SUSTAINABLE FIRE ANT MANAGEMENT

CURRENT TOPIC

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Abstract: Efforts are underway to introduce natural enemies of the red imported fire ant to lessen its competitiveness against native ants. Releases of fire-ant-decapitating phorid flies have been made in several southern states. Mass rearing and additional releases of these flies are underway now. Experimental releases of a disease-causing protozoan have been made in ten southern states. A number of least-toxic fire ant control materials are discussed. Sources for some materials are provided in the ***Resources*** *section. Physical controls such as hot water, steam, and ant traps are discussed.*

Fire Ant Ecology and Biological Controls

The red imported fire ant, *Solenopsis invicta,* arrived in the U.S. from central Brazil between 1933 and 1945 by hitchhiking on ship cargo. Though *S. invicta* has become quite a pest, not all fire ant species have achieved pest status. The black imported fire ant, *Solenopsis richteri,* arrived before the red imported fire ant, sometime around 1918. *S. invicta* has out-competed its black cousins and also crossed with them, creating hybrids between the two species (1). The Texas red ant, *S. geminata,* a native American fire ant found in much of Texas, is not considered a pest.

The red imported fire ant prospers in open sunny areas such as cropland, pastures, and urban lawns. It is an insect of disturbed, low-diversity habitats. In its native South America, the ant evolved in frequently disturbed floodplain areas. Undisturbed areas, such as swamplands and dense forests, have very low densities of fire ant nests (2). The ants have an aversion to deep shade. Their mounds, which they build in almost any type of soil, can reach 18 inches high and be 2 feet wide, with tunnels extending 5 to 6 feet underground. The mounds are often located in rotting logs and around stumps and trees. Ant colonies can also be found in or under buildings. Two types of mounds exist: single -queen colonies where there are t ypically 30 to 100 colonie s per acre, and multiple-queen colonies where the density of mounds per acre may average between 200 and 700, with each mature colony having 200,000 ants. Ants from the single-queen mounds form territories around the mound, which they protect from other fire ants. The multi-queen colonies are not territorial.

Fire ants spread in two ways, according to the type of colony. From the single-queen colonies, winged virgin queens emerge, fly high above the colony, and mate with winged males between spring and early fall. The queens land to establish new colonies alone. Such airborne spread should lead to a patchy distribution of new fire ant colonies interspersed with colonies of native ant species. Multiple-queen colonies spread when a new queen leaves the parent mound with a group of workers to form a new colony nearby (3, 4). This strategy has been more successful where native ant populations have prevented colonization by single-queen colony virgin females trying to start a

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colony alone. In a Texas study, imported fire ant spread was observed as a continuous moving carpet of fire ants spreading slowly across the landscape. Once an area had been invaded, there were seven imported fire ant mounds for every native fire ant mound formerly present. After invasion, all native ant species declined, and overall arthropod diversity was reduced by more than 40% (5). Interestingly, in this study area the last place to be colonized was a patch of little bluestem grassland that has been undisturbed since the 1920s. These observations support the idea that native ants have better resistance to invasion in undisturbed native grassland. Once established in a new area, the imported fire ant typically decreases the diversity of native insect communities and wildlife and out-competes native ant species, driving some to extinction.

The red imported fire ant consumes a wide variety of foods including many types of insects, carrion, seeds, and seedlings. They are considered a beneficial species in some crops like sugar cane, cotton, and pecans, where they prey on boll weevils and boring insects (6). In urban areas they feed on roach eggs, flea larvae, ticks, chinch bugs, and other pests. On the other hand, the imported fire ant stings painfully and causes problems with mowing, tilling, harvesting, and electrical equipment.

The red imported fire ant has flourished in the U.S. in the absence of co-evolved predators, pathogens, and parasites. The absence of these natural enemies has allowed it to dominate food sources despite the fact that it is largely identical to native fire ant species. Further, the aggressive use of insecticides against the imported fire ant has only served to wipe out competing and predatory native ant species and increase the competitive dominance of the imported species by killing off its competition.

