CRB Overview – Published at LICH Newsletter January/February 2024

https://hawaiiscape.com/news.php?id=7#Coconut_Rhinoceros_Beetle__CRB__management_options_for_Landscape_and_Nurseries_in_Hawaii

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BACKGROUND

This article summarizes the current methods available for Coconut Rhinoceros Beetle (*Oryctes rhinoceros),* commonly known as CRB, management in landscape and nursery settings in Hawaii. CRB was first detected on O‘ahu in 2013 but since then has become a major pest of coconut and palm species (Figure 1). CRB damage in Hawaii has been reported on other hosts as well, such as banana, taro, royal palms, foxtail palms, pigmy date palms, hala, and vegetables. CRB eat the meristem (e.g., growing tissue) located in the middle of the palm crown, causing either leaf damage or possibly complete crown death. Management of CRB can take an integrated pest management (IPM) approach of various preventative, cultural, physical, biological, or chemical practices. Management focuses either on the palm tree to target adults (e.g, insecticide sprays), or on mulch piles that serve as breeding sites for CRB larvae (e.g., mulch avoidance, heat treatment). However, practices to control CRB can be limited in landscapes and nurseries that do not use synthetic insecticides or need to use mulch for water management. Below is a list of most of the current methods available for CRB control in Hawaii.

Figure 1. Loulu palm (Pritchardia sp.) damaged by CRB at a nursery in Central Oahu. Photo taken March, 2023.

PREVENTION

Prevent introducing CRB to your landscape or nursery by avoiding the movement of and inspecting:
- mulch
- potting mix
- plants
- and any other breeding or host material entering your property.

MULCH TREATMENT

The mulch treatments can be categorized into three levels (adapted from CRB Response – Hawaii, accessed 2023):

Best: Incineration, heat treatment, fumigation, and/or chipping

Intermediate: Grinding, submersion, and/or manual Search

Minimal: Spread thin, and/or till in

Alternatives: Water-permeable weed mat, landscaping rock, gravel, rubber chips/pellets, and recycled asphalt gravel are a few common choices. For water retention, products that are incorporated beneath the soil surface work best. Water retention crystals hold much more water than mulch and are not very expensive.

Some of these treatments may be more practical than others for landscape management and nursery operations. Grinding green waste is common practice in tree work and will kill some CRB but kill rates have not been tested. Finer (smaller particle size) grinding is more likely to kill more CRB (CRB Response – Hawaii, 2023).

Digging through the material and searching for CRB is an effective way to monitor mulch piles. However, it is not a reasonable method for eradication of eggs and small larvae, which are very small and easy to miss. However, digging through the material and rotating if every 4 months is an effective way to monitor piles and eradicate large larvae before they become adults, since the eggs and small larvae will most likely grow to 3rd instars (approximately 2.5”) and therefore be easier to find.

Spreading mulch and compost thinner than 2 inches dries out the material faster and allows predators (chickens and mongoose) to find CRB (Figure 2). If the material stays moist or is irrigated this is not a treatment for CRB. Continuous addition of thin layers of compost might eventually build up the amount of organic matter in the soil, increasing its potential as a CRB breeding site.

Tilling material into soil reduces the scent, access, and calories per volume available to CRB. The smaller the organic component of the soil is, the lower the attractiveness will be to CRB.

Figure 2. Mulch spread thin (source: CRB Response Team)

NETTING TYPE, SIZE

Netting is a physical IPM practice that can trap and kill CRB adults on trees and mulch piles. Netting has been used in other locations such as Guam and India to catch or deter CRB (Moore et al. 2014, Sujithra et al. 2022). Monofilament netting is preferred for its flexibility, strength, and thinness to catch CRB. Netting of ~0.33mm thickness with ½" x ½" square or side measurements effectively catches CRB with minimal wrapping (Fig. 3). Larger nets (e.g., ¾" or 1" side measurements) can also be effective but require multiple wrappings to overlap net openings. Although not an exhaustive list nor an endorsement, Lee Fisher Fishing Supply or Memphis Net & Twine are two example companies where monofilament netting of this size can be purchased.

