Argentine ant management: Liquid bait program for vineyards

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The Argentine ant, *Linepithema humile* (Mayr) is one of the most pervasive ant species in Mediterranean climates worldwide, and was first reported in California in 1905. Although most commonly recognized as urban pests, these invasive ants also have damaging impacts in natural and agricultural systems, where they are associated with outbreaks of phloem-feeding pests, including aphids, mealybugs, and scale insects. They collect nutrient-rich honeydew excreted by these homopterans and disrupt biological control by protecting them from attack by natural enemies. In California's coastal vineyards, the Argentine ant exacerbates populations of grape, obscure, longtailed, and vine mealybugs, as well as Lecanium scale. The damage caused by mealybugs reduces vine vigor and affects fruit marketability. For additional information on vineyard mealybugs, refer to the following sources:

- Vine mealybug: What you should know. UC ANR pub. 8152, http://ucanr.org/pubs.shtml
- Mealybugs in California vineyards, http://vinemealybug.uckac.edu/Default.htm

Key steps in implementing an Argentine ant baiting program:

- Properly identify the ant prior to bait selection because the bait matrix is either a protein or carbohydrate attractant, depending on the target species.
- Build or purchase bait stations and place the outer PVC housing in the field in Jan-Feb, at a density of 15-20 per acre.
- Place bait bottles into the stations in Mar-Apr, to target developing larvae in the nest and the ants' increased demand for resources in early spring.
- Rely on soft pesticides or biological control for mealybug management.

Argentine ant biology

Unlike most ants, Argentine ants are unicolonial: all nests within an area are functionally inter-connected. For example, most Argentine ants in the state of California are part of a single super-colony. Therefore, ants taken from a colony in southern California and introduced into northern California will assimilate as part of the new colony, with little to no aggression. Unicolonialism gives the Argentine ants a distinct advantage over native ants in that nests share resources, instead of competing for them. Each Argentine ant nest typically contains 2-15 queens (polygyny), and two castes: reproductive and sterile females (queens and workers), and winged reproductive males. After eggs laid by the queen hatch, developing ants go through four larval and a pupal stage before reaching adulthood. The timing of this cycle is detailed for northern and central coastal California in Figure 1.

Argentine ant identification

Proper identification is essential to a successful bait program. The Argentine is the main pest ant associated with sap-feeding insects (scale, mealybugs, white flies, and aphids) in coastal California, and disrupts biological control of these insects. Eliminating native or benign ant species could disrupt an otherwise stable natural system and open a window for Argentine ants to invade.

Argentine ant workers are 1/8 in. long, and uniformly dull brown, with pale stripes visible on a distended (full of sugary liquid) abdomen. Once familiar, they can be recognized by the musty odor emitted when crushed. Several tools are available to assist in identification:

- A key to common household ants is available on the UC IPM website: http://www.ipm.ucdavis.edu/TOOLS/ANTKEY/index.html.
- AntWeb provides more information on native and introduced California ant species: (http://www.antweb.org/california.jsp).
- Ant samples may be identified by your local UCCE Farm Advisor or Area-IPM Advisor.

Argentine ant management

Management of Argentine ants is best achieved through the use of toxic baits. Contact sprays (e.g.; chlorpyrifos) that kill foraging workers provide temporary control, but have little long-term impact, since they do not generally contact the nest population of queens or brood. Ant populations typically rebound from a chlorpyrifos barrier spray in 1-3 months, necessitating multiple applications. Alternatively, baits are foraged by workers and then distributed to other workers, queens, and larvae through trophallaxis—the use of special glands by individuals of social insect groups to exchange food with colony members. These baits must be slow-acting (delayed toxicity of 1-4 days), so that foraging ants do not die before exchanging bait with colony members, and bait remains continually attractive to foragers. If the concentration of active ingredient in the bait is too high, it will kill ants before trophallaxis occurs, negating the advantages of a baiting system. Piles of dead ants in or surrounding the bait station are an indication that the concentration is too high. Because the baits are slow-acting, it will take 2-3 years to notice a drop in ant populations, and the Argentine ant may never be eradicated from an area.

