Coconut Rhinoceros Beetle: Current Management Updates

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UH Cooperative Extension

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Webinar outline:

- Coconut Rhinoceros Beetle (CRB) Origin & Life Cycle

- CRB Alternative Hosts and Damage

- Current Management Strategies

CRB Life Cycle – Geographical Distribution of *Oryctes rhinoceros*

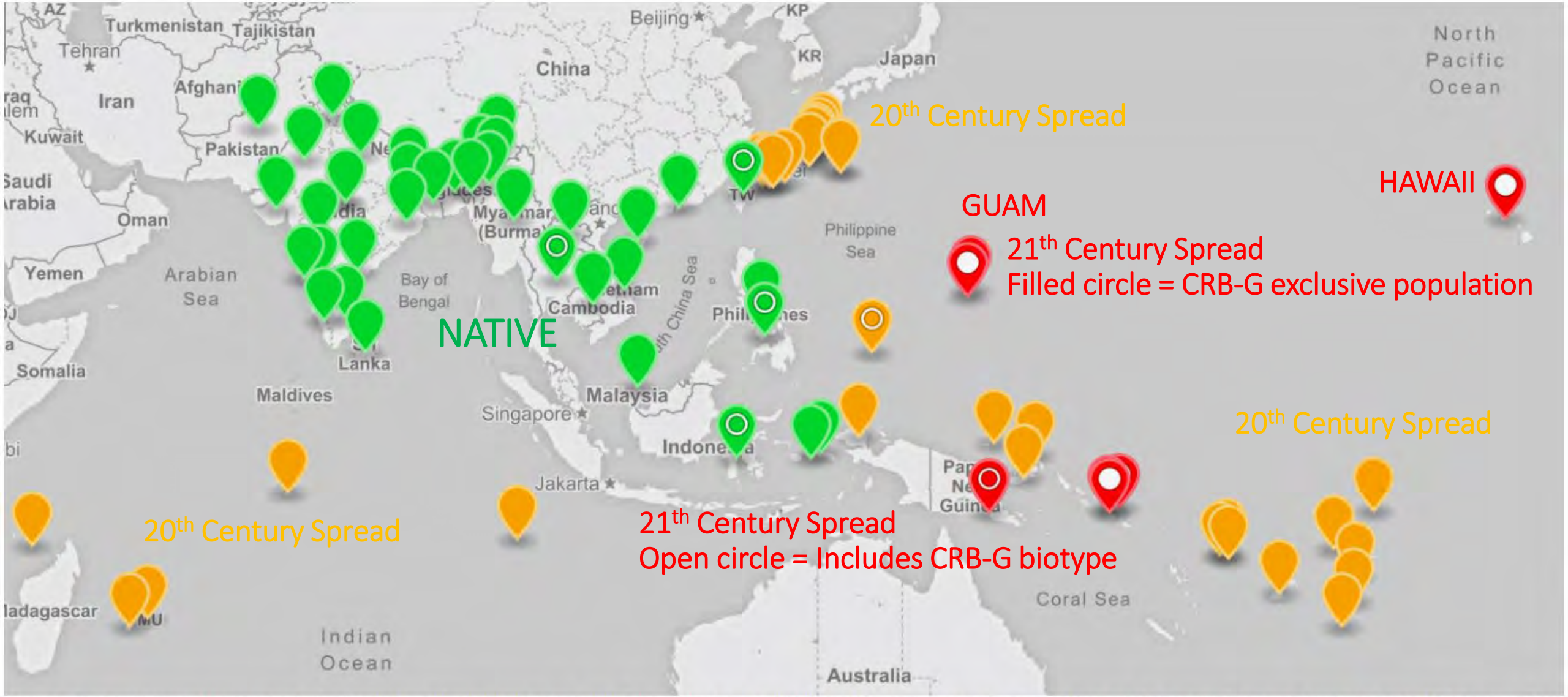

Figure 4 Distribution coconut rhinoceros beetle, *Oryctes rhinoceros*. Green markers: native range; Brown markers: first detected in the 20th century; Red markers: first detected in the 21st century; Open circle: population includes CRB-G biotype; Filled circle: population is exclusively CRB-G biotype. An interactive version of this map is available online at http://aubreymoore.github.io/crbdist/mymap.html.

CRB Life Cycle – Dispersal in the Pacific

Fig. 1. Invasion history and distribution of CRB (*Oryctes rhinoceros*) in the Pacific. Green indicates the native range whereas invaded range is indicated by orange (redrawn from Catley 1969).

A New Coconut Rhinoceros Beetle Biotype Threatens Coconut and Oil Palms in Southeast Asia and the Pacific

Sean D.G. Marshall, AgResearch, New Zealand, Sean.Marshall@agresearch.co.nz
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Maclean Vaqalo, Secretariat of the Pacific Community, MacleanV@spc.int

July 27, 2016

Initial attempts to introduce OrNV into the Guam CRB population were unexpectedly unsuccessful, raising the possibility that the population that invaded Guam is tolerant or resistant to the commonly applied OrNV isolates. Subsequent DNA analysis showed that the Guam population is genetically different from other populations in the region. On the basis of distinct genetics and tolerance to currently available OrNV isolates, the Guam population has been designated a new biotype, CRB-Guam.

Recent analysis of DNA from an ongoing survey has detected CRB-Guam in Guam, Hawaii, Palau, Port Moresby (PNG) and Honiara (Solomon Islands). Thus, current inva-

A major program for control of CRB, was initiated by United Nations Development Program (UNDP)/SPC in 1965 (Young 1986).
The discovery and introduction of a viral pathogen (OrNV) not only reduced CRB populations and associ ated damage effectively but also prevented further spread for more than 30 yr (Huger 2005, Bedford 2014, Marshall et al. 2017).

Sources:

Paudel, Sulav & Mansfield, Sarah & Villamizar, Laura & Jackson, Trevor & Marshall, Sean. (2021). Can Biological Control Overcome the Threat From Newly Invasive Coconut Rhinoceros Beetle Populations (Coleoptera: Scarabaeidae)? A Review. Annals of the Entomological Society of America. 20. 1-10. 10.1093/aesa/saaa057.
https://www.uog.edu/_resources/files/wptrc/coconut-rhinoceros-beetle.pdf
https://www.abc.net.au/news/2021-06-17/rhino-beetle-threat/100215642

Coconut Rhinoceros Beetle (CRB)

Invasive species

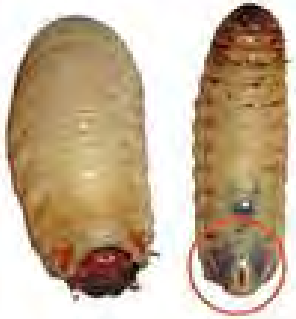
horn

~2-2.5 inches

Crawls on its side.
Larger head capsule.
Curls into C-shape.

Oriental Flower Beetle (OFB)

Nuisance



Crawls flat on its back.
Raster line on rear end.
Tucks head into midsection.

