

Western Regional IPM Grants Research/Extension Accomplishments Report

INSTRUCTIONS: PLEASE PROVIDE ONLY THE ESSENTIAL COMPONENTS OF ACCOMPLISHMENT WHICH ARE:

1. A CLEAR IDENTIFICATION OF THE PROBLEM/ISSUE ADDRESSED BY THE RESEARCH/EXTENSION.
2. A CONCISE EXPLANATION OF HOW THE RESEARCH/EXTENSION ACHIEVEMENT CONTRIBUTED TO THE SOLUTION OF THE PROBLEM/ISSUE BEING RESEARCHED.
3. THE IDENTIFICATION OF OTHER BENEFITS RESULTING FROM THE RESEARCH/EXTENSION, EVEN IF UNPLANNED.
4. PLEASE ATTACH A SUMMARY OF THE PAST YEARS PROGRESS, ONE PAGE MINIMUM.

CONTACT: _____

PROJECT NUMBER: _____

TELEPHONE: (808) 956-7281

PROJECT TITLE: Environmental-Friendly Strategies for Management of Mealybugs, Ants, Ampeloviruses, and Mealybug Wilt of Pineapple

PRINCIPAL INVESTIGATOR: Dr. John S. Hu

INSTITUTIONAL ADDRESS:

CO-PIs or TEAM MEMBERS:

Dr. Diane Sether

THE PROBLEM, ISSUE, OR REASON FOR CONDUCTING THE RESEARCH/EXTENSION:

Grey pineapple mealybugs are vectors of the Pineapple mealybug wilt associated viruses (PMWaV), a complex of several ampeloviruses. PMWaVs reduce pineapple fruit yield and, PMWaV-2 along with mealybugs, plays a role in the devastating disease, mealybug wilt of pineapple (MWP). Big-headed ants frequently tend and defend mealybug colonies in pineapple leading to the establishment of large mealybug colonies, increased spread of ampeloviruses, and MWP outbreaks. Diazinon is one of the few insecticides registered in pineapple for mealybug control and Amdro ant bait recently received approval for use in pineapple fields. We seek to determine if Amdro Pro ant bait can be used to control the spread of ampeloviruses in pineapple from the plant crop through the ratoon crop and into the fallow periods, by indirectly controlling ants and alleviating reliance on diazinon as the sole control measure for reducing mealybugs.

THE SINGLE MOST IMPORTANT ACCOMPLISHMENT OR BENEFIT RESULTING FROM THIS RESEARCH/EXTENSION:

This research has shown that Amdro® Pro ant bait could eliminate big-headed ants and reduce grey pineapple mealybug populations and subsequent virus spread if applied as a

broadcast in the ratoon crop. The efficiency of bait station-based application in the ratoon crop was less efficient at controlling BHA and the spread of ampeloviruses by grey pineapple mealybugs.

ADDITIONAL BENEFITS, SUCH AS:

SOCIAL BENEFITS -

The incorporation of granular Amdro® Pro ant bait into the mealybug and virus control management plans of pineapple plantations can reduce the number of diazinon applications to potentially one or less per crop cycle because large mealybug populations are less likely to form in the absence of ants. Fewer foliar applications of the organophosphate diazinon by a plantation reduces the chances of drift, residue, or nontarget exposure for workers and neighboring residential and business areas.

ECONOMIC BENEFITS – Ant control can reduce the spread of these viruses by indirectly reducing the number of mealybug vectors, and thus slowing the increase of virus incidence in the existing crop **and** future propagation material. In Hawaii, it takes a pineapple plant about 18 months to produce a single fruit for the plant crop harvest and an additional 13 months for the ratoon crop fruit to be produced. Propagation material is collected from previous crops which often include “healthy” appearing **PMWaV-infected** plants. These viruses can significantly reduce pineapple fruit yields. Maintaining continuously high and predictable yields helps to sustain the Hawaiian pineapple industry which competes with foreign producers with less labor costs. **BUT**, the method of ant control may depend on crop cycle and labor availability. Bait stations provide the most economically efficient use of product and provide durable protection during the plant crop but are labor intensive during distribution and re-baiting. Broadcast applications provided the most reliable ant control during the ratoon crop.

ENVIRONMENTAL BENEFITS –The inclusion of ant control as a component in integrated pest management approach to mealybug, virus, and MWP disease control can potentially reduce the foliar applications of diazinon to one or less thereby reducing exposure of nontarget arthropods such as bees and beneficial organisms, including natural enemies of mealybugs. Amdro® Pro granular has a short “life span” of 24 hours or less. For the plant crop, incorporation of the bait in ant bait stations wrapped with nylon net sustains the life of the bait, reduces the amount needed, and further minimizes nontarget exposure. For the ratoon crop, broadcast bait applications are necessary to obtain efficient control of ants and reduce mealybug populations.

