ESTIMATED AMOUNTS OF INSECTICIDE INGREDIENTS USED FOR IMPORTED FIRE ANT CONTROL USING VARIOUS TREATMENT APPROACHES

Bastiaan M. Drees, Professor and Extension Entomologist

The red imported fire ant, *Solenopsis invicta* Buren (Hymenoptera: Formicidae), is a highly destructive exotic pest ant in the southeastern United States, producing an average ant mound density of 68 mounds per acre (168 mounds/ha)(Porter et al. 1992). Control methods for imported fire ants depend largely on use of insecticides using one or more programs described by Drees et al. (2002). Recent demonstrations of community-wide management programs have used methods that dramatically reduce cost of insecticides for attaining superior control (Riggs et al. 2002). Implementing these methods throughout fire ant infested portions of Texas and the southeastern U.S. can also dramatically reduce insecticides applied in the landscape.

An attempt is made herein to calculate insecticide use and potential reduction of pesticides applied in urban areas for red imported fire ant control using broadcast applications of imported fire ant bait products, part of the Two-Step Method of fire ant control, particularly in larger-scale, community-wide management programs (Drees et al. 2002). This analysis does not address other issues related to selecting insecticides, such as cost of formulated products, labor and equipment costs necessary to make applications, which are discussed by Barr (2002), although some toxicological and performance differences of specific treatments will be considered.

Environmental Problems Associated with Imported Fire Ant Control Insecticide Use

A press release by the Water Department of the City of Fort Worth (1997) states that "The City of Fort Worth is urging residents to team with their neighbors to treat for fire ants using bait products during the month of September. The "Let 'em Eat Bait" campaign is designed to make residents aware of an effective way to treat for fire ants using less toxic pesticides. The city is targeting fire ants because a 1997 survey revealed fire ants are the primary reason residents use pesticides, and diazinon is the primary pesticide used to treat fire ants. Diazinon causes problems for the city when it enters the wastewater system or gets into local creeks and rivers. Diazinon has caused the city to periodically fail monthly tests required by the state and federal wastewater plant discharge permits. The city's federal storm water permit, managed by the Environmental Management Department, requires the city to periodically monitor diazinon levels in local creeks and rivers. The Two-Step Method for controlling the imported fire ants was developed by researchers at Texas Agricultural Extension Service (now called Texas Cooperative Extension) to help consumers best use fire ant control products on the market." Similar environmental threats from overuse and misuse of imported fire ant insecticide treatments exists throughout the range of this pest.

Sources of Information

Use patterns of insecticides for imported fire ant control are not generally available. Privately conducted marketing analyses have been conducted by some insecticide product manufacturers like Valent U.S.A. (Kline & Company, Inc. 1995)(Appendix 1), and surveys have been conducted by the Texas Cooperative Extension or contracted through the Texas Imported Fire Ant Research & Management Project (Scripps Howard Texas Poll 2000)(Appendix 2).

These are the best sources of information, but are somewhat out-of-date because of major changes in insecticide products available to the general public. Specifically beginning in 2003, diazinon and chlorpyrifos (Dursban®) are no longer being sold, in part, as a reaction to the effect of the Food Quality Protection Act (FQPA). This action is currently causing a major shift in pesticides being purchased and applied for imported fire ant control to the pyrethroid insecticides (bifenthrin, cyfluthrin, cypermethrin, deltamethrin, fenvalerate, fluvalinate, lambda-cyhalathrin, permethrin, s-bioallethrin, s-fenvalerate, tefluthrin, tralomethrin).

New products, such as those containing fipronil are constantly being added to the spectrum of products available to consumers. Pyrethroid and fipronil products generally contain far less active ingredients than older organophosphate and carbamate insecticides. As a result, insecticide quantities applied to the environment are constantly changing. However, effects of changes in pesticide use patterns can be modeled or estimated using available sources of data or specific sets of assumptions.

Use Pattern Considerations

The Scripps Howard Texas Poll released in March 2000 (Appendix 2) is the best information available on homeowner insecticide use patterns for imported fire ant control. About half of the people in Texas treat their yards to attempt to control fire ants. Most (65%) use individual mound treatments and 51% treat one or more mounds four or more times per year. Relatively few people (24%) report using broadcast-applied bait-formulated products, and of these 11% use the Two-Step Method (broadcast bait followed by individual mound treatment later). Riggs et al. (2002) have documented that managing imported fire ants on a community-wide basis using broadcast applied fire ant bait products dramatically reduced ant mound densities, pesticide cost and use.