antennae

~0.75 inch

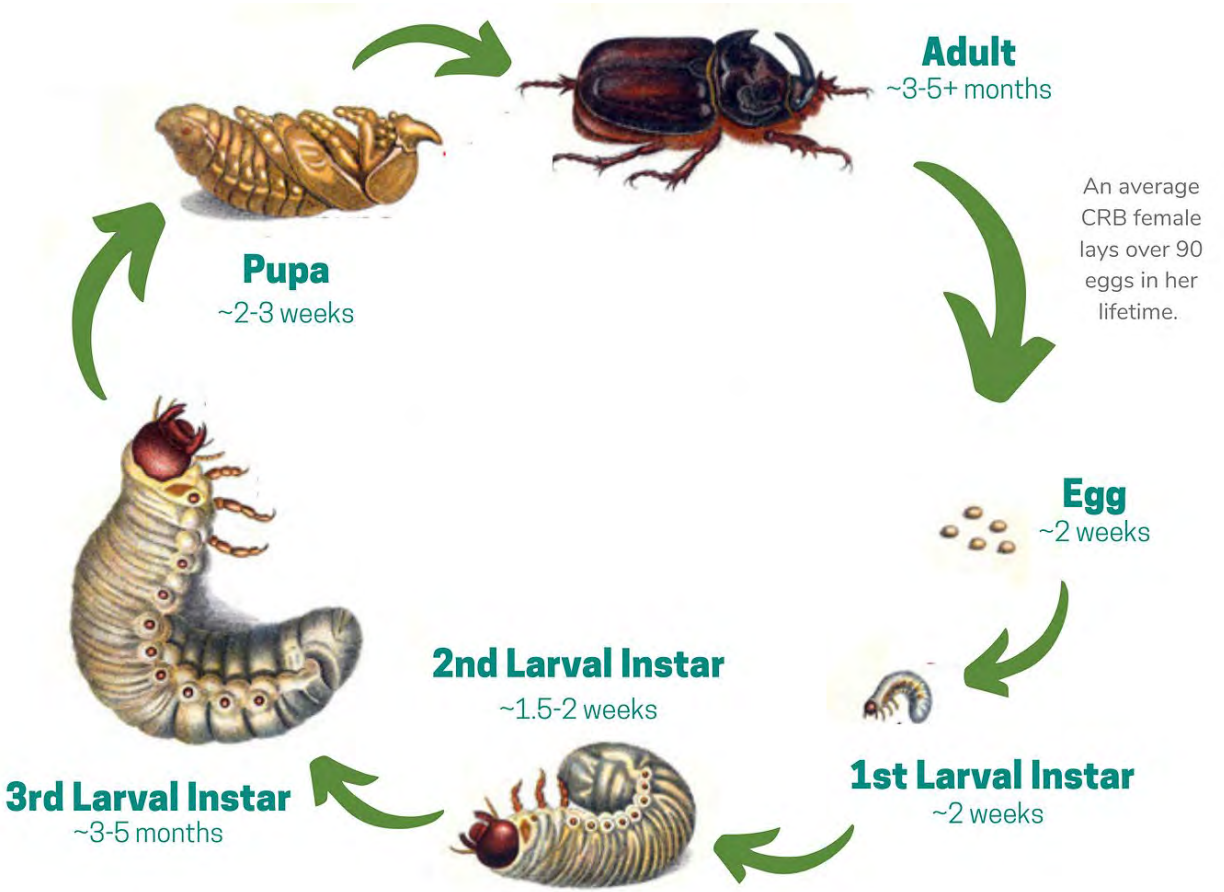
Source: CRB Response Team

CRB Life Cycle

1.2 – 2.5 inches

3 instars

Source: CRB Response Team



Larvae/Pupa= 5.5 months

Adults= 3-5 months

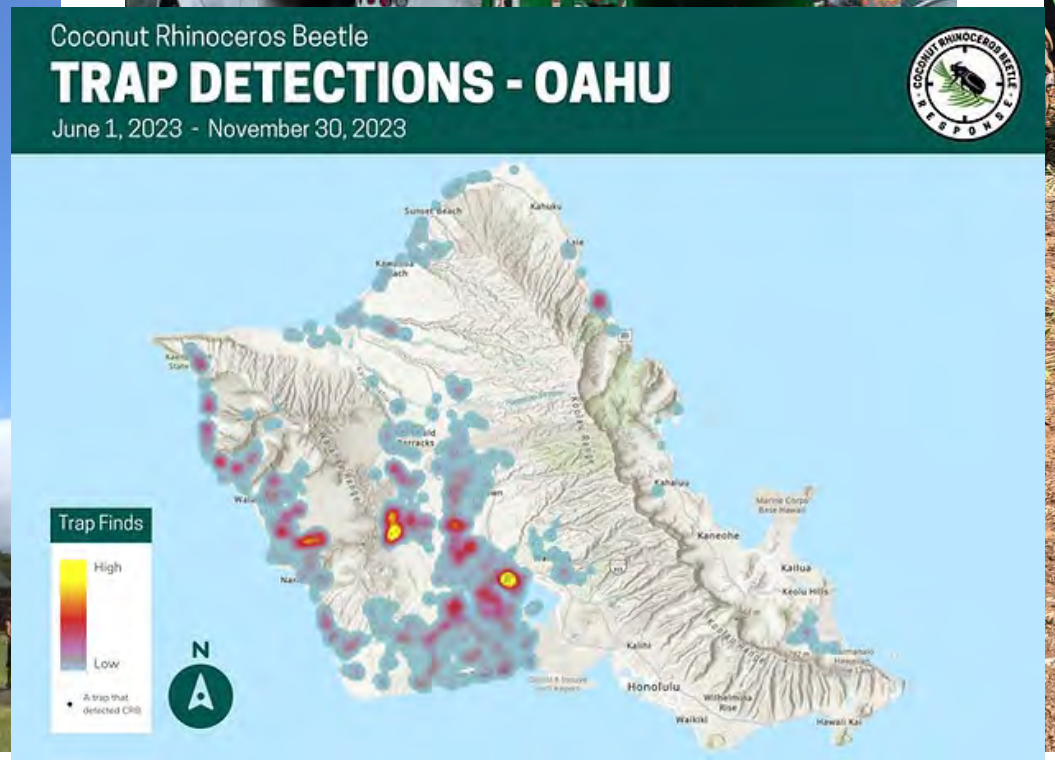
CRB Life Cycle

2 inches

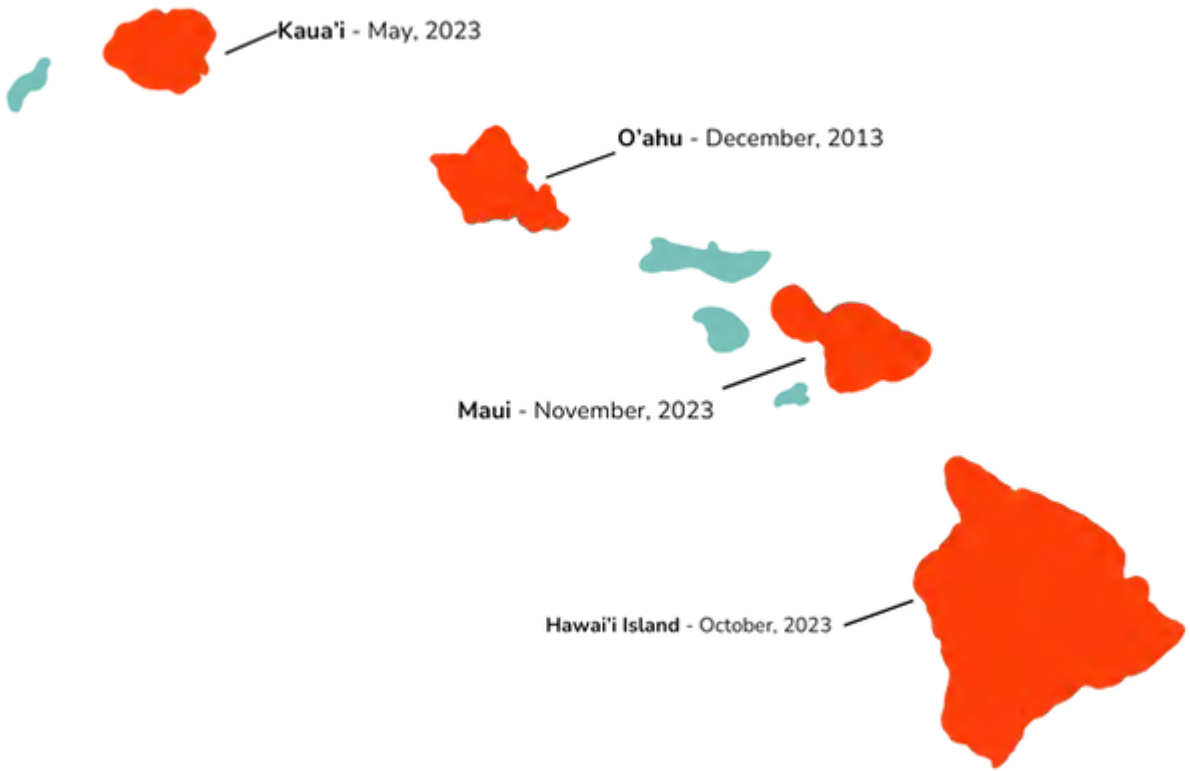
3 instars

Source: CRB Response Team

CRB Vectors: Mulch



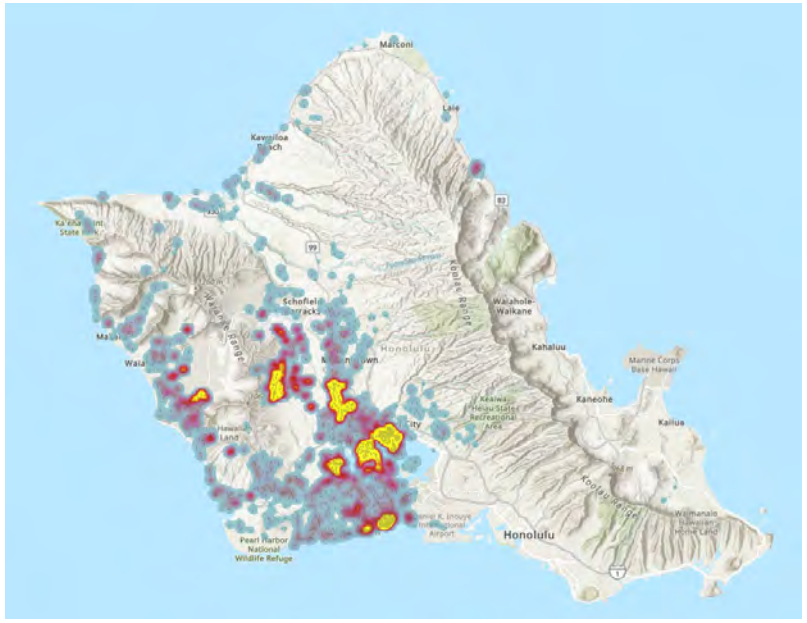
Timeline of Dispersal in Hawaii



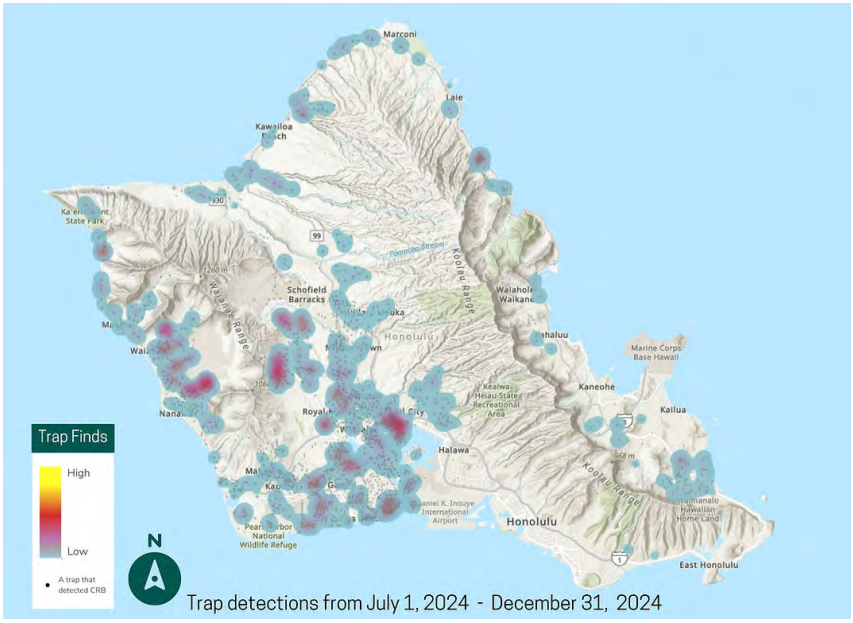
Source: CRB Response Team

Timeline of Dispersal in Oahu

CRB Finds: 2014 - 2018



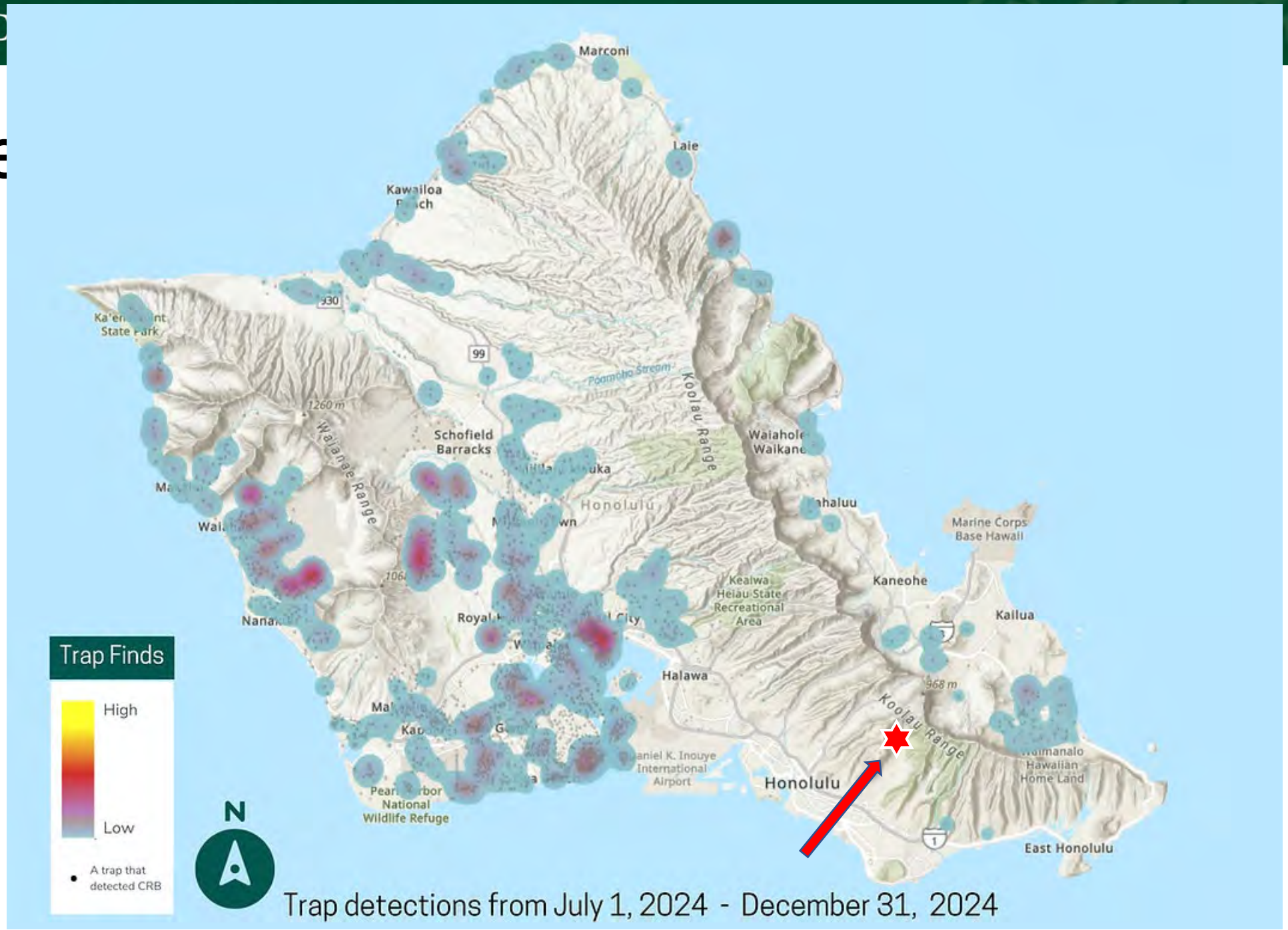
CRB Finds: 2019 – 2022



December 2024

