Assessment of Pesticide Use by Commercial Landscape Maintenance and Lawn Care Firms in Georgia[1]

S. Kristine Braman, Ronald D. Oetting and Wojciech Florkowski[2]

The Ornamentals Working Group
Departments of Entomology and Agricultural Economics[2]
University of Georgia
College of Agriculture and Environmental Sciences
Experiment Stations, Georgia Station
Griffin, GA 30223 U.S.A.

J. Entomol. Sci. 32(4): 403-411 (October 1997)

ABSTRACT Questionnaires on pesticide use and pest management practices were mailed to landscape maintenance/lawn care firms in the metro-Atlanta area; 25.4% or 350 firms responded. Of these firms, 159 provide pest management services for turfgrass or ornamentals or both. Responding professionals purchased 13,210 kg AI of insecticides, 93,447 kg AI herbicide, and 3,867 kg AI of fungicides during 1993. Total area serviced by these firms was 14,770 ha. The most commonly-purchased insecticides included products containing hydramethylnon, acephate, chlorpyrifos, carbaryl, and horticultural oil. Frequently-purchased herbicides included products that contain pendimethalin, 2,4-D, glyphosate, MCPP, dicamba, oryzalin, benefin, and oxadiazon. Fungicidal products purchased by the most respondents were chlorothalonil, thiophanate-methyl, oxazoladinadione, matalayl, and triadimefon.

Insecticides were most frequently applied to ornamentals (65%), while herbicides were the primary pesticide used on turf (93% preemergence, 79% postemergence). Fungicides were more evenly distributed. Prescheduled applications determined timing of application for 32% of respondents, while 46% report that monitoring of pest populations influences treatment decisions. Only 8% of respondents incorporate monitoring of beneficial arthropods into this decision-making process.

KEY WORDS Integrated Pest Management, Best Management Practices, Landscape Entomology, Plant Health Care, Survey, Ornamentals, Turfgrass

Recent research has begun to clarify the effects of pesticides, fertilizers, and other components of landscape management practices on fauna that contribute to natural processes such as thatch degradation and natural regulation of arthropod pests (e.g., Cockfield and Potter 1983, 1984, Potter et al. 1985, 1990a, b, Smiley et al. 1985, Smiley and Craven Fowler 1986, Arnold and Potter 1987, Balsdon et al. 1993, Braman and Pendley 1993, Terry et al. 1993, Potter 1994). A concerned landscape management industry is currently experiencing an increased transition

[1] Received 19 December 1996; Accepted for publication 25 April 1997.

toward integrated pest management. Garber and Bondari (1996), for example, report a trend toward greater usage of non-chemical pest control measures among landscape maintenance firms in Georgia from 1988 to 1993. The usage trend for chemicals during that period as reported by firms responding to a survey was an increase for fungicides/bactericides and herbicides and a decrease for insecticides, with growth regulator use remaining steady.

Oetting and Allison (1994) provide estimates of insecticide usage in greenhouse, nursery, and sod production by region within the United States. Neely et al. (1984), extrapolating from survey data, reported that commercial and municipal arborists in Illinois spent $2.2 million in 1982; 85% for insecticides and 15% for fungicides. Hudson et al. (1996) reported use of 46 different compounds and an estimated 2.8 million lbs of active ingredient to control insects and mites by respondents to a national survey of greenhouse and nursery pesticide use. Estimates of quantities of active ingredients of pesticides applied to landscape turf and ornamentals are not, however, readily available. The present study was undertaken to obtain definitive data concerning pesticide use and pest management practices currently utilized in one of the fastest growing metropolitan areas of the country. These data will support the development of educational programs that will facilitate implementation of integrated pest management within the landscape maintenance industry.

Materials and Methods

An extensive questionnaire was mailed to landscape maintenance and lawn care (LM/LC) firms within the 20-county Atlanta Statistical Reporting District. This area was selected because of the high concentration of commercial activity and high population density. The list was developed using business license records and membership lists from the professional associations Metro Atlanta Lawn and Turf Association, Professional Lawn Care Association of America, Georgia Green Industry Association, and the Professional Grounds Management Society. A gross return rate of 25.4% was realized yielding a total of 350 usable questionnaires.

