

Factors Influencing Pesticide Use and Integrated Pest Management Implementation in Urban Landscapes: A Case Study in Atlanta

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ADDITIONAL INDEX WORDS. integrated pest management, insecticide, herbicide, fungicide, lawn care, landscape maintenance

SUMMARY. Questionnaires on pesticide use and other aspects of integrated pest management (IPM) were mailed to 1678 lawn care and landscape maintenance firms in the 20 county metropolitan Atlanta area. The survey return rate adjusted for nonapplicable addresses and undeliverable mailings was 25.4%, yielding a total of 350 usable surveys. Responding lawn care and landscape maintenance professionals purchased a total active ingredient of 250,527 lb (93,447 kg) of herbicide, 35,416 lb (13,210 kg) of insecticide and 10,367 lb (3,867 kg) of fungicide during 1993. Most insecticides and fungicides were applied during June, July, and August. About one-third of herbicides were applied during March to May, one-third during June to August, and one-third during September to February. Key pests and plants were identified by survey respondents. Opportunities and impediments to implementation of IPM in the landscape as reported by respondents are discussed.

Pesticide use in the United States accounts for one-quarter of the total active ingredients (a.i.) of conventional pesticides used in the world, ≈ 1.1 billion pounds according to U.S. Environmental Protection Agency estimates (Aspelin, 1994). Although only $\approx 25\%$ of the total amount of pesticides sold in the United States is used for nonagricultural purposes, their use in highly populated urban areas increases the perceived impact of these chemicals (Aspelin, 1994). Landscape managers face unique constraints to implementing integrated pest management including high aesthetic standards, lack of appropriate decision making guidelines, and lack of reliable and cost-effective alternatives to traditional pesticides (Potter, 1993; Potter and Braman, 1991; Raupp et al., 1992). However, abundant opportunities exist for reduction in pesticide use and increased pollution prevention in the landscape (Latimer et al., 1996).

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The 1993–94 National Gardening Survey reports that 16% of households purchased the services of lawn care or landscape professionals, with 12% of the households purchasing lawn care service and 6% purchasing landscape maintenance services (National Gardening Association, 1994). Surveys of specific areas, such as San Diego County, Calif., found that 10% of the households had someone outside the home applying their pesticides (Pittenger and Lazaneo, 1989). Preliminary results of a survey of residents of Albuquerque, N.M., indicate that 8% of the residents have professional applicators apply pesticides for the control of landscape pests (Ward et al., 1993).

To determine current outdoor commercial urban pesticide use, a survey of lawn care and landscape maintenance firms was conducted in the fast-growing metropolitan area of Atlanta. Our objective was also to determine baseline information concerning pesticide use, primary pest problems, and attitudes towards integrated pest management (IPM) in the landscape to assess more accurately change in management practices and for comparison with future pesticide use patterns.

Materials and methods

Atlanta was selected for study because of its high population density and high level of commercial activity. Two approaches were used to prepare the final mailing list. Membership lists of professional associations of the landscape maintenance and lawn care industries were incorporated including mailing lists of the Professional Lawn Care Association of America (PLCAA), the Metro Atlanta Lawn and Turf Association (MALTA), the Georgia Green Industry Association (GGIA), and the Professional Grounds Management Society. Business licenses issued for landscape maintenance

and lawn care firms were also obtained from the county governments in all 20 counties to ensure accurate representation of the spectrum of firms offering lawn care and landscape maintenance services.

A subsample of randomly selected firms pretested the survey resulting in minor adjustments to the survey questions being made in response to comments from this review. Subsequent to the pilot test, 1678 questionnaires were mailed during September 1994. A second (reminder) mailing occurred in October. Recipients were asked to return the uncompleted questionnaire if the subject matter appeared not applicable to their business.

Results and discussion

The survey return rate adjusted for nonapplicable addresses and undeliverable mailings was 25.4%, yielding 350 usable surveys. Responses provided valuable information concerning services provided, pesticide use, timing of application, and pest problems most frequently encountered. The survey also allowed an assessment of the current status of and attitudes toward IPM practices, limitations to the implementation of IPM, and source and availability of information on topics related to landscape management.

SERVICES PROVIDED. Lawn care and landscape maintenance firms responding to the survey offered a variety of services, including plant selection, plant installation, plant maintenance, fertilization, pest management, and landscape design for ornamentals. Pest management services on turf were provided by 49% of respondents and 48% of respondents provided pest management for ornamentals.