In their native Brazil, red fire ants exist in much lower numbers than in the southern U.S. (Figure 1). Even in desirable habitat such as Brazilian roadsides, the fire ant density is 10% of that seen in the U.S. It is not uncommon to walk 100 to 200 yards from one mound to the next one. Our native U.S. fire ant was present in similar densities in Texas before the arrival of the imported fire ant. The reason for the staggering difference in fire ant abundance in Brazil and the U.S. is the presence of natural enemies. In its native Brazil, the red fire ant is attacked by several species of flies in the Phoridae family. When a fire ant mound is disturbed, the workers rush out to defend the mound. But they quickly run back underground to avoid attack by these flies. Our native U.S. fire ants are also attacked by phorid flies that specifically parasitize the native fire ants but not the imported fire ant.

The same behavior has been observed in native U.S. fire ants with native phorid flies. Fire ants recognize these flies as harmful and will seek cover when they are present. So, in addition to killing fire ants outright, the flies hamper their feeding behavior. This change in feeding and foraging behavior allows other ant species to compete effectively with fire ants. In other words, the appropriate phorid fly species levels the playing field by removing the fire ants' competitive edge.

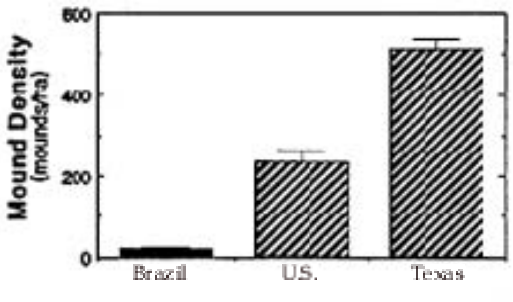

Figure 1. Fire ant mound density in Brazil compared to the U.S. and Texas(3).

The small phorid flies are about 1/16 inch long and spend their time hovering above disturbed mounds or along foraging trails looking for fire ants. When a fly locates a fire ant, it swoops down and lays an egg on the ant. The egg will hatch into a tiny maggot that bores into the fire ant's head. The fly maggot grows inside the ant's head by eating the brain and other head contents. Once the ant dies the fly maggot pupates inside the head that has by now fallen off. Eventually, an adult fly emerges from the ant head and flies off to lay eggs on other fire ants.

Figure 2. Phorid fly.

Photos courtesy of USDA Gainesville, FL

Figure 3. The phorid fly larva lives in the decapitated fire ant's head.

Figure 4. A young phorid fly emerges from the ant's head after pupating.

Scientists have identified two species of decapitating phorid flies that are host-specific to red imported fire ants. Mass rearing of phorid flies at several USDA facilities has been underway since the spring of 2001, and releases have been made in 12 southern states. After talking with USDA scientists in Florida and Mississippi, I realized that the phorid fly-release programs are still in the early stages. Although scientists are selecting demonstration sites on both private farms and research stations, no flies are available for purchase or for general release on farms by individuals. The phorid flies will not provide complete control of fire ants but rather contribute to keeping both their numbers and their foraging activity down. For more information on phorid flies, see the Web sites listed under the **Resources** section.

The USDA Agricultural Research Service has sponsored an area-wide suppression of fire ants in pasture projects in five southern states. Cooperating states are Florida, Mississippi, Oklahoma, South Carolina, and Texas. The project's goal is to demonstrate practical, long-term control of fire ants over a large area using a combination of baits and biological controls. Two 300-acre sites of improved pasture in each state have been selected for the demonstration treatment. Fire ant populations are reduced through a combination of aerially applied baits plus biological controls of phorid flies and *Thelohania solenopsae*, a disease-causing protozoan released around the perimeter of the treated area. The researchers expect this program to provide sustainable control, thus reducing the need for repeated bait or pesticide applications. Read more about the project at the USDA-ARS Web site: http://www.ars.usda.gov/fireant/.

Releases of *Thelohania solenopsae*, a disease-causing protozoan that attacks the imported fire ant, have been made in 10 southern states (8). This disease apparently came to the U.S. with the fire ant, and releases are being made without quarantines. ARS scientist David Williams, who is working with colleagues to mass-produce the pathogen, says the disease is slow but very efficient (9). It infects the queen, and soon she starts losing weight. Subsequently, she produces fewer eggs and the colony slowly declines. The diseased queen produces diseased young queens that fly off infected with the disease. An infected colony dies out in a year to 16 months (10). Once USDA scientists work out an effective mass-production method, more releases of *Thelohania* disease will be made. Currently there are no commercial products containing *Thelohania* available.

