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New Approach to Boric Acid Ant Baits

By John H. Klotz and Dave F. Williams

Due to public concern about pesticide use and its effect on the environment and human health, there has been a renewed interest in least-toxic pesticides such as boric acid. Another reason for this reevaluation of some of the "old" compounds is the difficulty and expense of finding or synthesizing effective new compounds for pest control. Boric acid has been used for ant and cockroach control since the late 1800s (Quarles 1993; Riley 1889; Rust 1986). Recently, the use of boric acid and its derivatives has been advocated for control of wood-destroying organisms, ants, fleas and other pests (Hamel 1990; Williams and Mitchoff 1990, Olkowski et al. 1991; Quarles 1992; Quarles 1993).

Boric acid's full potential in pest control may not yet be fully realized. For example, boric acid could be used in a bait for flea control (Klotz et al. 1994) and its further refinement as an ant bait needs to be explored. In fact, boric acid has many of the characteristics of an ideal bait toxicant (see Box A).

Ants and Baits

Ants are ideal pests to control with baits because of their highly social habits, such as chemical recruitment to food sources using odor trails, and food sharing, known as trophallaxis, between nestmates. If a bait is attractive to foraging ants, it will be rapidly collected, carried back to the nest, and distributed to the entire colony. Ant baits are more target-specific than traditional control techniques such as perimeter treatments, and in many cases, baits are more cost effective.

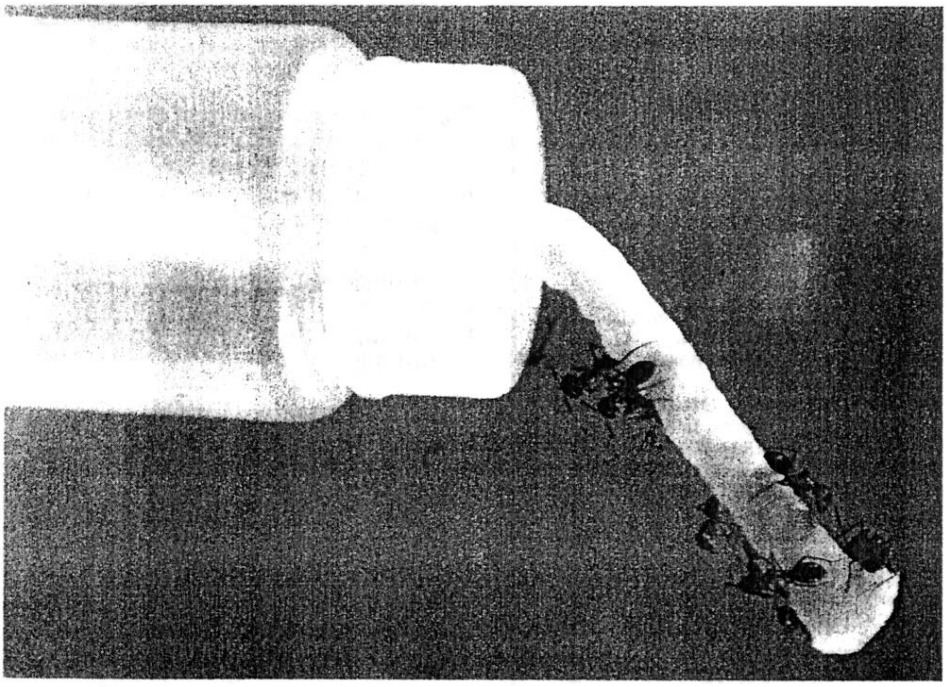

Photo courtesy of Lloyd Davis, Jr.

These Florida carpenter ants, *Camponotus abdominalis floridanus*, are ingesting an ant bait composed of boric acid in sugar water. Very low boric acid concentrations make the bait acceptable to the ants and safer for non-target organisms.