A post-harvest chlorpyrifos application for vine mealybug control can be compatible with a bait program, especially if ant populations are particularly high, because the bait can be used to maintain the population at low levels, following the initial knock-down from the pesticide spray. Ant populations will recover from a post-harvest application in early spring, when there are few resources in the vineyard more attractive than the baits, at which the ants will forage almost exclusively. Conversely, ant populations will recover from a pre-bud break (delayed-dormant) chlorpyrifos application in early summer, when the demand for resources is reduced because there are fewer larvae in the nest, and mealybug honeydew and ripening grapes provide more attractive foraging options than the bait. Therefore, bait combined with delayed-dormant chlorpyrifos does not provide any more benefit than chlorpyrifos alone, and is not economical.

Bait stations: Instructions for assembly of a UC-designed bait station (Battany & Cooper) are included with Figures 3 and 4. Adjustments to size and design can be made, to improve or customize the stations. The bait bottle should be rigid; a soft-sided bottle (soda bottle, for example) will not properly dispense bait because it collapses under pressure. Bait should become available from the distributor in suitable bottles. The outer PVC housing supports the bait bottle, prevents breakdown of the active ingredient by shielding it from light, and minimizes mold by insulating the bottle from heat. Ants enter through vertical slits cut in the sides of the station, which are sized to minimize access to non-target organisms. The slits also reduce friction between the housing and the sewer cap, making it easier to remove. Burying the station to within ¼ to ½ in. of the vertical slits and securing the housing to a trellis post with a zip tie will stabilize it. Stations should be placed within the vine row, because those protruding into the row middle are likely to be toppled or crushed by vineyard machinery. We recommend placing the stations in the field during the winter, when vineyard crews are not busy with other activities. The bait bottle should then be placed in the station at a later date, when ants become more active (see *bait* section below). Density of stations per acre may be somewhat variable, depending on the level of ant activity, but we recommend a density of 15-20 stations per acre, based on previous studies. Bait stations may be rotated about the property, to yield higher densities in newly baited areas, and lower densities in areas which have been baited for 3-5 years.

Ant pro® (http://www.kmantpro.com) is a commercially available station. The maximum capacity of this station is 0.6 liters (19 oz), so it will need refilling several times throughout the season. The UC-designed stations need only be filled once a year.

The bait: Bait should be deployed in early spring (Mar-Apr), when developing larvae must be fed (Figure 1) and there are few alternative resources available to foraging ants. In late summer, there is a drop in ant activity at bait stations resulting from a decreased demand for resources from the nest as larvae become scarce, and the increasing attractiveness of homopteran honeydew and ripening grapes compared to the bait solution (Figure 2). Therefore, proper timing is essential to the success of the ant baiting program. There will be no significant effect on ant or mealybug populations in the current year, if baits are deployed in July instead of April; although the effects will be apparent in subsequent years, if baiting continues.

Any of a variety of toxicants (boric acid, fipronil, hydramethylnon, imidacloprid, and thiamethoxam) may be incorporated into a bait matrix, as long as the concentration falls within the delayed toxicity range for the particular chemical. Several of the toxicants (including imidacloprid and hydramethylnon) break down quickly, so the bait bottle should be protected from direct light.

Since the diet of Argentine ants is composed mainly of carbohydrates (sugar in the form of excreted honeydew by sap-feeding insects), any bait must be formulated as liquid, with a sugary attractant. Argentine ants will not feed heavily on dry, protein-based baits (as typically formulated for red imported fire ants, *Solenopsis invicta*). Differences in dietary preference can be attributed in part to physiological need: fire ants require nitrogen, derived from proteins, as the basis of their chemical defense system, whereas carbon forms the base of the Argentine ants' system. As of January 2007, commercially available, liquid baits include (1) Gourmet Liquid Ant bait (1% borate, Innovative Pest Control Products) and (2) imidacloprid bait (0.001% imidacoprid, Bayer CropScience). Several other companies are interested in developing bait for the agriculture market, and more options may become available.