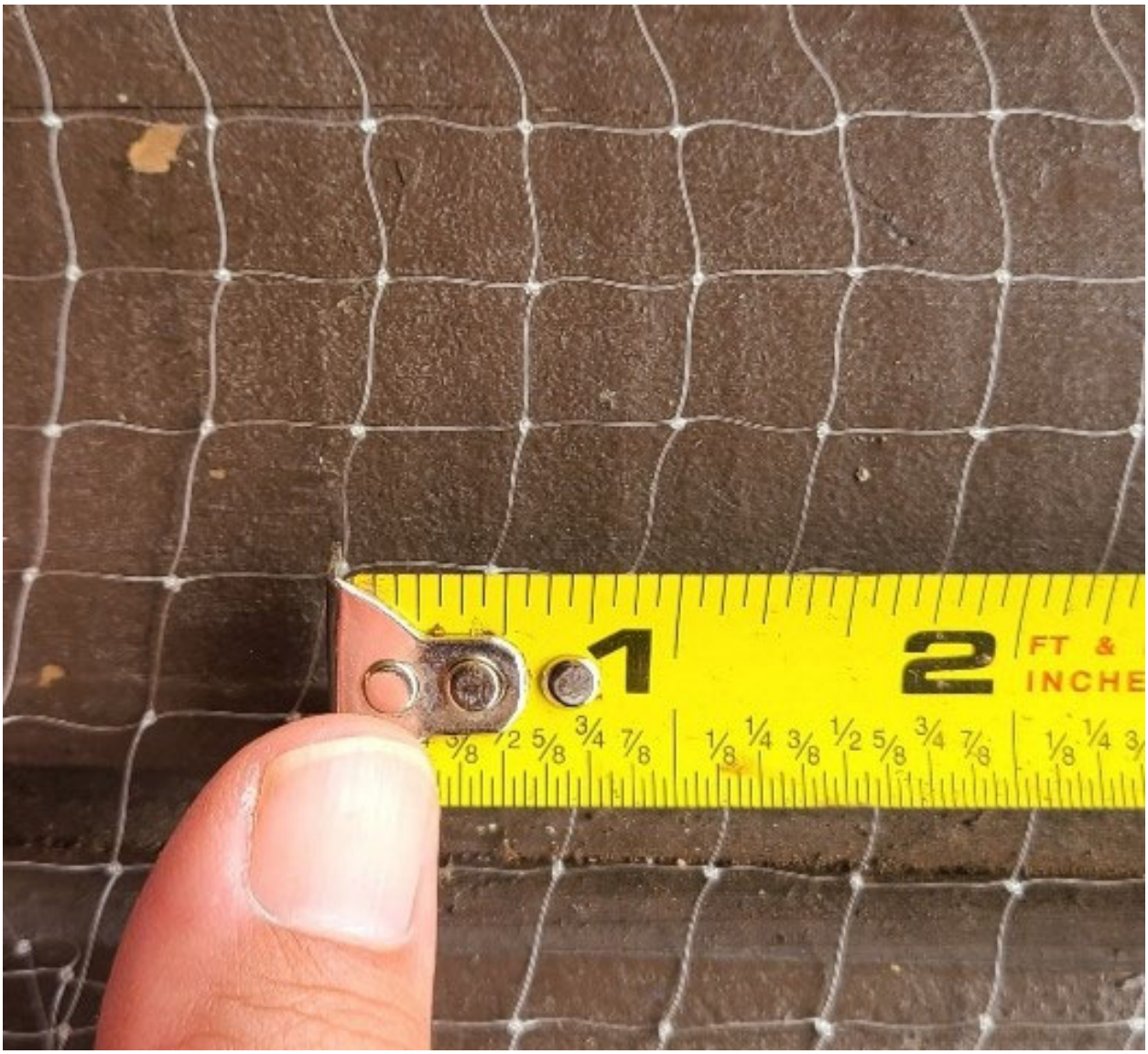

Figure 3: Netting size (Source: Silva, 2023)

NETTING TREES

Netting coconut and palm trees can prevent CRB from damaging the plant and is most feasible for low-bearing trees that can be easily managed. Here are some tips to net trees effectively.