Source: CRB Response Team

Time



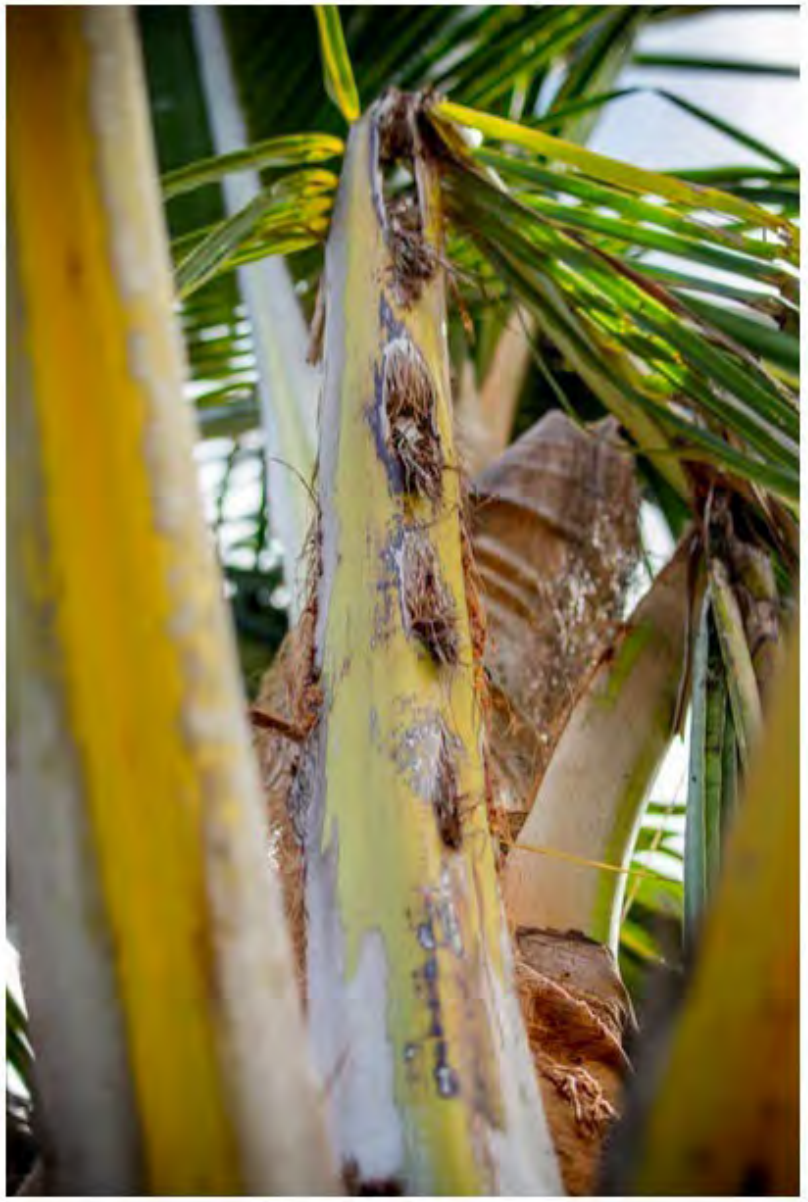
Source:
CRB Response Team

CRB Damage in Coconut palms

CRB Damage in Coconut palms

Multiple damage cycles

“Infested” vs “Infected”



2" bore holes caused by CRB

45 degree v-cuts on palm fronds

Source: CRB Response Team

CRB Alternative Hosts

**Fan Palms (e.g. Loulu)

Loulu palms affected at a nursery

CRB Hosts

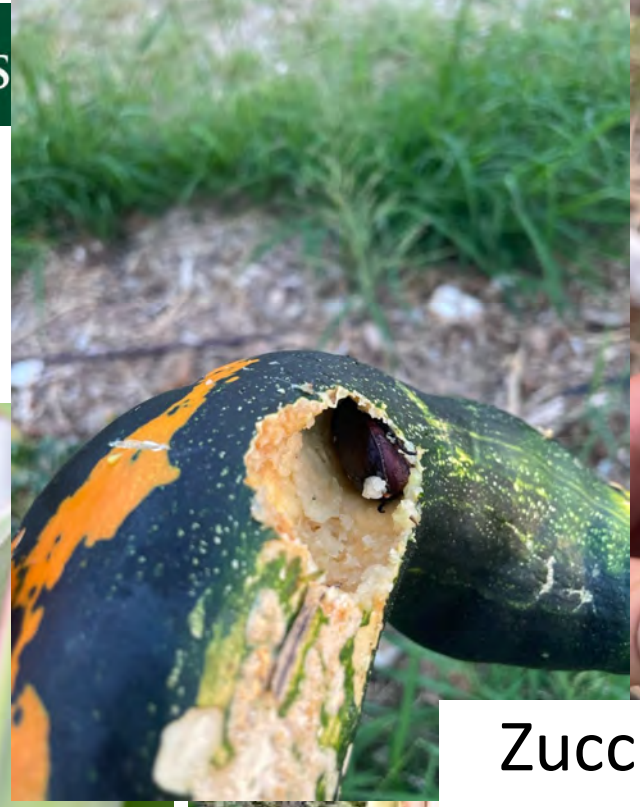
Date Palms

Pigmy Date Palms

Royal Palm, Foxtail

CRB Hosts

Banana



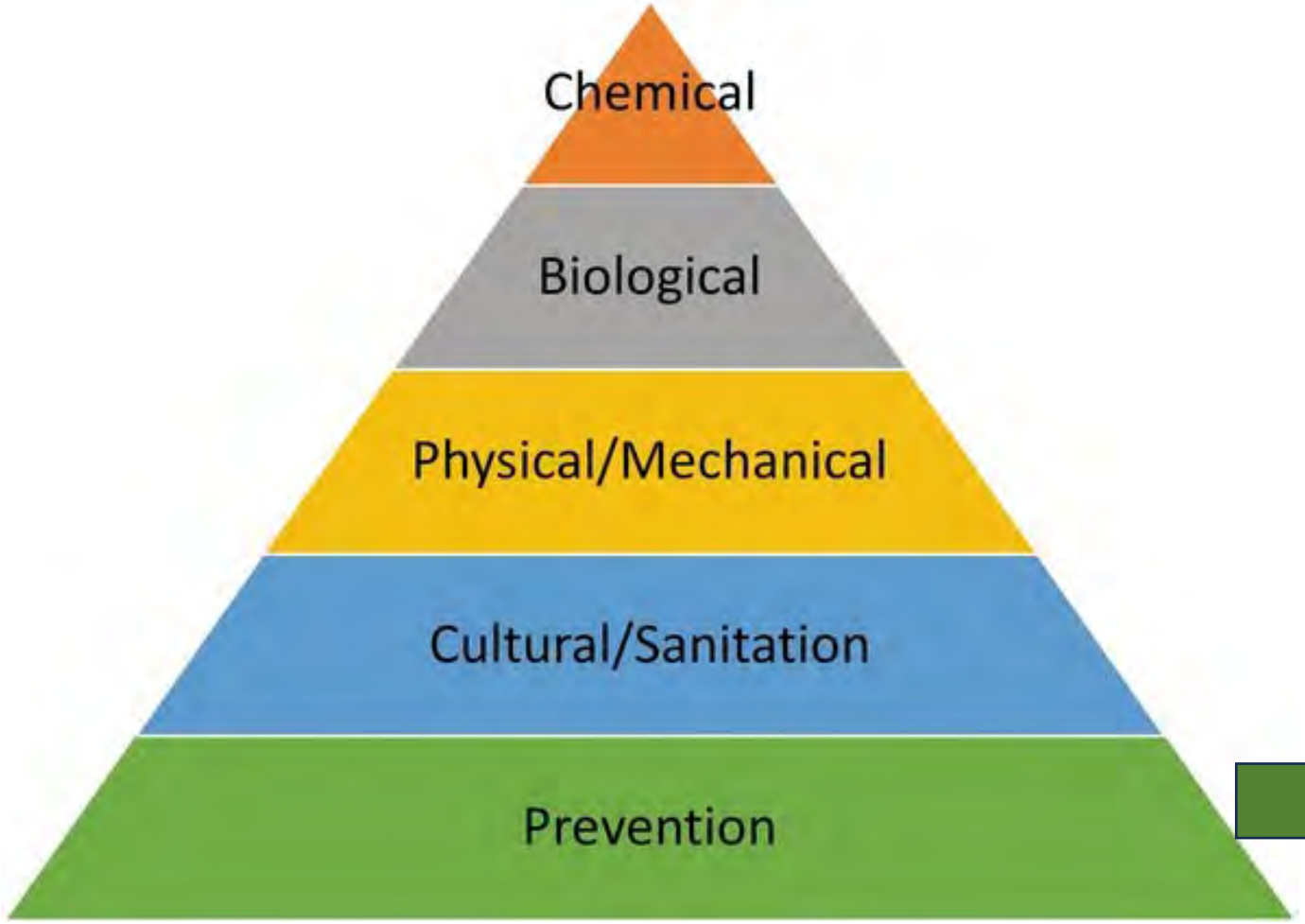
Zucchini

Taro

Hala

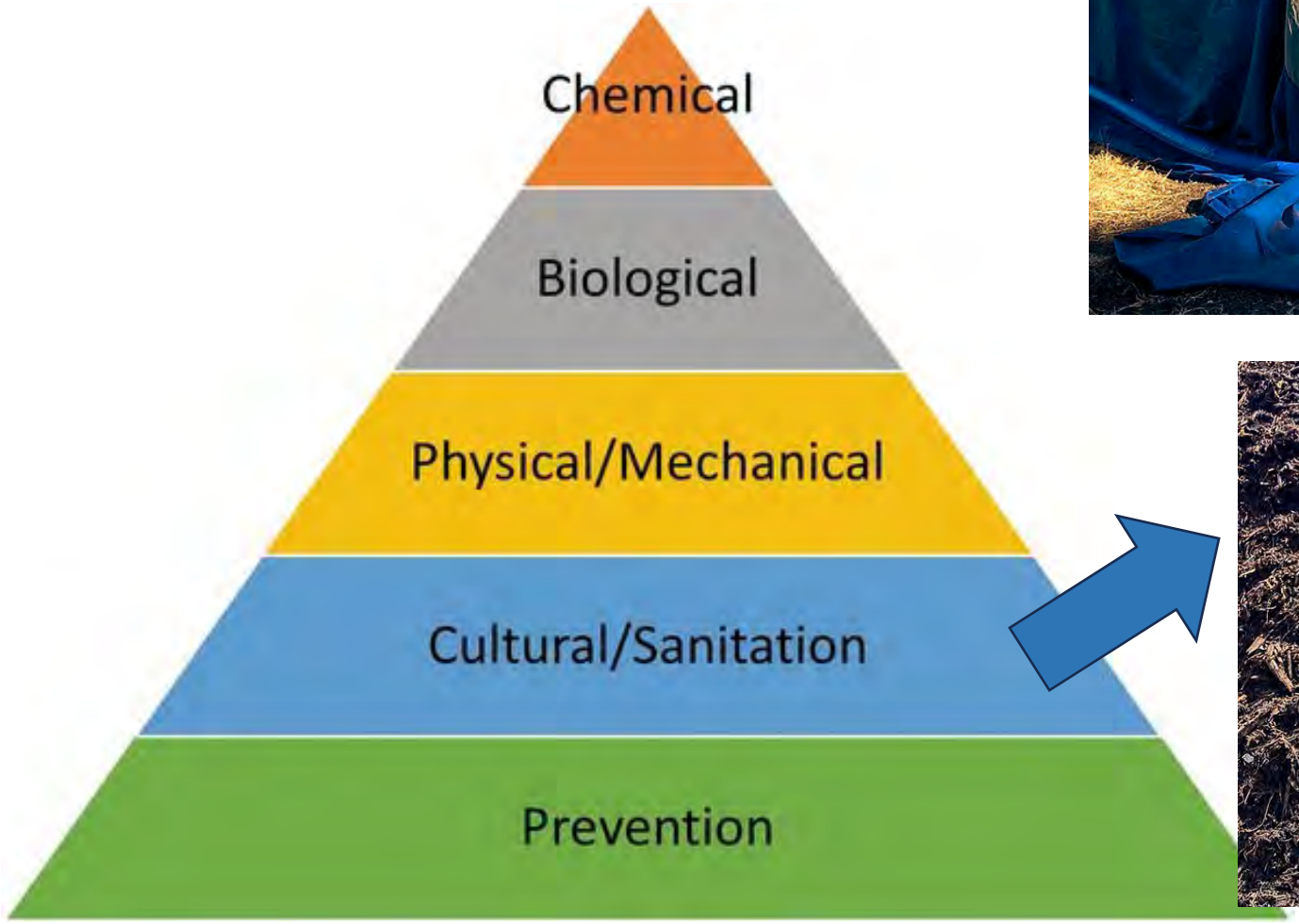
PC: https://nrcb.icar.gov.in/album/index.html