The Texas Cooperative Extension educational programs are focused on promoting methods which dramatically reduce or eliminate the excessive use of individual mound treatment methods. Individual mound treatments use more insecticide, cost more to apply in product and labor, potentially contaminate surface runoff water, serve as a potential non-point source of groundwater pollution, and are less effective under most conditions (e.g., small treatment areas such as single yards or properties or where ant mound densities exceed 20 mounds per acre).

Amount of Insecticides Applied to the Environment

Insecticide products are formulated as dusts, granules, liquids, fumigants and baits. Each of these formulations contains a specific amount of active ingredient(s) (a.i.). These amounts have been computed for selected insecticide products as a basis for calculating the amount applied to treat an imported fire ant mound and for various levels of mounds/acre/year (Table 1). However, the a time element should be included because some products and treatment patterns provide short-term control while others provide longer-term control (see discussion below). Duration of control, depending on product chosen and how it is applied, can result in the need for multiple applications per season. From values calculated for each product, the amount of materials (ounces) applied over time to a unit area (acre) can be computed (Table 3). From there, specific examples of insecticide use can be calculated using selected assumptions such as product combinations, cases of different ant forms and treatment type or inputs (data) from actual demonstrations such as Riggs et al. (2002) (Table 2).

Use of individual fire ant mound treatments results in an additive load of insecticides used per unit area depending on initial mound density and the re-infestation rate. The organophosphate insecticides (e.g., acephate, chlorpyrifos and diazinon) contain more active ingredient per mound treatment than pyrethroid insecticides (e.g., bifenthrin, cyfluthrin and deltamethrin)(Table 3). Even within groups, refinements in formulations (i.e., acephate 50% versus 75% dust) can result in reduced active ingredient applied.

Bait-formulated insecticides contain 1% (i.e., MaxForce®, the bait containing the highest percent a.i.) or less active ingredients (Table 1). When applied as ant mound treatments, the application rates are similar to pyrethroid products used in the same manner. However, broadcast application of bait products results in the use of far less active ingredient an area regardless of initial mound density. Fipronil granular formulations, broadcast-applied to the surface, are formulated in an amount equivalent to some bait-formulated products (i.e. fipronil at 0.14348 oz a.i./acre versus hydramethylnon 0.73% at 0.112 oz a.i./acre using 1 lb. granulated product/a).

Re-treatment Considerations

When comparing one treatment to another, the number of ant mounds treated over time should be considered. In small plot (or yard) demonstrations, re-invasion is relatively rapid from surrounding, untreated areas. Often, these plots are re-invaded within the 30-day duration of the trial, although mounds are often in different locations than where they were at the beginning of the trial. Thus, a more accurate assessment would also address the need for re-treatment. The concept of managing imported fire ants on a community-wide basis rests on the assumption that because a larger area is treated, re-invasion occurs more slowly. This assumption has been verified by Hooper-Bui et al. (2000). As an example, if an acre of land was infested with 50 mounds per acre and treated with an individual mound treatment, four applications per year might be required to maintain control requiring 200 mound treatments, whereas one or two broadcast-applied bait treatments could achieve the same level of control.

Estimated Pesticide Use Reduction

If one were to use the weighted average active ingredient applied to ant mounds based on Kline & Co. 1995 product sales estimates (see calculation Appendix 1) using the national average mound density estimate of 68 mounds/acre (Porter et al. 1992), use of individual mound treatments alone would require 1.14 oz a.i./acre for a single treatment. Compared to use of hydramethylnon 1% applied as a broadcast application using 0.240 oz a.i./acre, the reduction in insecticide use to the environment would be 79.73%. Similarly, using the average mound density of 57.7 (Note: using the low, 1 lb/acre rate of hydramethylnon, reduction would be 84%) mounds/acre reported in community-wide fire ant programs (Riggs et al. 2002), the reduction would be 74%. These estimates are probably low because areas treated with mound treatment would most likely require re-treatment. Conversely, the shift away from availability of organophosphate insecticide products, notably chlorpyrifos and diazinon, to pyrethroid insecticides has undoubtedly reduced the weighted average oz a.i/acre values calculated from product sales data of Kline & Co. for 1995 (Appendix 1). Unfortunately, these new data are currently unavailable. However, using methods employed here, alternate assumptions of the product use spectrum could, theoretically, be made.