- Use the appropriate type of net and size described in the previous section (monofilament, ½" square eye).
- Trim off old branches or flowering parts that may tangle the net during the wrapping process.
- Utilize a technique that fully covers entry points and prime feeding zones (Fig. 4). Prime feeding zones are typically between the lowest/oldest and youngest fully-expanded leaf frond.
- One easy method is to simply wrap a bundle of net around the inner crown, weaving up to the next frond layer after wrapping the lower layer about twice (Fig. 4). Depending on the width of the net, a typical good net length to measure is approximately twice the height of the feeding zone needing protection. No zipties are required, as zipties can create gaps as the coconut fronds grow and expand (Fig. 5). Here is a QR code for a video with more information on this technique.
- Other techniques include the Bow-Tie method developed by the University of Guam (2015) and netting the whole tree. However, we have not evaluated the effectiveness and labor of these methods yet.
- Ensure no gaps are in the net wrapping (Fig. 5).
- Keep the net "fluffy". This will increase the likelihood of tangling and catching CRB.
- Readjust the net wrapping at least monthly. The coconut or palm will continue to grow, creating gaps in the wrapping. This is one step that can make netting traps very labor-intensive.

Figure 4: Proper netting of a coconut palm, covering all entry points (Source: Silva, 2023)

Figure 5: Examples of poor net wrapping techniques leaving exposed frond layers or using fixed zipties (Source: Silva, 2023).

NETTING MULCH PILES

Minimizing mulch thickness via spreading thinly or completely eliminating mulch from your area are critical management practices to prevent the increase of CRB populations as CRB larvae live in mulch piles. However, if you choose to use mulch in your growing areas, netting mulch piles and debris along with other practices (e.g., avoid storing infested mulch, mulch heat treatments, etc.) can prevent CRB from breeding in mulch piles and reduce the population in an

area, as a Guam study found netting mulch piles caught 25x more CRB adults than pheromone traps and other trapping methods (Moore et al. 2014).

As seen in Fig. 5, one “fluffy” layer of ½” monofilament netting is an adequate barrier that catches both CRB adults that try to enter mulch piles but also newly emerged adults attempting to leave and feast on coconut trees. Once caught, CRB adults desiccate and die in the sun. During an on-farm trial of netting a fresh 20’x6’x2’ mulch pile, netting the pile caught a considerable number of CRB adults entering and exiting the pile (Fig. 6 and 7).

Figure 6: Mulch piles covered with monofilament netting that catches entering and exiting CRB adults (Source: Silva, 2023).

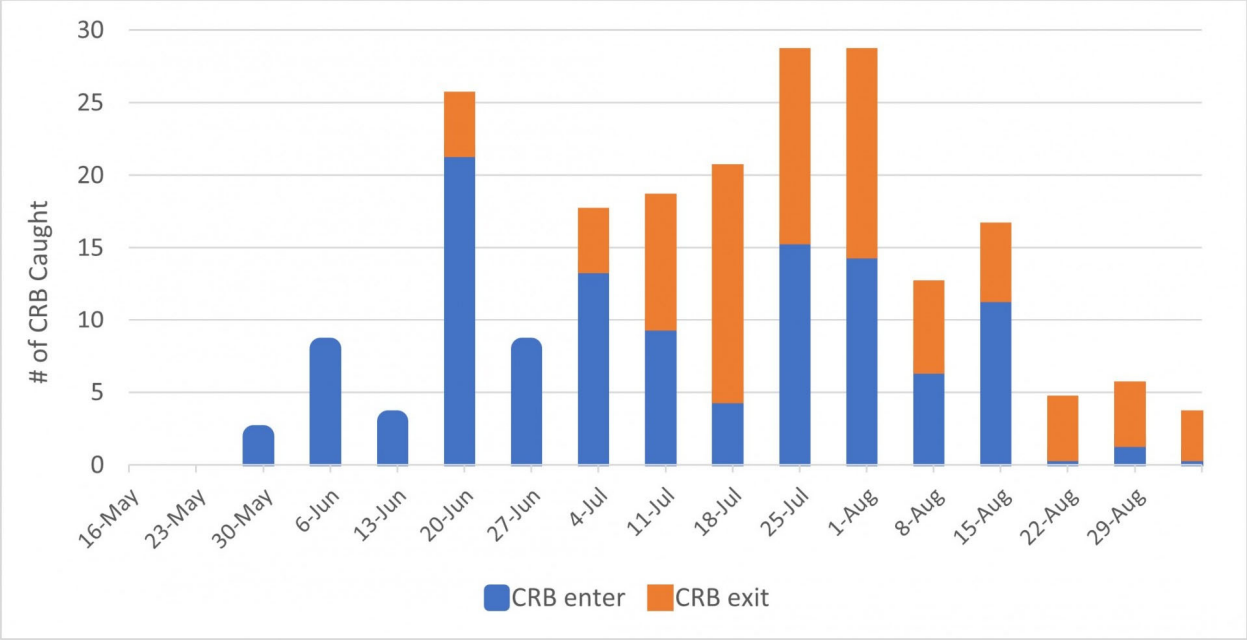

Fig. 6. Netted mulch pile trial (20ft x 6ft x 1ft) monitoring number of CRB caught over 4 months (May 16-Sept 6) (Source: Silva, 2023).