CRB Integrated Pest Management



Don't bring in host, infested mulch

CRB Management



Fumigation by certified applicator

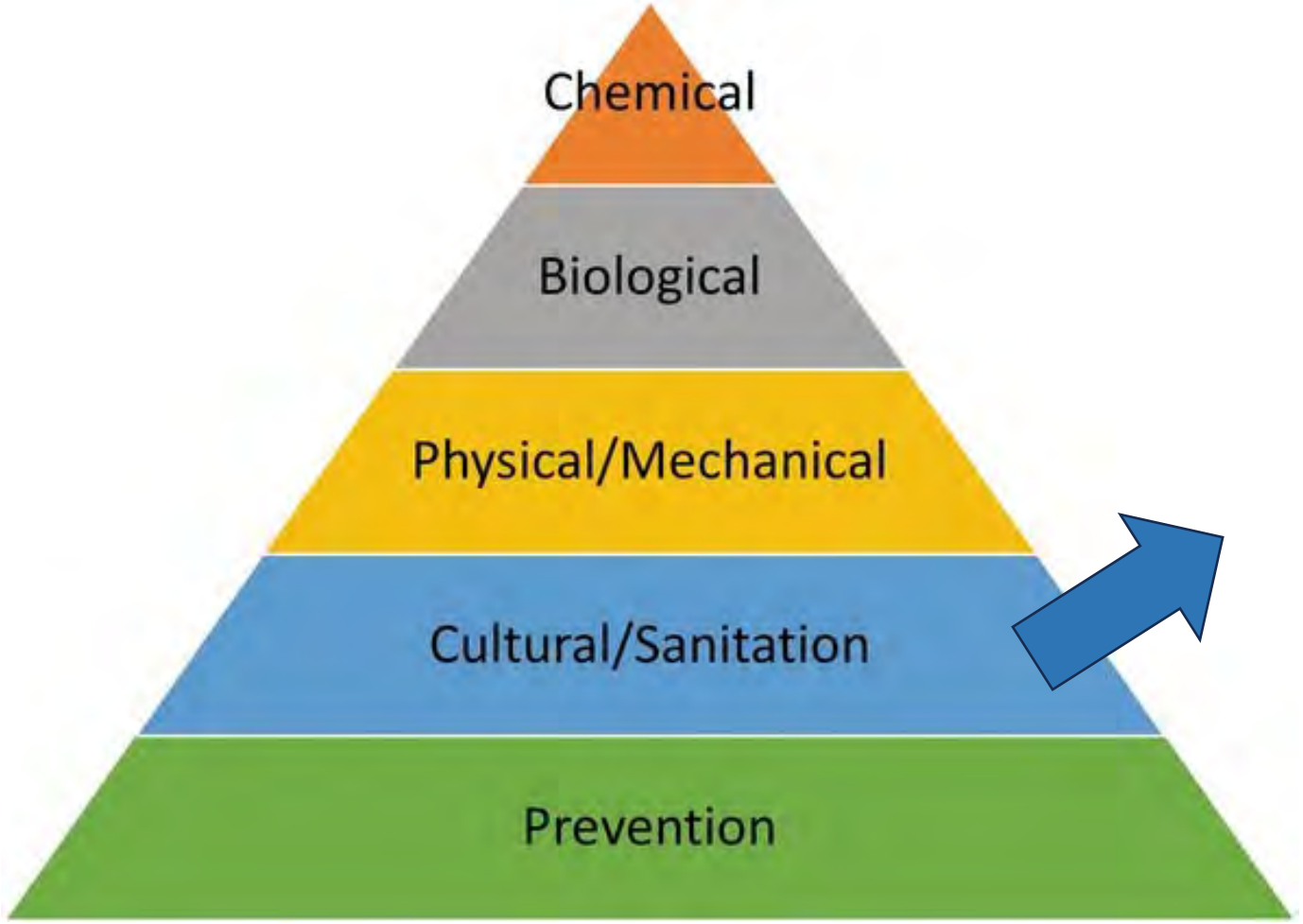
Source: CRB Response Team

Heat Treatments

(but may reinfest when cools)

30 C : 1 N Composting

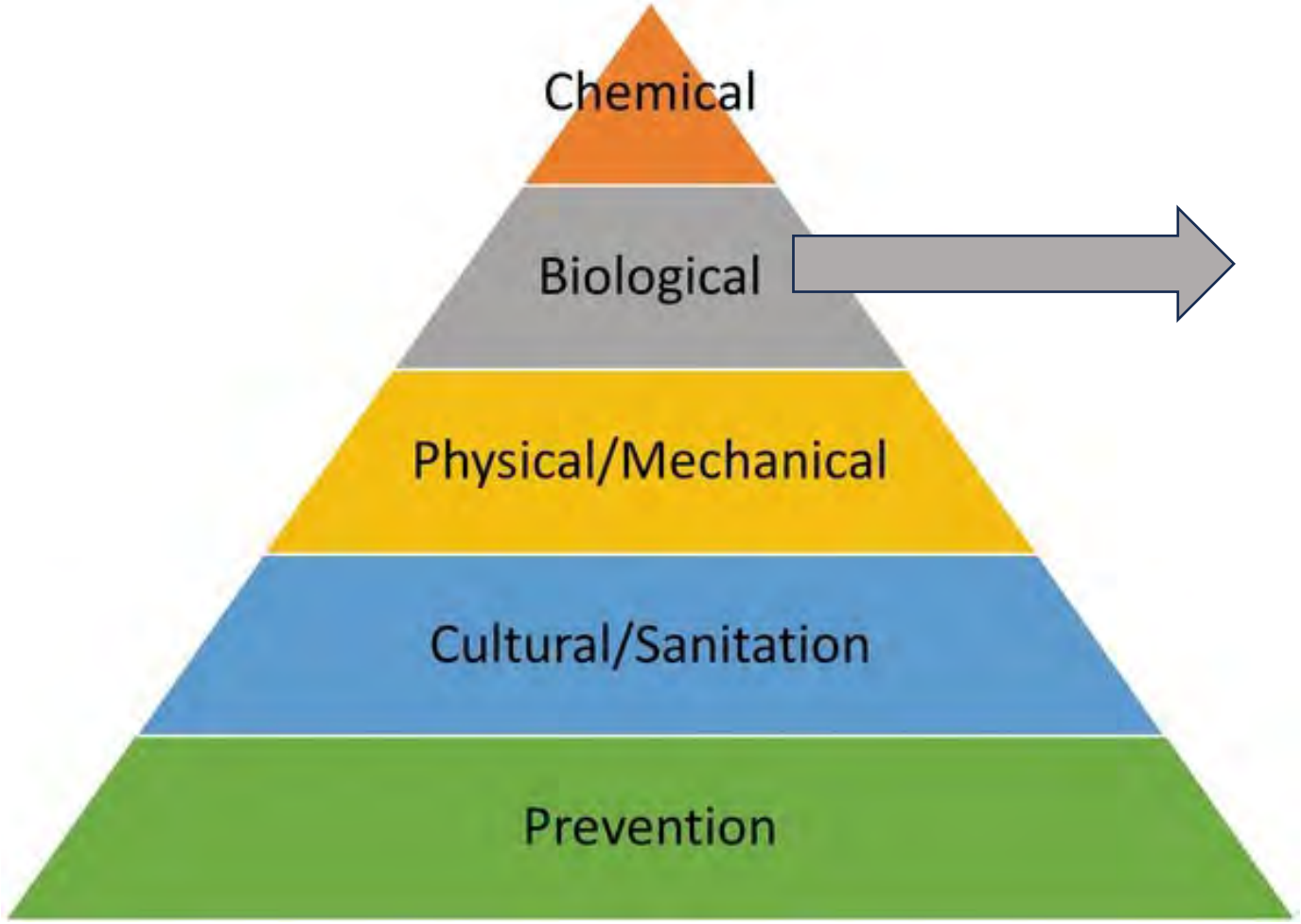
CRB Management



Source: CRB Response Team

Spread mulch thinly
(<2 inches)

CRB Management

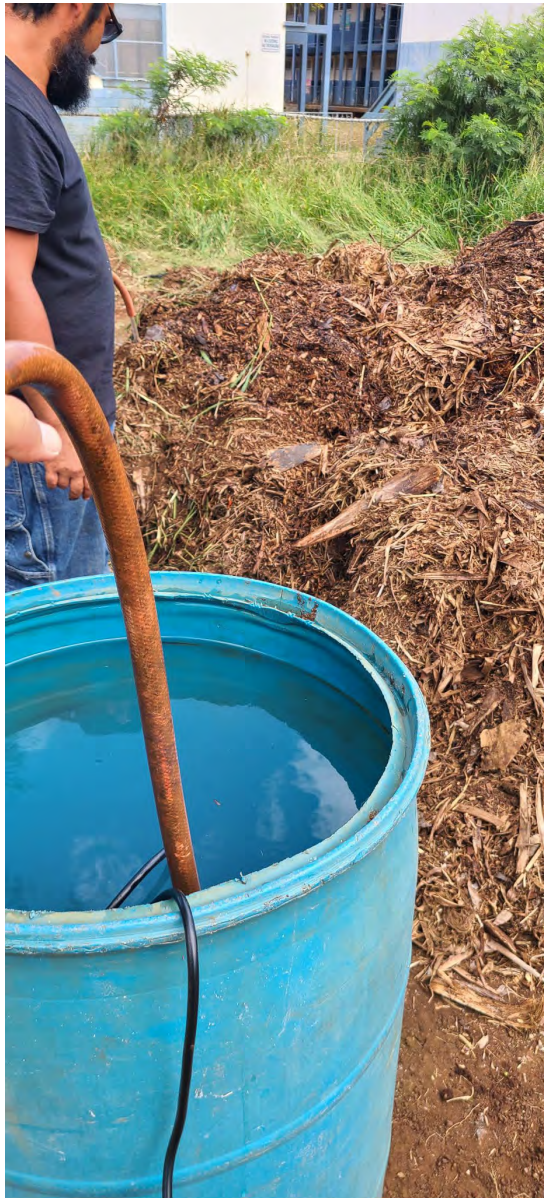


- Virus OrNV (CRB-G biotype in Hawaii)

- Metarhizium spp.

CRB Management

CRB Management

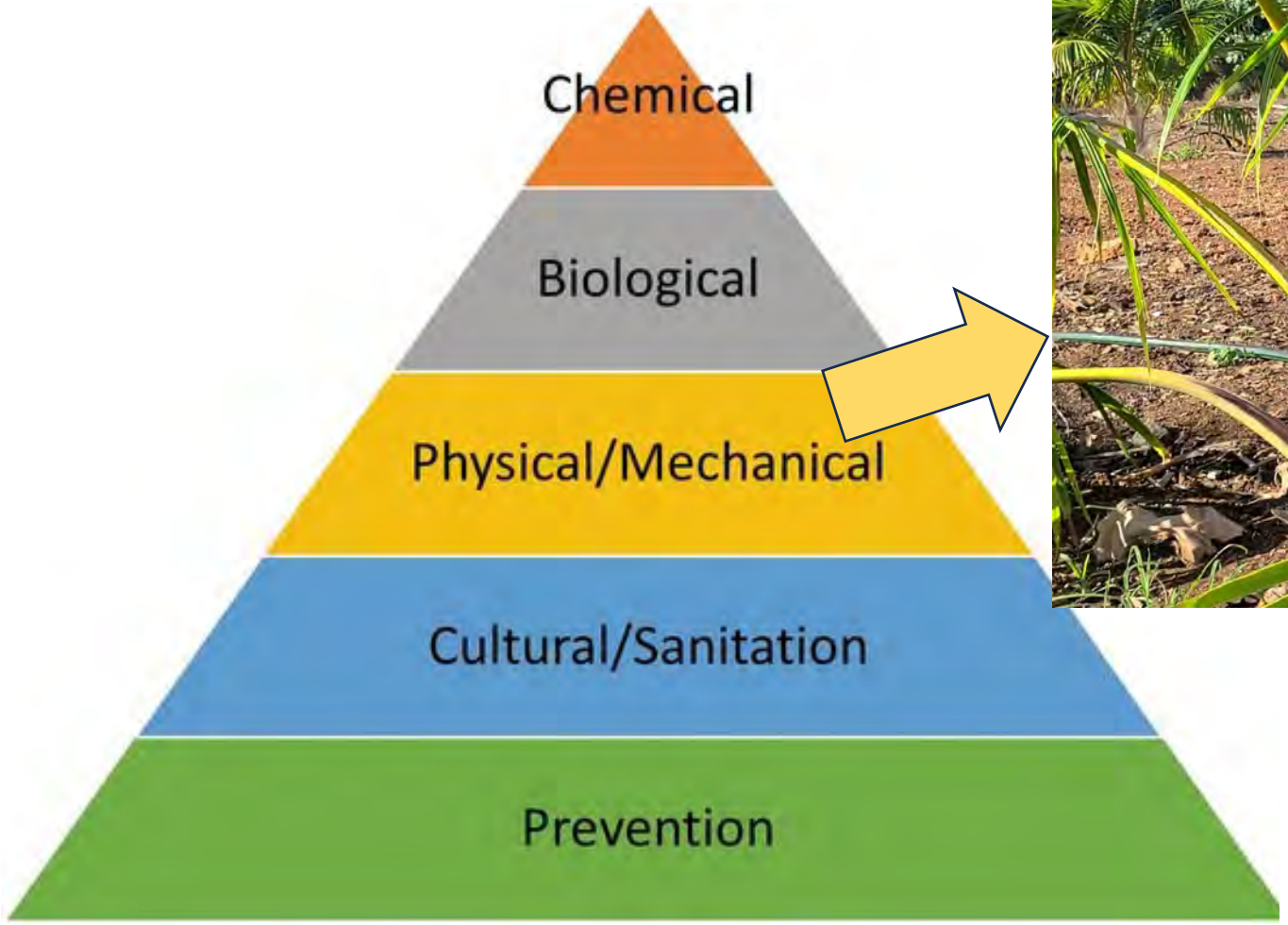


Metarhizium majus (Paudel et al. 2021)

