Field evaluation of essential oils in preventing damage from Coconut Rhinoceros Beetle in young coconut palms

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Background

Coconut Rhinoceros Beetle (*Oryctes rhinoceros* L., CRB) was first detected on O'ahu in 2013 but since then has become a major pest of coconut and other palm species. CRB bores into the palm crown, causing damage to developing fronds and sometimes complete crown death. Ideal management of CRB uses an integrated pest management (IPM) approach including preventative, cultural, physical, biological, or chemical practices.

Current chemical practices for management of CRB focuses on the use of synthetic insecticides that require the removal of flowers and fruits, to prevent harm to fauna and humans. There is a need for CRB management options that prevent damage from CRB while allowing the harvest of coconuts for edible or cultural uses.

Previous research (Ravindran et al, 2019; Ricordi and Silva, 2023) confirmed that essential oils can repel and kill CRB adult beetles and larvae. In Hawaii, essential oils were tested under controlled conditions. Essential oil extracted from basil (*Ocimum basilicum*) at a 6% dilution repelled and caused death of CRB when the 6% oil solution was sprayed directly on the adult beetles and 1st instar larvae (Ricordi and Silva, 2023).

The objective of this study was to evaluate the effectiveness of different essential oils in preventing damage from CRB in young coconut palms in field conditions.

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Materials and Methods

A field trial was conducted from November 2, 2023 to September 17, 2024, in an agricultural lot located in Waimanalo, Oahu, Hawaii. The site was surrounded by farms, nurseries, and inactive farm lots. A large mulch pile was visible in the neighbor lot (Figures 1 and 2). The field consisted of two rows of coconut palms randomly interplanted with banana trees, with a 12 feet spacing, for a total of 94 coconut palms. The coconut palms were recently planted, with an average of 5 leaves per palm on November 2, 2023, no brown trunk, and no signs of CRB.

The field was divided into five blocks. Six pairs of coconut palms were selected within each block. The website www.randomizer.org was used to randomize each block (Figure 3). The following treatments were used for this trial:

1. Control (no treatment)
2. Basil (*Ocimum basilicum*)
3. Thyme (*Thymus zygis*)
4. Clove (*Sysigium aromaticum*)
5. Ajowan (*Trachyspermum ammi*)
6. Ajowan double rate (removed from analysis due to phytotoxicity caused by high concentration sprayed in January/February)

Essential oils were purchased from the GreenHealth Amazon Store. All treatments were applied with Surfactant Excel90-NF by BEI (except control, which was not sprayed). The use of surfactant was necessary in order to mix the oil with the spray solution with agitation.

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Figure 1. Overview of experimental site. The mulch pile is clearly visible on the neighbor lot.

Initial applications consisted of a 6% solution of each oil. The solution was increased to 12.5% solution in January, however, the 12.5% rate caused phytotoxicity in certain treatments. In March 2024, the solution was adjusted to 2.5% in order to reduce risk of phytotoxicity. All applications were done in the evening between 4:30pm and 6pm. Palms were sprayed with spray pumps and Zep spray bottles. The section of the crown of the palm where the palm fronds meet the base of the palm was sprayed to the point where all surfaces were wet (Figure 4). The amount of solution per palm varied based on the palm size. On average, a 32 fl. oz. bottle treated 6 palms (5.3 fl. oz. per palm).

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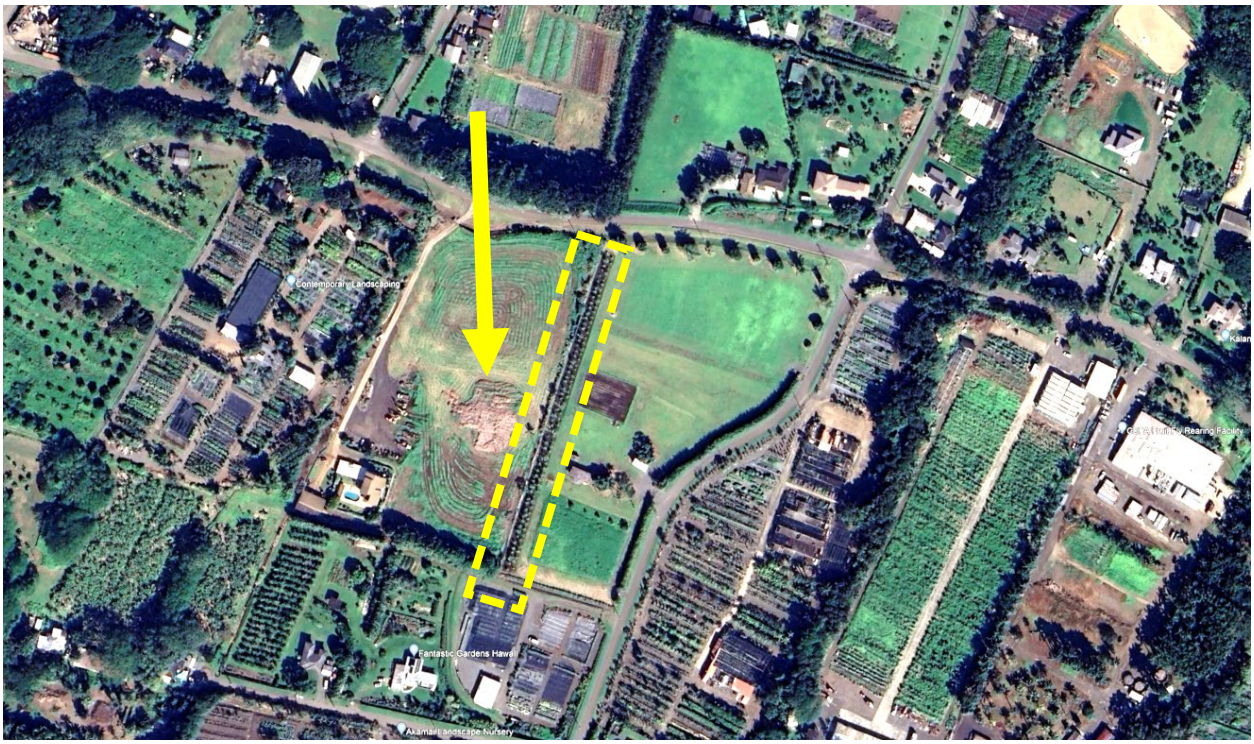