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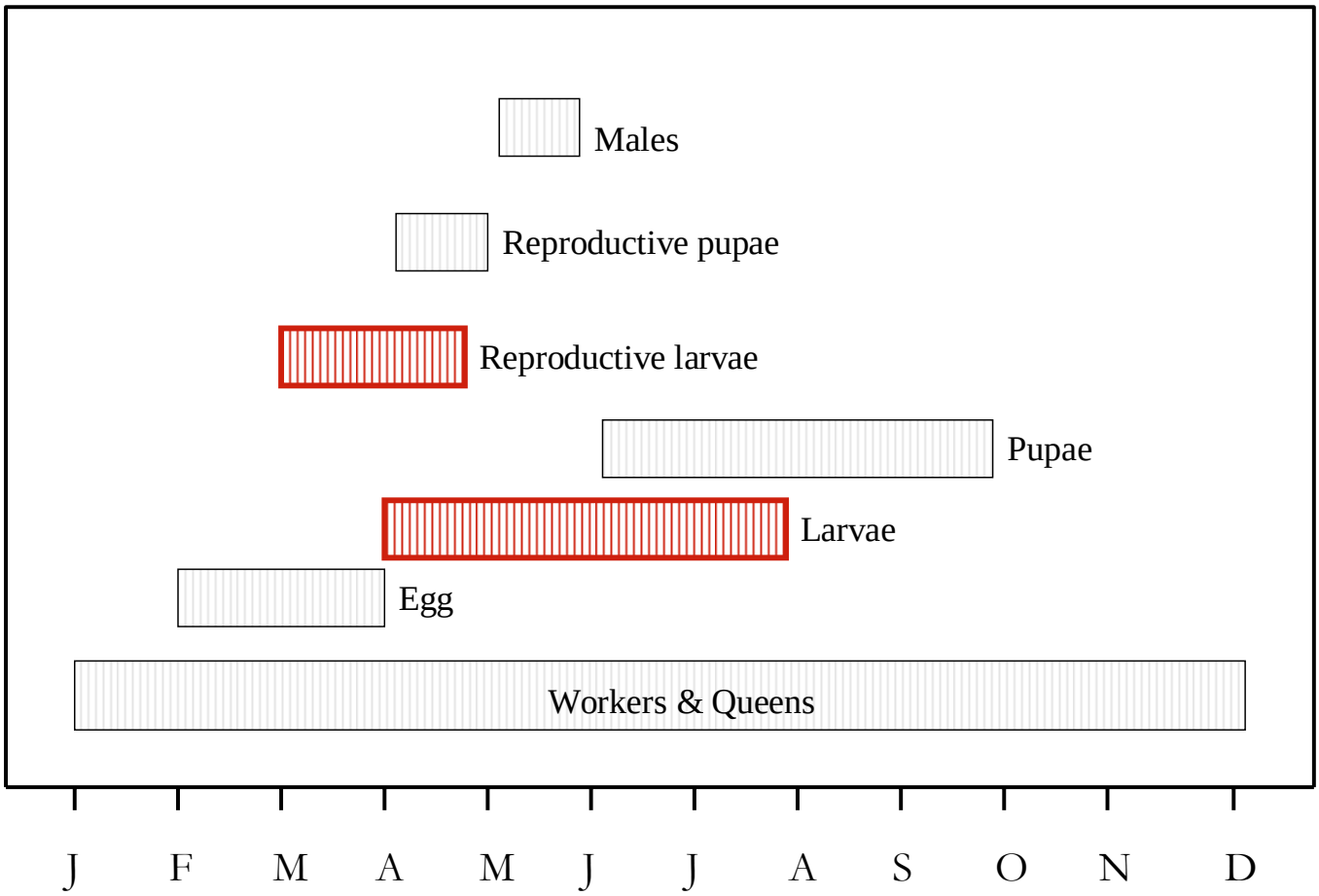

Figure 1. Argentine ant life cycle in coastal California vineyards, based on monthly nest collections in 2004-2006. Ant bait should be deployed in early spring, when larvae are present in the nest. Workers will not recruit heavily to bait in late summer (Jul-Aug), because there are fewer larvae in the nest, and homopteran honeydew and ripening grapes are more attractive foraging options.