SAND

Sand can be applied to the crown so that it sits between the bases of the fronds surrounding the spear. The efficacy of this treatment has not been tested in Hawaii. Sand requires regular reapplication as it washes away and new fronds grow out from the spear. In India, the use of "botanical cakes" that include neem oil or other botanical compounds have been documented as a method for CRB IPM control (Ravindran, 2019).

SYNTHETIC INSECTICIDES (summary from CRB Response – Hawaii website)

Pesticides may be applied as foliar sprays, systemic injections, or systemic root drenches. Since systemic pesticides require CRB to feed on the palm to die, damage will still occur but will be reduced when there is a reduction in the local CRB population.

Injection: Imidacloprid (e.g. ImaJet) and Acephate (e.g. AceJet) kill CRB in lab trials and have reduced populations when applied to most palms in an area. Systemic injections require trimming of flowers and fruits at least every 6 months to protect pollinators and ensure the fruits are not consumed.

Soil drench: Imidacloprid (e.g. Imidacloprid 75 WSP) can be applied as a soil drench for systemic treatment of palms. Field efficacy has not been tested for this application method. A soil drench with imidacloprid requires trimming of flowers and fruits at least every 6 months to protect pollinators and ensure the fruits are not consumed. Fully trimmed palms can be treated as "shrubs" when consulting the label for application instructions. Full instructions for soil drench click here.

Foliar spray: Spraying of the crown with cypermethrin (e.g. Demon Max) has been shown to kill CRB in the lab and field. However, this treatment is currently only approved for experimental use. Spraying the spear and upper central part of the crown will be more effective than spraying outer and lower frond areas. Drones can be used for foliar applications, however, a commercial drone operation license and permit are required for such use (UH Press, 2022; DeFrank and Jenkins, 2023).

"Evergreen Pyrethrum Concentrate" is a USDA Organic certified product that can be used on all CRB hosts and infested material. Pyrethrin is purified from plants and kill CRB by contact causing paralysis. Spray of the crown center can kill adult beetles inside the palm. Pyrethrins degrade quickly in sunlight, so this product does not provide long-term residual activity. This should only be applied to plants with recent CRB damage or suspected to have CRB actively feeding. For full instruction for Evergreen application, click here.

Fig. 7. Drone used for foliar application (Source: UH Press, 2022).

ESSENTIAL OILS (adapted from an article in press for CTAHR's Hana 'Ai Oct-Dec 2023 Newsletter)

Essential oils have been reported in India to cause mortality of CRB larvae and adults. Preliminary trials on O'ahu indicated that essential oils have the potential to be used as an IPM practice for CRB management. Below are results from preliminary trials for the use of essential oil on CRB control.

Previous research from India (Ravindran et al, 2019) revealed that essential oils extracted from basil (*Ocimum basilicum*), eucalyptus citriodora (*Eucalyptus citriodora*), ajowan

(*Trachyspermum ammi*) and thyme (thymol oil derived from *Thymus* sp.) caused electrophysiological response in the antennae of O. rhinoceros adults. The behavioral response of beetles was tested in 'Y' tube olfactometer having a choice between an odor arm containing essential oil and a control arm without essential oils. Over 70-85% of the beetles moved towards the control arm, indicating the potential of these essential oils to repel CRB. The same essential oils caused over 90% mortality when beetles were placed in containers lined with a 6% essential oil solution for 48 hours (Figure 8).