Current Research

- M. anisopliae = 0% mortality in field
- Local Metarhizium spp.
  > 60% mortality rate (Russo 2019)
- Mass-production and distributions of Metarhizium spp. not approved at the moment.

CRB Management



Net trees (1/2 inch eye best)

- However, labor intensive (monthly)
- Monofilament net ~6-8 months

CRB Management

https://www.youtube.com/watch?v=S8ifHs22uBk&t=1s

Net trees – (Silva, 2023)

https://gms.ctahr.hawaii.edu/gs/handler/getmedia.ashx?moid=72224&dt=3&g=12

CRB Management

Univ of Guam

Bow Tie Method

https://www.youtube.com/watch?v=2CSX1p-2kJg

Figure 6. Tree bow tie with 2 in rock in the middle.

Figure 7. Bow tie placed into pockets where fronds attach to trunk.

Figure 8. CRB caught in bow ties.

DeFence Traps

Figure 15. A DeFence trap for trapping coconut rhinoceros beetle adults, constructed by attaching a piece of tekken fish netting to a fence and hanging an oryctalure dispenser near the center. The dispenser shown here has the oryctalure covered by a cup to protect it from the sun and wind. Above the cup is a solar-powered, ultraviolet light emitting diode, which can increase trap catch by a multiple of 3 compared to traps without a light emitting diode. Photos by Aubrey Moore, University of Guam.

Netting traps

Average 15 beetles per week caught in traps at an oceanfront 2 acre property in Mokuleia with 90 coconut palms.

CRB catch count at an oceanfront 2 acre property in Mokuleia with 90 coconut palms.

Coconut Rhinoceros Beetles CRB Chart									7/25/2024			
						TRAPS						
Date	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10	#11	TOTAL
6/6/2024	2	1	0	1	1	0	0	0	2	3	2	12
6/13/2024	5	2	2	0	1	0	2	1	3	3	1	20
6/27/2024	0	2	1	0	0	0	2	2	0	2	0	9
7/5/2024	2	5	1	2	0	1	3	1	0	2	1	18
7/11/2024	5	7	1	0	0	1	3	1	2	0	0	20

CRB Management

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Home Mono Netting- No.104 (0.33mm) x 1"

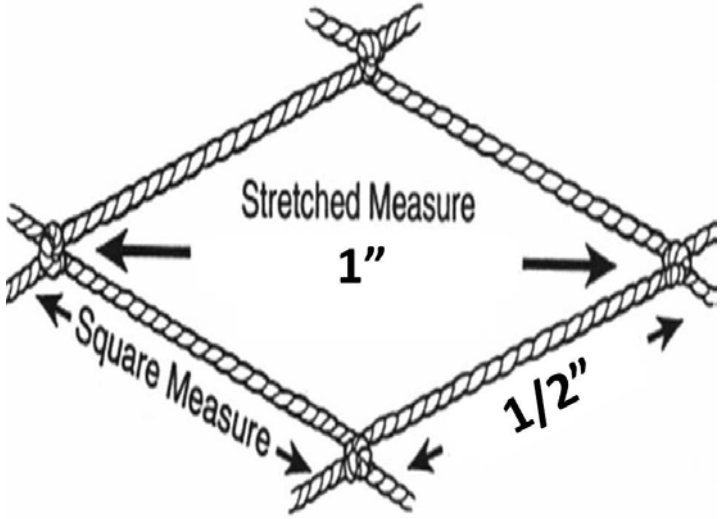
Mono Netting- No.104 (0.33mm) x 1"

Product Description

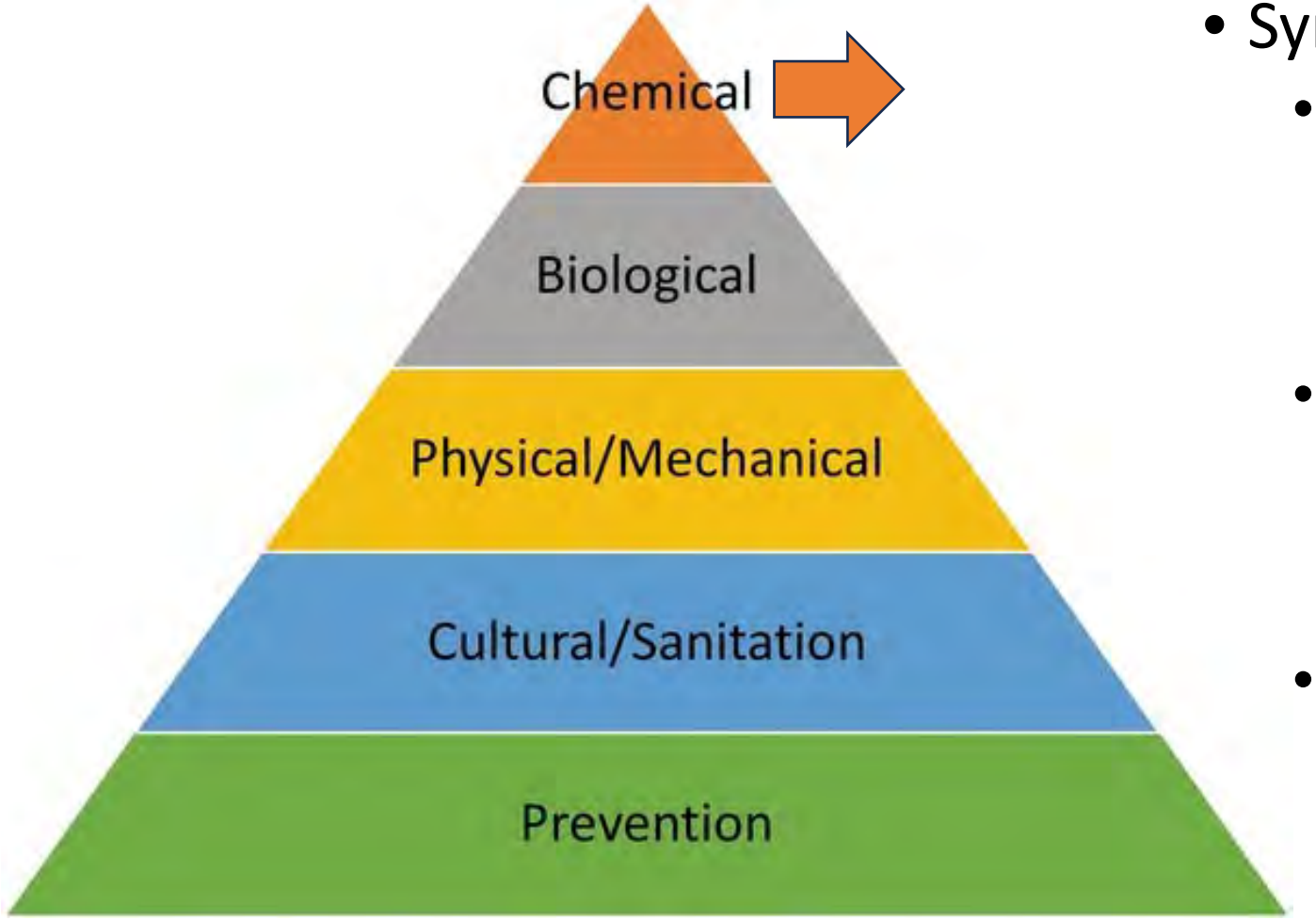
Single Monofilament Netting

- Single strand monofilament is similar as regular fishing line using in rod and reel fishing.
- Single monofilament nets is easily clearn of mud, debris and pull out the catches.
- It is more abasion than regular nylon multifilament netting.
- It is also lighter than regular nylon multifilament because it does not absore a lots water.
- Most used for gill net and trammel net in commercial fishing.

This netting constructed as double knot to avoid knot slipping, double selvage top and bottom to hold strongly with top rope with floats or float line, and bottom rope with lead or lead core rope. Depthway stretched, come with different color, most we stock are natural white and light green. Packed in 200 yards bundle for easy



CRB Management



- Synthetic insecticides
  - **Imidacloprid**:
    most common treatment currently used as trunk injection; 4 to 6 months
  - **Cypermethrin**:
    contact mode-of-action
    (used in drone application)
  - **Carbaryl**:
    contact & ingestion insecticide

Trial at Department of Urban Forestry Nursery in Waikele - Feb to May 2024 (Ricordi, Silva, Weiser, Melzer, Huizingh, 2024)

Treatments:

- Imidacloprid (IMA-Jet Injection)
- OneGuard (canopy drench)
- PTWK (soil drench)

Field Trial at landscape nursery in Waimanalo

Trial at Department of Urban Forestry Nursery in Waikele (Feb to May 2024)

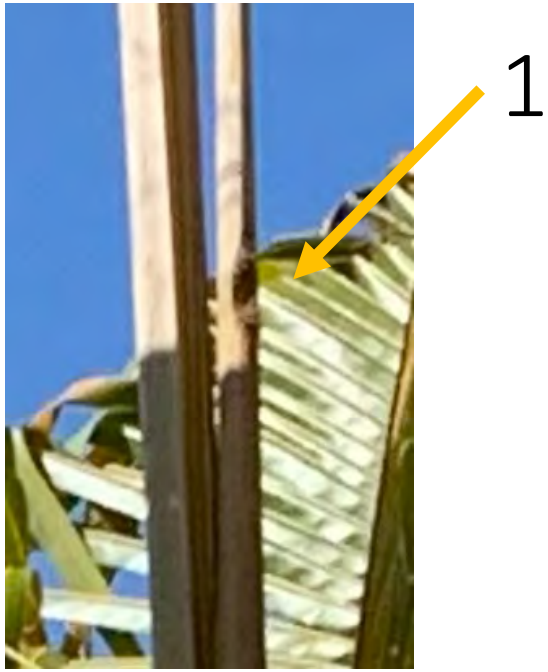
Evaluation 90 days after treatment, two youngest leaves:

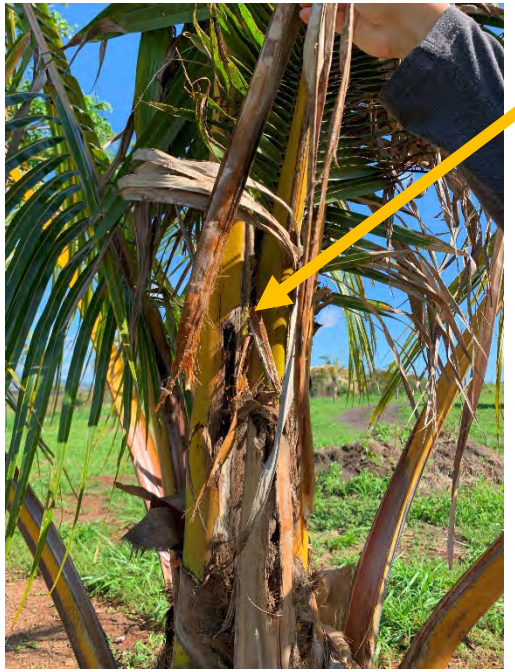
0 – No damage in 2 newest leaves

1 – Small damage (nibble, not cut through)