Efficacy Information

Given the long-term use of boric acid in ant control, there is a surprising lack of information concerning its efficacy. Rust and Knight (1990) found that a 5% boric acid gel bait was ineffective at controlling laboratory colonies of the Argentine ant, *Linepithema humile*. Olkowski et al. (1991) reported on a boric acid bait for Argentine ants that contained water, sugar (30%) and boric acid (approximately 2.7%). In laboratory and field tests, Newton (1980) successfully controlled Pharaoh ants, *Monomorium pharaonis*, with bait formulations of 5% and 7% boric acid. Wright and Stout (1978) recommended 2% boric acid in either a liquid or solid bait.

The various results for boric acid baits may be due to the varying amounts of bait ingested by a colony as a function of boric acid concentration. In their desire to rid themselves of pest ants quickly, pest control operators (PCOs) and others in the past may have used boric acid concentrations that were too large.

In This Issue

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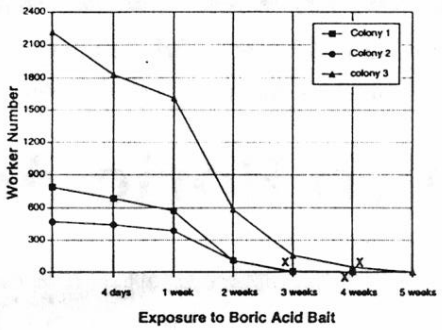


Fig. 1. Colony mortality of Florida carpenter ants exposed to 1% boric acid sucrose water bait. Xs indicate queen death. Control colony (not shown in graph) grew in size.

When more appropriate concentrations were used, researchers may have stopped monitoring the results too quickly.

Economically Important Ants

In our laboratory studies, we have worked extensively with the Florida carpenter ant, *Camponotus abdominalis floridanus*, red imported fire ant, *Solenopsis invicta*, ghost ant, *Tapinoma melanocephalum*, Pharaoh ant and Argentine ant. All of these species are economically important urban pest ants (Klotz et al. 1995) but two of these, the fire ant and the Pharaoh ant, have received the lion's share of research. For these two species a number of different commercially available baits have been developed.

Argentine ant, *Linepithema humile*

Hydramethylnon (Maxforce®) and sulfluramid (Pro-Control®, Fluor-Gard®) baits, for example, can give adequate control in some situations (see Quarles 1995). However, baits for other urban pest ants still need to be developed. In the spirit of using a least-toxic approach to pest control, we report here our recent findings using a boric acid/sucrose water bait for ants.

Sugar Water Bait

We have found that sugar water (10% by weight sucrose) is sufficiently sweet as a food attractant to initiate large scale recruitment in many species of ants. Boric acid is conveniently soluble in water, and water not only is a convenient carrier or bait matrix, but, in addition, provides the ants with moisture. Liquid baits exploit the natural feeding habits of sweet-eating ants who collect honeydew, nectar or other plant juices which are in a liquid state. Boric acid (1% by weight) serves as the slow-acting toxicant so that the ants have enough time to collect and share the poisoned bait before it reaches a lethal level. This lower concentration also reduces the likelihood of bait avoidance. At

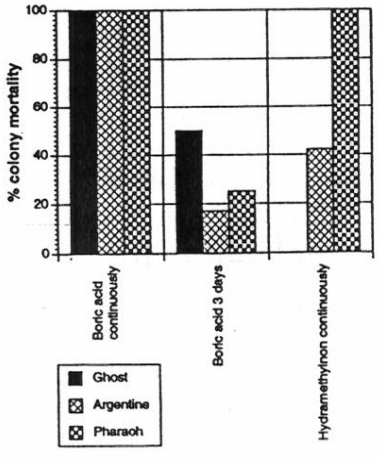


Fig. 2. A comparison of the percent mortality of colonies of ghost ants, Argentine ants and Pharaoh ants after 10 wks exposure to boric acid and hydramethylnon baits. Six small colonies of ghost and Argentine ants were tested and four small colonies of Pharaoh ants. None of the control colonies were eliminated.

lower concentrations such as 1%, boric acid kills at a slower rate (Klotz and Moss 1996).

