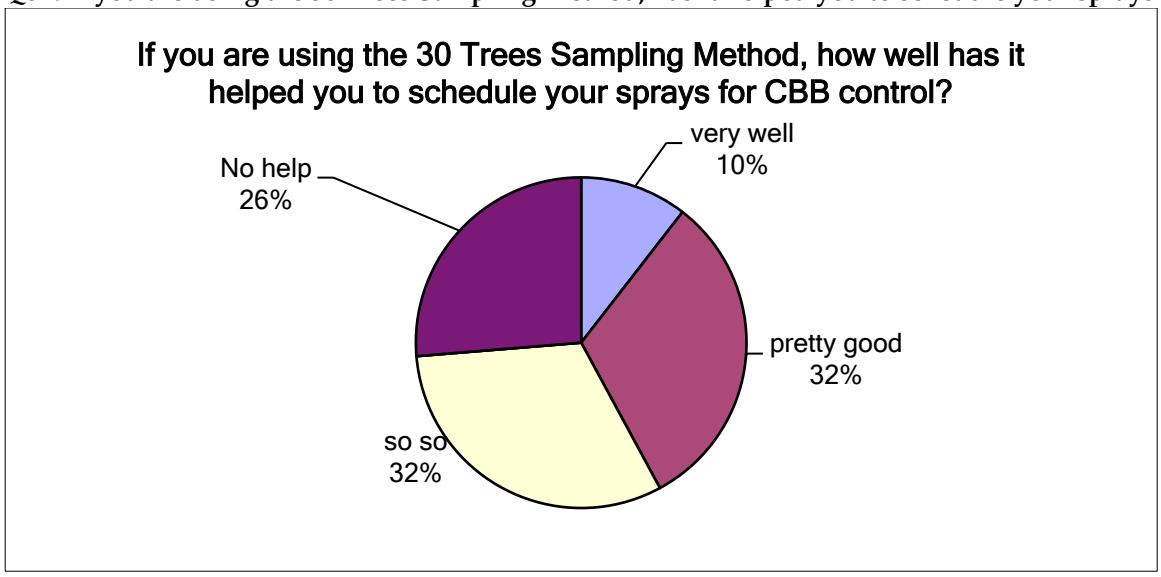
Q30. If you are using the 30 Trees Sampling Method for CBB monitoring, when did you start?
In 2014, farmers were equally divided on when to begin sampling -1, 2, 3, or 4 months after first flowering. In 2013, 44% started 2 months after the first flowering.

Q31. How often do you use the 30 Trees Sampling Method?



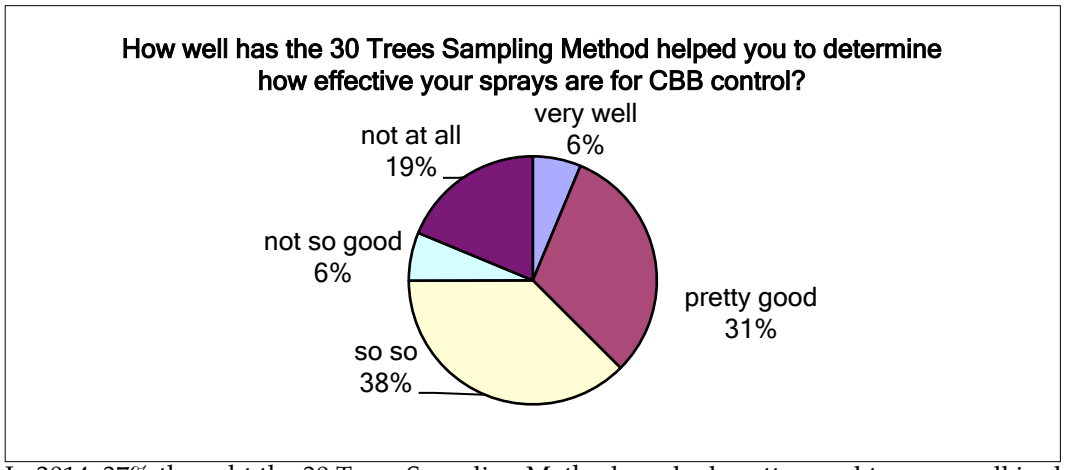
About 33% sample every 4 or 8 weeks, a decline from 2012 when 50% sampled every 4 weeks and 33% every 3 weeks. This probably reflects the required effort to sample and uncertainty with the method.

Q32. If you are using the 30 Trees Sampling Method, has it helped you to schedule your sprays for CBB control?



In 2014, 42% felt this helped schedule their sprays vs. 33% in 2013, the poor performance for others could be due to the wide range of sampling intervals.

Q33. How well has the 30 Trees Sampling Method helped you to determine how effective your sprays are for CBB control?