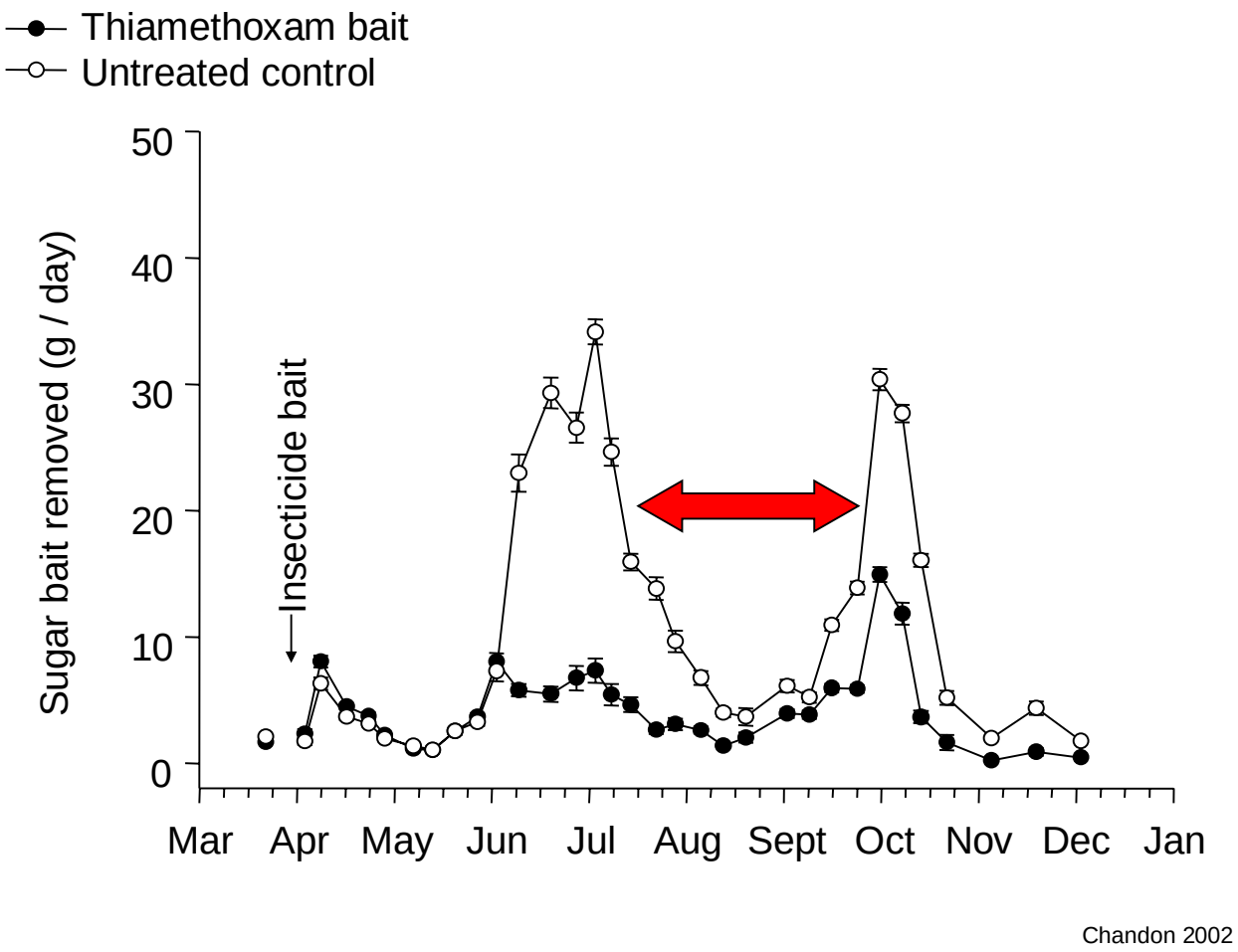

Figure 2. Sugar water removed from monitoring tubes deployed in ant bait trials. The two treatments are thiamethoxam (0.0001%) bait, and untreated control. Of note is the decline in feeding activity from late July to late September, consistent with the availability of more attractive resources (mealybugs feeding in bunches and juice from ripening grapes) in the vineyard, and the scarcity of larvae in the nest.

