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METAFLUMIZONE: A NEW INSECTICIDE FOR URBAN INSECT CONTROL FROM BASF

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Abstract Metaflumizone (proposed common name) is a high performance insecticide submitted for crop registration approval in the USA in 2004. Other key country registration submissions are expected to follow the USA application.Toxicological and environmental studies indicate that there is low risk to applicators and handlers and non-target invertebrates including beneficial insects and pollinators. In addition, metaflumizone exhibits outstanding efficacy on a variety of urban pests. Metaflumizone is a representative of the semicarbazone class of chemistry and has a novel mode of action, making it an ideal candidate insecticide for urban pest control and insect resistance management. Laboratory studies with bait formulations of metaflumizone conducted on nuisance ants (*Crematogaster* spp., *Linepithema humile*, and *Camponotus floridanus*), subterranean termites (*Reticulitermes flavipes)*, red imported fire ant (*Solenopsis invicta),* and German cockroach (*Blatella germanica*) have shown excellent potency. Field trials with bait formulations have shown excellent control on *S. invicta* and nuisance ants, comparable in efficacy to the leading market standards.
Key Words Semicarbazone, ant, termite,cockroach

INTRODUCTION

BASF Agricultural Products has developed metaflumizone (proposed common name) as a new insecticide from the semicarbazone class for both urban and crop pest markets. Toxicological and environmental studies indicate that metaflumizone has a low risk to applicators and handlers and non-target invertebrates including beneficial insects and pollinators and the U.S. EPA is considering it as a reduced risk candidate for U.S. registration.

Metaflumizone's mode of action is to block the sodium channel of the nervous system causing "relaxed" paralysis of the insect. This mode of action requires no metabolism for toxicity to target insects. There is no known cross-tolerance by insect strains resistant to carbamates, organophosphates, pyrethroids, or benzoylureas. Metaflumizone has demonstrated efficacy on a number of urban and crop pests including nuisance ants and fire ants, termites, and cockroaches.

MATERIALS AND METHODS

Laboratory and field studies have been conducted on major urban insect pests to characterize the efficacy of metaflumizone.

Nuisance Ant, Laboratory Evaluation. The test materials consisted of metaflumizone at 0.05, 0.1, and 0.5% a.i. added to a 20% honey/water solution or in a 0.25% gel formulation gel. The ant species tested were *Linepithema humile, Pogonomyrmex occidentalis*, and *Crematogaster* sp. Bioassays were conducted in 100 x 50 mm crystallizing dishes with the upper rim of each dish coated with FLUON (Northern Products, Woonsocket, RI) to prevent ant escape. A piece of cellulose sponge (ca. 2 x 2 x 1 cm) was glued to the inside surface of a plastic lid and dampened as needed. All tests were done at room temperature (~23˚C) and shaded from direct light. Ants were held in test dishes with humidity but no food or free water for 18 h prior to introduction of the bait or provided water but no food for 24 h prior to bait introduction. Duplicate sets of dishes were prepared for each test for exposure of ants to bait treatments for periods of 2 h and 24 h. Following exposure to test bait, the ants were provided with untreated honey-water and observed for mortality or intoxication for 5 days. Mortality was defined as dead or moribund.

Subterranean Termite, Laboratory Evaluation. Bioassays were conducted in 150 x 15 mm Petri dishes with moist sand and 50 *Reticulitermes flavipes* termite workers per dish. One-year field aged bait samples (0.25 g) were enclosed in 50 x 9 mm Petri dishes and placed into a larger test dish. Access to bait was provided by a 3-mm hole drilled into the side of each Petri dish containing bait. Recruitment was determined by the presence of termites inside each Petri dish. Treatments were replicated in three test dishes and maintained at 25˚C and 85% RH. Tests were monitored at intervals for recruitment and mortality. Mortality was determined by counting the number of dead or moribund insects.