2 - Cut through leaf

Score = sum of two youngest leaves





Trial at Department of Urban Forestry Nursery in Waikele (Feb to May 2024)

- Imidacloprid (Injection)
- OneGuard (canopy drench)
- PTWK (soil drench)

Damage 95% Confidence (No difference)

Tukey HSD[a,b]

	Subset
Treatment	1
IMD	1.5 a
SPRAY	1.5 a
PTWK	2.8 a
CONTROL	3.2 a
Sig.	0.090

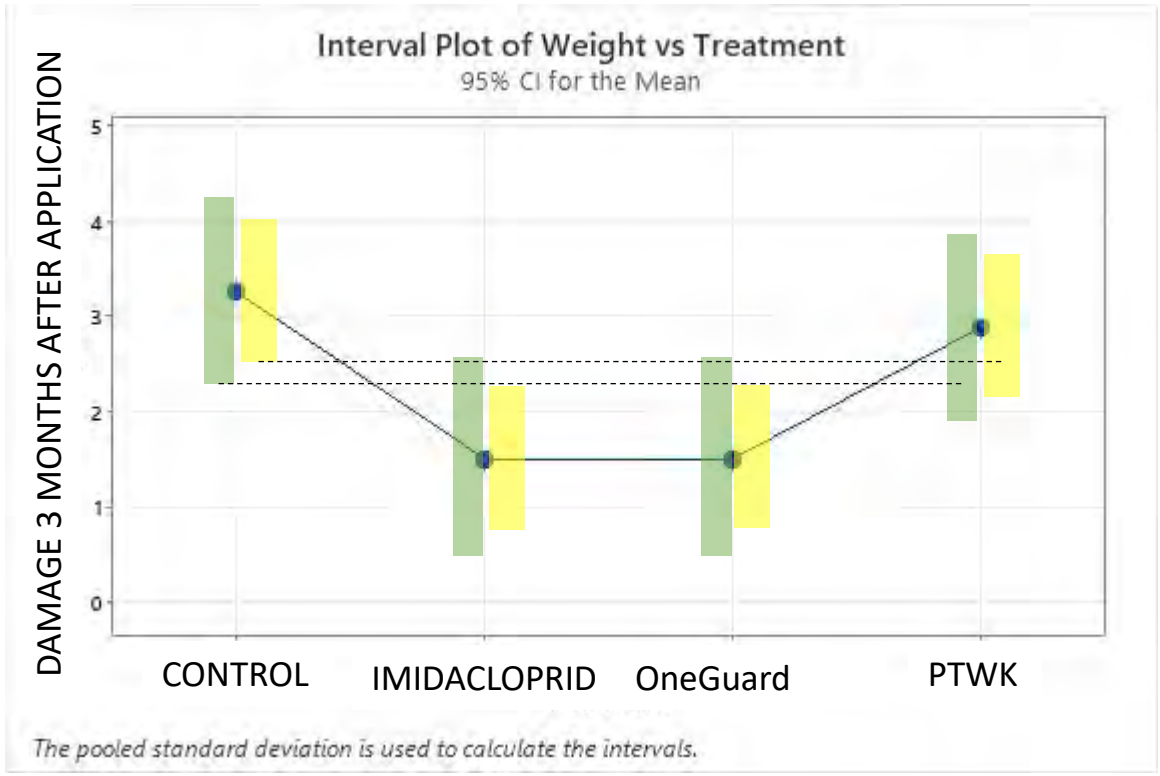
b. Alpha = .05.

Damage 90% Confidence **(IMD and SPRAY different from Control; PTWK same as Control)**

Tukey HSD[a,b]

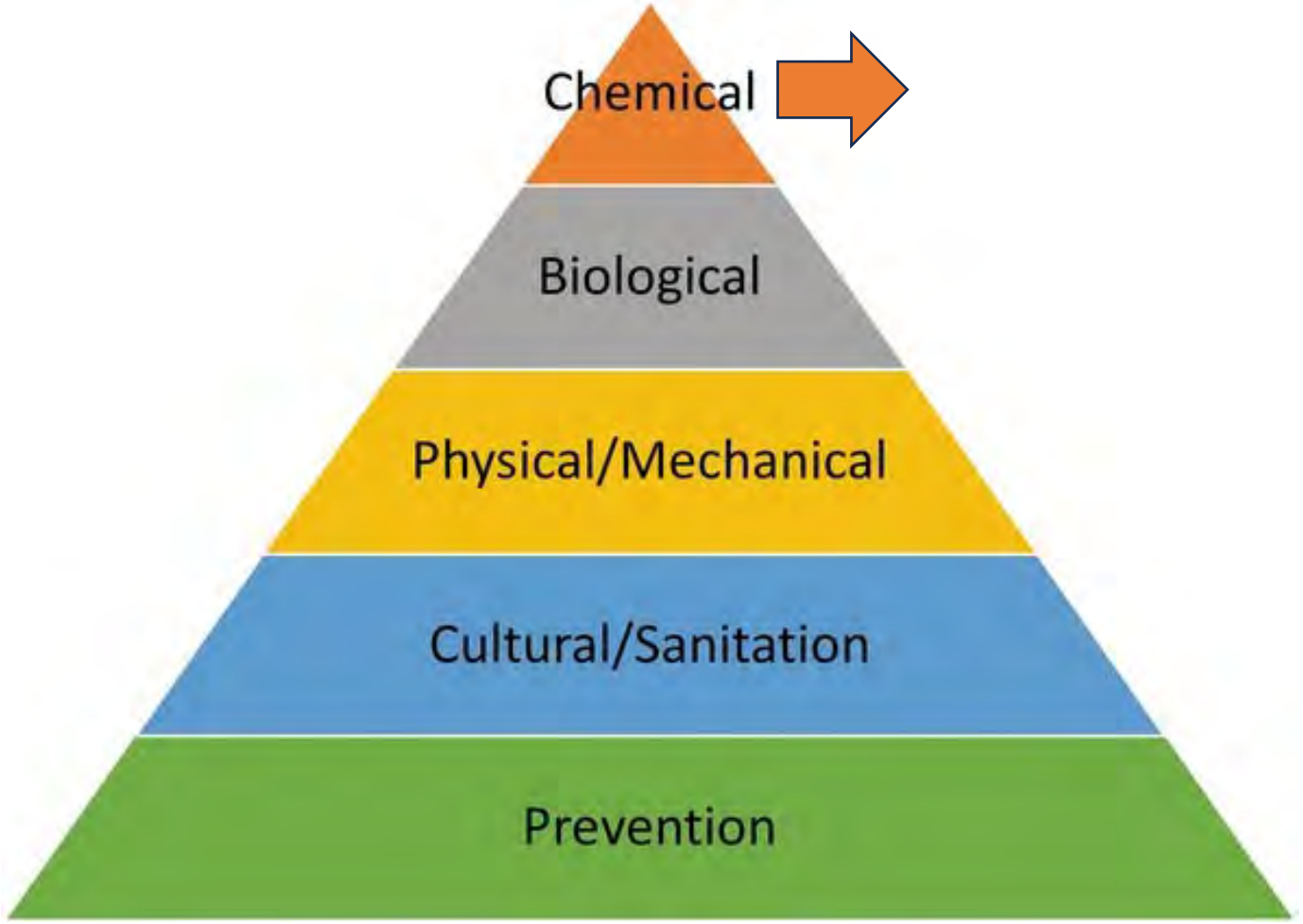
	Subset	
Treatment	1	2
IMD	1.5 a	
SPRAY	1.5 a	
PTWK	2.8 ab	2.8 b
CONTROL		3.2 b
Sig.	0.210	0.934

b. Alpha = .10.



[Full Article: https://go.hawaii.edu/bSw](https://go.hawaii.edu/bSw)

CRB Management



Organic Insecticides

- Essential oils – Previous research from India
- Does not require removal of fruits
- Preliminary results showed 66% efficacy in lab conditions
- Field tests in progress

CRB Management

Indian Journal of Entomology, 81(3): 603-608 (2019) DoI No.: 10.5958/0974-8172.2019.00136.6

ESSENTIAL OIL IN MANAGEMENT OF COCONUT RHINOCEROS BEETLE *ORYCTES RHINOCEROS* L.

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ABSTRACT

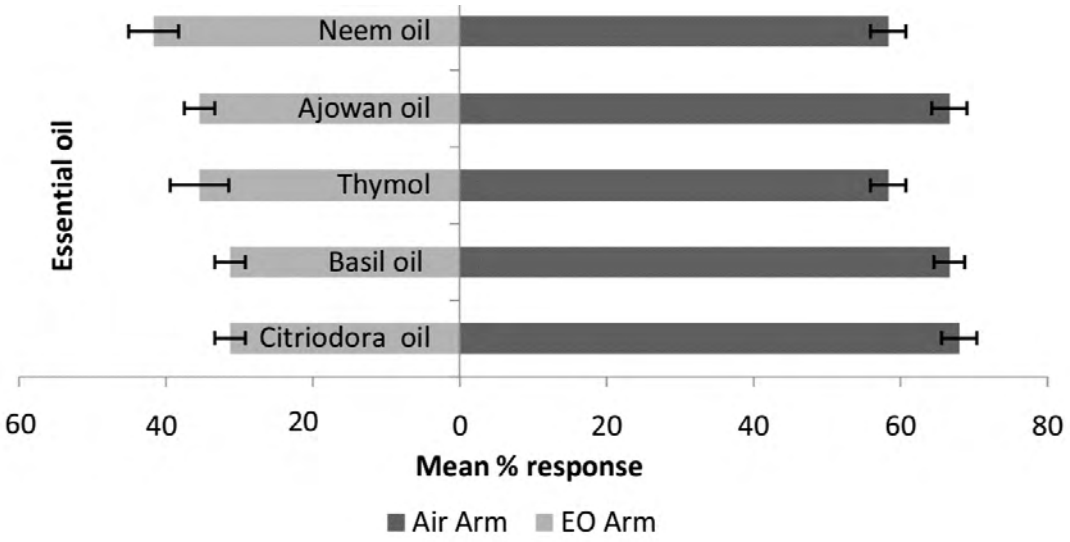
Plant derived essential oil is used as a component in management of coconut rhinoceros beetle *Oryctes rhinoceros* L. (Coleoptera: Scarabaeidae). A study was undertaken to evaluate the bioefficacy of essential oil from *Ocimum basilicum*, *Eucalyptus citriodora*, *Trachyspermum ammi* and their major constituent thymolin for management of *O. rhinoceros*. These essential oils derived from plant parts were characterized and their physiological response and biocidal activity was determined. Basil, citriodora, ajowan oil and thymol caused electrophysiological response in the antennae of *O. rhinoceros* adults. Behavioural response of beetles was tested in 'Y' tube olfactometer having a choice between odour arm containing essential oil and control arm having zero air. Orientation of beetles to essential oil laden arm ranged from 15-30%. Over 70-85% of the beetles moved towards the control arm. Citriodora and basil oil inhibited hatching of 70% of eggs and also caused larval mortality. The mean larval mortality ranged from 61-66%. The repellence, ovicidal and growth regulating effect of essential oil offers an ecofriendly option in management of coconut rhinoceros beetle.

