

Renewal progress report for CDFA Agreement number 15-0219-SA

EVALUATION OF COMMERCIAL ANT BAITS AS A COMPONENT OF AN INTEGRATED PEST MANAGEMENT PROGRAM FOR VINE MEALYBUG, *PLANOCOCCUS FICUS*

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REPORTING PERIOD: The results reported here are from work conducted July 1, 2015 to January 31, 2016.

INTRODUCTION: The vine mealybug (VMB), *Planococcus ficus* (Signoret), is a destructive vineyard pest that contaminates fruit, debilitates vines and vectors plant pathogens such as *grapevine leafroll-associated virus-3* (Daane et al. 2012). First reported from vines in the Coachella Valley (Gill 1994), VMB soon spread throughout California, likely on infested nursery stock (Haviland et al. 2005). It is currently found in most California grape-growing regions (Godfrey et al. 2002; Daane et al. 2004a, 2004b) and has the potential to spread throughout the western United States.

Management of VMB populations can prove challenging and often requires the use of multiple tactics, including biological control, mating disruption and insecticides (Daane et al. 2008b). Management can be particularly complicated in coastal wine grape growing regions where VMB populations are tended by Argentine ants, *Linepithema humile* [Mayr]. In the presence of tending ants, biological control of mealybugs can be significantly interrupted, resulting in large VMB populations that may be more easily spread to new areas. These populations also contaminate the fruit, causing yield losses and decreased fruit quality. In vineyards where Argentine ant is prevalent, management of ant populations is a critical part of an IPM program for VMB and necessary for containment of insect populations (Nyamukondiwa and Addison 2011; Mgochecki and Addison 2009).

Liquid ant baits adapted from the urban environment (Klotz et al. 2002) for use in vineyards (Cooper et al. 2008), significantly reduce mealybug populations in vineyards by contributing to increases in biological control (Daane et al. 2007). The costs associated with the manufacture, deployment and maintenance of bait stations have been prohibitive to widespread adoption of Argentine ant management in vineyards, despite the benefits that could result from such programs (Nelson and Daane 2007).

There is continued interest among coastal grape growers in the development of a simpler and more economical bait program that could be widely implemented. Granular bait that can be broadcast with a commercial spreader could be distributed more quickly and frequently over a large area, and would not require the manufacture and maintenance of bait stations. Although granular baits have been shown to effectively reduce the population of foraging Argentine ants (Krushelnycky and Reimer 1998) and the spread of ant populations (Krushelnycky et al. 2004) in natural areas, they have not been widely tested in agricultural settings. The sustained use of the baits could lead to longer-term containment and control of Argentine ant populations (Krushelnycky et al. 2004).

Granular baits have the potential to become an alternative to the liquid bait program. We are evaluating commercially available granular ant baits that can be broadcast under vines to control populations of Argentine ant. Ant control would in turn contribute to the sustainable control of VMB populations. In the absence of an economical bait program, ant suppression must be achieved with the broad-spectrum

insecticide, chlorpyrifos that can affect water quality, disrupt populations of beneficial insects and pose vertebrate health risks.

OBJECTIVE: The broad goal of this research is to increase the efficacy and adoption of integrated pest management programs for vine mealybug, a destructive pest of grapevines in California. Our specific objective is to: Evaluate the efficacy of commercial baits to control Argentine ant as part of an integrated pest management program for vine mealybug.

OBJECTIVE 1. Evaluate the efficacy of commercial baits to control Argentine ant as part of an integrated pest management program for vine mealybug.

ACTIVITIES: Our experiment was established in two vineyard blocks in Napa, California (Carneros American Viticultural Area (AVA)). Both blocks were planted in 1999 and are a mix of Chardonnay clones (17-Robert Young and 6) on SO4 rootstock (*Vitis berlandieri* x. *V. riparia*). We used a randomized complete block design, and established six, 6-row replicates of each treatment. The treatments were 3 commercial granular bait products (Table 1).

