

Efficacy of bifenthrin in reducing feeding damage caused by adult coconut rhinoceros beetle (*Oryctes rhinoceros*) on coconut palms in Hawai'i



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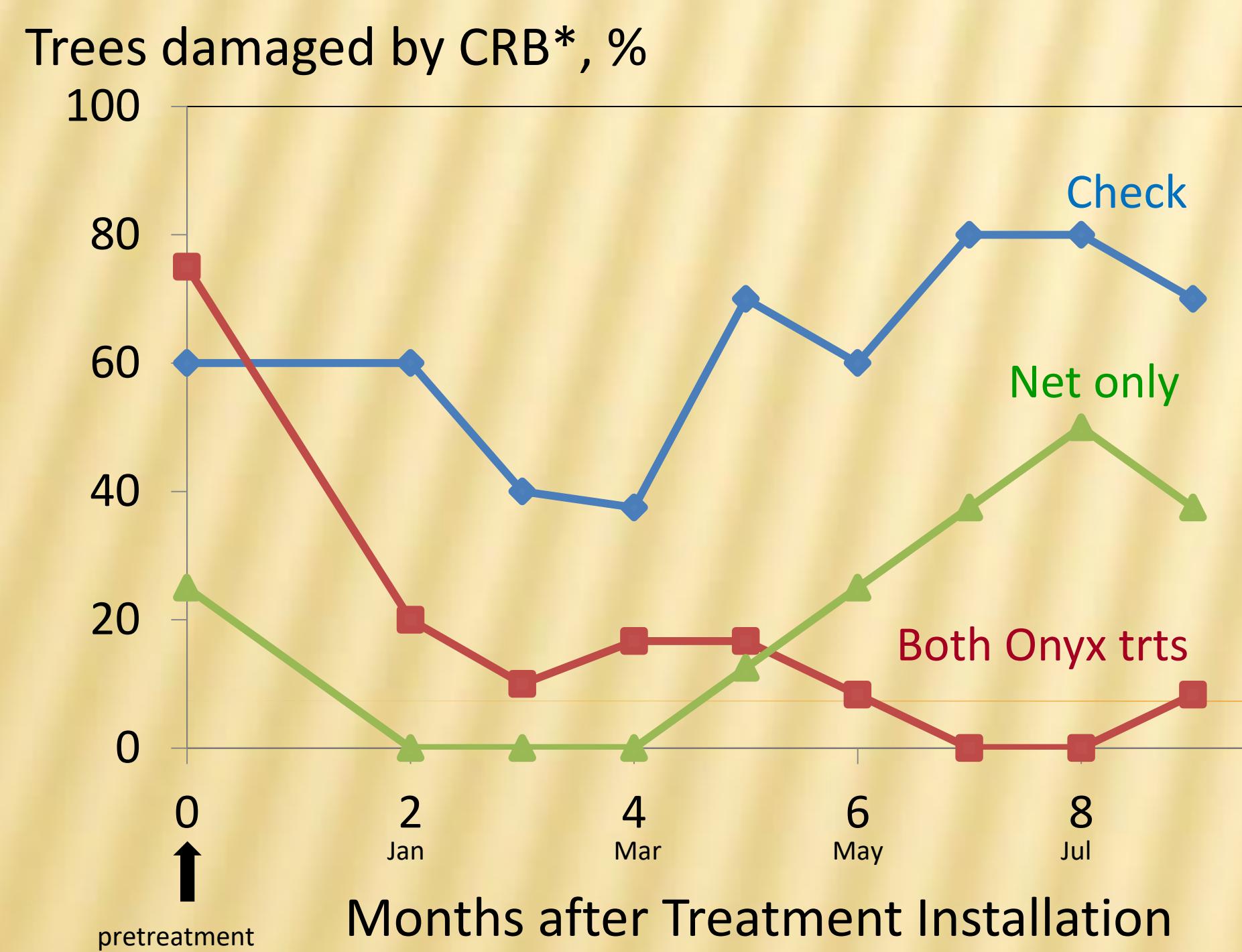
ABSTRACT: Feeding damage by adult coconut rhinoceros beetles (CRB), *Oryctes rhinoceros* (Coleoptera: Scarabaeidae), on coconut palm trees (*Cocos nucifera*) consist of bore holes, mainly by the use of spines on their forelegs, through the base (petiole) of mature fronds, immature frond spears, and apical meristem (heart) where the beetles feed on the exuding sap. The mechanical boring damage and sucking on sap can result in death of the tree. Observations from October 2015 to July 2016 at United States Marine Corps Pu'uloa Rifle Training Facility, Iroquois Point, O'ahu, indicated that 37.5 to 80% of untreated trees sustained CRB damage. Installation of nylon fish net "collars" (0.25 mm monofilament, 1-inch mesh, 1.5 x 3 ft length) secured to the base of inner frond petioles in tree crowns deterred CRB activity, resulting in damage to 12.5 to 37.5% of net-treated trees; however, monthly adjustments to reposition nets around the base of growing fronds was required. Laboratory bioassay trials indicated that the combination of pyrethroids, bifenthrin (Onyx Pro), plus a synergist, piperonyl butoxide (PBO) (Exponent), was most effective against CRB adults; both products are registered by U.S. Environmental Protection Agency for use on coconut trees. Therefore, in the field trial, bifenthrin and PBO were applied to the crowns of palm trees every 4 weeks (based on prior residual field trials) via a PVC pipe delivery system fitted with anti-drift spray nozzles that directed the insecticide only to the growing spear frond. After 10 months, CRB damage among Onyx Pro-treated coconut trees was reduced from 75 to 8.3%.