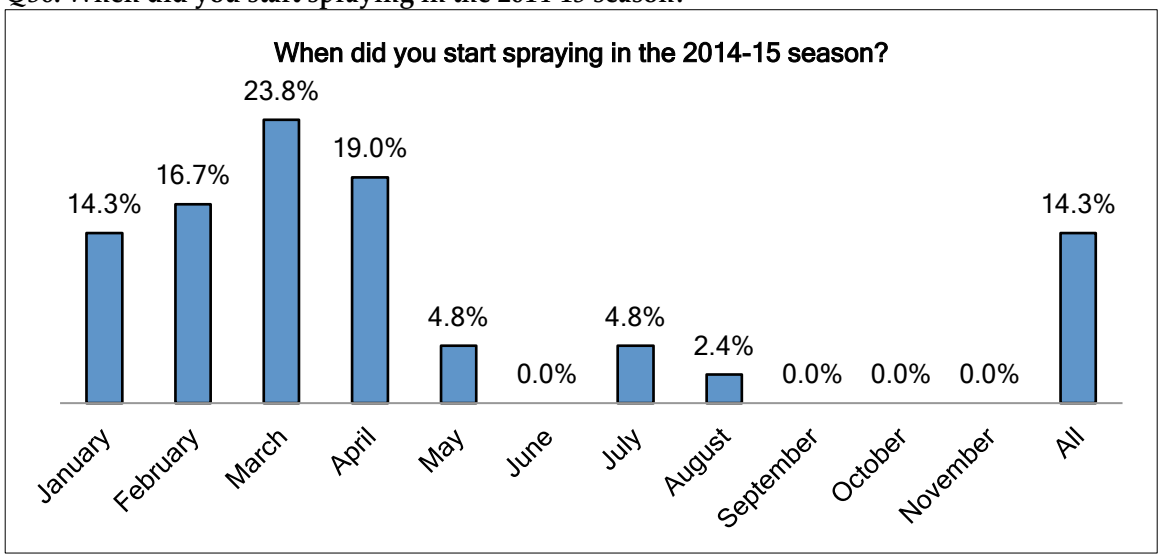
In 2014, 37% thought the 30 Trees Sampling Method worked pretty good to very well in determining the effectiveness of their spray program, 63% were not impressed. Again, looking at **Q31** there is much diversity of sampling intervals which is likely responsible for a wide range of outcomes.

Q34. Will you use the 30 Trees Sampling Method in the 2015-16 harvest season?
In 2014, 45% of farmers say they will use the 30 Trees Sampling Method in the 2015-16 season. This is an increase over 2013 when 30% planned to use it. Those who will not use it say it's too much work and they will use own observations and continue spraying at close intervals.

Spraying *Beauveria bassiana* fungus to control CBB.

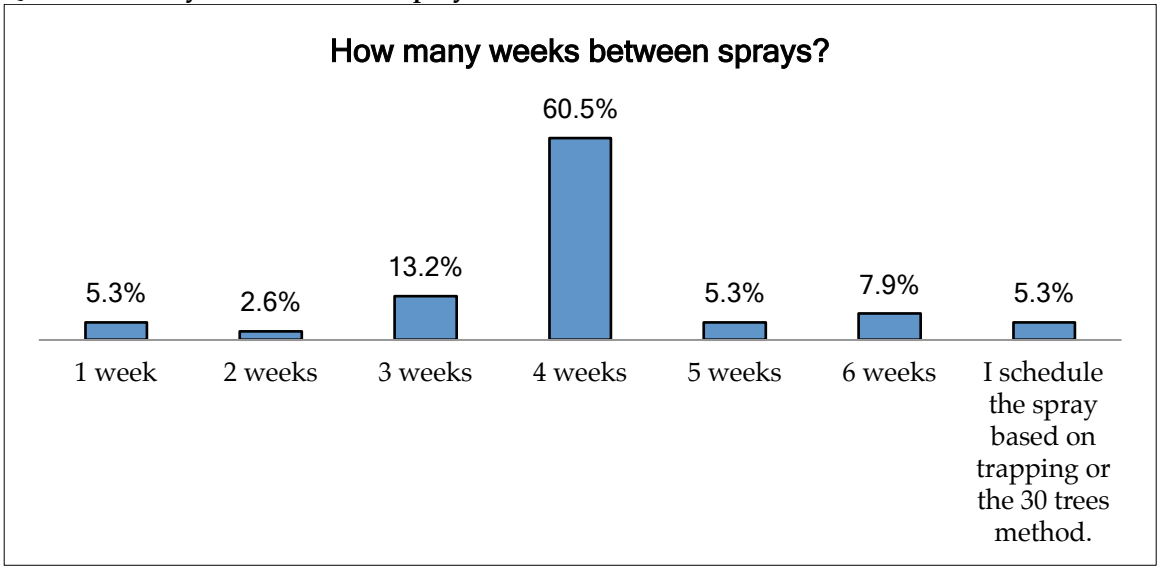
Q35. Are you spraying commercial insecticides that contain spores of the fungus *Beauveria bassiana*?
Today, 85% are using *Beauveria bassiana*, very similar to 80% in 2013 and 2012. The 15% using Mycotrol O matches with the certified organic percentage in **Q7**.