PESTICIDE USE. Responding Atlanta lawn care and landscape maintenance firms purchased a total a.i. of 250,527 lb (93,447 kg) of herbicide, 35,416 lb (13,210 kg) of insecticide, and 10,367 lb (3,867 kg) of fungicide during 1993 (Braman et al., 1998). More than 40 different product formulations were purchased for insect and mite control during 1993. The most commonly purchased insecticide was hydramethylnon, which is used primarily for fire ant suppression. Other commonly purchased insecticides included acephate, chlorpyrifos, carbaryl, isofenphos, horticultural oil, and insecticidal soap. The most commonly purchased herbicides included glyphosate, pendimethalin, 2,4-D, MCPP, dicamba, triamine, and oryzalin. The most commonly purchased fungicides included chlorothalonil, oxazoladinadione, metalaxyl, triademefon, thiophanate methyl, and iprodione.

APPLICATION TIMING. Most insecticides (55%) and fungicides (46%) were applied during June, July, and August. Responding firms reported that about one-third of herbicides were applied during March to May, one-third

Fig. 1. Proportion of lawn care and landscape maintenance professionals in the metropolitan Atlanta area that apply chemicals to lawns and turf on a preventive basis according to a predetermined schedule.

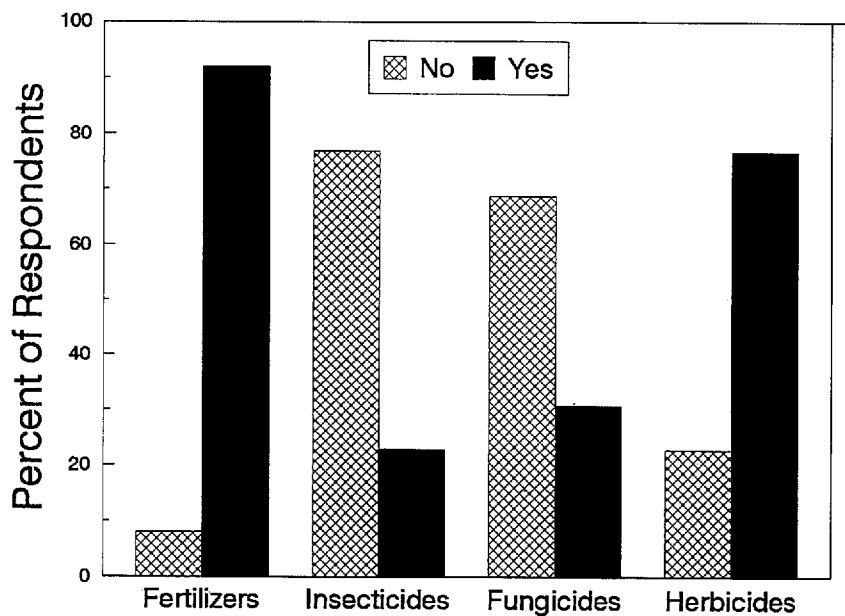


Table 1. Specific pests identified as most problematic by lawn care and landscape maintenance professionals in metropolitan Atlanta; percent of respondents identifying specific pest problems in an open-ended question.