The industry was characterized by a disparity in stability (age of firm) and size. A relatively young age (less than 10 years old) and limited size characterize the majority of firms in the densely-populated metro-Atlanta area (Florkowski et al. 1996). Most firms generated no more than $100,000 in sales during 1993 with the value of equipment owned most often reported as less than $25,000, and provided services for no more than 25 residential accounts. A few respondents, however, represented major firms with more than 25 years of experience, annual gross sales exceeding $1,000,000, equipment valued at greater than $100,000, and servicing more than 500 clients.

Survey respondents were requested to check which services their firm provided on turf and ornamentals. Those firms that provided pest management services were asked to indicate the amounts of various herbicides, insecticides, fungicides, and growth regulators that they purchased during 1993. To determine seasonal application rates, respondents were asked to estimate what percentage of the total annual distribution of each of the classes of chemicals was applied during each of four, 3-month periods. Finally, respondents were asked how their firm determines when to treat for diseases, insects or mites.

Results and Discussion

Services offered. Lawn care and landscape maintenance firms provide a variety of services in the metro-Atlanta area. One half to three quarters of responding firms are involved with plant selection, landscape design, turf and/or ornamental installation, and plant maintenance once plants are in place. Pest management services were provided for turf and ornamental plants by 48.6 and 48.0% of responding firms, respectively. The remainder of the discussion refers to those respondents that indicated that they provided pest management services for turf or ornamentals or both.

Types of pesticide and amounts applied. Respondents purchased more than 40 different product formulations for insect and mite control during 1993, resulting in a combined purchase of 13,210 kg AI of insecticides by the 159 firms that provide pest management services. A similar array of pre- and post-emergence herbicides and more than 25 fungicidal products were purchased for a combined total of 93,447 kg AI of herbicide and 3,867 kg AI of fungicidal products purchased during 1993. Only six plant growth regulator products (157 kg AI) were reported as purchased by responding firms during this time.

Total area of serviced accounts for firms which provided pest control services was 14,770 ha. Accounts were further categorized as residential (6,669 ha), commercial (7,503 ha), and utility or right-of-way areas (597 ha). Therefore, the amount of active ingredient of pesticides per hectare from professional use may be estimated as 6.3 kg/ha for herbicides, 0.9 kg/ha for insecticides, and 0.3 kg/ha for fungicides in the metro-Atlanta area. These estimates do not include homeowner use which may exceed that used by landscape professionals.

The most commonly-purchased insecticides (Table 1) included materials used primarily for fire ants, common pests in the southern region. A survey of South Carolina residents conducted between 1983 and 1985 (Lemke and Kissam 1989) revealed that 87% of the 430 respondents felt that they had a severe red imported fire ant (*Solenopsis invicta* Buren) problem on their property. Control measures were taken by 74% of those respondents. Calls concerning the red imported fire ant were received by 97% of 55 pest control companies surveyed, and 82% of companies offered a service to control red imported fire ants.

Results of our survey showed that horticultural oils were used extensively while insecticidal soaps are used less often for the management of ornamental plant pests within the metro-Atlanta area. Traditional insecticides, such as products containing chlorpyrifos, acephate, and carbaryl, were also among those most commonly purchased by LM/LC professionals. Synthetic pyrethroids, such as cyfluthrin, fluvalinate and the more recently registered lambda-cyhalothrin, were purchased by less than 20% of the firms, which provide pest management services. Less than 2% of firms that provide pest management purchased neem-based products (e.g., Azatin®, Bioneem®, Margosan-O®, Turplex®).

Among the most commonly purchased herbicides were glyphosate, dicamba, MCPP, 2,4-D, and pendimathalin. The fungicides thiophanate methyl, metalaxyl, oxazoladinedione and triadimeton were each purchased by 17 to 19% of respondents. Chlorothalonil was purchased by 50% of the firms supplying pest management services.

Table 1. Number of commercial lawn care and landscape maintenance firms that reported purchase of a particular pesticide and % of total Kg active ingredients (a.i.) of that pesticide purchased in 1993.