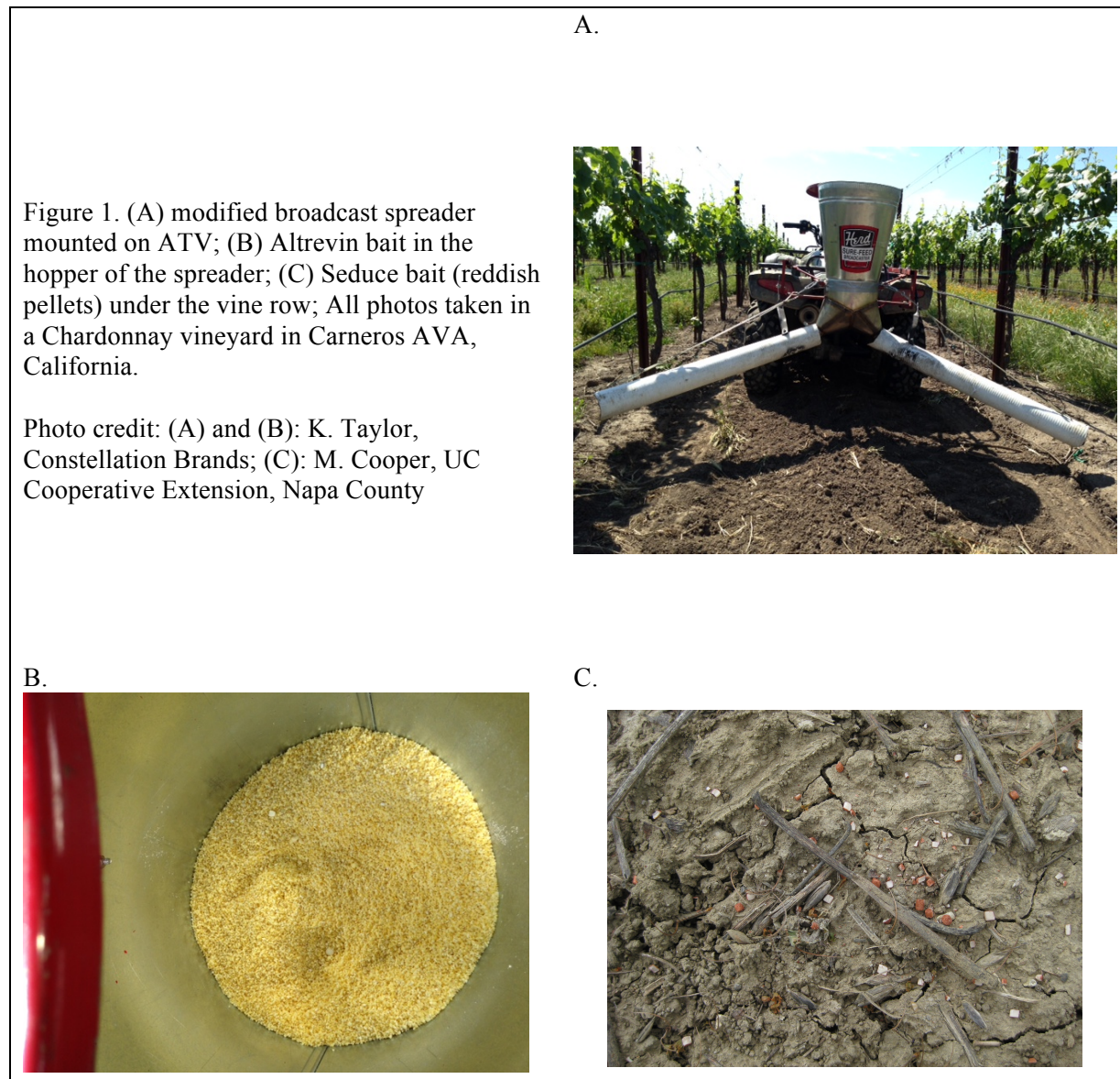
Table 1. Ant bait products applied in trial blocks in a Napa County vineyard.