Methods

- Field trial conducted at USMC Pu'uloa Range Training Facility, Iroquois Point, HI (Fig. 1); coconut rhinoceros beetle (CRB) were detected in March 2014
- Treatments assigned to coconut trees (*Cocos nucifera*) in February 2015 and modified in October 2015, consisted of pesticide, netting, a combination of pesticide and netting, and an untreated check (table 1, Figs. 2 & 3).
- Observations were taken every 4 weeks by project personnel in a NAVFAC bucket truck from two months after PVC delivery systems were installed.
 - Damage to the emerging new spear and inner fronds, including bore holes to the tree crown, were noted and photographed.
 - Any adult CRB observed in the crowns were removed, and live beetles were transferred to the laboratory, where they were placed in colony boxes, provided food and water, and observed.

Results

Figure 4. Coconut tree damage sustained from adult CRB after treatment installation at Pu'uloa Rifle Training Facility, Iroquois Point, HI.

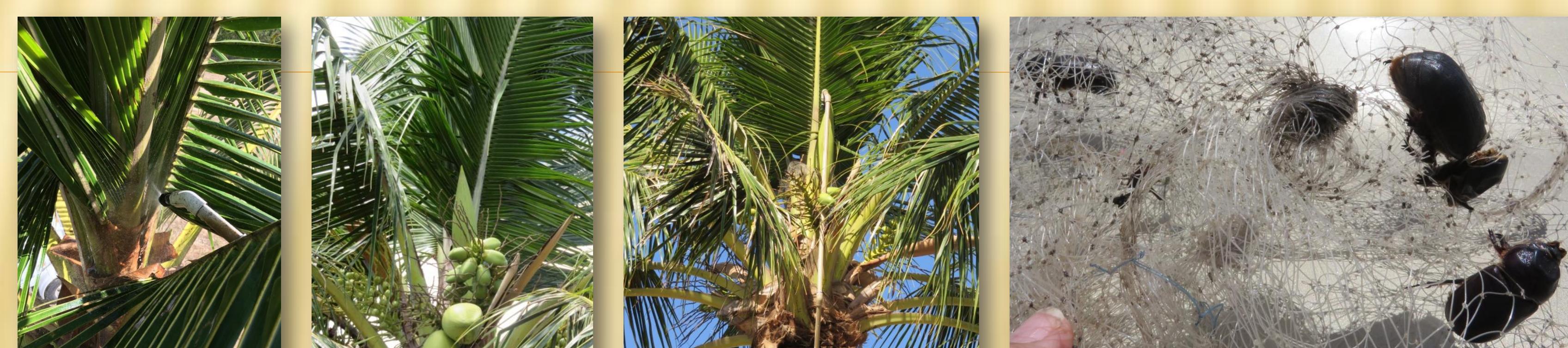


*Average % of trees exhibiting new damage caused by coconut rhinoceros beetles to emerging spear and inner fronds [untreated control (n = 5), Onyx (n=6), Net (n=4)]. Treatments began in November 2015, with first observations reported for January 2016.



Untreated Check: Adult CRB damage consistently observed on inner fronds, newly emerging leaf spears (above)

- Monthly damage to untreated coconut trees (Fig. 4) was consistently between **37.5 to 80%** from **Jan to May 2016**, with an increase in damage to **70 to 80% at the start of summer (Jun to Jul)**. Damage included bore holes on inner and outer fronds and emerging leaf spears.