Key words: Behavioural response, essential oil, insect behaviour, rhinoceros beetle, *Ocimum*, *Eucalyptus*, *Trachyspermum*, thymolin, electrophysiology, repellence

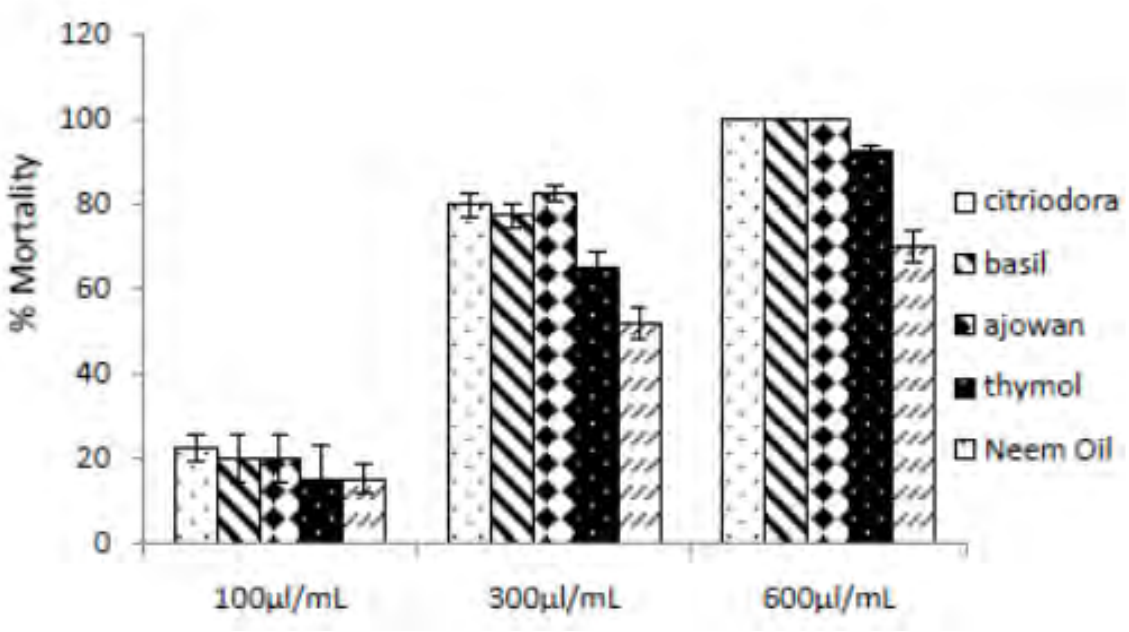
The rhinoceros beetle, *Oryctes rhinoceros* L. (Scarabaeidae: Dynastinae) is a major pest of coconut in coconut growing tracts across the world (Singh and Rethinam, 2005). The black colored beetle bores holes and feeds on the unopened spear leaf and spathe. Upon unfurling, the damaged leaves show geometric cuts (V shaped) on leaflets. The beetles cause damage to seedling, young and adult palms. Damage when done to the leaves reduces the photosynthetic area and renders them unsuitable for thatching purpose, but when damage is done to spathe it causes direct

CPCRI @ 3/palm on top most three leaf axils (Joseph Rajkumar et al., 2015).

Though botano chemicals are being used, it is imperative to search for plant derived parts with enhanced bioaction on beetles. On this line, essential oils were screened for rhinoceros beetle management as they possess broad spectrum of bioactivities viz., insecticidal, repellence and growth regulating effect on insects (Attend and Mary Eapen,1980; Bakkali et al., 2008) that are exploited for pest control (Regnault Roger, 1997). The chemical compounds in the essential



CRB Management
Essential oils



India research on contact toxicity of essential oils to adult CRB (Ravindran et al, 2019)

Preliminary trial on North Shore affected palms.

Tree trimmer trimmed palms and sprayed 6% eucalyptus solution directly inside holes bored by CRB and to cover palm frond stems.

Two adult CRBs retreated from the crown of one palm.

Beetles dead 2 hrs after sprayed eucalyptus 6% solution.

CRB Management
Essential oils

Controlled Trial (Ricordi and Silva, 2023)

CRB were sorted into 3 growing stages:

- Larvae 1st to 2nd instar, 5 larvae per container
- Larvae 3rd instar, 5 larvae per container
- Adults, 3 beetles per container

Treatments (3 repetition each):

- Control (tap water only)
- **Basil** essential oil 6% + spreader-sticker
- **Eucalyptus** citriodora essential oil 6% + sticker

LINK AND QR:
https://go.hawaii.edu/bS9

1st to 2nd instar

3rd instar

adults

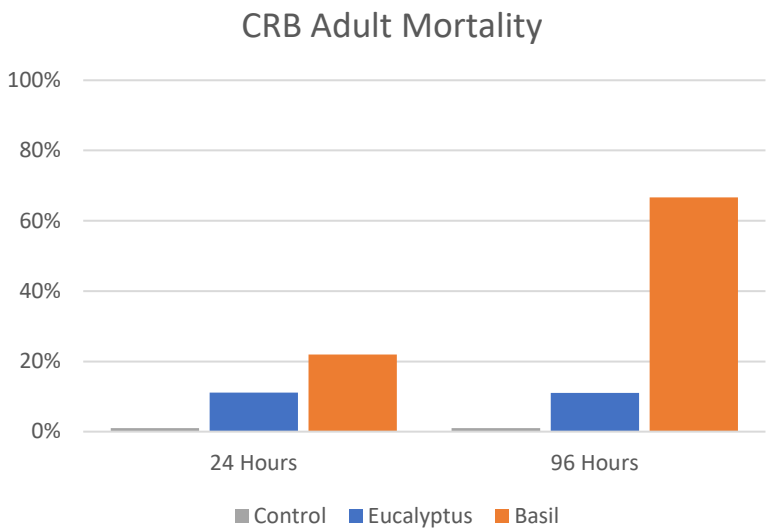
CRB Management
Essential oils

Controlled Trial (Ricordi and Silva, 2023)

Larvae 1st and 2nd instar: 100% mortality after 30 minutes

Larvae 3rd instar: no mortality (all survived)

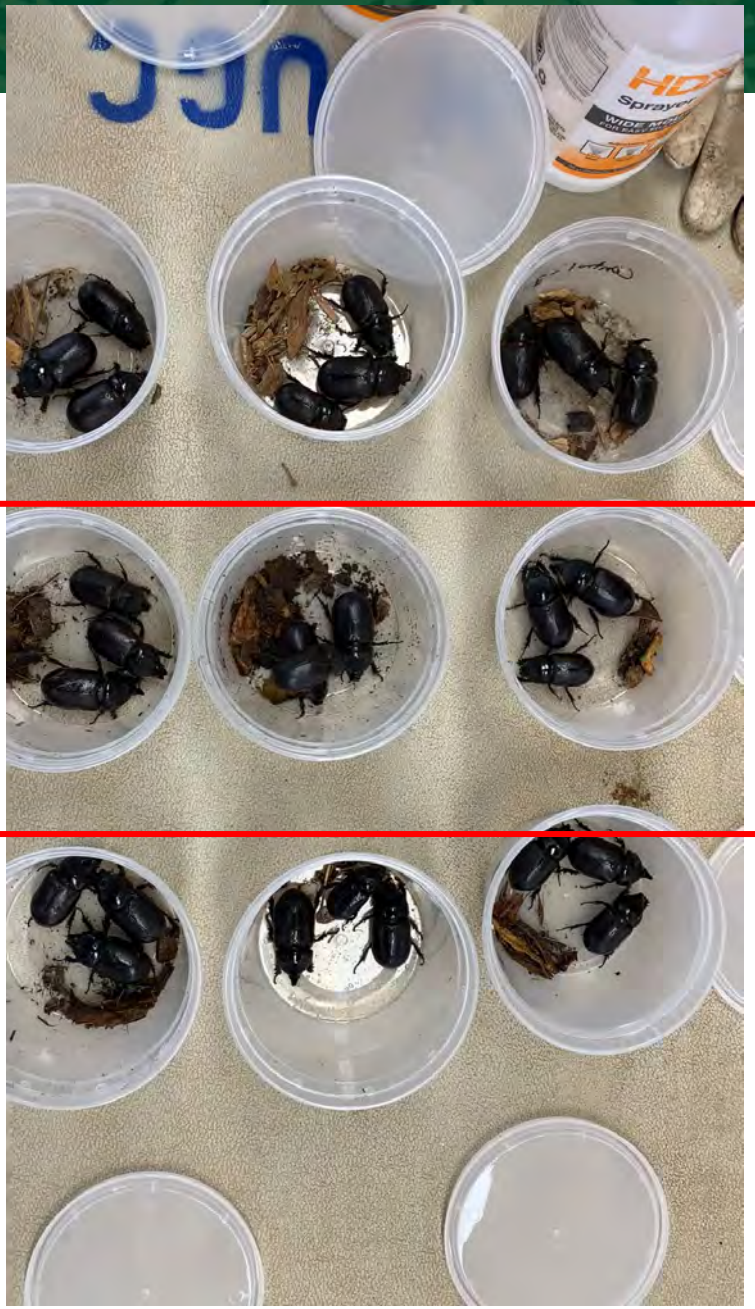
Adults: Basil at 66% after 96 hrs; Eucalyptus 11%



Control →

Basil →

Eucalyptus →



VIDEO

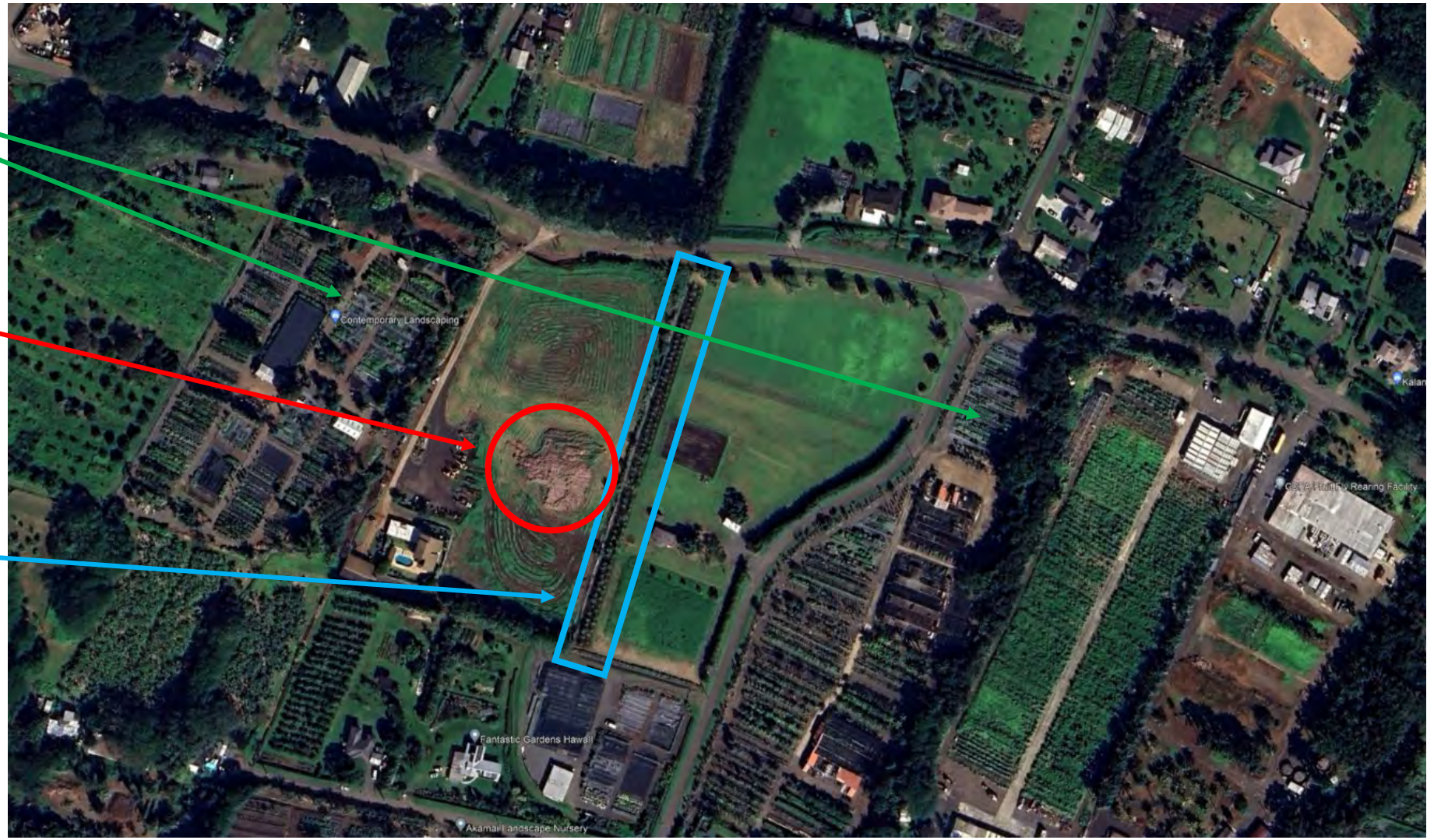
https://youtube.com/shorts/NXMoMNqQMBU?feature=share