Notably, the "action threshold" of 20 mounds per acre for use of broadcast bait versus individual mound treatments advocated by Drees et al. (2002) closely approximates to an equivalent amount of active insecticide ingredient applied to the environment as an individual mound treatment (e.g., 0.240 oz a.i./acre for 1% hydramethylnon versus 0.320 oz a.i./acre from Klein & Co. in Table 3).

Monogyne versus polygyne forms of imported fire ants

Greenberg et al. (1985) reported that density of mounds was greater in areas infested with the polygynous or multiple queen form of the red imported fire ant. Areas infested with the monogyne (single queen) colonies range from 40 to 150 mounds per acre (rarely more than 7 million ants per acre). In areas with multiple queen colonies, there may be 200 or more mounds and 40 million ants per acre (Drees et al. 2002) although polygyne colonies can also occur in lower mound densities. Texas, unlike the other southeastern U.S., is infested largely with the polygyne form and therefore, has on the average higher mound densities than the national average of 68 mounds per acre (Porter et al. 1992).

In one published study conducted in Texas in 1986, polygynous red imported fire ant mound densities required 640 individual mound drenches per acre, using 79.36 oz or 4.96 lbs active ingredients of chlorpyrifos (Dursban® 4E applied at 0.124 oz a.i./gal/mound). Only 29 individual mound drenches, using 3.60 oz or 0.22 lbs a.i., were required to treat monogynous ant mounds. Percent reduction of polygynous mound densities was initially greater but mound re-infestation after approximately 10 weeks occurred at a higher rate for the polygynous ant (Drees and Vinson 1990).

The effect of monogyne versus polygyne form of fire ant on amount of insecticide required for control is shown in Table 3. For organophosphate insecticides, almost a pound or more (11.250 oz to 18.6 oz) active ingredients must be applied to treat mound densities of 150 or higher. Using the Mt. Pleasant example from Riggs et al. (2002) and weighted average from Klein & Co. (1995), the 296 mounds/acre in this neighborhood would have required 4.739 oz a.i. applied as mound treatments verses 0.240 oz a.i. hydramethylnon 1% bait broadcast-applied, a difference of 94.9% active ingredients applied to the environment.

Considerations for Surface Broadcast Applications of Contact Insecticides

Although homeowners have historically not often used surface broadcast applications of contact insecticides according to the Scripps Howard Texas Poll (Appendix 2), this has been a common treatment used by professional pest control companies. Values of amounts of active ingredients calculated for contact insecticide surface treatments (Table 1) can be used to calculate mound densities which would justify a shift from use of individual mound treatments to use of broadcast treatment for these products. For instance, diazinon is broadcast-applied at a rate of 69.696 oz/acre. At 0.152 oz a.i. per mound, that amount can treat slightly less than 500 mounds (Table 3). Similarly, chlorpyrifos, broadcast applied at 16 oz a.i. per acre used as a mound treatment (0.0125 oz a.i./mound) can treat just over 100 mounds per acre, and bifenthrin broadcast-applied at 6.4 oz a.i. /acre can treat just over 51 mounds at 0.0124 oz a.i./mound. The recently introduced fipronil granular product, Over 'N Out! will dramatically reduce pesticide load applied to the environment using only 0.14348 oz a.i./acre, which is comparable to several bait-formulated insecticide product use rates. Granular fipronil treatment, unlike baits, provide residual control preventing re-invasion for many months following application.

Other Toxicological Property Considerations

Reduction on insecticide active ingredients applied to the environment alone does not address all of the toxicological properties that should be considered when selecting a fire ant control strategy as discussed by Drees and Pietrantonio (2002) and Barr (2002, see Table 4). Even within the organophosphate insecticide group, toxicological differences between active ingredients occur. For instance, acephate is much less persistent in the environment than are chlorpyrifos or diazinon, breaking down rapidly when in contact with organic material. Furthermore, acephate has a relatively lower toxicity to aquatic organisms such as catfish. Conversely, pyrethroid insecticides, as formulated and applied, have lower amounts of active ingredients than do organophosphate products. Pyrethroids are relatively less toxic to mammals (higher oral and dermal LD_{50} values), they are less water soluble, more persistent and have higher toxicity to aquatic organisms. Fipronil, although formulated and applied at rates even lower than pyrethroid insecticides, is even more persistent, and the active ingredient is relatively more toxic to mammals and aquatics. Both pyrethroid and fipronil product label directions restrict application near bodies of water.