Treatment	Active Ingredient (concentration)	Rate per acre	Bait applications (2015)
Altrevin	metaflumizone (0.063%)	1.5 lb.	March 14 & 15; April 15 & 16; June 15 & 16
Altrevin & powdered sugar	metaflumizone (0.063%)	1.5 lb.	
Extinguish	hydramethylnon (0.365%) & methoprene (0.25%)	1.5 lb.	
Seduce	Spinosad (0.07%)	20 lb.	
Untreated	none	none	none

In March, April and June 2015, the cooperating vineyard manager applied the bait in the vine row with a modified broadcast spreader mounted on an all-terrain vehicle (ATV) (Figure 1). Because Altrevin and Extinguish are formulated with a protein attractant specifically for control of red imported fire ant (*Solenopsis invicta*), we included one Altrevin treatment in which the bait was coated with powdered sugar before application to make it more attractive to Argentine ants. The spinosad bait, Seduce, is formulated with a carbohydrate attractant (sugar) specifically to target the Argentine ant. Additionally, Seduce has been approved for use in organic vineyards. Since there are a limited number of insecticides approved for VMB management in organic vineyards, ant bait can be an essential component of an IPM program in these vineyards.

Ant densities were determined indirectly as a measure of feeding activity, assessed as the amount of nontoxic sucrose water removed from 50-milliliter (ml) polypropylene centrifuge tubes (Corning Inc., Corning, NY) tied to the vine trunk (Klotz et al. 2002, Daane et al. 2008a) in the center two rows of each plot. The 50-ml tubes are henceforth referred to as monitoring tubes. A 2-centimeter (cm) hole was drilled in the cap, and a square of permeable plastic mesh (Weedblock, Easy Gardener Inc., Waco, TX), was placed between the cap and the filled tube, covering the hole. The mesh is fine enough to retain the liquid when the tube is inverted, but coarse enough to allow ants to remove the liquid on contact. A second lid was fixed to the original lid, and covered with a permanent mesh to discourage feeding by honeybees and wasps. Before the tubes were deployed in the vineyard, each tube was filled to 45 ml with 25% sucrose water and the weight of each tube was recorded. Tubes were inverted on a vine trunk for 4 to 7 days (depending on ant activity), at a density of 12 tubes per plot, or a total of 72 tubes per treatment. At the end of the monitoring period, the tubes were brought back to the laboratory and the new weights were recorded. One additional monitoring tube per plot was attached to an ant-excluded bamboo stake to