Q36. When did you start spraying in the 2014-15 season?



28% of farms (January + All) began spraying *Beauveria bassiana* in January and likely sprayed the remainder of the year. 90% of spraying began before May. In 2012, 48% of farmers began spraying in February or March and 10% sprayed year-round. 90 days (3 months) or earlier after the first flowering, CBB is likely to attack. Spray earlier if CBB swarming is seen in the orchard.

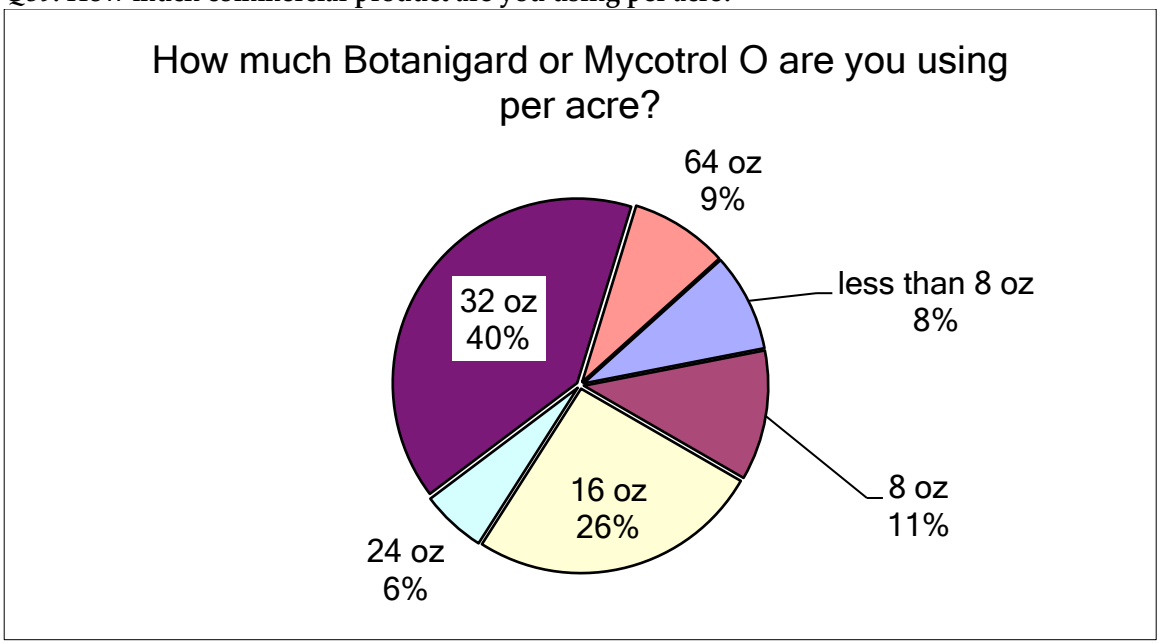
Q37. How many weeks between sprays?



The spray interval is shortening. 60% of farmers spray every 4 wks and 25% spray more frequently. In 2013, 66% of farms sprayed every 3-4 weeks and 8% sprayed based on the 30 Trees Sampling Method. In 2012, 39% of farmers sprayed every 4 wks and 29% every 6 wks.

Q38. How much spray solution do you apply (gallons per acre)?
Average amount of spray (gallons per acre) containing *Beauveria* is 29 gal/acre, a slight decrease from 2013 reflecting increased mist blower usage.