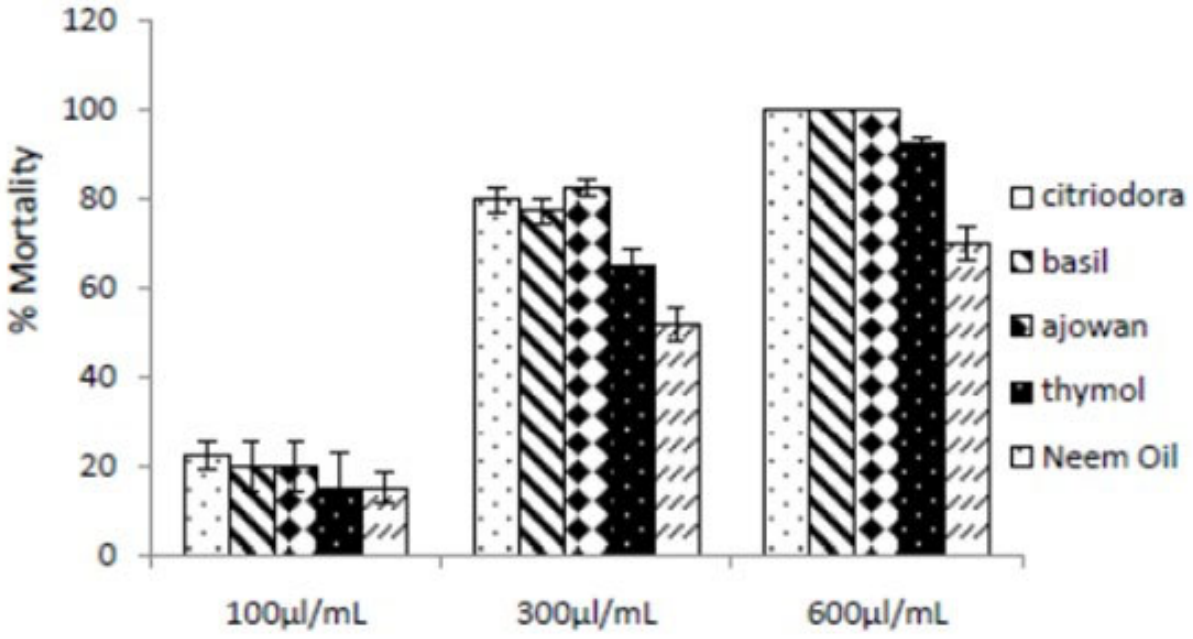

Fig. 8. Contact toxicity of essential oils to adult O. rhinoceros (Ravindran et al, 2019)

Recent field trials demonstrated the potential for essential oils as an IPM tool in Hawaii. On 11/02/2023, several coconut trees with CRB symptoms on the North Shore of Oʻahu were trimmed and sprayed with a solution of 6% Eucalyptus citriodora oil and Excel 90 spreader-sticker at the manufacturer's recommended rate (1/2 ounce per gallon). A 1-gallon pump sprayer was used to spray directly inside holes bored by CRB and to cover palm frond stems (Figure 9). Two beetles retreated from the crown of one palm. One beetle appeared dead once collected from the ground, while the second beetle was still alive and active. The beetles were transferred to an uncovered container and sprayed with the solution. Both beetles were dead 2 hours after being sprayed with a 6% solution of eucalyptus.

On 11/16/2023, five coconut palms at the Department of Urban Forestry Nursery in Waipiʻo were trimmed and searched for CRB adults. Only one adult was found, placed on a jar, and lightly sprayed with 6% ajowan oil. The CRB beetle sprayed with 6% ajowan oil was reported dead 4 hours after spray.

Fig. 9. Tree climber spraying the crown of a coconut palm crown with CRB damage using a pump sprayer.

ESSENTIAL OIL CONTROLLED TRIALS

On 11/07/2023, CRB adults and larvae were collected from a mulch pile in Waiʻanae. The mulch pile was approximately 40” tall, with a mix of chipped wood and leaves. Pitchforks and rakes were used to graze through the mulch. Most of the larvae were found in the bottom layer near ground level, in fine mulch and compost. Adults were mostly found in coarse mulch in the upper half of the pile. The collected CRB were kept with mulch, overnight, indoors, in coolers and buckets.

Adults were sorted and placed in containers for treatment approximately 18 hours after collection (Figure 10). At this point, less than 2.5% of adults (1 of 40) and larvae (2 of over 100) were dead (note: most of the dead specimens had signs of injury from collection). Treatments:

- Control (tap water only)

- Basil essential oil 6% + spreader-sticker
- Eucalyptus citriodora essential oil 6% + spreader-sticker

Each container was treated with 3 sprays of the respective solution. Beetle mortality was assessed at 5, 10, and 30 minutes, and 1, 2, 3, 4, 24, and 48 hours after treatment. On 11/09, 48 hours after the initial treatment, the beetles were treated again. They were transferred to a clean container, sprayed 5 five times to ensure the beetles were coated with the solution, and then transferred to the same container they were kept before, with clean mulch from the same mulch pile added to the containers. This was to simulate a beetle fully coated with the solution that retreated from the bored hole in the coconut crown then hid into mulch. The beetles were evaluated 3 hrs, 24 hrs, and 96 hrs after treatment.