Red Imported Fire Ant, Field Evaluation. Individual red imported fire ant, *Solenopsis invicta*, mounds were marked with flags over an approximately 1.2 hectare area and counted or the number of mounds within a 0.1 hectare area were counted. Evaluations were made by examining each flagged mound within the plot at 0, 7, 14, 21, 28, and 35 days post-treatment and estimating the number of active fire ants as follows: 0 = no ants, 1 = 1 to 10 ants, 2 = 11 to 50 ants, 3 = 51 to 100 ants, 4 = 101 to 500 ants, 5 = >500 ants or counting the number of active mounds within a 0.1 hectare area at 0, 1, 3, 10, 17, 31, and 60 days after treatment. All granular materials were weighed for each individual plot and applied using a hand held granular applicator at a rate of 1.75 kg/ha.

Nuisance Ant, Field Evaluation. Three to four white paper cards, 7.5 x 12.5 cm, containing a mixture of honey and sardines were placed around *Tapinoma nigerrium* colonies and the number of ants on the cards after 30 min were counted. Metaflumizone at 0.0625, 0.125, or 0.25% gel baits were placed on 50 x 9 mm Petri dishes and three to four dishes were placed around each colony for a 24 hour period. Cards containing the honey/sardine mixtures were placed in the same areas around the colonies at 3, 7, 14, and 21 days after treatment and the number of ants on the cards after 30 min were counted.

RESULTS

Laboratory and field trials show metaflumizone to be efficacious against a variety of common urban insect pests.

Laboratory Trials

Laboratory trials against nuisance ants and subterranean termites show that metaflumizone incorporated baits provide very high mortality after a reasonably short time period. Evaluations of metaflumizone at 0.05, 0.1, and 0.5% in a honey/water bait on *Linepithema humile* show 100% mortality at 4-5 days after exposure (Figure 1). Similar tests on *Pogonomyrmex occidentalis* show greater than 90% mortality at 0.5% at 5 days after exposure (Figure 2).

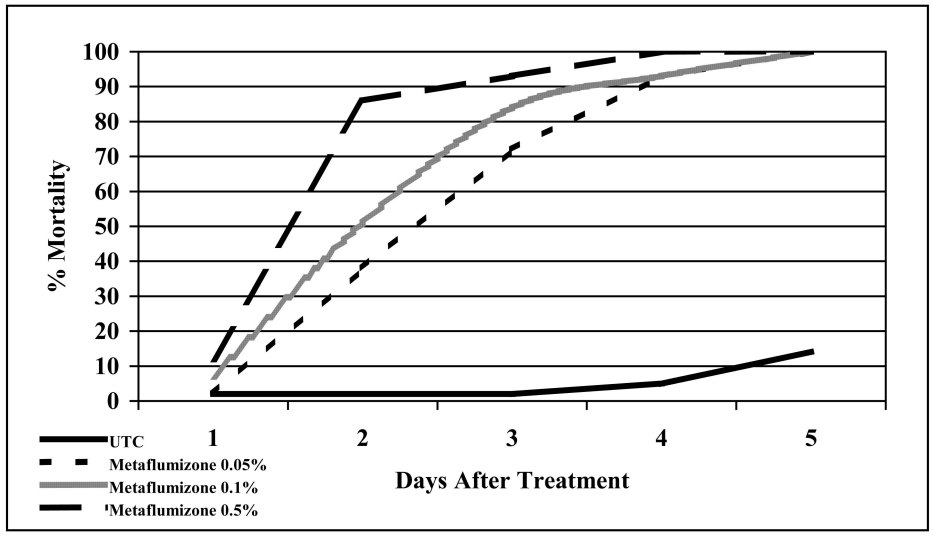

Figure 1. Laboratory evaluation of metaflumizone efficacy in 20% honey-water bait studies on *Linepithema humile* after 24 hour exposure.