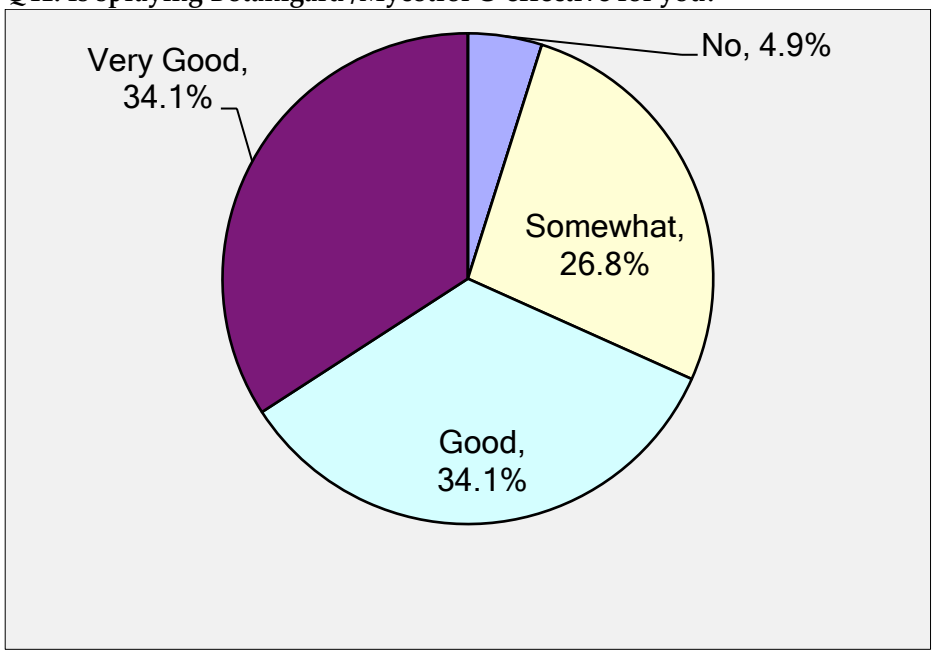
Q39. How much commercial product are you using per acre?



In 2014, 40% sprayed 32 oz/acre and 9% sprayed 64 oz/acre. 51% of farms sprayed 24 oz or less per acre. In 2013, 40% of farms sprayed 16 oz/acre and 38% sprayed 32 oz/acre. This is an increase compared to 2012, when 38% of farmers sprayed less than 16 oz of *Beauveria* per acre per application, 28 % used 16 oz, and 28% used 32 oz. The label says 32 oz/acre but CTAHR research (E. Greco Burbano, 2013) found that 8, 24, and 32 oz per acre gave similar results when sprayed at 24 day intervals.

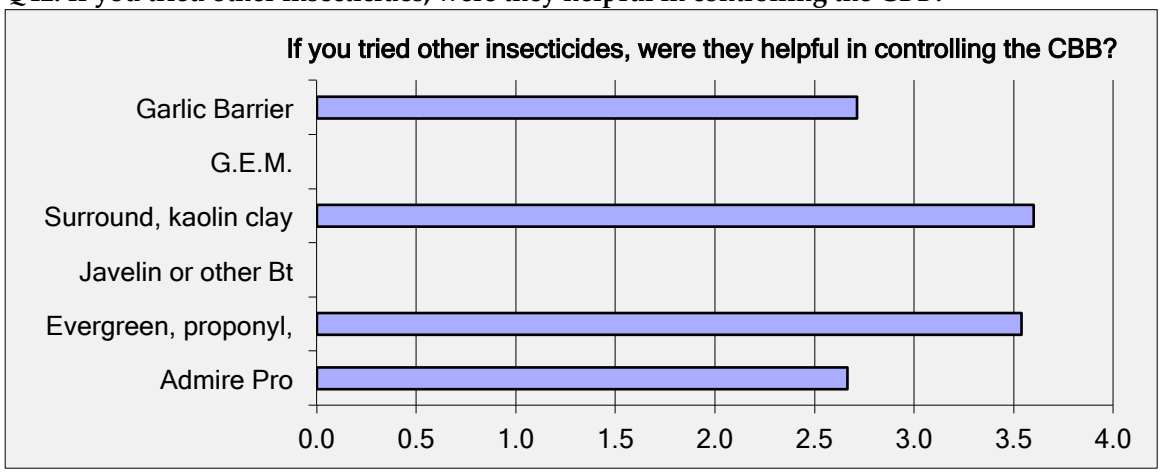
Q40. What type of sprayer do you use?
55% use a mist blower, 30% a motorized pump and 15% use a backpack lever pump sprayer. Use of a mist blower is increasing while motorized and manual back lever sprayers use is decreasing. Mist blowers can be backpack or tractor/ATV-mounted and are easier to use and provide better coverage of trees.

Q41. Is spraying Botanigard /Mycotrol O effective for you?



Effectiveness ratings of good to very good decreased slightly to 68% from 75% in 2013. Lower effectiveness might be due to the wide interval between applications since 78% spray every 4 wks or more. Starting sprays no later than March in Kona should be considered.