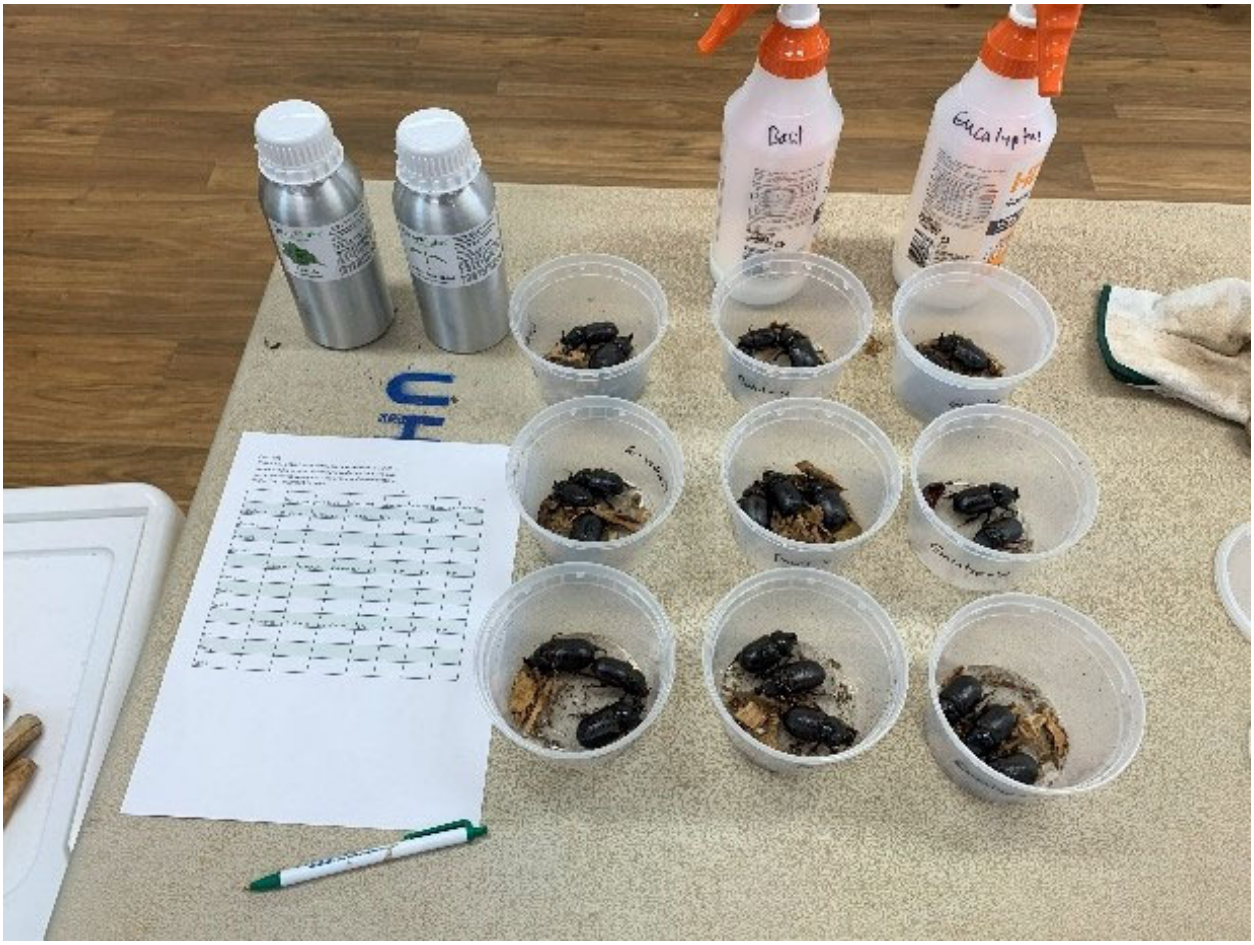

Fig. 10. Trial setup.