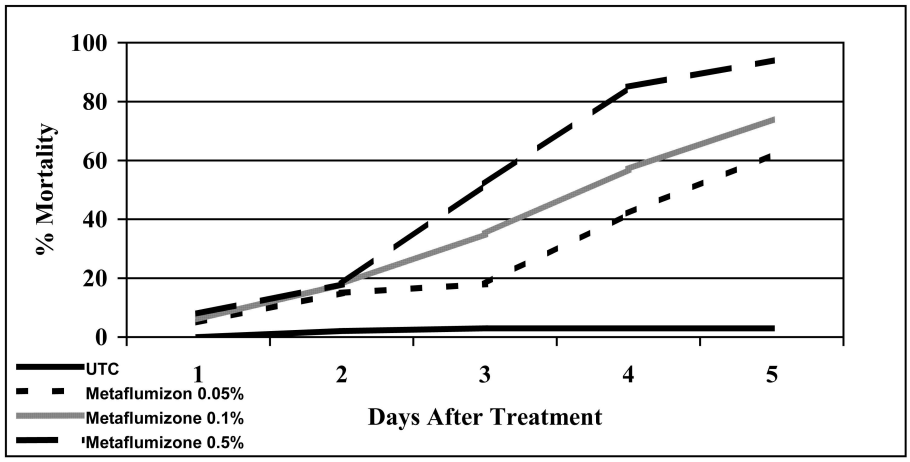

Figure 2. Laboratory evaluation of metaflumizone efficacy in 20% honey-water bait studies on *Pogonomyrmex occidentalis* after 24 hour exposure.

Additional trials show the efficacy of metaflumizone incorporated into commercial ant and subterranean termite baits. A laboratory evaluation of 0.25% gel bait containing metaflumizone as large or small particle size, shows the large particle size has more effect within one day on *Crematogaster* sp. but within three days there is no difference between sizes (Figure 3). An evaluation of metaflumizone at 0.3% in a commercial termite bait shows greater than 80% mortality at 5 days after exposure and 100% within 11 days (Figure 4).

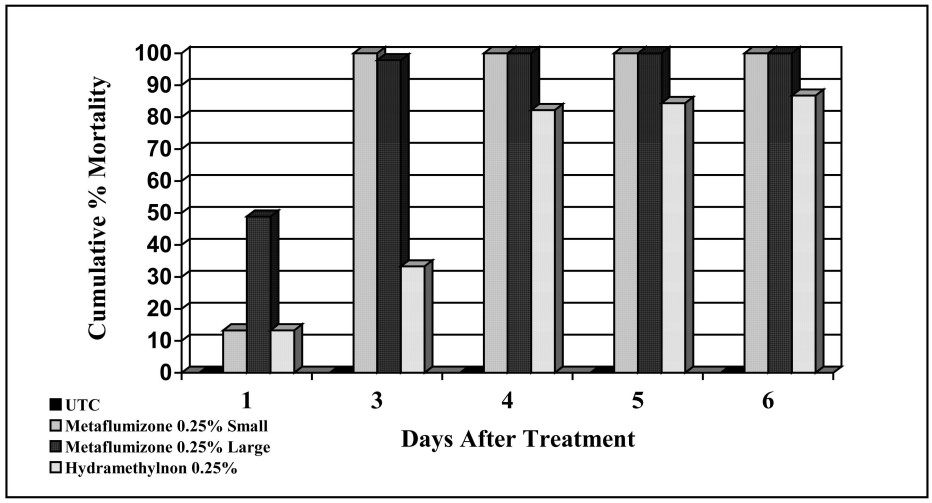

Figure 3. Efficacy of metaflumizone at two different particle sizes in gel bait on *Crematogaster* sp. in a laboratory study.