Certain species of beneficial nematodes attack the imported fire ant. Treatment is expensive, and the effectiveness of parasitic nematodes can vary. Sources of nematodes are limited, but include Gulf Coast BioTech Controls (see **Resources** section). Their ANTidote® product contains three species of nematodes that parasitize and kill fire ants. These three types of nematodes enter the various castes of ants (males, workers, and queen). ANTidote works more slowly in black gumbo soils than in sandy loam soils, simply because the nematodes are better adapted to sandy soils than to heavy clays. The product is mixed with water and applied as a drench to the mound.

Other biocontrol agents are: workerless parasite ant (*Solenopsis daguerri* and *S. ricteri*), armadillos, beetles, millipedes, silverfish. This Web page has references to these controls:
http://uts.cc.utexas.edu/~gilbert/research/fireants/faenviron/predators.html
which will lead you to:
http://uts.cc.utexas.edu/~gilbert/research/fireants/faenviron/index.html
which will lead you to the references.
Another Web page with alternative controls:
http://www.thebestcontrol.com/pests/fireants/ipm2.htm

Least-toxic Pesticides

A wide variety of insecticides are labeled for fire ants. Since many field studies have been done in the states with fire ant populations, it is advisable for readers to contact their local Extension agents and other sources for those studies before investing in fire ant treatments. Money and time can be saved with appropriate *local* information evaluating efficacy of available materials for fire ant control. Information on the least toxic and most environmentally appropriate options is presented below.

Disclaimer: Pest control products are changing all the time. One year a product may be widely available and the next year off the market for various reasons. ATTRA assumes no responsibility for the efficacy of any of these products, nor for their availability. As with any product, read and follow label directions and safety precautions with all fire ant controls. Sources for some of these products are found at the end of this publication. There may be other appropriate products that have been omitted here. ATTRA makes no claim that this coverage of fire ant control products is comprehensive.

Baits

Baits containing a toxicant (frequently dissolved in soybean oil) are considered effecti ve methods of controlling fire ants (13). Corn cob grits are typically used to absorb the toxicant and oil. The baited grits are then applied by hand with a broadcast seeder to a large area around individual mounds. Stringent requirements for these baits dictate that they have delayed toxicity, are effective over a 10-fold dose range, degrade quickly, and are otherwise environmentally acceptable (13). Baits can poison non-target ants if care is not taken to put the bait around fire ant mounds only. Baits are applied during spring and fall when fire ants are actively feeding, and not during the hottest part of summer. A void applying just after a rain or when the ground is wet with dew, as water decomposes the bait.

The following section on fire ant baits is based on a University of Georgia Cooperative Extension Service publication entitled *Managing Imported Fire Ants in Urban Areas: A regional publication developed for the southern states* . (Bulletin 1191, September, 2000). It is available on the Web at: < http://www.ces.uga.edu/pubcd/B1191.htm#Table1>. Baits are listed by generi c names of active ingredients, followed by some examples of product names, how they are used, and their modes of action.

Hydramethylnon and sulfluramid (Amdro®, Siege®, Combat®, MaxForce®, Raid® Ant Baits Plus) are ingredients that kill ants by preventing them from converting food into energy. These baits eliminate fire ant colonies within a week when applied to individual mounds, but take several weeks when broadcast. They are also formulated in bait granules and bait stations. Some of these baits cannot be used on cropland producing food or feed (check the labels).

Avermectin, also known as abamectin (Ascend ™, Clinch™, Varsity™), is a bait product derived from a soil fungus that inhibits nerve transmission. As a mound treatment, it kills worker ants and colonies quickly, but as a broadcast treatment it acts more like an insect growth regulator, preventing the production of viable eggs. Being an insect growth regulator, it causes sterility of the queen, and eventual death of the entire colony. Fire ant populations were reduced by 87% within six weeks of treatment (13). Abamectin is quickly degraded in the environment and binds strongly to soil.