Herbicide	Frequency	% total a.i.	Insecticide	Frequency	% total a.i.	Fungicide	Frequency	% total a.i.
Asulam	1	<1	Abamectin	1	<1	Benomyl	12	1
Atrazine	8	<1	Acephate	68	8	Chlorathalonil	80	52
Benefin	51	<1	Azadirachtin	2	<1	Copperhydroxide	1	<1
Bentazon	9	<1	Carbaryl	54	8	Fenarimol	5	1
Chlorsulfuron	1	<1	Chlorpyrifos	83	5	Iprodione	19	3
2,4-D	155	18	Cyfluthrin	18	1	Mancozeb	9	<1
Dicamba	152	1	Diazinon	10	1	Metalaxyl	31	2
Dichloroprop	7	4	Dicofol	19	2	Oxazoladinadione	33	11
Diquat dibromide	9	<1	Dienochlor	2	<1	Propamocarb-hydrochloride	1	4
Frenoxaprop-ethyl	17	<1	Dimethoate	3	<1	Propiconazole	6	2
Fluazipop-p-butyl	23	<1	Disulfoton	21	4	Thiophanate-methyl	32	12
Glyphosate	191	11	Fluvalinate	7	<1	Triadimefon	31	7
Imazaquin	29	<1	Horticultural oil	53	42	Thiadiazol	1	<1
Isoxaben	8	<1	Hydramethylnon	101	11			
MCPP	149	11	Insecticidal soap	26	2			
MSMA	28	1	Isazophos	3	<1			
Metachlor	6	<1	Isofenphos	10	11			
Metribuzin	1	<1	Lambda-cyhalothrin	9	<1			
Oryzalin	91	3	Lindane	1	<1			
Oxadiazon	44	4	Malathion	37	4			
Pendimethalin	70	41	Trichlorfon	2	<1			
Pronamide	4	<1						
Sethoxydim	23	<1						
Simazine	20	2						
Triclopyr	7	<1						
Trifluralin	22	<1						

Pesticide use for different plant types. Respondents were asked to indicate whether each product was applied to turf, ornamentals or both (Fig. 1). Insecticides were most frequently applied to ornamentals (65%) while herbicides were primarily used on turf (93% preemergence; 79% postemergence). Fungicides were more evenly applied among plant types. Garber and Bondari (1996) reported that 55% of current pesticide usage in landscape maintenance is for turf management, while shrubs/ground covers accounted for about one-third and 12.5% was applied to trees. Educational programs with the objective of reducing pesticide use should include components for alternative management of each group of target pests; weeds, insects, and disease-causing organisms. Opportunities and imperatives clearly exist for modifying public tolerance of some low-moderate level of weed and insect presence. Defining these aesthetic thresholds and increasing public acceptance of moderate pest pressure are current critical research and education needs.