Effective Against Several Species

Our laboratory tests indicate that this bait is highly effective against the Florida carpenter ant (see Fig. 1). Small colonies of Pharaoh ants, Argentine ants and ghost ants are also eliminated, even when alternative food and water sources are available.

Exposure Time the Key

A key point is exposure time. The bait eliminated all colonies of Pharaoh, Argentine and ghost ants when they were continuously exposed for 10 weeks (see Fig. 2). However, removing the bait after three days of feeding did not give the ants enough time to drink a lethal dose (Klotz et al. 1996). Therefore, baits must be carefully placed in areas where ants are actively foraging, and empty stations should be refilled so that there is plenty of the bait available for a couple of weeks.

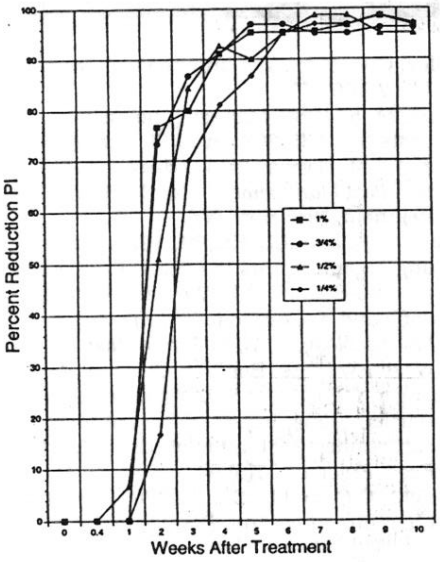


Fig. 3. Mean percent reduction of PI (population index) in *Solenopsis invicta* colonies exposed for 10 weeks to various concentrations of boric acid in 10% sugar water. The PI is a combined value of worker number and brood quantity. Each point represents the mean of 3 colonies of fire ants, each with one queen and >50,000 ants at the beginning of the test. Control colonies (not shown in graph) grew in size.

Fire Ants Controlled

The boric acid/sucrose water bait has been equally successful in eliminating large laboratory colonies of fire ants. For example, four different

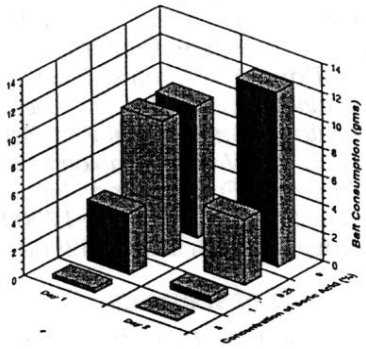
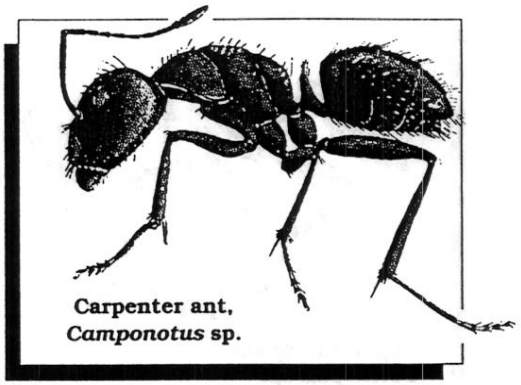


Fig. 4. Fire ant consumption of 10% sucrose water bait with different percent concentrations (wt/vol) of boric acid over a 24 hour duration.



Carpenter ant, *Camponotus* sp.

concentrations of boric acid (1.0%, 0.75%, 0.50% and 0.25%) reduced workers in colonies by 90% in 6 weeks (see Fig. 3). However, we found that colonies consumed less bait at the higher boric acid concentrations (see Fig. 4). This result suggests that the currently available boric acid ant baits contain too

Box A. Characteristics of an Ideal Ant Bait

Strategies for baiting social insects are somewhat different than baiting other pests. Foraging ants gather food and then take it back to the nest to feed other members of the colony (trophallaxis). Only a small percentage of the nest is foraging at any one time. If a bait acts too swiftly, foragers will die before they are able to poison the rest of the colony, and most of the colony will escape. New foragers see the old ones dying, avoid the bait and move the colony. A good ant bait, then, must show delayed action. One definition of delayed action is less than 15% mortality after 24 hour exposure and better than 89% mortality in 20 days (Knight and Rust 1991, Stringer et al. 1964). However, even a bait toxicant that does not meet these standards may still give relief from an infestation.