In general, bait products must be consumed in order to have an affect on target and non-target organisms and they persist for shorter periods of time in the environment, with the notable exception of fipronil. Hydramethylnon, for instance, can be degraded by sunlight and degrades in the soil in about 3 days. Aquatic toxicity is less of a problem, particularly for some bait products. For instance, Extinguish® containing the active ingredient, methoprene, is also formulated as products for treatment of aquatic larval stages of mosquitoes and other flies (Diptera). Furthermore, insect growth regulator baits (fenoxycarb, methoprene, pyriproxyfen) are not known to have acute toxic affects on vertebrate animals, although fenoxycarb has been designated as a Class B carcinogen by the Environmental Protection Agency. The ingredients, abamectin and spinosad, are produced by microorganisms through a fermentation and extraction process and are considered by some to be "of natural origin" and could arguably be "organic."

For these reasons, all insecticides should be used judiciously and only when necessary. Cost-effectiveness, labor-intensiveness and environmental effects should be considered in any pesticide selection process. However, the analysis presented here can be useful in considering methods for reducing the amount of insecticide active ingredients to the environment for imported fire ant control.

Acknowledgments

The author wishes to thank Joe Chamberlin of Valent USA for permission to use the marketing analyses conducted by Kline & Company, Inc. 1995. He also acknowledges reviews the entire manuscript by Steve Holmes, Ray Frisbie, Charles L. Barr and Nathan Riggs, and Table 1 by Vernon B. Langston (Dow AgroSciences), and Daniel J. O'Byrne (BASF).

Literature cited

Barr, C. L. 2002. Broadcast Baits for Fire Ant Control, B-6099, Texas Cooperative Extension, College Station, TX, 13 pp.

Drees, B. M. and S. B. Vinson. 1990. Comparison of the control on monogynous and polygynous forms of the red imported fire ant (Hymenoptera: Formicidae) with a chlorpyrifos mound drench. J. Entomol. Sci.25(2):317-324.

Drees, B. M., C. L. Barr, S. B. Vinson, R. E. Gold, M. E. Merchant, N. Riggs, L. Lennon, S. Russell and P. Nester, D. Kostroun, B. Sparks, D. Pollet, D. Shanklin, K. Vail, K. Flanders, P. M. Horton, D. Oi, P.L. Koehler, J. T. Vogt. 2000, revised 2002. Managing imported fire ants in urban areas. B-6043. Texas A&M University, College Station, Texas, 20 pp.

Drees, B. M. And P. Pietrantonio. 2002. Considerations for Selecting Imported Fire Ant Control Insecticide Products, Fire Ant Research & Management Plan Fact Sheet FAPFS036 available on http://fireant.tamu.edu, Texas Cooperative Extension, Texas A&M University, College Station, TX, 4 pp.

Greenberg, L., D. J. C. Fletcher, and S. B. Vinson. 1985. Differences in worker size and mound distribution in monogynous and polygynous colonies of the fire ant Solenopsis invicta Buren. J. Kansas Entomol. Soc. 58(1):9-18.

Hooper-Bui, L. M., A. M. Pranschke and H. M. Story. 2000. Area-wide bait treatments compared with individual mound treatments for red imported fire ant management, Pp. 71-74. In J. L. Crocker, K. M. Vail and R. M. Periera (eds), Proc. of the 2000 Imported Fire Ant Conference, Chattanooga, TN.

Porter, S. D., H. G. Fowler and W. P. McKay. 1992. Fire ant mound densities in the United States and Brazil (Hymenoptera: Formicidae). J. Econ. Entomol. 85: 1154-1161.

Riggs, N. L., L. Lennon, C. L. Barr, B. M. Drees, S. Cummings, and C. Lard. 2002. Community-wide red imported fire ant programs in Texas (B. M. Drees, ed.). Southwestern Entomologist Supplement No. 25:31-42.

Table 1. Ounces a.i./acre for imported fire ant control.