Figure 2. Location of evaluation site in Waimanalo. The field used for this evaluation are indicated by the dashed yellow rectangle. A large mulch pile in the neighbor property is indicated with the yellow arrow. The site is surrounded by farms, nurseries, and inactive agricultural lots.

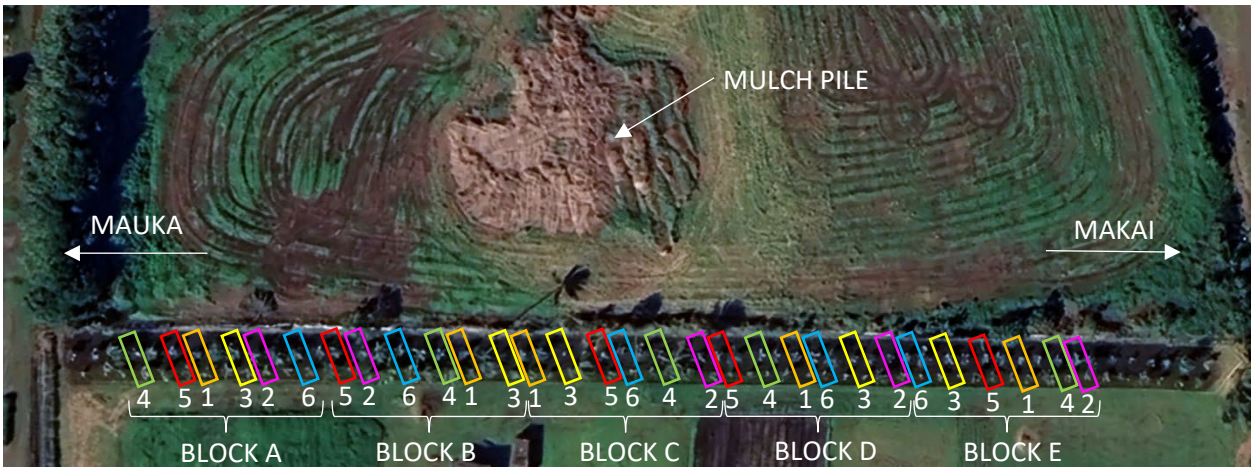

Figure 3. Experimental design overlaid on aerial image extracted from Google Earth (image dated January 2024). Mulch pile is visible in neighbor lot.

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Palms were sprayed with a 3-to-4-week interval between November 2, 2023 and March 14, 2024. There were no treatments in May, April and June. Treatments resumed on July 5, 2024, the latest treatment prior to this report was on September 7, 2024.

Treatments were evaluated on September 17, 2024. Each palm was carefully inspected for damaged leaves or bore holes (Figure 5). Each damaged leaf was recorded in chronological order, with the spear or youngest visible leaf being number 1, second youngest leaf number 2, third youngest leaf number 3, etc.

Figure 4. The dashed rectangle indicates the area of the palm that was sprayed.

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Figure 5. Examples of bore hole (left) and damaged fronds (right).

Results and Discussion

The first sights of CRB damage within the treated palms were observed on July 5, 2024. The evaluation performed on September 17, 2024 revealed that basil oil provided the highest level of protection, with only 10% of the palms treated with basil damaged by CRB, although the chi square test resulted in no statistical significance at 5% with P=0.1815. Basil was followed by thyme and ajowan (30% damage), and clove (40% damage). Control palms presented 60% damage.