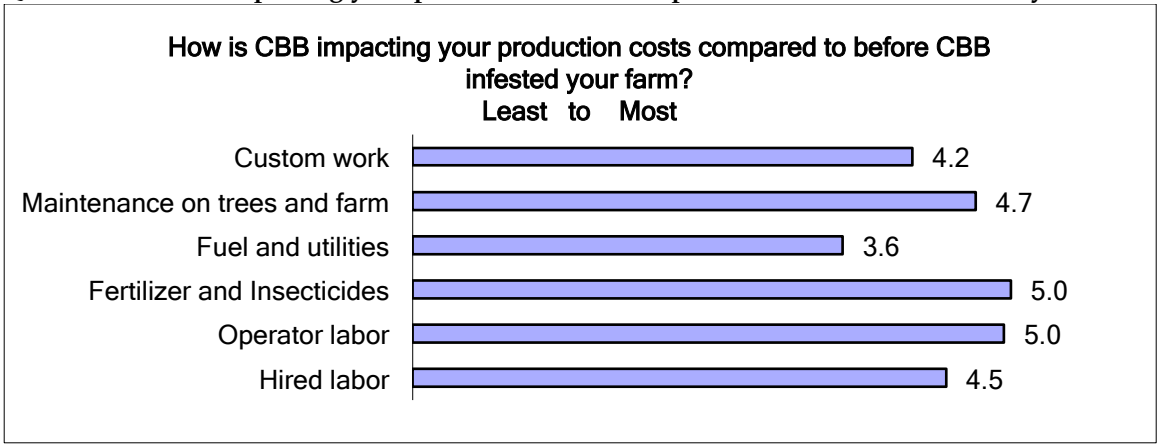
Q42. If you tried other insecticides, were they helpful in controlling the CBB?



Other insecticides that farmers tried and rated were Surround WP (kaolin clay) and Evergreen/Pyronyl (pyrethrins) that rated good. Surround WP may adhere longer and be more effective in low summer rainfall areas. Pyrethrins kill CBB quickly but lack residual impact, and therefore, are good for CBB swarms early in the season and likely for following mechanical harvesters. Garlic Barrier and Admire Pro were somewhat effective. No one reported using G.E.M. or Bt products.

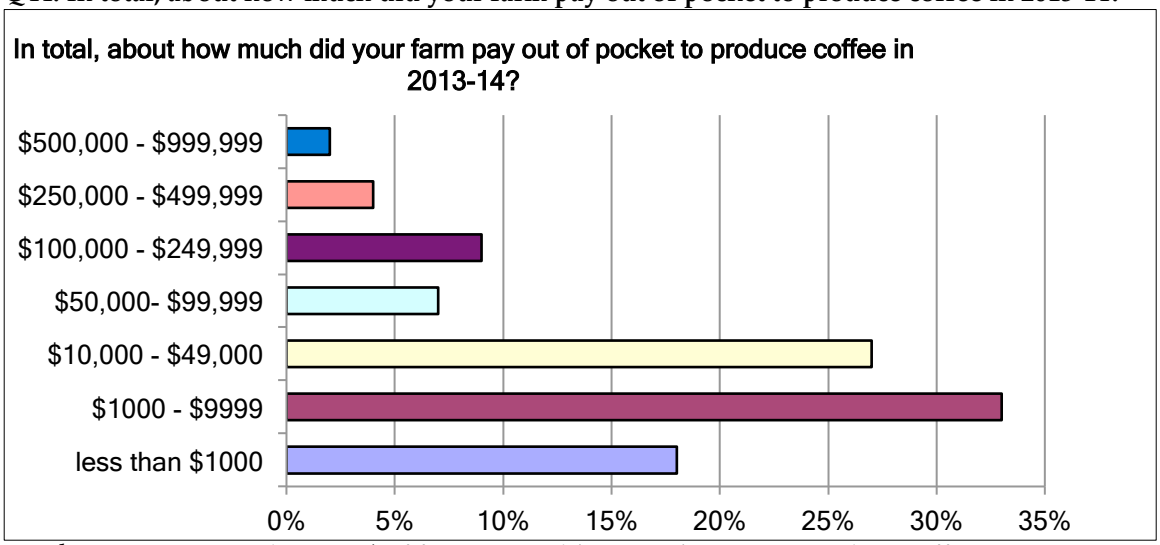
Questions about Economic Impacts of CBB.

Q43. How is CBB impacting your production costs compared to before CBB infested your farm?