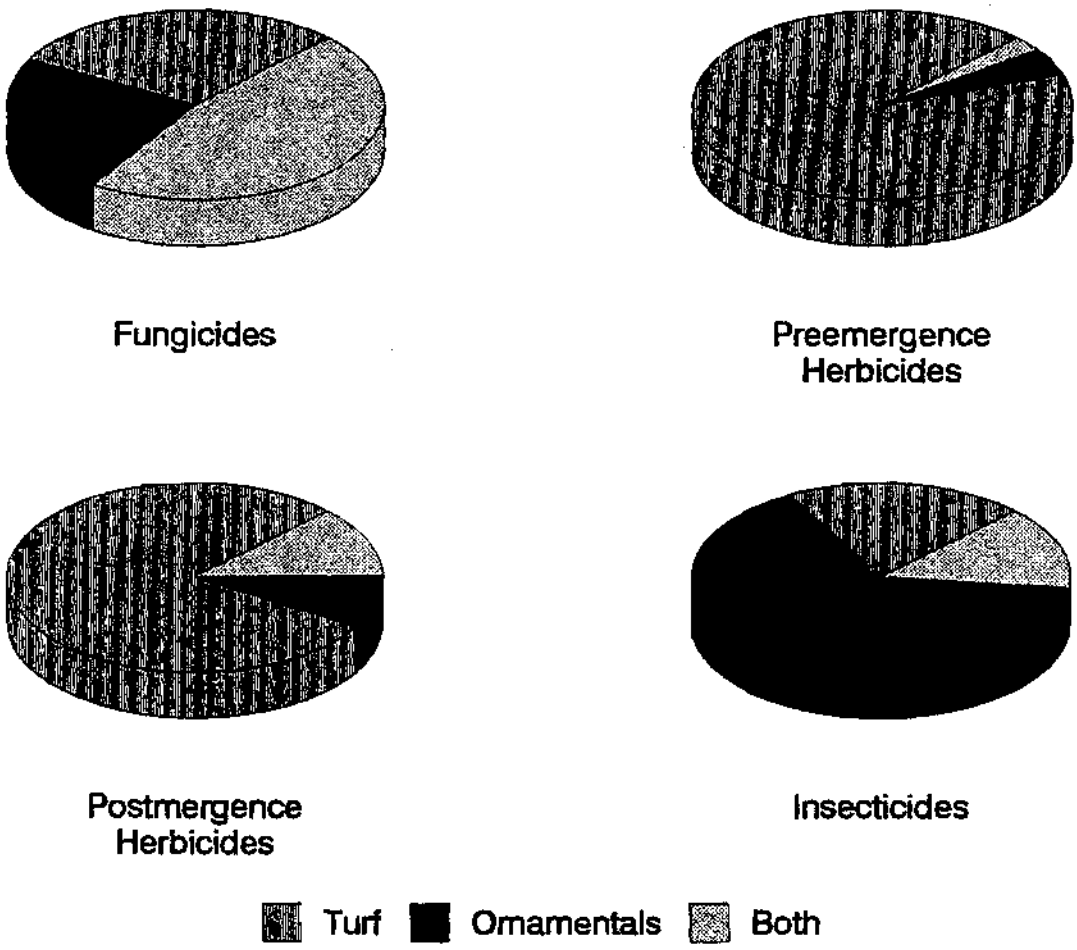

Fig. 1. Distribution of pesticides applied to either turfgrass, ornamental plants or both by LM/LC firms in metro-Atlanta.

Timing of pesticide applications. The majority of insecticides were applied from June through August (Table 2), coinciding with greatest pest activity. While 46% of fungicides were applied during that same time period, a substantial proportion (31%) was also applied from March through May with 17% applied in the fall. The proportion of total herbicides applied during any 3-month period is more evenly divided than other types of pesticides applied.

When respondents were asked "How do you determine when to treat for diseases, insects or mites?" (Fig. 2), the most often selected response was "when pests and/or damage are found to be present." Although 32% of the respondents indicated treatments on a predetermined schedule, 46% reported that pest activity was monitored. Only 8% of respondents, however, indicated that beneficials are regularly monitored or influenced treatment timing. Customer requests determined timing of applications for 55% of respondents. These results suggest that incorporation of natural enemies into landscape integrated pest management has been slower than adoption of other IPM tactics (e.g., increased use of horticultural oils). A lack of fundamental knowledge concerning the biology and potential impact of indigenous natural enemies inhibits their incorporation into the decision-making process.

Pesticide use reported here for the Lawn Care/Landscape Maintenance Industry in the metro-Atlanta area parallels EPA estimates for total pesticide use in the United States with herbicide use (281 million kg) exceeding insecticide use (112 million kg) followed by fungicides (59.4 million kg) (Aspelin 1994). Blanco-Monterro et al. (1995), in a discussion of the potential environmental and economic impacts of turfgrass in Albuquerque, NM, estimated the potential annual purchase of 37,408 kg of active ingredients of insecticides or 4.9 kg/ha based on satellite imagery of turfgrass cover (7,650 ha) and recommended rates for one application of insecticide to turf. Those authors also stressed the need for public education, especially of the homeowner to reduce unnecessary water, fertilizer, and pesticide inputs and reduce the pressure for growing "perfect lawns." Opportunities for research and educational efforts identified in the present study similarly included education of the consumer and increased incorporation of biological control agents in management decisions.

Table 2. Timing of pesticide applications.

	Proportion of total a.i. applied during:			
	Dec-Feb	Mar-May	Jun-Aug	Sept-Nov
Herbicides	14.4%	32.5%	31.8%	20.7%
Insecticides	3.5%	28.1%	55.3%	12.4%
Fungicides	4.4%	31.2%	46.1%	17.4%