A second analysis was performed without palms from Block A and revealed statistical significance with P=0.0065. In this analysis, basil provided 100% protection, while thyme presented 87.5% protection from CRB damage. The reason for doing this additional analysis is because there was only one palm treated with basil that presented CRB damage, which likely occurred towards the end of the period with no treatment because the damage observed on

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September 16 was located on the tip of the spear, on second youngest leaf, and on the third youngest leaf. CRB damage typically takes months to be visible on newly emerged fronds, which emerge at a rate of approximately 1 new frond per month. The position of the damage in the only damaged palm treated with basil indicates that the damage probably occurred at least 3 months prior to the September 16 evaluation, which coincides with the April-May-June period with no treatments. Also, a preliminary evaluation on July 30 that only looked for damaged fronds did not record any damage on that same palm.

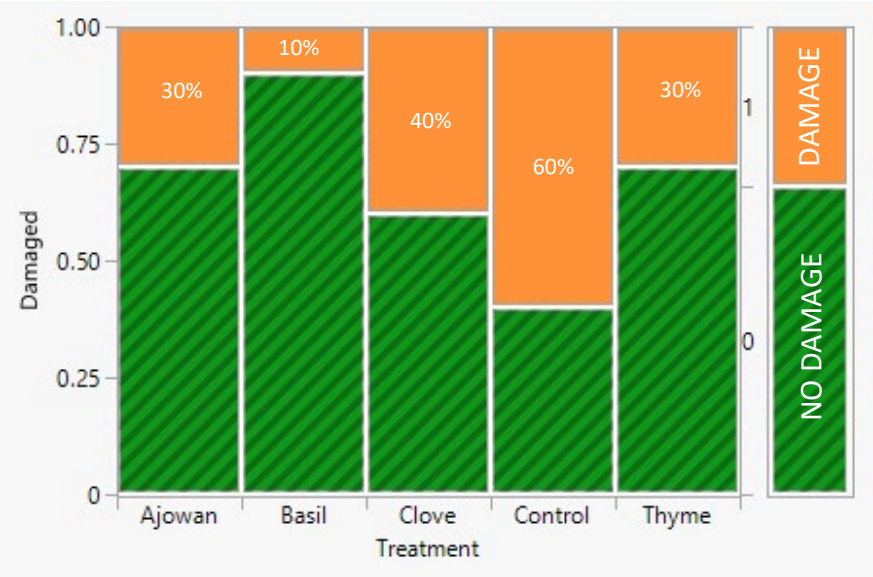

Figure 3. Distribution of the frequency of CRB damage in coconut palms. Orange bars represent percentage of damaged palms. Basil provided the highest level of protection from CRB, however, there was no significant relationship between treatment and damage (P=0.1815, Chi-Square Test, JMP Pro).

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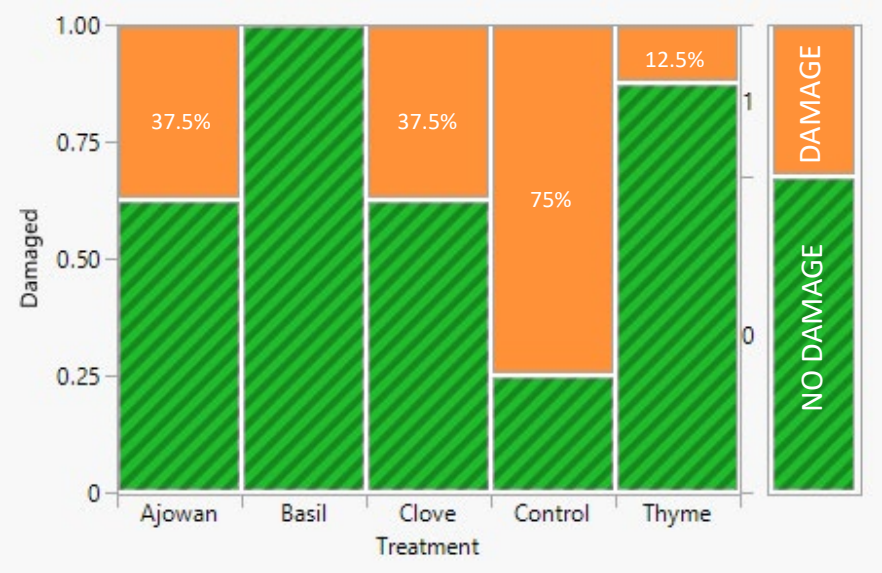

Figure 4. Distribution of the frequency of CRB damage in coconut palms. Basil provided 100% the highest level of protection from CRB, although there was no significant relationship between treatment and damage (P=0.1815, Chi-Square Test, JMP Pro)

Although previous research showed that basil and other essential oils thyme are probably working as

Conclusion

The solution of 2.5% to 6% basil essential oil with a surfactant, sprayed in a 3 week interval, was effective in protecting young coconut palms from CRB damage, probably as a result of basil's repellent properties against CRB. Thyme oil was not as effective as basil, however, it provided high levels of prevention against CRB when compared with untreated palms. Palms must be treated at least every 3 weeks to ensure protection. Consistency of treatment is crucial because essential oils are volatile and palms with extended gaps between applications will lose the oils' repellent properties and be exposed to damage from CRB.

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