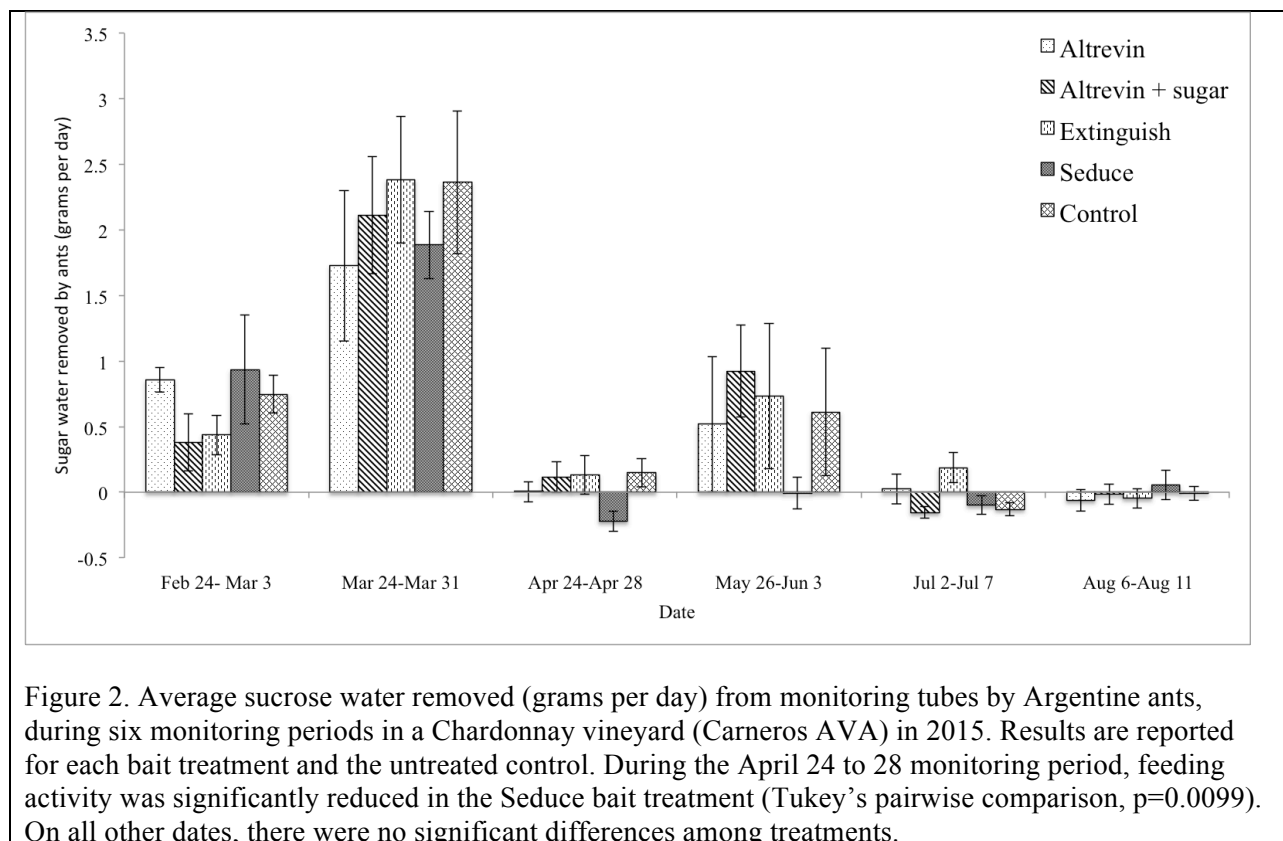
measure the amount of water lost to evaporation; this amount was averaged across all plots and used to adjust the final weight.



We measured ant feeding activity with monitoring tubes during six periods: February 24 to March 3 (pre-treatment); March 24 to 31; April 24 to 28; May 26 to June 3; July 2 to 7; and August 6 to 11. We conducted an additional monitoring September 18 to 25; however, bees foraging at the tubes removed large quantities of sugar water so the September data were discarded.

RESULTS: Ant feeding activity is reported as grams (g) of sugar water removed from monitoring tubes per day (Figure 2). During the February and March monitoring periods (pre-treatment and 10 days after the first treatment, respectively) ant feeding activity was not significantly different across all treatments. This is not surprising since we blocked for consistent ant populations prior to treatment; also, and most importantly, baits have delayed toxicity and would not be expected to control populations so quickly (10 days) after application. During the April 24 to 28 monitoring period, feeding activity was significantly reduced in the Seduce bait treatment (Tukey's pairwise comparison, $p=0.0099$); this is roughly 6 weeks