CRB Management - *Essential oils – Waimanalo field trial* (Ricordi, 2024)

Surrounded by landscape nurseries and farms

LARGE MULCH PILES *NEIGHBOR*

TRIAL



CRB Management - *Essential oils – Waimanalo field trial* (Ricordi, 2024)

Waimanalo nursery, started November 2023
94 total coconut palms; average monthly sprays;
10 palms per treatment

1. Control (no treatment)
2. Basil (*Ocimum basilicum*) (2.5 to 5%)
3. Thyme (*Thymus zygis*) (2.5 to 5%)
4. Clove (*Sysigium aromaticum*) (2.5 to 5%)
5. Ajowan (*Trachyspermum ammi*) (2.5 to 5%)

After 8 months, 17 damaged palms:
12 (70%) were on fence side (neighbor with mulch)
5 (30%) on open field side

CRB Management - *Essential oils – field trial*

Typical bore

Damaged leaf

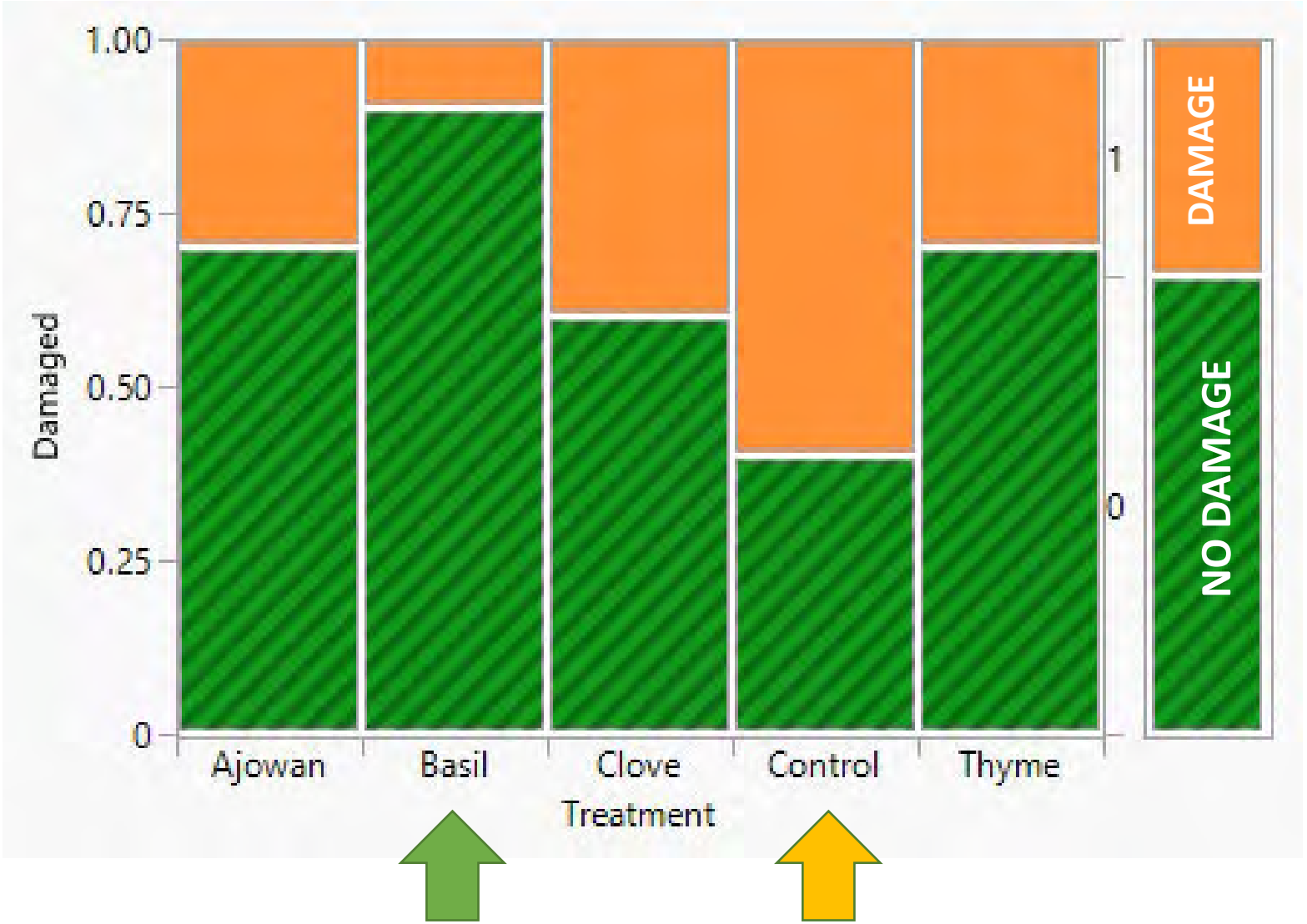
CRB Management - *bore holes*

CRB Management - *Essential oils – field trial*

Treatments were evaluated on September 17, 2024.
(10 months after beginning of treatment)

Basil was the most effective with only 1 of 10 palms damaged, and damage occurred in a 2 month window with no treatment.

LINK TO FULL PAPER:
https://go.hawaii.edu/hSb



CRB Management - *Essential oils – use the right dose*

Phytotoxicity with Ajowan at 12%

Phytotoxicity with Ajowan at 25%

CRB Management - *Essential oils – use the right dose*

Phytotoxicity with Ajowan at 25%

"RC* Spray system"
**Ricordi-Cannon*

- Nozzles are set at the crown of the palm;

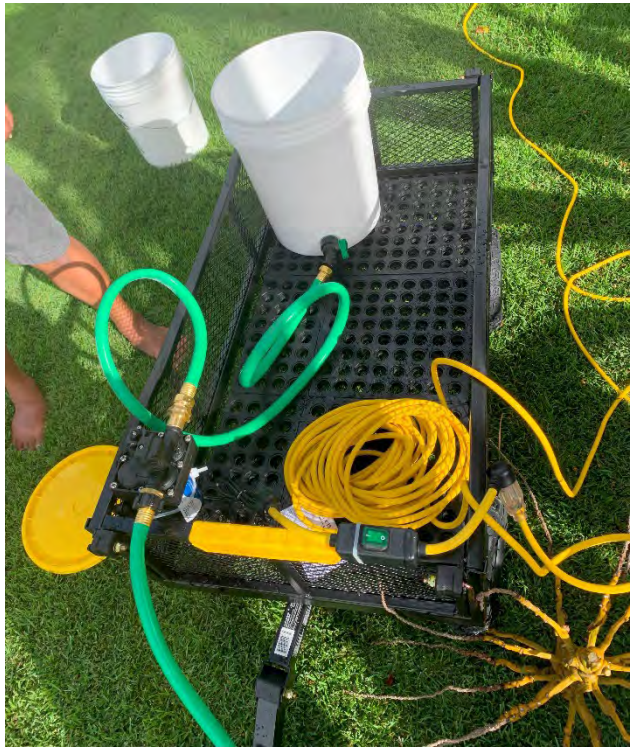
- Swing (funny) pipe runs on the back side of the trunk with slack at the bottom and a quick coupler;

- Cart with spray solution and a booster pump ($100 excluding cart)

- Pump connects to each system via quick coupler

- Size of tank and vehicle may vary depending on the number of palms to be sprayed at the site.

"RC* Spray system"
**Ricordi-Cannon*



"RC* Spray"

Very low visibility when installed on back side of the palms

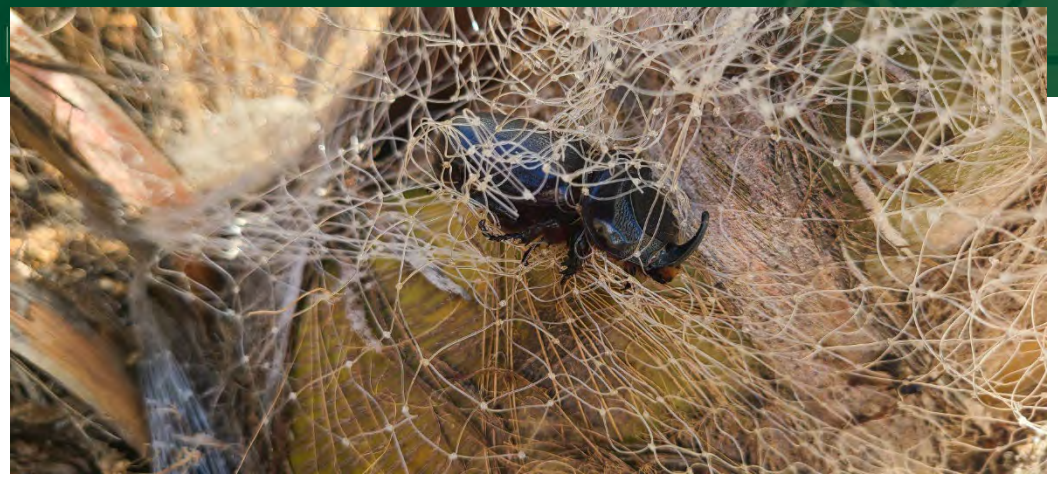
"RC* Spray" cost analysis

Parts List for a Coconut Tree Halo						
	Units	Size in Inches		Cost Per Halo	Price Per Item	
SPXFLEX100 Rain Bird Swing Pipe for a large Halo	1	66	Large Halo	$1.32	$0.02	Pacific Pipe Co.
SPXFLEX100 Rain Bird Swing Pipe for a small Halo	1	61	Small Halo	$1.22	$0.02	Pacific Pipe Co.
2 Quick Couplers						
FPA-0750 .75" Funny Pipe Adapter MIPT	4			$1.56	$0.39	Pacific Pipe Co.
3/4" GHT Male x 3/4" NFT Female	2			$10.00	$5.00	Amazon
Liulo Tool 3/4" Plastic Water Hose Fitting Male and Female	2			$2.14	$1.07	Amazon
AP-106 .75" x .75" Swivel ADP FIPT X FHT	2			$12.98	$6.49	Pacific Pipe Co.
HUN 4A Hunter 4' Nozzle ADJ 0-360 DEG	3			$2.79	$0.93	Pacific Pipe Co.
PSA-M Plastic Shrub Adapter	3			$1.14	$0.38	Pacific Pipe Co.
FPA-0500 .50" Funny Pipe Adapter MIPT X INS 3400-005	3			$1.17	$0.39	Pacific Pipe Co.
Parts cost for the Large Halo				**$31.78**		
Parts List for a Coconut Tree Service Line						
		Size in Inches		Service Line	Price Per Item	
SPXFLEX100 Rain Bird Swing Pipe for a 50' Tree		600		$12.00	$0.02	Pacific Pipe Co.
FPA-0750 .75" Funny Pipe Adapter MIPT	2			$0.78	$0.39	Pacific Pipe Co.
3/4" GHT Male x 3/4" NFT Female	1			$5.00	$5.00	Amazon
Liulo Tool 3/4" Plastic Water Hose Fitting Male and Female	1			$1.07	$1.07	Amazon
Parts Cost for 50' of Service Line				**$18.85**		
Total Tree Cost				***$51.95***		

"RC* Spray"

Parts List for a Coconut Tree Cart and Pump					
Gorrila Cart			$125.00		Home Depot
TDRForce 5.5 GPM 75 PSI			$60.00		Amazon
Hoses and connections			$15.00		Home Depot
5 Gallon Bucket with Outlet			$15.00		Amazon
			_____		
			$215.00		
Total Cost of Parts for the 1st tree (cart + pump + line + halo)			***$265.63***		
Total Cost of Parts for each additional Tree			***$51.95***		
Cost of Basil Oil and Excell 90					
Gallon of Basil Oil			$200.00		Amazon
Gallon of Ecell 90 Emulsifier			$40.00		BEI Honolulu

Mahalo!



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UH Cooperative Extension

Acknowledgments

- *Josh Silva*
- *UH Professors*
- *CRB Response Team*
- *Farmer, Nursery collaborators*

Also, for more info,
https://www.crbhawaii.org/