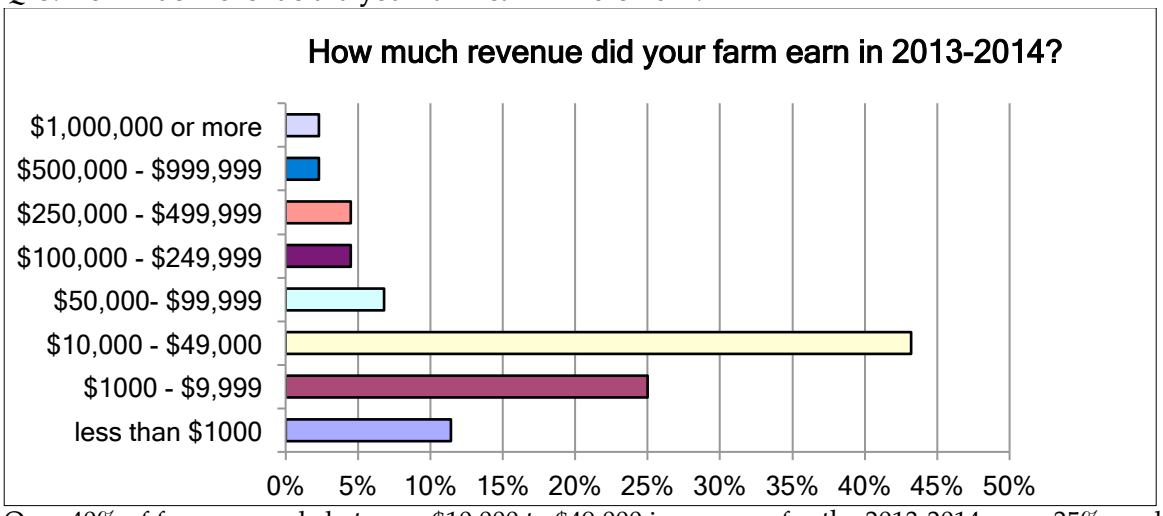
In terms of production cost increase, farmers rated 'Insecticides (mostly) & Fertilizer', 'Operator labor' and 'Maintenance on trees and farm' as the areas with the most cost increase. Custom work', 'Fuel and utilities', and 'Hired labor' saw smaller cost increase.

Q44. In total, about how much did your farm pay out of pocket to produce coffee in 2013-14?



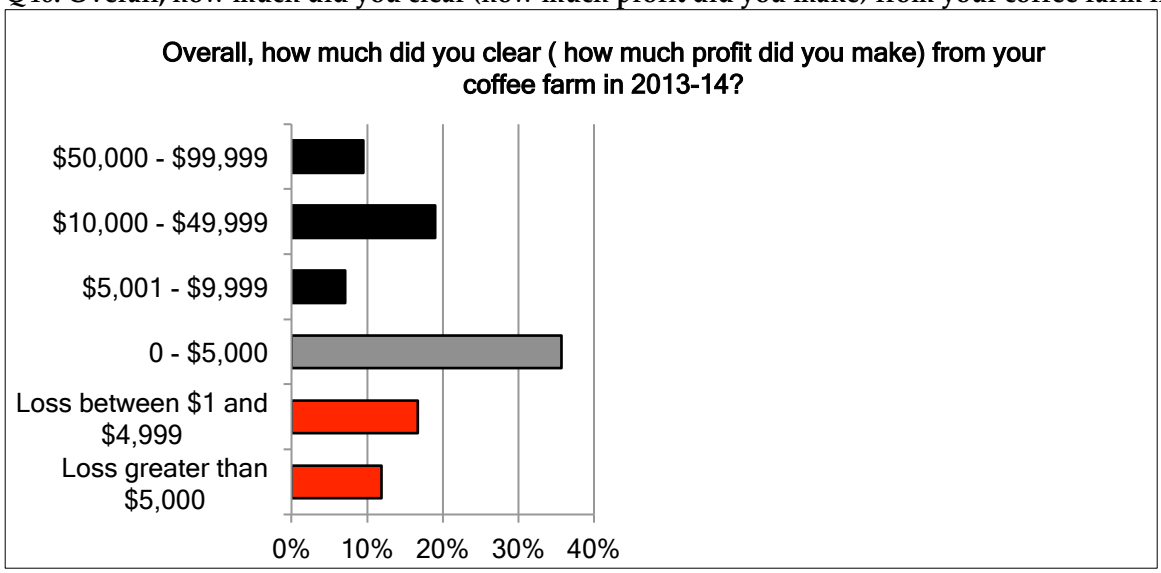
For the 2013-14 crop, about 60% of farmers paid $1000 to $49,000 to produce coffee.

Q45. How much revenue did your farm earn in 2013-2014?



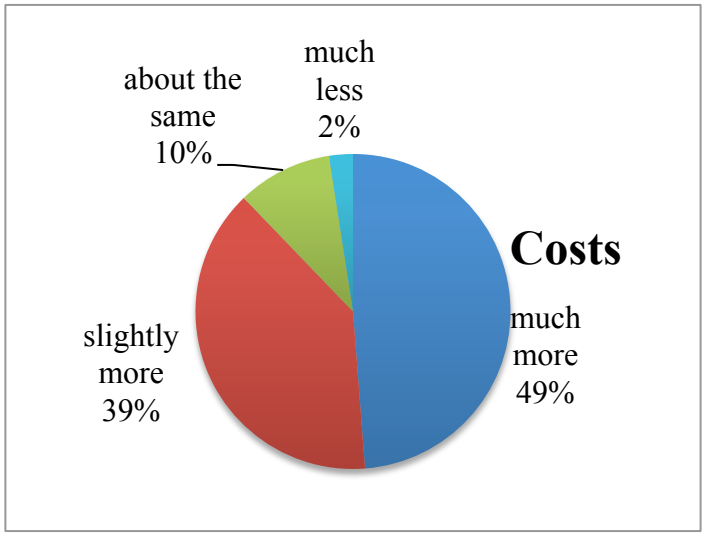
Over 40% of farmers made between $10,000 to $49,000 in revenue for the 2013-2014 crop, 25% made $1000 to $9,999.