Class, ingredient, concentration (product)	Amount active ingredient (a.i.)
Organophosphate insecticides	
acephate 50% (Orthene® Fire Ant Killer)	0.075 oz a.i./mound
acephate 75% (Surrender® Brand Fire Ant Killer)	0.111 oz a.i./mound
diazinon 5% (Ortho® Fire Ant Killer Granules)	0.1515 oz/mound
chlorpyrifos 23.5% (Dursban® Pro)	0.125 oz a.i/mound/1gal
chlorpyrifos 50% (Dursban® 50W)	0.124 oz a.i./mound/1 gal
Pyrethroid insecticides	
bifenthrin 0.2% (Ortho® Fire Ant Killer Granules)	0.0124 oz a.i./mound
cyfluthrin 1.0% (Bayer® Advanced Lawn® Fire Ant Killer)	0.0015 oz a.i./mound
deltamethrin 0.05% (Terro® Fire Ant Killer and (Bengal® UltraDust® Fire Ant Killer II)	0.0027 oz a.i./mound
Hydramethylnon bait	
hydramethylnon 1.0% (MaxForce® Fire Ant Killer Granular Bait)	0.005 to 0.01 oz a..i./mound
hydramethylnon 0.73% (Amdro® Fire Ant Bait, AmdroPro®, SiegePro®)	0.002 to 0.01 oz a.i./mound
Surface Treatments:	
BAIT PRODUCTS (from Barr 2002)	
abamectin 0.011% (Clinch®, Varsity®)	0.00176 oz a.i./acre
fenoxycarb 1.0% (Award®, Logic®)	0.16 oz a.i./acre
fipronil 0.00015% (Firestar®)	0.00036 oz a.i./acre
hydramethylnon bait	
1.0% (MaxForce® Fire Ant Killer Granular Bait)	0.16 to 0.32 oz a.i./acre
0.73% (Amdro® Fire Ant Bait, AmdroPro®, SiegePro®, ProBait®)	0.112 to 0.16 oz a.i./acre
0.002 to 0.01 oz a.i./mound	
methoprene 0.5% (Extinguish™)	0.08 oz a.i./acre
pyriproxyfen 0.5% (Distance®, Esteem®)	0.08 oz a.i./acre
spinosad 0.015% (Justice®)	0.0024 oz a.i./acre
CONTACT INSECTICIDES	
chlorpyrifos 50% (Dursban® 50W)	16 oz a.i./acre
diazinon 5% (Spectracide® Fire Ant Killer Mound and Broadcast Granules)	69.696 oz a.i./acre
bifenthrin 0.2% (Talstar® EZ or PL Granular Insecticides)	3.2 to 6.4 oz a.i./acre
bifenthrin 7.9% (Talstar® F Insecticide/Miticide)	3.58 oz a.i./acre
cyfluthrin 0.1% (Bayer® Advanced Garden™ Lawn and Garden Multi-Insect Killer	1.3939 oz a.i./acre
fipronil 0.0103% (Over 'n Out!®)	0.14348 oz a.i./acre

Table 2. Examples of fire ant mound density in Texas community-wide fire ant management pilot programs (Riggs et al. 2002).

Location	Mounds/1,000 sq ft	Mounds/acre
Jade Oaks	1.18	51.4
7,600/4,000 sq ft lot/turf		
Countryside	0.15	6.5
7,950/5,500 sq ft lot/turf		
Mt Bonnell	1.70	74.0
Apache Oaks	2.27	98.9
Average		57.7
Mt. Pleasant	6.80	296.2

43,560 sq ft = 1 acre

Note: Levels cited in this table are pre-program implementation mound densities in these communities. As such, they represent levels of ant mounds existing using current methods of treatments by residents before implementing community-wide programs employing broadcast application of bait-formulated products.

Table 3. Ounces a.i./acre for Imported Fire Ant Control.