Onyx with or without netting: Damage by adult CRB was reduced after two monthly applications (above), and continued to be suppressed through 9-mo observation

- Coconut trees treated every 4 weeks with Onyx and Exponent delivered from the ground through their installed PVC systems incurred less damage from CRB (**75 to 10% after two applications**).
- CRB damage among Onyx-treated trees **decreased from April to July** while damage among the untreated and netted trees increased (Fig. 4).
- Three adult CRB were recovered on or under Onyx-treated trees during the observation period (above); two beetles found paralyzed in a tree's crown never recovered, and died within 48 h in the lab colony.

FIGURE 1. USMC Pu'uloa Range Training Facility, Iroquois Point, 'Ewa Beach, HI (CRB present since March 2014).



TABLE 1. Treatments installed in coconut palm trees at two sites with active infestations of *Oryctes rhinoceros* to determine efficacy in deterring damage by adult beetles.

TREATMENT	PRODUCT	NUMBER OF TREES	ACTIVE INGREDIENTS	RATE / DESCRIPTION	APPLICATION
1: Onyx Pro and Exponent*	(FMC) EPA Reg. No. 279-4269 (Valent) EPA Reg. No. 1021-1511	4	bifenthrin 23.4% piperonyl butoxide 91.3%	0.144 fl oz/gal 2.0 fl oz /gal	1.89 l per tree every 4 weeks
2: Fish Netting	1-inch mesh 0.25 mm nylon monofilament	4	Netting wrapped as "collars" (0.5 m H x 0.9 m L) around newly emerging spear and upper crown, and stapled in place.		"Collars" added/adjusted to new fronds at each observation period
3: Treatments 1 & 2	Onyx Pro + Exponent Fish netting	2	see above for Treatments 1 and 2		
4. Check	Untreated	5			

FIGURE 2. A pesticide delivery system installed to apply Onyx + Exponent to coconut tree crowns from ground level.