OTHER - Ant bait appears to be compatible with the natural enemies and parasitoid wasps present in Hawaii which attack pineapple mealybugs. By removing the ant component and reducing the diazinon component, generalist predators and specific parasitoid wasps of mealybugs have more opportunity for success, be it through naturally occurring populations or inundative releases.

PLEASE SUBMIT A HIGH RESOLUTION DIGITAL IMAGE REPRESENTATIVE OF YOUR RESEARCH/EXTENSION PROJECT THAT WE CAN USE TO HIGHLIGHT YOUR PROJECT!

When you have completed this form, return to both:

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THIS FORM WAS COMPLETED BY:

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Summary of past years progress

Abstract

In the pineapple ratoon crop, pest detection-based broadcast applications of ant bait required 7 ± 2 weeks and 9 ± 2 weeks to reduce big-headed ants (BHA) below detection in the first and second 6 month periods, respectively. Incidence of virus infected plants increased $2\% \pm 1\%$ in regions with mealybugs being tended by ants from the time of initial broadcast application until control of BHA. This increase was similar to that observed in regions with mealybugs not tended by ants. Control with bait stations was achieved 16 ± 2 and 23 ± 3 weeks for the first and second six month periods of the ratoon crop although increases from 50' intervals to 10' intervals was incorporated as the ratoon crop aged. Increases in mean virus incidence ($2\% \pm 1\%$) did not differ between the first or second six months in regions infested with mealybugs not tended by ants. Virus incidence increased by $4\% \pm 2\%$ and $10\% \pm 2\%$ in the first and second six months, respectively, when mealybugs were tended by ants. BHA control with calendar-based broadcast applications of ant bait applied only at week 16 and 36 of the ratoon crop required $7 \text{ weeks} \pm 1 \text{ weeks}$ and $10 \text{ weeks} \pm 2 \text{ weeks}$ for the first and second six months of the ratoon crop, respectively. Virus incidence increased $1\% \pm 1\%$ in regions infested with mealybugs not tended by BHA, regardless of age of the ratoon crop. Virus incidence increased $6\% \pm 2\%$ and $7\% \pm 3\%$ when mealybugs were tended by BHA in the first and second six months of the ratoon crop, respectively. These results showed that PMWaVs were spread in the ratoon crop by grey pineapple mealybugs in the absence of BHA, regardless of ant bait application method. However, when mealybugs are tended by BHA, the time period until BHAs tending mealybugs

were controlled impacts the number of new virus infections detected in the ratoon crop. Broadcast applications of ant bait clearly provide more rapid control than bait station applications for BHA in the ratoon crop.

Methodology and experimental design

Planting blocks of pineapple in the ratoon cycle were 52 rows wide and 500 meters long. All blocks had received a diazinon application prior to harvest of the plant crop fruit. Approximately 31% of the pineapple plants were infected with Pineapple mealybug wilt associated viruses at the start of the ratoon cycle. Ant presence was evaluated with attractants composed of conical tubes provisioned with dental wicks saturated in 20% sucrose and dipped in clover honey. Attractants were placed at 100' intervals throughout the treatment plots and left in place for 48 hours. At time of collection, ants were identified and relative counts made. Ant monitoring was conducted at two week intervals. Three treatment regimes were evaluated in three replicates. Treatments consisted of granular Amdro Pro ant bait applied as a broadcast with a turbine sprayer at 1.5 lbs/acre. Broadcast application rationale was either calendar-based applied in week 16 and 36 of the ratoon crop or applied upon detection of *Pheidole megacephala*, big-headed ants (BHA) tending mealybugs. The third treatment consisted Perimeter Patrol bait stations provisioned with 20 g and were distributed at 50' intervals when ants were found tending mealybugs. Comparisons included a) time until BHA was controlled, b) increases in virus incidence in regions infested with mealybugs not tended by ants, and c) increases in virus incidence in

regions infested with mealybugs tended by BHA. Pineapple mealybug wilt associated virus infections were accessed initially when infestations were first detected and after control was achieved. Control was defined as the time when less than 2 BHA were detected with attractants in the treated region.