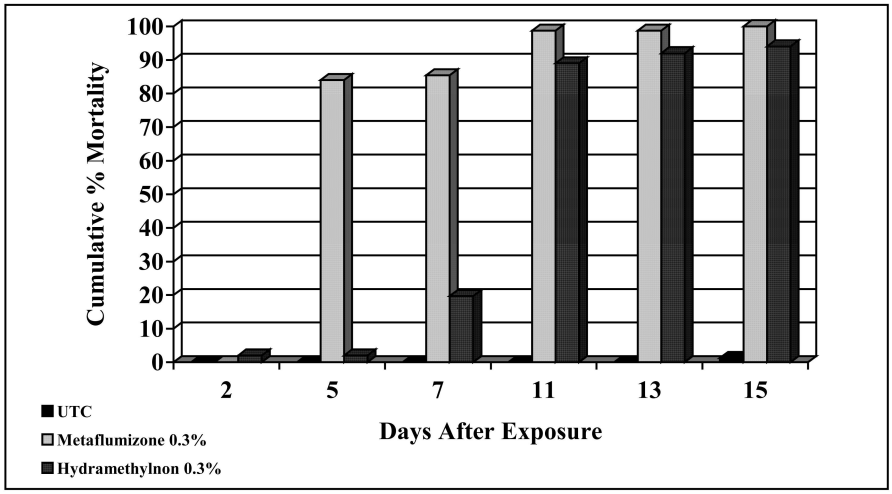

Figure 4. Efficacy of metaflumizone in 0.3% wood fiber matrix bait aged in the field for one year on *Reticulitermes flavipes* in a laboratory study.

Field Trials

A trial in Mississippi comparing metaflumizone at 0.063% with hydramethylnon at 0.73% for *Solenopsis invicta* control shows a similar reduction of the population at 7 days after treatment (Figure 5). A similar trial in Texas shows a quick effect on *Solenopsis invicta* with metaflumizone at 0.063% (Figure 6). At 60 days after treatment, all materials tested were comparable for control of fire ants. Efficacy of metaflumizone in a gel bait at 0.063, 0.125, and 0.25% was ≥ 80% within three days after treatment in a test in Spain on *Tapinoma nigerrium* (Figure 7). At 7 and 14 days after treatment, the two highest rates of metaflumizone provided greater than 80% control.

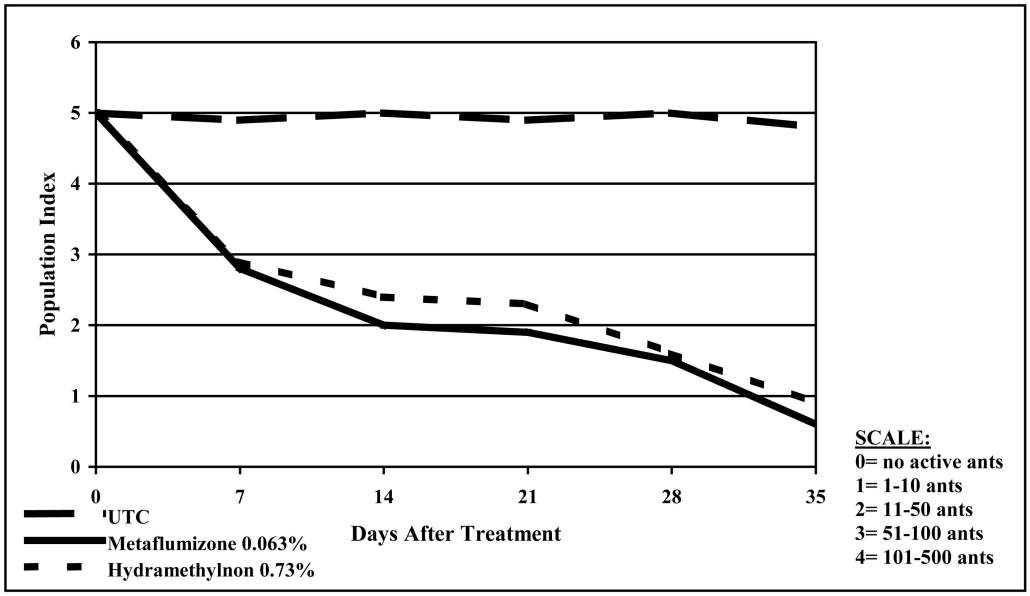

Figure 5. Efficacy of metaflumizone on *Solenopsis invicta* in a broadcast bait trial in Mississippi.