Spinosyns, also known as spinosad (Eliminator Fire A nt K iller Bait with Conserve®, Penn Kill ™ Fire Ant Killer, and others), are natural metabolite products, produced by a soil microorganism,

(*Saccharopolyspora spinosa*) that affect the nervous system. Bait formulations have a speed of activity similar to hydramethylnon and sulfluramid baits.

Insect growth regulators include fenoxycarb, methoprene, and pyriproxyfen (Award®, Logic®, Extinguish®, Distance®, Spectracide® Fire Ant Bait). These materials mimic the effects of the insect's own juvenile hormone, reducing the production of viable eggs and preventing the development of worker ants for up to a year after application. They do not kill adult ants. Treated ant colonies persist for several months after treatment, until worker ants present at the time of treatment die naturally. These products are formulated as a bait to be applied to individual mounds or broadcast.

Fenoxycarb, an insect growth regulator, shows low toxicity to birds, fish, and mammals (13). Field test results showed 60% of treated colonies were dead after 13 weeks. About 33% of those left had fewer than 1,000 forager ants. Only 13% of surviving colonies had any worker brood (13).

Boric acid baits

Boric acid has been used to kill a wide variety of insects in various situations for many years. It can be mixed with sugar or syrup to make a household ant bait as well. In a laboratory study, four dilutions of boric acid (.25%, .50%, .75% and 1%) were mixed with sugar water and offered as a bait to treat fire ant mounds. All dilutions achieved 95 to 100% control within 8 weeks (14). Bushwhacker® is an 18% boric acid granular bait that is registered for fire ants. A new gel bait containing orthoboric acid, called Drax Nutrabait, came on the market in July 2003. It is available from the Waterbury Company. The Web site <http://www.thebestcontrol.com/pests/fireants/ipm2.htm> mentions electric attractants to baits as well as mechanical disturbance, water controls, kill-clean enzymes, and orange or grapefruit juice concoctions.

Plant-derived contact insecticides

The following section on fire ant contact insecticides also comes from the University of Georgia Cooperative Extension Service publication *Managing Imported Fire Ants in Urban Areas,* available on the Web at: < http://www.ces.uga.edu/pubcd/B1191.htm#Table1>.

Botanicals include d-limonene, pyrethrins, rotenone, pine oil, and turpentine. These plant-derived products have various modes of action. D-limonene is a citrus oil extract that kills ants quickly. Pyrethrins, which act on nerve axons, also kill ants quickly (within minutes to hours) and can be used as mound treatments or surface sprays. Rotenone acts on respiratory tissues, nerves, and muscles. Pyrethrins and rotenone products break down rapidly in the environment. Rotenone and pine oil (turpentine) products are relatively slow-acting (days to weeks) and are applied as mound drenches. Brand names include Citrex™, Insecto® Formula 7, Organic Solutions ™ Multipurpose Fire Ant Killer, Organic Plus® Fire Ant Killer, and others.

Derivatives of Pyrethrins include allethrin, resmethrin, sumithrin, and tetramethrin. These products destabilize nerve cell membranes and kill quickly, but are quickly deactivated and have little residual activity. They are applied as aerosol injections, mound drenches, or surface sprays. Brand names include Enforcer® and Fire Ant Killer.

Other miscellaneous products not listed above include:

Products combining diatomaceous earth with pyrethrin: Organic Plus®, Perma-Guard®, and Concern®.

Exxant™, a mound drench consisting of turpentine, ammonia, and other natural products.

A study in Texas led by Dr. B astiaan Drees, Extension Entomologist, evaluated the effectiveness of **organic treatments** for fire ant control (15). Six products were compared to three controls: water drench, Orthene insecticide, and no treatment. The results observed 14 days after treatment are shown in Table 1.

Table 1. Percent fire ant reduction from six organic insecticide products, compared to three controls, 14 days after treatment.