Basil caused beetles to become very agitated when sprayed with basil solution. Click here to see video, control is top row, basil is middle, eucalyptus is bottom row. However, all beetles remained alive 48 hours after the first treatment. This was unexpected since previous research and preliminary field trials indicated that beetles were supposed to die within 2 to 48 hours. One hypothesis is that beetles were not sprayed with enough solution to cause their death, or a higher

concentration is required. After the second and heavier treatment, all beetles in the control treatment remained alive and active after 96 hours. Basil caused a 22% and 66% mortality rate after 24 hours and 96 hours (second treatment), respectively (figure 11). Eucalyptus oil caused only 1 beetle to die 24 hours after treatment. These results indicate that basil essential oil has the potential to be part of Integrated Pest Management for control of CRB in Hawai‘i, and further studies are necessary to confirm its efficacy and applicability to field use. Recently, commercial products containing herbal essential oils have been introduced in the local trade.

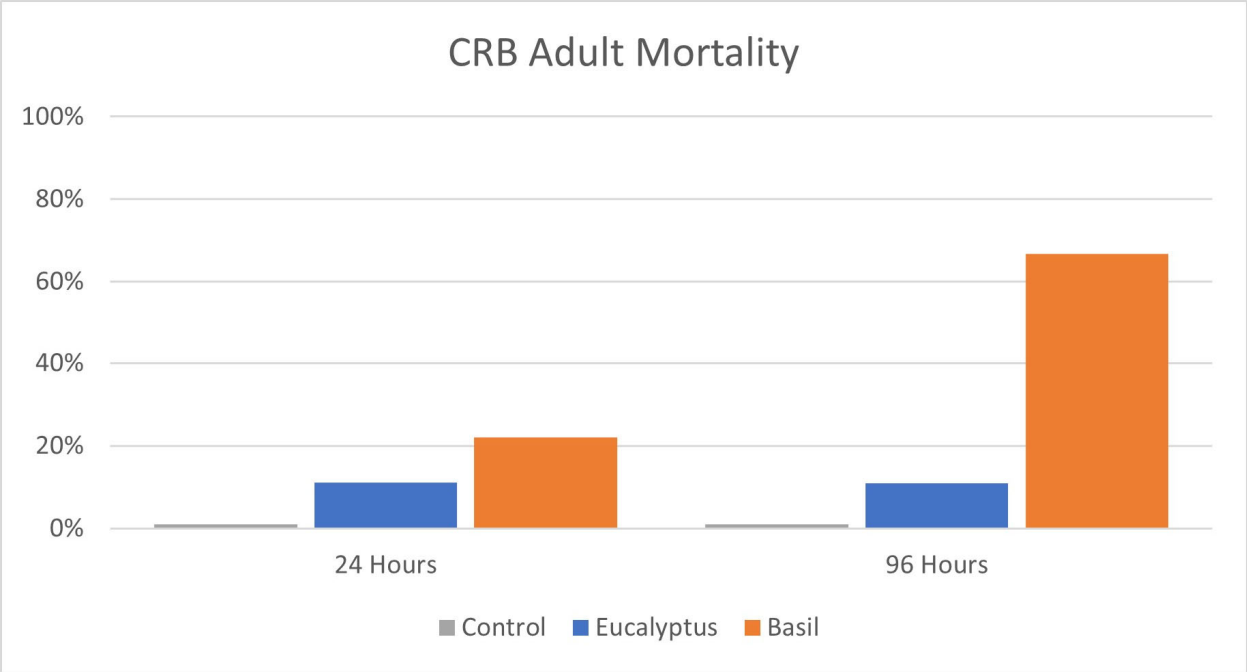

Fig. 11. CRB adult mortality 24 and 96 hours after second treatment.

SUMMARY

In summary, currently available IPM methods include:

- Prevent movement of infested material and inspect for host and breeding material
- Mulch treatment: rotating, spreading thin, and tilling
- Netting mulch piles and palms
- Chemical control with synthetic insecticides and essential oils

FUTURE WORK

Future research is looking into other biological and chemical approaches to kill CRB and protect coconut and palm trees. These include fungal species like Metarhizium spp. that infest and kill CRB larvae, application and essential oil deterrents, drone application of pesticides, and pesticide rotation studies. Be on the lookout for news of these other IPM approaches in the pipeline.

Acknowledgements:

Thank you to: the Coconut Rhinoceros Beetle Response Team for their support and sharing information regarding net sources; Dr. Aubrey Moore with the University of Guam for providing resources regarding his team's successful work in Guam; Kyle Bennett (Coconut Landscapes) and Brandon Au and his team from the Department of Parks and Recreation, Division of Urban Forestry, for their support with essential oil field trials.

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