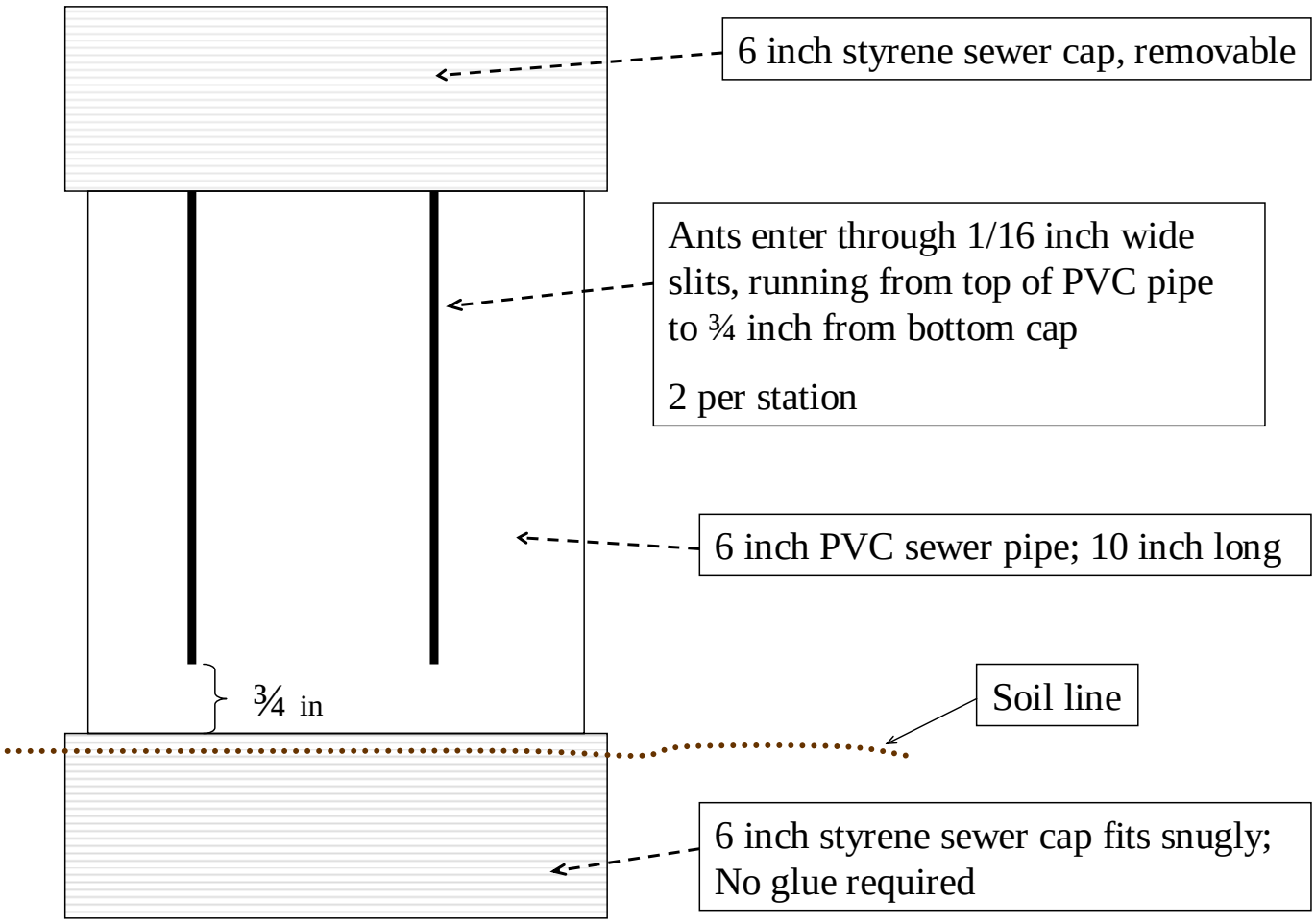

Figure 3. Exterior view of UC-designed ant bait station. (Battany, Cooper, & Daane)