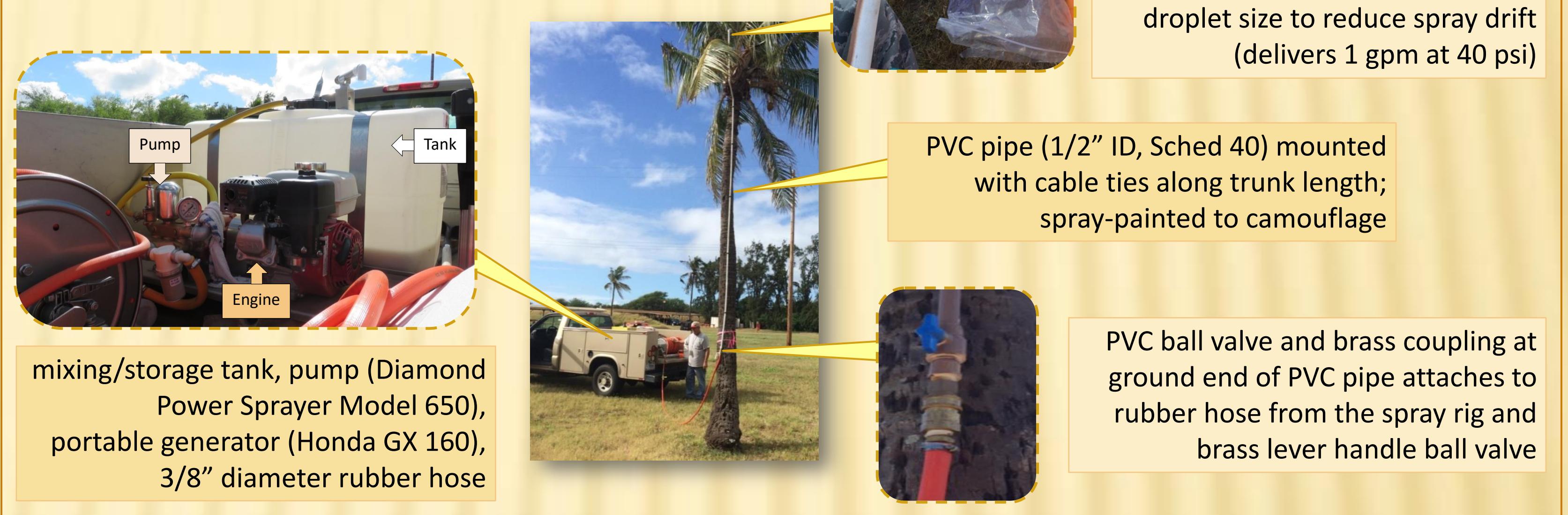
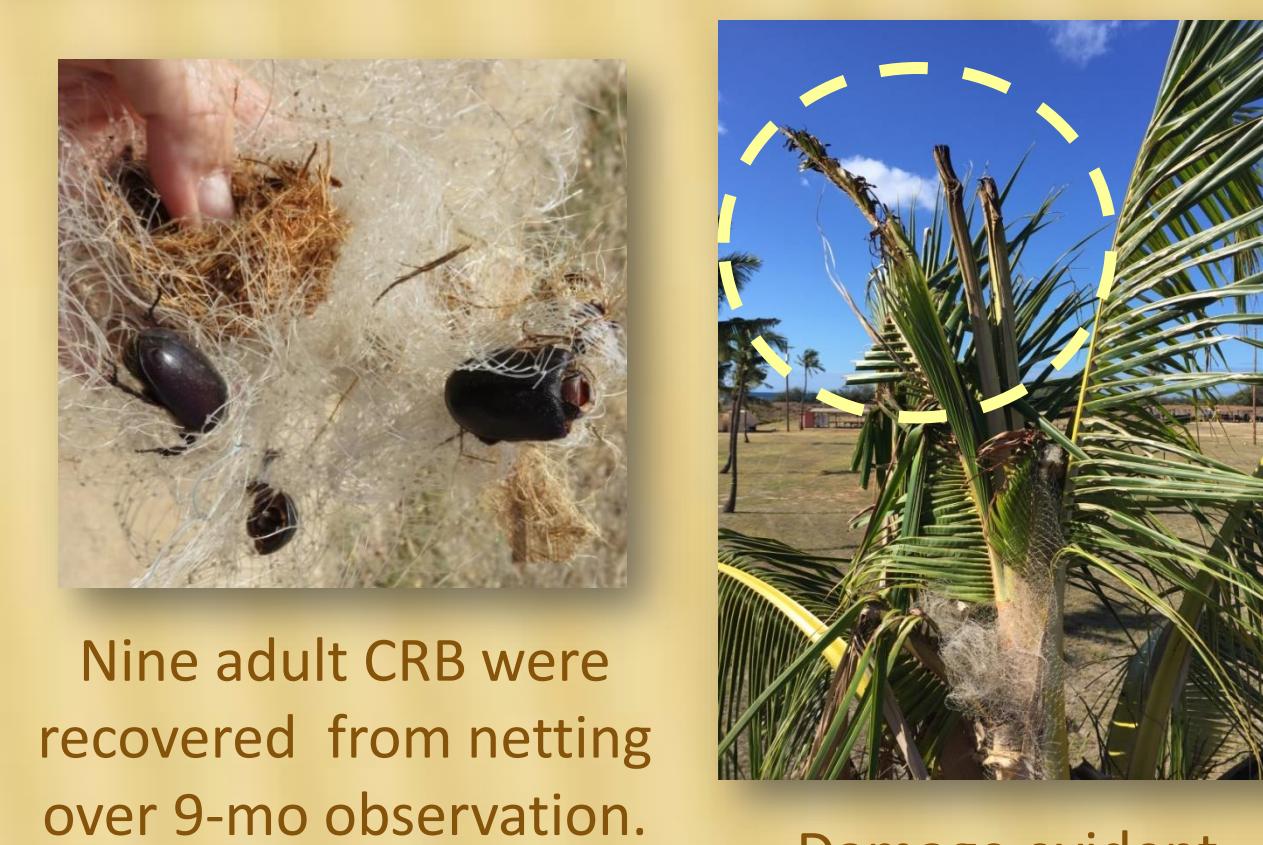


FIGURE 3. Monthly adjustments to nozzles and netting.



Nine adult CRB were recovered from netting over 9-mo observation.

Damage evident (circled) as bored fronds emerge

Conclusions

- Coconut palm trees along the northeastern boundary of the field plot (see 1 in aerial view at right) as well as trees aligned with wind currents from the direction of the NE boundary appeared to be more susceptible to CRB damage than trees along the western boundary.
 - Live and dead adult CRB were collected repeatedly from these trees.
- Undetected CRB breeding sites in the predominantly *kiawe* or *algarroba* brush (*Prosopis* sp.) along the NE boundary (see 2 at right) are likely sources of CRB adults regularly captured in mass traps deployed by HDOA in the *kiawe* brush and in an adjacent plot (see 3 at right).
- Monthly applications of bifenthrin (Onyx Pro) with synergist piperonyl butoxide (Exponent) consistently prevented damage by CRB to coconut palm trees. After 10 months, CRB damage among Onyx-treated coconut trees was reduced from 75 to 8.3%.



1 = field trial plot
2 = *kiawe* brush with CRB breeding sites
3 = adjacent plot with CRB mass traps

Acknowledgements

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