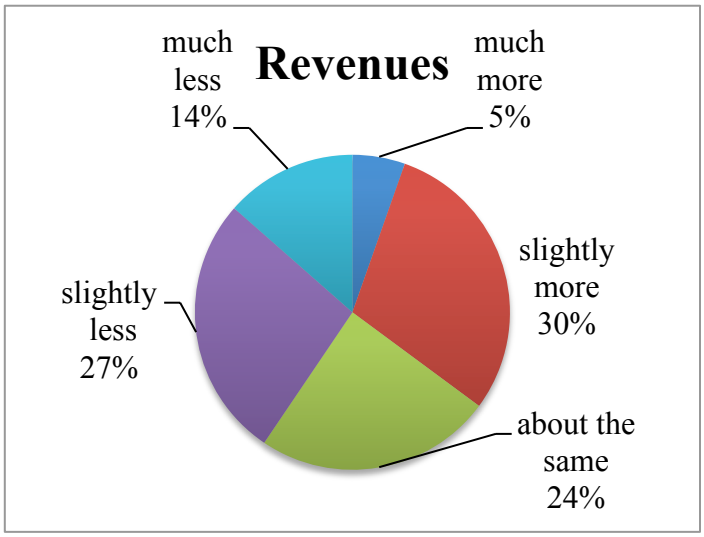
Q46. Overall, how much did you clear (how much profit did you make) from your coffee farm in 2013-14?



Profitability for the 2013-14 crop was mixed; 29% of farms made no profit, 36% made between 0 and $5,000, and 36% made between $5,000 and $100,000 in profit.

Q47. How do the costs and revenues in 2013-2014 compare to the year before CBB infested your farm? Select the choice that best represents your situation.



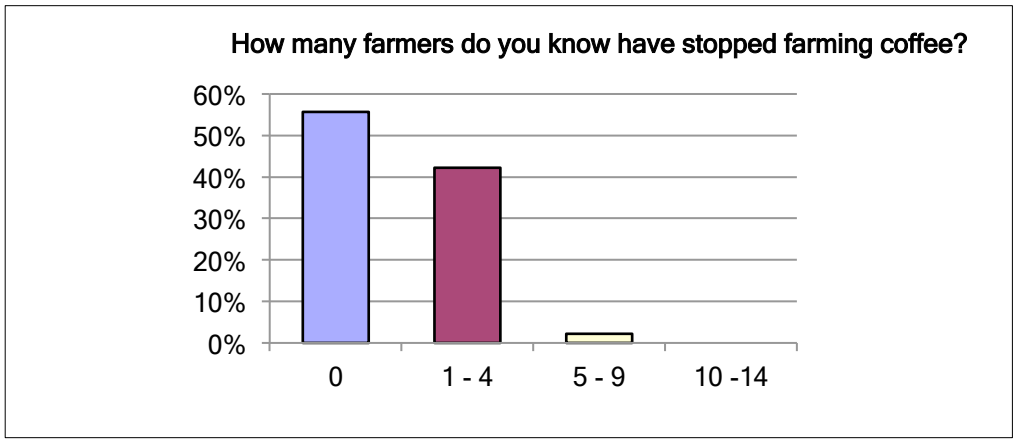


About 90% of farmers reported 'much more' or 'somewhat more' costs for producing coffee in 2013-14. Only 35% had 'much more' or 'somewhat more' revenues from coffee in 2013-14.

Questions about farmers leaving coffee due to CBB.

Q48. Are you planning to stop growing coffee because of CBB?
In 2014, 2% said they are planning to stop growing coffee; a decrease from 2013 when 5% said yes. In 2012, it was 3%.

Q49. How many farmers do you know have stopped farming coffee?



In 2014, 56% of farmers said that no one they knew were quitting coffee, 42% said they knew between 1 and 4 farmers were quitting. This is an improvement over 2013 and may indicate increased morale.

Questions about abandoned farms and feral coffee.

Q50. Does your farm border a farm that is not trying to control CBB?
In 2014, 63% of farms, about the same as 2013 and 2012, have neighbors not trying to control CBB.

Q51. Does your farm border an area with wild, feral or abandoned coffee?
In 2014, 54 % of farms border areas with feral or abandoned coffee. This is similar to 2013 and 2012.