Mounds/ acre/yr	Examples of Infestations	Organophosphates				Pyrethroids			Bait		
		acephate 50%	acephate 75%	diazinon 5%	chlorpyrifos 50%	bifenthrin 0.20%	cyfluthrin 1.00%	deltamethrin 0.05%	hydramethylnon 1% Mound	hydramethylnon 1% Broadcast	Kline & Co. 1995
1		0.075	0.111	0.152	0.124	0.012	0.002	0.003	0.008	0.240	0.016
6.5	*Countryside*	0.488	0.722	0.988	0.806	0.078	0.010	0.020	0.049	0.240	0.104
20		1.500	2.220	3.040	2.480	0.240	0.030	0.060	0.150	0.240	0.320
50		3.750	5.550	7.600	6.200	0.600	0.075	0.150	0.375	0.240	0.800
51.4	*Jade Oaks*	3.855	5.705	7.813	6.374	0.617	0.077	0.154	0.386	0.240	0.822
57.7	*Avg. Community-wide*	4.328	6.405	8.770	7.155	0.692	0.087	0.173	0.433	0.240	0.923
68	*National Avg.*	5.100	7.548	10.336	8.432	0.816	0.102	0.204	0.510	0.240	1.088
74	*Mt. Bonnell*	5.550	8.214	11.248	9.176	0.888	0.111	0.222	0.555	0.240	1.184
98.9	*Apache Oaks*	7.418	10.978	15.033	12.264	1.187	0.148	0.297	0.742	0.240	1.582
100		7.500	11.100	15.200	12.400	1.200	0.150	0.300	0.750	0.240	1.600
Polygyne 150		11.250	16.650	22.800	18.600	1.800	0.225	0.450	1.125	0.240	2.400
250		18.750	27.750	38.000	31.000	3.000	0.375	0.750	1.875	0.240	4.000
296.2	*Mt. Pleasant*	22.215	32.878	45.022	36.729	3.554	0.444	0.889	2.222	0.240	4.739
500		37.500	55.500	76.000	62.000	6.000	0.750	1.500	3.750	0.240	8.000
1000		75.000	111.000	152.000	124.000	12.000	1.500	3.000	7.500	0.240	16

Appendix 1. Fire Ant Product Sales and Market Share - 1995
Home Market Segment Summary
(U.S. Fire Ant Market, 1995, Kline & Company, Inc.)

	Thousands			
Product	**lb**	**gal**	**$**	**% of total/HO**
diazinon	13,425.8	57.0	$8,298.5	26.0/26.2
chlorpyrifos/Dursban®	8,182.5	76.7	7,180.0	22.5/22.7
hydramethylnon/Amdro®	1,353.4	0.0	7,037.6	22.1/21.9
acephate/Orthene®	236.4	116.6	6,055.3	19.0/19.1
fenoxycarb/Award® and Logic®	117.0	0.0	1,194.0	3.7/2.6
pyrethroids	0.0	40.8	818.8	2.6/3.0
carbaryl/Sevin®	982.4	5.6	661.6	2.1/2.1
other	589.7	7.7	661.2	2.2/2.4
Totals	24,887.1	304.4	31,907.0	100.2/
HO	19,204.0	239.9	24,342.0	100.0

HO = urban/suburban household market
Note: Solid products accounted for 65.6% of sales, while liquid products (with higher a.i. content) accounted for 34.4%

Calculation of Weighted Average Used in Table 3 for Kline & Co. 1995:

Product (formulation) use/a.i. use	**% of Sales**	**a..i./mound***	**a.i. x % of sales x 100**
diazinon (5%)	26.2%	0.1515 oz	0.03969 oz
chlorpyrifos (23.5%)	22.7%	0.125	0.02838
hydramethylnon (0.73%)	21.9%	0.006	0.00131
acephate (50%)	19.1%	0.075	0.01433
pyrethroids (deltamethrin)	3.0%	0.0027	0.00008
total:	89.9%	0.3714	0.08379
other	7.1%	–	–
average of 5 top (90%)	–	0.07428 oz	–
weighted average	–	–	0.016758 oz a.i./mound

* Values from Table 1

Appendix 2. "Fire Ants in Texas" March 2000. Scripps Howard Texas Poll 815 Brazos Suite , Austin, TX 78701 (512/478-9646; FAX 512/478-1537)

1. Have you treated for fire ants in the past year?

	February 2000 % (N=1,000)
Yes	56
No	44
Don't know/ no answer	--

2. How often did you treat for fire ants in the past year?

	February 2000 % (N=568 who treated for fire ants)
Once	11
Twice	18
Three times	16
Four or more	51
Don't know/no answer	4

± 4.1 percentage point margin of error

3 When treating for fire ants, which of the following treatments are you most likely to use?

	February 2000 % (N=568 who treated for fire ants)
Apply insecticide directly/ on mounds	65
Broadcast slow-acting bait/ over entire yard	8
Broadcast fast-acting insecticide/ over entire yard	5
Use non-chemical methods/ such as boiling water/ or digging them up	3
Broadcast bait followed by/ individual mound treatment later	11
Other	3
Don't know/no answer	5

± 4.1 percentage point margin of error