Product	Percent reduction 14 days after treatment
Organic Plus (pyrethrin + piperonyl)*	98
Insecto Formula 7 (botanical oils)	98
Orthene T. and O. Spray (control)	98
Bonide Rotenone 5	68
Natural Guard Nicotine sulfate	23
Water drench (control)	20
Gardenville Diatomaceous Earth	18
Untreated (control)	5

*piperonyl is prohibited in organic production

Dr. Charles Barr, fire ant specialist with the Texas Cooperative Extension, states that spinosad is considered organic because it is produced from a bacterial fermentation process that produces a toxin, which is then extracted and put into a bait. Spinosad baits work well in small areas or as mound treatments, achieving maximum control in two to four weeks (16). Spinosad costs about $8 to $10 per pound and is available at some lawn and garden outlets. In some cases it may need to be specially ordered. The bait is best applied during spring and fall when temperatures are warm (above 65 degrees) but not too hot. Summer applications are best done in the late afternoon or early evening. Conserve® is one formulation of spinosad. Only the product Justice® can be used on individual mounds in pastures. Other formulations are labeled for ornamental, turf, plants, yards, or flowerbeds, but not for anywhere food is grown or animals are grazed (16).

Physical controls

Boiling water

Boiling water is an effective treatment for individual mounds. If it does not kill the queen, it will not eliminate the colony. Boiling water kills grass and sterilizes soil and may best be considered as a last resort.

To use hot water as a mound treatment for fire ants, start with a sunny but cool day when ants are near the surface. Be careful to avoid scalding yourself! Pour about three gallons of boiling water slowly over the mound. Try to collapse as much of the mound as possible while pouring. Portable boilers that generate hot water and steam are available. The Original Ant Eater is one such boiler, available from M&B Enterprises (see **Resources**). The boiler comes with a dome-shaped delivery device that is placed over the mound and through which the steam passes. The ants, their larvae, and their stored food are all scalded within seconds. A hot-water pressure washer can also be used to apply steam and hot water to ant hills.

Other

"Earthfire" is a species specific mound injection tool used to kill whole RIFA mounds in seconds. It is a hand-held tool complete with a propane cylindar, trigger assembly, and probe that is inserted in the mound. Once the probe is in the mound, the trigger is pulled, releasing a propane-charged insecticide into th e mound. The tool is a patented low -pressure, sub-surface vapor-delivery device. It w orks by creating a venturi, causing the vapor to fill the entire fire ant mound from the bottom up. The ants suffocate from the vapor throughout the tunnel network. The EPA approved and registered pesticide used is a 1% formulation of Resmethrin, a pyrethrin derivitive. Resmetrin is a class III pesticide and has an LD-50 (rat) toxicity of > 2500 mg/kg. It is much less toxic than Dursban, Diazinon, and Rotenone. For more information on Earthfire, contact Pete Johnson. (see **Resources**).

The Ant Charmer™ is a solar-powered ant trap that catches ants and drowns them in a soapy water solution. It is available from Heitman Laboratories (see **Resources**).

Medusa Ant™, a complete ant management system using biological control methods, is available from Praxis. Medusa Ant is listed for carpenter ants and other species. It is pesticide-free.

References:

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8) Weaver-Missick, Tara. 1999. Ouch! The fire ant saga continues. Agricultural Research. September. p. 5–8.

9) David Williams (USDA, ARS, CMAVE)
P.O. Box 14565
Gainesville, FL 32604
352-374-5982

10) Wolfshohl, Karl. 2000. Fighting fire with fire. Progressive Farmer. October. p. 40–41.

11) Chenault, Edith A., and Bart Drees. 1999. Biological control offers hope for fighting fire ants. http://agnews.tamu.edu/stories/ENTO/Sep1699a.htm.

12) Troy Biosciences
113 South 47 th Avenue
Phoenix, AZ 85043
800-448-2843
http://www.troybiosciences.com/

13) Quarles, William. 1998. Living with fire ants. Common Sense Pest Control. Summer. p. 5–16.

14) Klotz, J.H., K.M. Vail, and D.F. Williams. 1997. Toxicity of boric acid-sucrose water bait to *Solenopsis invicta*. Journal of Economic Entomology. Volume 90, Number 2. p. 488-491.

15) Drees, Bastiaan M., and S. Bradleigh Vinson. No date. Fire Ants and Their Management. B-1536. Texas Agricultural Extension System, College Station, TX. 18 p.

16) Chenault, Edith A. 2003. Organic fire ant baits available. American Small Farm. May. p. 24.