Q52. Do you or someone you know, need information on how to kill unwanted coffee trees?
Only 20% in 2014 vs. 34% in 2013 needed or knew of someone who needed information to kill coffee trees.

Where do farmers get information to make decisions about controlling CBB.

Q53. Where do you get information to control CBB?
Most farmers use multiple sources to get CBB control information.
The most important sources are:
CTAHR workshops 72%
other farmers 70%
CTAHR webpage for CBB 66%
my coffee organization webpage 62%
my coffee organization workshops 57%
my coffee organization newsletter 47%

The importance of CTAHR workshops and webpage has increased over 2013.

Observations by farmers and millers.

Q54. Farmer/miller observations.
CBB habitat
Infested berries are more in the shady dark areas and borders to neighboring farms who do not control the insects.
CBB is more prolific in shaded trees
I have some dwarf coffee trees. The B. bassiana seems to survive longer amongst those trees, perhaps because the foliage is dense.
Rain seems to inhibit CBB infestation

Beauveria bassiana habitat.
Return of rain and endemic BB etc. most helpful. Keeping some sporulating BB bodies in the orchard can help increase control.
I don't think Beauveria is as sensitive to short term exposure to heat as you might think from the label warning. My mechanical agitator routinely overheats the last 20 gallons of mixture or so, and I spray on sunny mornings, with no apparent loss of effectiveness. Also once I left a full gallon of Botanigard in my closed pickup cab parked in the sun all day and it seemed to work just fine.

Using Beauveria sprays

Need to spray at the early stage when the beans are still little.

I finally get how important it is to spray BB early.

Timing of spraying very important weather 'not always ideal

Spraying intervals should probably not exceed 3 weeks

It would be great to use a regenerating strain of fungus

Cost of Beauveria spraying

Spraying with Beauveria bassiana every three weeks is very expensive, even with subsidized spray. Price of Kona coffee will have to go up to sustain farming.

Need work on frequency and quantity of spraying to reduce cost. time, labor, and materials is killer.

Need smaller size Botanigard for casual coffee growers. Buy gallon, goes bad before can use it up.
I spend about $4,000 on Pest Control alone. My highest cherry yield (2009) was 36,000 lbs., and 2013-14 was 15.5 K lbs.!!!

Sanitation

Strip picking at end of season, before pruning appears to have been most effective. Continue spraying Botanigard through picking also appears important.

Plastic bags inside burlap bags for picking have a huge kill ratio. In field and at mill.

Monitoring CBB

Monitor your farm with traps it can save time and money especially on your boarders

Winter trapping and consistent and frequent spraying of fungus are crucial.

Traps seem a waste of effort.

30 Tree CBB survey method

Because I feel I must spray all of my coffee orchard, the 30 tree method is pretty useless. I think it was designed for 1000 acre plus plantations.

Q55. What research do you want done about the CBB problem?

CBB

Need to sterilize borers. No matter how much we maintain with spraying, we will never get rid of them especially with so many coffee farms unmaintained.

Walachia & systemic antibiotics in tree to break reproduction cycle in female CBB.

CBB control

Any other fungicide, natural predators or can introduce predators without damage to other plants find more effective killing agents

Need different Find a better medicine aside from Botanigard. It seems that it's not strong enough to control the increase of the CBB

Develop something effective that kills quickly (not 3-5 days) through contact by spores in the air. CBB must be killed before they enter the cherries.

Natural predator of CBB

Natural fixes, neem, garlic, cilantro. Things that help without chemicals or costs.

Beauveria bassiana

Finding other/more biological solutions. Understand if native B. bassiana is more effective than commercial strains.

What can be done to control infestation before the rainy season when Botanigard is effective? Mostly, I'm interested in knowing the least amount of spray and the longest spray intervals I can get away with without sacrificing good results (2-3% cherry or less).

How can I use 30 trees method to schedule sprayings?

In Central America, they spray when they see 5% in the AB. Could you go through a whole season in Hawai'i using that as a trigger for spraying and get good results? I find 1-2% in AB and spray once a month anyway because I'm afraid not to.

Research and extension methodology

Establish research orchards at different elevations where larger scale trials can be conducted, with say, 30 trees or more for each treatment, and 6 repetitions per treatment.

How can those who are actually doing the work with coffee be educated about how to best understand the system and care for the problems at hand beyond simply dealing with a problem, like CBB, by reaction and trying to isolate one cause and effect and not dealing with the broader picture and environment.

Research would be a combination of scientific and sociological and would help create effective educational tools that are not simply listening to an "expert" and then reacting by taking prescribed actions, but rather would help people learn how to comprehend and evaluate the whole picture at hand, which CBB is only one component of...

Control feral coffee and abandoned fields

Most effective way to kill CBB

Cost effective ways to control

Orchard biological balance and health and CBB endosperm destruction,

Need access to entomologist, soil scientist, microbiologist.