As well as being slow acting, effective doses of the toxicant cannot be repellent. Repellency is to some degree overcome by using an enticing bait matrix. If a colony has been starved by effective sanitation measures, baits are also accepted more readily. Non-repellency might be the most important bait characteristic because if the bait is not taken by foragers, nothing happens at all.

Baits must also be readily transferred by trophallaxis. For worker exchange, the bait must be liquid or chewed into very small particles. The physical state of the food is not a problem with larvae, as they are are able to eat either solids or regurgitated liquids.

A bait should show delayed action over at least a 10- to 100-fold dosage range. This requirement is necessary due to dilution of the bait during trophallaxis. Enough residual poison must remain after regurgitation to kill the foragers, and the amount delivered must be concentrated enough to do the job, even if it is spread among a number of larvae.

Finally, relatively large amounts of the bait must not be poisonous to non-target species. For instance, if a dog ate a whole bait station, nothing should happen (Stringer et al. 1964).

—Bill Quarles

Imported fire ant, *Solenopsis* sp.

much active ingredient, making bait acceptance and efficacy less than ideal.

We feel this bait may be equally attractive to many other sweet-eating ants, and at the low concentration which we recommend, this product would be safer not only for the user but for the environment as well.

Conclusion

Boric acid/sucrose water baits were evaluated for efficacy against laboratory colonies of the Florida carpenter ant, the red fire ant, the ghost ant, the Argentine ant, and the Pharaoh ant.

Colonies of the Florida carpenter ant exposed to a 1% boric acid bait were eliminated within one month. All colonies of ghost, Argentine and Pharaoh ants continuously exposed to the 1% boric acid bait were completely eliminated. Exposure to the bait for only three days showed partial reduction. Control results with boric acid were equal to or better than hydramethylnon.

Tests with the red imported fire ant demonstrated the efficacy of this bait in elimination of fire ant colonies. Our consumption tests indicate that current concentrations of boric acid in ant baits are too large.

Some of the advantages of using boric acid as a bait toxicant for ants include its delayed activity and its solubility in water. At low concentrations boric acid is slow-acting, and less likely to be repellent. The effective concentration of boric acid in this ant bait is much lower than what is currenty being used or recommended.

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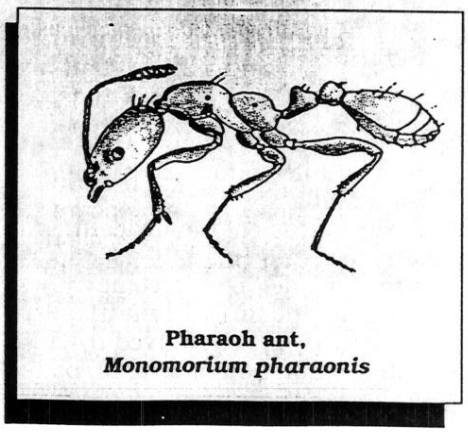

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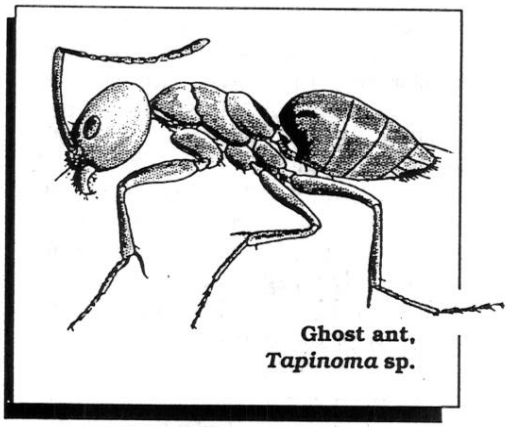

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