Fire Ant Resources:

For additional information about imported fire ant management, contact your county Extension agent and visit these World Wide Web sites:

http://fireant.tamu.edu *This is one of the most comprehensive sites available on fire ants.*
http://www.ag.auburn.edu/dept/entplp/FireAnts/ *The Alabama fire ant site.*
http://www.lsu.edu/ants/index.shtml
http://www.ces.uga.edu/pubcd/b1068-w.html
http://www.safe2use.com/pests/fireants/fireants1.htm

A Review of "Organic" and Other Alternative Methods for Fire Ant Control by Dr. Bastiaan Drees, Fire Ant Project Coordinator at the Texas A&M University. A copy is available on the Web or may be obtained from Dr. Drees at:

Department of Entomology
2475 TAMU
Texas A&M University
College Station, TX 77843-2475
979-845-5895
979-845-7029 FAX
E-mail: b-drees@tamu.edu
http://fireant.tamu.edu/materials/factsheets/FAPFS012.2002rev.pdf

Other publications on the subject of fire ants at this Web site include:

- *Fire Ants and their Management*
- *Managing Red Imported Fire Ants in Agriculture*
- *Managing Red Imported Fire Ants in Urban Areas*
- *The Two-Step Method for Fire Ant Control*
- *Pattern of Interactions Among Imported Fire Ants and Native Ants on the Invasion Boundary*
- *Potential Biological Control Agents for the Red Imported Fire Ant*

BIRC, Bio-Integral Resource Center, a non-profit corporation, provides practical information on the least-toxic methods for managing pests based on IPM principles. BIRC publishes the *Common Sense Pest Control Quarterly*. It can be subscribed to by contacting:

BIRC
PO Box 7414
Berkely, CA 94707
510-524-2567
http://www.birc.org

Suppliers of least-toxic fire ant control products:

ARBICO (D.E., Boric acid powder and ant bait, Insecto Formula 7, Rotenone)
P.O. Box 4247 CRB
Tucson, AZ 85738
800-827-2847
http://www.goodearthmarketplace.com

Bethurum Research & Development, Inc. (Bushwhacker boric acid product)
P.O. Box 345
Rancho Mirage, CA 92270
800-422-2687
http://www.bethurum.com

Gulf Coast Bio tic Technology Inc. (ANTidote beneficial nematode formulation)
1041 Elkins Lane
Huntsville, TX 77320

Heitman Labs (solar powered ant trap)
6829 K Avenue, Suite 112
Plano, TX 75074
800-472-5024
972-509-2400
972-509-2401
http://www.antcharmer.com

M & B Enterprises (steam ant mound killer)
Box 27
Norphlet, AR 71759
870-546-3552

Earthfire
Pete Johnson
Earthfire Corp. -- for fire ant eradication
Scottsdale AZ 85 267
480-951-3654
480-951-0040 FAX
E-mail: johnsoncom@aol.com

Syngenta (Award and Logic growth regulator baits)
Box 18300
Greensboro, NC 27419
800-334-9481
http://www.syngenta.com

Organic Solutions (Fireant killer #107)
8745 Grissom Road
San Antonio, TX 78251
800-862-7482
210-688-3416
http://www.organicinsecticide.com

Planet Natural (Ascend Abamectin bait)
1612 Gold Avenue
Bozeman, MT 59715
800-289-6656
406-587-5891
http://www.planetnatural.com/

Praxis (Medusa Biotool kit for fire ants - a site-specific ant management system)
2723 116th Avenue
Allegan, MI 49010
616-673-2793
http://www.praxis-ibc.com
E-mail: praxis@allegan.net

Troy Biosciences (developing a biological control product from *Beuvaria bassiana*.)
113 South 47 th Avenue
Phoenix, AZ 8504 3
800-448-2843
http://www.troybiosciences.com/

Wellmark International (Extinguish fire ant bait)
1100 East Wood Field Road, Su ite 500
Schaumburg, IL 60173
800-842-3134
847-330-5300
http://www.zoecon.com

The Eradicator (mound venturi injection system)
Park North Technology Center
255 West Airtex
Houston, TX 77090
713-876-7153
713-876-0043 FAX

Lang Laboratories, Inc. (producer of Exxant™)
P.O. Box 565
Scottsville, TX 75688-0565
903-938-2272
http://www.exxant.com

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The electronic version of Sustainable Fire Ant Management is located at:
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