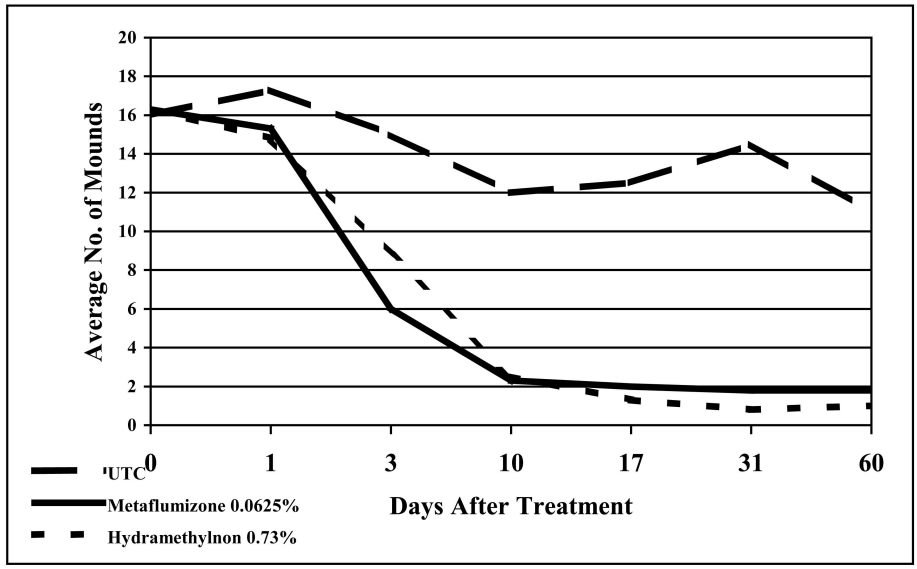

Figure 6. Efficacy of metaflumizone on *Solenopsis invicta* in a broadcast bait trial in Texas.

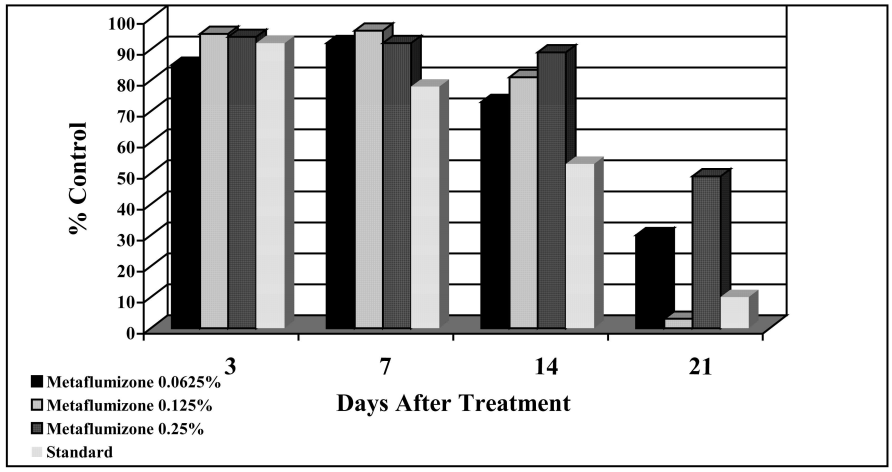

Figure 7. Efficacy of metaflumizone on *Tapinoma* sp. in a gel bait trial in Spain.

CONCLUSION

Studies indicate that metaflumizone is a very efficacious insecticide against a variety of key insect pests in both urban and crop markets particularly for pest species in the Orders Hymenoptera and Isoptera. It is a new chemistry with a novel mode of action and no known cross-resistance to existing products. Research results indicate that metaflumizone will be an excellent low risk pest and resistance management tool for urban pest control.