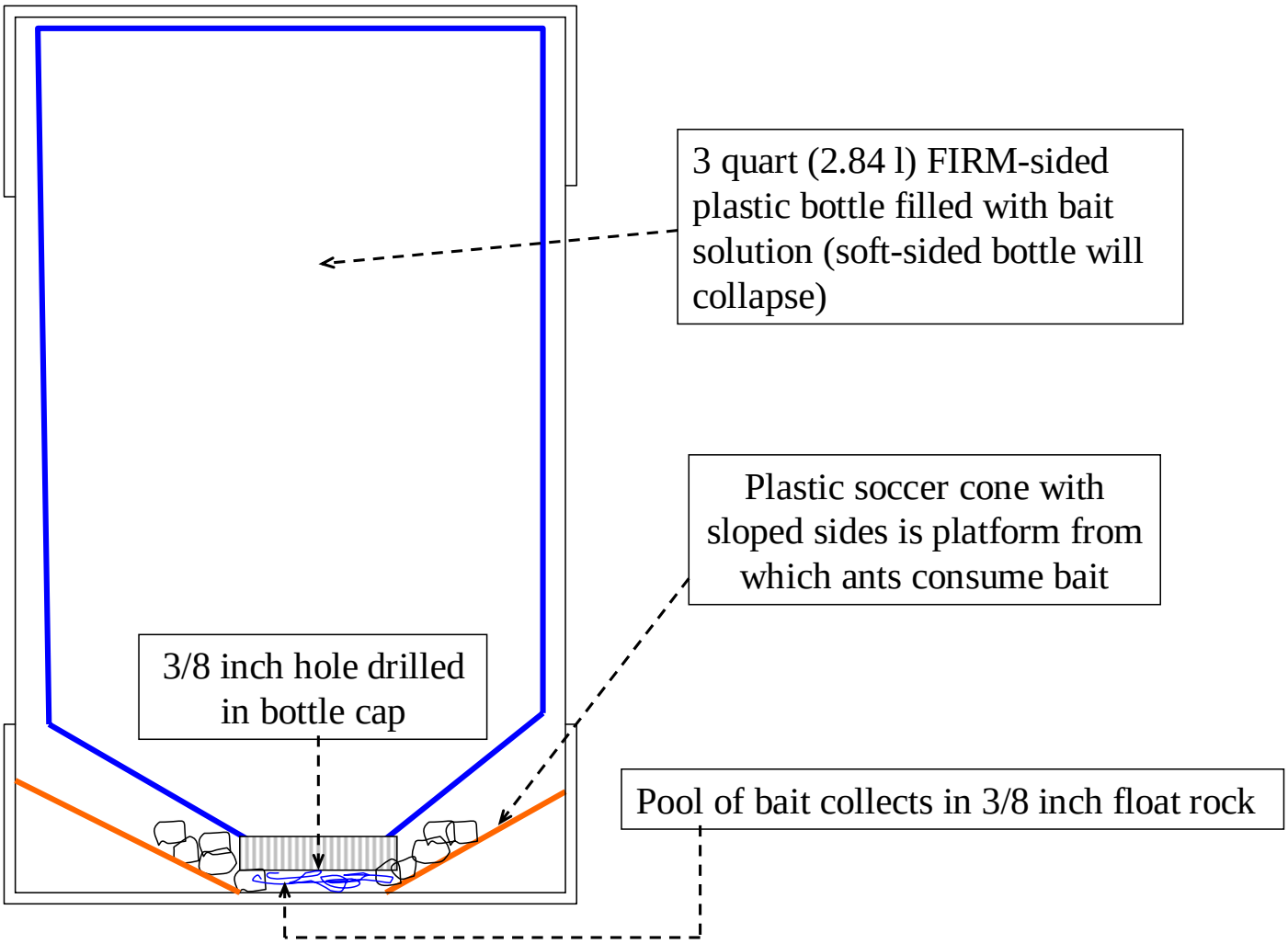

Figure 4. Cut-away view of UC-designed ant bait station. (Battany, Cooper, & Daane)