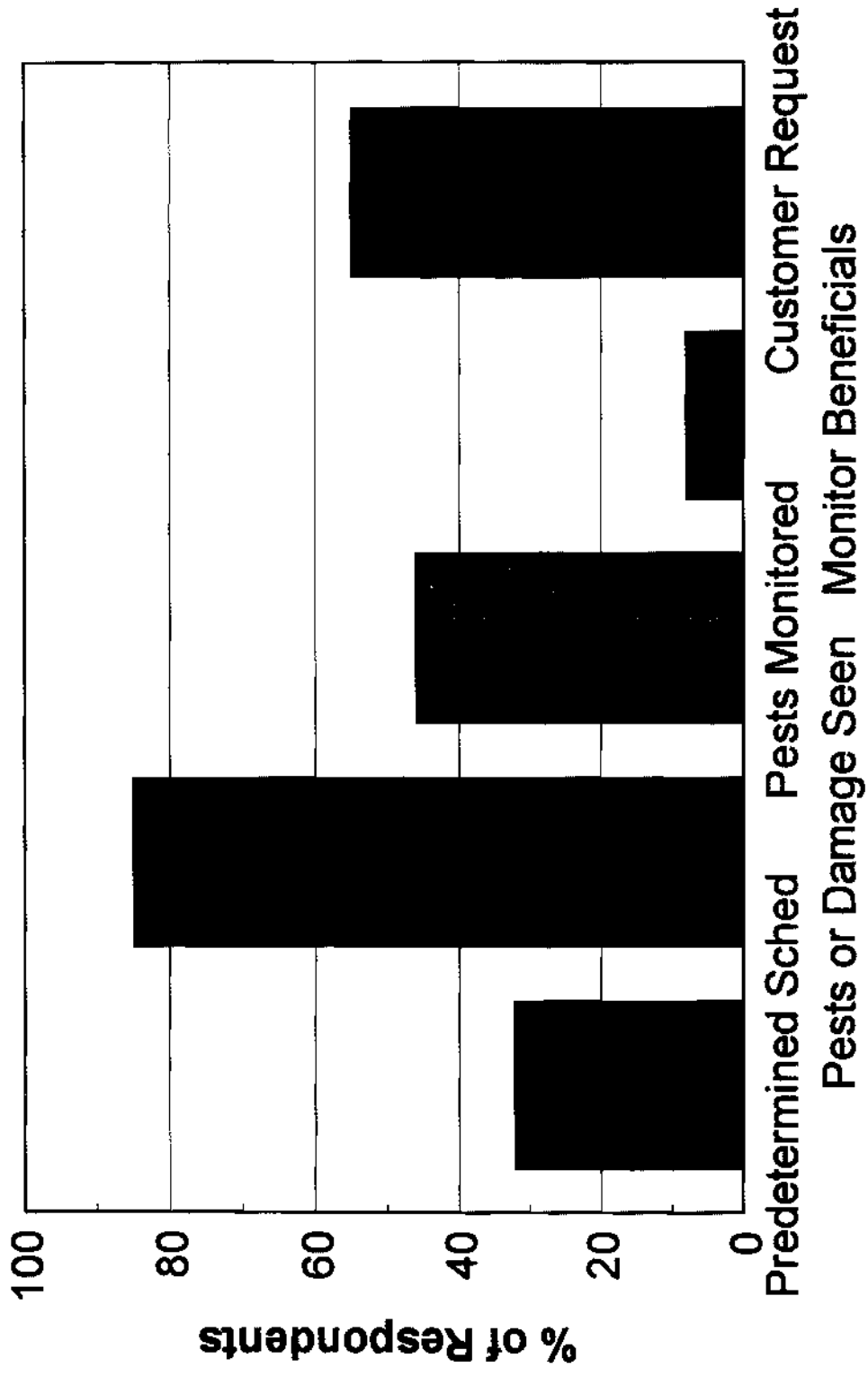

Fig. 2. Factors influencing the timing of pesticide application by LM/LC firms in metro-Atlanta.

These survey results also suggest the importance of designing educational programs that target both types of firms identified in the survey; small firms with relatively little experience, and relatively low sales and equipment, as well as large well-established, highly-capitalized firms. Practices reported by the industry seem well in line with the integrated pest management concept, including fairly extensive use of horticultural oils and timing of treatments based more on monitoring of pest activity and less on predetermined applications of pesticides. Finally, we must be cognizant of the existence of additional opportunities to reduce the need for pesticides in the landscape. For example, when landscape maintenance firms were asked to identify ways that landscape architects could reduce the need for pesticide use (Garber and Bondari 1996), the most frequently identified opportunity was in better plant selection, particularly in the use of pest resistant plants. Since landscape architects specify about 75% of the plants used by landscape installation firms in Georgia (Garber and Bondari 1992, 1995), they have a large influence on plant material placed in the landscape. Thus, this group represents an ideal target audience for educational efforts with the goal of reducing the need for pesticide use in the landscape.

Acknowledgment

We thank D. Olson and T. Murphy for comments on an earlier draft. This project was supported in part by funding from the Pollution Prevention Assistance Division of the Georgia Department of Natural Resources.

References Cited

Arnold, T. B. and D. A. Potter. 1987. Impact of a high-maintenance lawn-care program on non-target invertebrates in Kentucky bluegrass turf. Environ. Entomol. 16: 100-105.