after the first bait application and 1 week after the second. From May 26 to June 3, feeding activity in the Seduce treatment (-0.007 ± 0.12 g per day) was reduced compared to other treatments (0.52 to 0.92 ± 0.35 to 0.55 g per day), although the difference was not statistically significant due to the high variability in ant feeding—particularly in the Altrevin and untreated blocks. During the July and August monitoring periods, ant feeding was low to none in all treatments. In other ant bait trials, we have detected similar feeding lulls at our monitoring tubes during the summer (Daane et al. 2006, 2008a). We did not see any differences in population suppression between the powdered sugar-coated bait and those protein-based baits without powdered sugar. Since the sugar is not an inert ingredient of the bait, it may not adhere well to the bait. It could have been removed during the application process or not durable in the field. At this point, there does not appear to be a measurable improvement in bait performance through the addition of the powdered sugar under these conditions. And adverse effects were noticed as the sugar heated (and melted) in the spreader, thereby clogging the mechanisms of the spreader that impacted application efficiency and necessitated additional disassembly/cleaning time. Overall, the collaborating vineyard manager concluded that the Seduce bait was the easiest to apply; we attributed this to weight and consistency of the bait as well as application rates (higher rates made the applied bait more visible, and therefore easier to calibrate the spreader and adjust drive speeds). This study will continue in 2016, and we will shorten our monitoring intervals to 14 days from April to June to more clearly elucidate the impacts of bait during this key ant foraging period. This is also a critical period for early-season control of VMB; concurrent control of Argentine ant populations has the potential to reduce VMB populations through an increase in biological control.



PUBLICATIONS & PRESENTATIONS: We have not produced any publications because we aim to collect a 2nd year of data before summarizing and publishing our results. We presented results from the 2015 growing season trials, on November 3, 2015 during the **Continuing Education Seminar Series** organized by Napa County Farm Bureau, Napa County Agricultural Commissioner, and UC Cooperative

Extension. The session was held in Yountville, CA and attended by 130 grape growers, vineyard managers and pest control advisers. We are also scheduled to present our results at a March 17, 2016 regular meeting of the **Sonoma County Vineyard Technical Group**.

RESEARCH RELEVANCE STATEMENT: We are evaluating three granular bait products for control of Argentine ant populations in a coastal California vineyard. Because Argentine ants disrupt biological control of VMB by interfering with the activity of predators and parasitoids, control of Argentine ants can be an essential component of IPM programs for VMB. Granular baits that can be broadcast under vines are a more manageable alternative to the current stations with liquid bait used in vineyards. Handling and distribution of granular baits is simpler and more cost effective than liquid baits that must be contained within bait stations. Additionally, Argentine ant nests are typically multiple and widely dispersed throughout agricultural ecosystems in the spring, summer and fall (Markin 1970) so multiple point-sources make bait more accessible to all nests within an infested area (Boser et al. 2014). Our results suggest that one of the baits, Seduce, which is formulated with a sugary attractant, has the potential to control populations of Argentine ant, particularly early in the growing season (April and May). This is also a critical period to control VMB because early-season population control—while the fruit is developing—can reduce pest pressure later in the season. Later-season VMB populations are more likely to cause economic damage by infesting and soiling the fruit, thus subjecting it to potential rejection by the processor.

LAYPERSON SUMMARY: Vine mealybug is a destructive pest in California vineyards; it contaminates fruit and reduces vine health and productivity. Grape growers may use multiple tactics (IPM) including insecticides, mating disruption and biological control, to achieve control of VMB populations. Argentine ants are invasive insects common in coastal California vineyards. Ants disrupt IPM programs for VMB because they interfere with the activity of a parasitic wasp that attacks VMB. Ant baits are an effective approach to manage ant populations while minimizing impacts on non-target organisms. We are investigating the potential of three commercial bait products to control Argentine ants in vineyards. Baits were applied under the vine with a modified broadcast spreader in mid-March, mid-April and mid-June, 2015. Ant populations were monitored monthly from February to August 2015. Only one of the bait products impacted ant populations, and only on one monitoring date. Modifications of our monitoring strategy in 2016 may allow us to capture more clearly the impact of baits on ant populations.

STATUS OF FUNDS: We have expended funds primarily as Salary/Benefits for two research assistants working on this project. We support .20 FTE for each assistant from these funds. We have also expended funds to buy sugar and other supplies to monitor ant activity.

INTELLECTUAL PROPERTY: There are no intellectual property issues associated with this project. We are evaluating commercially available ant bait products.

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