Pest		Respondents (%)
Lawn and turf		
Crabgrass	<i>Digitaria</i> spp.	43
Brownpatch	<i>Rhizoctonia solani</i>	31
White grubs	Scarabaeid larvae	13
Dollar spot	<i>Sclerotinia homeocarpa</i>	12
Nutsedge	<i>Cyperus</i> spp.	10
Fire ants	<i>Solenopsis invicta</i>	10
Clover	<i>Trifolium</i> spp.	6
Chick weed	<i>Stellaria media</i>	6
Annual bluegrass	<i>Poa annua</i>	6
Wild onion	<i>Allium canadense</i>	6
Wild garlic	<i>Allium vineale</i>	2
Violets	<i>Viola</i> spp.	4
Buttonweed	<i>Diodia virginiana</i>	3
Bermudagrass	<i>Cynodon</i> spp.	2
Johnson grass	<i>Sorghum halapense</i>	2
Chinchbugs	<i>Blissus</i> spp.	2
Spittlebugs	<i>Prosapia bicincta</i>	2
Caterpillars	Lepidopteran larvae	2
Shrubs and trees		
Aphids	Aphididae	27
Lacebugs	Tingidae	20
Mites	Acari	20
Japanese beetles	<i>Popillia japonica</i>	15
Leafspot		10
Caterpillars	Lepidopteran larvae	8
Powdery mildew	<i>Erysiphe</i> spp., etc.	7
Whitefly	Aleyrodidae	7
Borers	Lepidopteran and Coleopteran	5
Leaf beetles	Chromelidae	5
Leafminers	Agromyzidae, etc.	3
Anthraxnose		3
Oakworms	Notodontidae	2
Bagworms	<i>Thyridopterix ephemeraeformis</i>	2
Perennial flowers		
Aphids	Aphididae	15
Crown and root rots	<i>Botrytis</i> , <i>Rhizoctonia</i> , etc.	9
Whitefly	Aleyrodidae	8
Japanese beetles	<i>Popillia japonica</i>	6
Mites	Acari	6
Crabgrass	<i>Digitaria</i> spp.	6
Bermudagrass	<i>Cynodon</i> spp.	5
Fire ants	<i>Solenopsis invicta</i>	3
Leaf beetles	Chrysomelidae	2
Spittlebugs	Cercopidae	2
Nutsedge	<i>Cyperus</i> spp.	2
Annual flowers		
Crown and root rots	<i>Rhizoctonia</i> spp., others	17
Aphids	Aphididae	13
Fungal leafspots	<i>Septoria</i> spp., others	12
Mites	Acari	11
Slugs		10
Crabgrass	<i>Digitaria</i> spp.	6
Bermudagrass	<i>Cynodon</i> spp.	6
Whitefly	Aleyrodidae	6
Japanese beetles	<i>Popillia japonica</i>	4
Fire ants	<i>Solenopsis invicta</i>	3

during June to August, and one-third during September to February. Respondents reported that of those providing pest management services, herbicides, and fertilizers are more often applied on a predetermined schedule than are insecticides or fungicides (Fig. 1).

When asked what determines timing of treatment, 85% of respondents reported that the decision to treat follows observation of pests or pest damage seen, while 32% report applications made on a predetermined schedule whether pests are determined to be present or not. Treatments in response to customer requests were reported by 55% of firms. Pests were monitored by 46% of responding firms, while presence of beneficial mites and insects (predators, parasites, etc.) influenced decisionmaking for only 8% of lawn care and landscape maintenance firms responding to our survey. This emphasizes the need for increased research and educational efforts targeting mechanisms for incorporation of natural enemies into management strategy.

PEST PROBLEMS. The most frequently reported problematic pest groups varied by plant system of interest (Braman et al., 1998). In lawns and turf, for example, weeds were considered far more problematic than any other pest group, followed by diseases, insects, and nematodes. For trees and shrubs, insects followed by weeds were deemed most often problematic. The most problematic pests of annual and perennial bedding plants were again weeds followed by insects, diseases, and nematodes.

Atlanta lawn care and landscape maintenance professionals identified several specific pest problems for which they treat most

frequently (Table 1). Again, these varied by plant material. A list of those pests most often cited includes aphids, lace bugs, mites, Japanese beetles (*Popillia japonica* Newman), whiteflies, slugs, white grubs, crabgrass (*Digitaria* spp.) and other weedy grasses, brown patch (*Rhizoctonia solani* Kuhn), dollar spot (*Sclerotinia homeocarpa* F.T. Bennett), leaf spot (*Helminthosporium*), and crown and root rots.

Key plants, those that were represented in most landscapes and often required insecticide or

fungicide applications, included azaleas (*Rhododendron* spp.), crape myrtles (*Lagerstroemia* spp.), red tips (*Photinia* spp.), and junipers (*Juniperus* spp.) (Table 2). However, survey respondents reported that they "seldom to never" applied insecticides to oaks (*Quercus* spp.) or hollies (*Ilex* spp.). When time for monitoring is limited, focusing scouting efforts on key plants is an effective management tactic.

IMPETUS AND IMPEDIMENTS TO IPM IMPLEMENTATION. When asked whether their companies

Table 2. Relative pesticide use reported on key plants by lawn care and landscape maintenance professionals in metropolitan Atlanta.