Aspelin, A. L. 1994. Pesticide industry sales and usage: 1992 and 1993 market estimates. Office of pesticide programs, US-EPA, Washington, DC.

Balsdon, J. A., S. K. Braman, A. F. Pendley, and K. E. Espelie. 1993. Potential for integration of chemical and natural suppression of azalea lace bug (Heteroptera: Tingidae). J. Environ. Hort. 11: 153-156.

Blanco-Montero, C. A., T. B. Bennett, P. Neville, C. S. Crawford, B. T. Milne and C. R. Ward. 1995. Potential environmental and economic impacts of turfgrass in Albuquerque, New Mexico (USA). Landscape Ecology 10: 121-128.

Braman, S. K. and A. F. Pendley. 1993. Relative and seasonal abundance of beneficial arthropods in centipedegrass as influenced by management practices. J. Econ. Entomol. 86: 494-504.

Cockfield, S. D. and D. A. Potter. 1983. Short term effects of insecticidal applications on predaceous arthropods and oribatid mites in Kentucky bluegrass turf. Environ. Entomol. 12: 1260-1264.

1984. Predation on sod webworm eggs as affected by chlorpyrifos application to Kentucky bluegrass turf. J. Econ. Entomol. 77: 1542-1544.

Florkowski, W. J., C.D. Robacker, J. G. Latimer and S. K. Braman. 1996. Economic profile of Atlanta landscape maintenance and lawn care firms. Hort. Technology. (In press).

Garber, M. P. and K. Bondari. 1992. Landscape architects as related to the landscape/nursery industry: I. Impact on demand for plant material. J. Environ. Hort. 10: 69-72.

1995. Landscape installation firms: I. Business characteristics and trends affecting industry performance. J. Environ. Hort. 13: 31-34.

1996. Landscape maintenance firms: II. Pest management practices. J. Environ. Hort. 14: 58-61.

Hudson, W. G., M. P. Garber, R. D. Oetting, R. F. Mizell, A. R. Chase and K. Bondari. 1996. Pest management in the United States greenhouse and nursery industry: V. Insect and mite control. HortTechnology. 6: 216-219.

Lemke, L. A. and J. B. Kissam. 1989. Public attitudes on red imported fire ant (Hymenoptera: Formicidae) infestations in homes and recreational areas. J. Entomol. Sci. 24: 446-453.

Neely, D., E. B. Himelick and S. Cline. 1984. Assessment of pesticide usages by commercial and municipal arborists. J. Arboriculture. 10: 143-147.

Oetting, R. D. and J. Allison. 1994. The biologic and economic assessment of chlorpyrifos and diazinon in ornamentals and sod production. USDA Tech. Bull. No. 1837.

Potter, D. A. 1994. Effects of pesticides on beneficial arthropods in turf, Pp 59-70. *In* A. R. Leslie [eds.], integrated Pest Management for Turf and Ornamentals (CRC Press Boca Raton, FL.

Potter, D. A., B. L. Bridges and F. C. Gordon. 1985. Effect of N fertilization on earthworm and microarthropod populations in Kentucky bluegrass turf. Agron. J. 77: 367-72.

Potter, D. A., A. J. Powell and M. S. Smith. 1990a. Degradation of turfgrass thatch by earthworms (Oligochaeta; Lumbricidae) and other soil invertebrates. J. Econ. Entomol. 83: 205-211.

Potter, D. A., M. C. Buxton, C. T. Redmond, C. G. Patterson and A. J. Powell. 1990b. Toxicity of pesticides to earthworms (Oligochaeta: Lumbricidae) and effect on thatch degradation in Kentucky bluegrass turf. J. Econ. Entomol. 83: 2362-2369.

Smiley, R. W., M. Craven Fowler, R. T. Kane, A. M. Petrovic and R. A. White. 1985. Fungicide effects on thatch depth, thatch decomposition rate, and growth of Kentucky bluegrass. Agron. J. 77: 597-602.

Smiley, R. W. and M. Craven Fowler. 1986. Turfgrass thatch components and decomposition rates in long-term fungicide plots. Agron. J. 78: 633-636.

Terry, L. A., D. A. Potter and P. G. Spicer. 1993. Effect of insecticides on predatory arthropods and predation on eggs of Japanese beetle (Coleoptera: Scarabaeidae) and pupae of fall armyworm (Lepidoptera: Noctuidae) in turfgrass. J. Econ. Entomol. 86: 871-878.