Results

In the first six months of the ratoon crop, broadcast applications of ant bait required 7 ± 2 weeks to reduce big-headed ants (BHA) below detection with sugar-based attractants. In the second six-month period of the ratoon crop, broadcast applications required 9 ± 2 weeks to reduce BHA populations below detection (Table). Ant detection with sucrose/honey based attractants was conducted at 2 week intervals regardless of when ant bait was applied. The greatest reduction in BHA number was always detected at the first sampling date after a broadcast application, regardless of age of the ratoon crop. Subsequent BHA population decline was gradual. At the beginning of the ratoon crop, approximately 31% of the plants were infected with PMWaV. Regardless of which treatment method was used, less than 2% of the plants previously testing negative for a PMWaV became infected when infested with mealybugs that were not tended by ants, regardless of age of the ratoon crop. Incidence of virus infected plants increased $2\% \pm 1\%$ in regions with mealybugs being tended by ants from the time of initial broadcast application until control of BHA. This increase was similar to that observed in regions with mealybugs not tended by ants.

In the first six months of the ratoon crop, bait stations were initially applied at 50' intervals when BHA infestations were detected. Control was achieved 16 ± 2 weeks

within the first six months but density of bait stations was increased to 25' intervals after 14 weeks (Table 1). In the second six months, bait stations used were used at 25' densities during the first 14 weeks of the infestations and were increased to 10' densities after 18 weeks. Control of BHA infestations required an average of 23 ± 3 weeks in the second six months of the ratoon crop. Unlike what was observed in the plots treated with broadcast applications, dramatic population declines by the first ant sampling date were not observed with bait stations. Increases in mean virus incidence ($2\% \pm 1\%$) did not differ between the first or second six months in regions infested with mealybugs not tended by ants. Virus incidence increased by $4\% \pm 2\%$ in the first 6 months and $10\% \pm 2\%$ in the second six months when mealybugs were tended by ants.

BHA control with calendar-based broadcast applications of ant bait applied only at week 16 and 36 of the ratoon crop required $7 \text{ weeks} \pm 1 \text{ weeks}$ and $10 \text{ weeks} \pm 2 \text{ weeks}$ for the first and second six months of the ratoon crop, respectively (Table). Dramatic BHA population declines were observed at the first sampling date following application, similar to what was observed pest-based broadcast applications. Virus incidence increased $1\% \pm 1\%$ in regions infested with mealybugs not tended by BHA, regardless of age of ratoon crop. Virus incidence increased $6\% \pm 2\%$ and $7\% \pm 3\%$ when mealybugs were tended by BHA in the first and second six months of the ratoon crop, respectively. The larger increases in virus incidence observed under the calendar-based application regime are likely the result of the longer time periods mealybugs were tended by ants prior to application and control because the length of time until control was similar to that observed with pest-based applications .

Conclusions

These results showed that PMWaVs were spread in the ratoon crop by grey pineapple mealybugs in the absence of BHA, regardless of ant bait application method.

However, when mealybugs are tended by BHA, the time period until BHAs tending mealybugs were controlled impacts the number of new virus infections detected in the ratoon crop. Broadcast applications of ant bait clearly provide more rapid control than bait station applications for BHA in the ratoon crop. Bait stations required longer periods of time to control BHA with ratoon crop age. Higher incidences of new virus infections were correlated with this delay in control. Calendar-based broadcast applications of ant bait had similar control times as pest-based broadcast applications. However, a greater increase in virus incidence were detected in these plots which is likely the result of mealybug colonies tended by ants having more time to develop and expand prior to control initiation.

Unlike results obtained in the plant crop, bait stations required substantially longer period of time to achieve BHA control compared to broadcast applications of ant bait nor did the continued presence of bait stations in the field prevent infestations of nearby vicinities during the ratoon crop. Although PMWaVs can be spread by mealybugs in the absence of ants, the presence of BHA tending mealybugs correlated with greater increases in virus incidence. In general, control of ants with baits stations required longer periods of time as the ratoon crop aged.

Table 1. Time until control of big-headed ant under three ant control regimes and resulting increase in virus incidence in the presence of mealybugs only or mealybugs tended by ants for a ratoon crop cycle in pineapple.

	Calendar-based broadcast			Pest-based broadcast			Pest-based bait stations*		
	First 6 months	Second 6 months	Overall	First 6 months	Second 6 months	Overall	First 6 months	Second 6 months	Overall
Time until control (weeks)	7 ± 1	10 ± 2	9 ± 2	7 ± 2	9 ± 2	8 ± 2	16 ± 2	23 ± 2	19 ± 4
Increase in virus incidence (%)									
Mealybugs only	1 ± 1	1 ± 1	4 ± 3	2 ± 1	1 ± 1	2 ± 1	2 ± 1	2 ± 1	2 ± 1
Mealybugs tended by ants	6 ± 2	7 ± 3	4 ± 4	2 ± 1	2 ± 1	2 ± 1	4 ± 1	10 ± 2	7 ± 4

* Initial density of bait stations was at 50' intervals in the infestation area and 50' beyond. After 14 weeks density was increased to 25' intervals and after 18 weeks density was increased to 10' intervals.