Ornamental	Present in landscapes (%)	Respondents (%) who					
		Apply insecticide			Apply fungicide		
		Often	Seldom	Never	Often	Seldom	Never
Evergreen azalea (<i>Rhododendron</i> spp.)	87	35	32	19	7	33	35
Crape myrtle (<i>Lagerstromia</i> spp.)	87	42	30	16	33	25	22
Juniper (<i>Juniperus</i> spp.)	85	27	29	28	8	16	49
Holly (<i>Ilex</i>)	84	8	37	39	8	23	48
Dogwood (<i>Cornus</i>)	83	8	30	45	10	27	40
Oak (<i>Quercus</i>)	80	3	31	47	1	15	57
Pine (<i>Pinus</i>)	80	5	26	49	1	14	59
Euonymus (<i>Euonymus</i>)	79	28	30	20	12	24	34
Maple (<i>Acer</i>)	79	1	29	49	2	18	53
Liriope (<i>Liriope</i>)	80	0	13	67	1	10	63
River birch (<i>Betula</i>)	80	9	32	39	2	17	51
Hosta (<i>Hosta</i>)	78	2	23	52	2	13	56
Boxwood (<i>Buxus</i>)	77	14	27	35	5	22	43
Camellia (<i>Camellia</i>)	77	7	36	34	4	24	43
Leyland cypress (<i>Cupressocyparis leylandii</i>)	76	3	29	44	6	21	43
Rhododendron (<i>Rhododendron</i> spp.)	75	3	29	44	6	21	37
Pyracantha or Cotoneaster	74	28	22	24	7	21	37
Rose (<i>Rosa</i>)	72	40	16	15	38	12	18
Gardenia (<i>Gardenia</i>)	72	14	26	33	5	21	39
Red tips (<i>Photinia</i> spp.)	68	22	14	33	43	12	21
Deciduous azalea (<i>Rhododendron</i> spp.)	66	11	26	30	5	20	35
Pecan (<i>Carya illinoensis</i>)	57	1	12	44	1	7	46

offered an IPM option, 39% of those firms providing pest control services reported that they offered an IPM option. However, many respondents carry out pest control practices consistent with IPM philosophy, including scouting and monitoring (82%), use of soaps and oils (39%), and spraying only as needed (87%), regardless of whether an explicit IPM option is advertised. Tactics that are poorly represented in the industry, based on survey response, include use of biological control agents (13%), insect growth regulators (10%), and commercial insect traps (10%). Respondents were asked for their perception of public support for IPM. Most responded that their clients would be willing to pay for scouting as a service (52%) and that their clients favor less pesticide use (52%). Few, however, believe that clients are willing to accept any loss in quality to achieve this goal (13%). Reported limitations to the use of IPM included a lack of information on pest biology (46%), that IPM is too costly and too time consuming (58% and 60%), alternatives to traditional chemicals are either not available (66%) or not effective (73%), and that clientele support is lacking (48%). Clearly, acceptance and implementation of IPM tactics in lawn care and landscape maintenance will be influenced by several factors, including educating the public to tolerate nondamaging levels of pests in landscapes.

AVAILABILITY OF INFORMATION. Lawn care and landscape maintenance professionals in Atlanta receive their information concerning pest management from a variety of sources including commercial sales representatives, trade magazines, county extension offices, university specialists, peers, and other sources. Most respondents reported that adequate information was almost always or often available relative to fertilizers, herbicides, insecticides, and fungicides. Respondents felt information was less readily available for nematicides, plant growth regulators, organic products, and alternative pest control products.

Survey results reported here evaluated only one segment of pesticide use in urban landscapes. Homeowner use of pesticides was not evaluated in the present survey but is a planned priority for future study. The National Gardening Survey for 1993-94 reports that 54% of all U.S. households (52 million) participated in do-it-yourself lawn care in 1993 (National Gardening Association, 1994). In addition, 28% and 21% of the households participated in shrub and tree care, respectively. Fifty-six percent of the households purchased outdoor fertilizers, insect controls, or weed management chemicals. The most common do-it-yourself products purchased were weed and feed fertilizer (28% households purchasing), ready-to-use insect control spray (22%), and ready-to-use or concentrate weed control or

herbicide (13%). Alternative reduced-toxicity insect control products were purchased by only 6% of the households.

The landscape maintenance and lawn care industry in Atlanta is characterized by many relatively young firms; 79% have been established within the last 10 years (Florkowski et al., 1996). Most firms serviced 50 or fewer accounts and earned under \$100,000 per year. However, among companies >20 years old, only 12% reported sales in that same range, with 59% reporting sales of at least one million dollars and servicing >500 accounts. The current climate of change provides opportunities for this growing industry to offer alternative programs based on plant health care and alternative management practices. It remains the obligation of university and industry professionals to communicate the benefits of best management practices to the general public.

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