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Cool season grasses should be removed from directly under the conifers. Nimblewill, a warm season grass, may be an alternate to cool season grasses in tree planting ground cover systems.

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## Urban Integrated Pest Management in Kentucky— A Case Study<sup>1</sup>

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### Abstract

Integrated Pest Management (IPM) principles and techniques were applied to woody landscape plants and turfgrasses in the urban landscape in Louisville during the 1980-83 growing seasons. The program, at first directed towards professional horticulturists and institutional grounds maintenance persons, gradually grew to include commercial nurserymen and homeowners. Operating procedures, pricing strategies, and use of personnel changed each year of the program to take advantage of previous experience. Developing this program provided an opportunity to learn about the various ways that this and similar programs might succeed or fail.

**Index words:** IPM, pest management, urban horticulture

### Introduction

Recently the Cooperative Extension Service (CES) in several states has been involved in implementing Integrated Pest Management (IPM) programs for urban clientele. These programs involve pest management in diverse areas including vegetable gardens, structures, and landscapes and range in complexity from advising via newsletters and personal contact to specific site visits by scouts and precise monitoring of appropriate pests

(6). In most urban areas landscape plantings have a high value, and plant health and appearance are important to persons owning and maintaining these plantings. In many cases, an objective of a CES-sponsored IPM program is to demonstrate its feasibility so that privately-owned companies can utilize the technology to form a profitable business (3). Needs and priorities for implementing CES sponsored IPM programs have been described (1). In Maryland, for example, a successful IPM program was implemented for landscape plants in institutional and residential settings (2,5). The IPM program devised for the Louisville area involved an organized, comprehensive approach to the management of the health of woody landscape plants and turfgrasses in the urban landscape. This approach used University students or graduates trained in the plant sciences as "scouts" who systematically looked for important insects, diseases, weeds, and cultural problems in the

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monitored landscape so that appropriate control measures could be considered.

## Materials and Methods

Prior to the 1980 growing season, the first and third authors made an informal survey of professional horticulturists, and concluded that there was a need for an urban landscape IPM program in the Louisville area. At a meeting of interested professionals, articles of incorporation for "Louisville Area Integrated Landscape Pest Management, Inc." were developed. The nonprofit corporation that was established provided a means for collecting money and making payments without the direct involvement of the CES. In this way an elected board of directors and an appointed secretary-treasurer helped influence the scope and direction of the program and handled billings and payroll. To meet the needs of the local community, the following urban landscape IPM clientele were identified:

*Institutional Landscape Managers.* This program was designed for managers and owners of nonresidential landscapes. The program offered the user biweekly (monitored May-September) landscape inspections, with follow-up reports backed by appropriate laboratory analyses and personal consultations. In addition, the grounds manager or owner received a weekly newsletter describing current problems, reminders, and observations relating to landscape plant health in the area. The fee charged for this service ranged from \$75 to \$600 per season and varied from user to user depending on the size and complexity of the landscape. Typically, the charge for a landscape requiring 2-3 hours to monitor was \$180 per season.

*Professional Horticulturists.* Commercial horticulturists in the private sector including arborists, nurserymen, lawn service operators, landscape contractors, garden center operators, and consultants were targets of this phase of the program. This group was provided with a weekly newsletter (May-September) incorporating pest monitoring information to provide an update of specific turf and ornamental pest conditions, with reminders of timely preventive actions. In addition to information obtained from scouting other facets of the program, information from pheromone traps, disease and insect indicator plants [similar to the concept of IPM "key plants" (4)] and weather instruments located in representative landscapes were included in the newsletter. Commercial horticulturists were charged a fee of \$50 per year for the pest monitoring and newsletter service.

*Homeowners.* An IPM program designed for private residence owners included 3-4 visits per season by scouts and/or supervisors, a landscape sketch with plants and problems identified, a concise landscape insect and disease report including recommendations, and a packet of relevant Extension literature. The fee for this service ranged from \$25 to \$50 for standard-size residential lots.

*Nurserymen.* The nursery IPM program involved wholesale landscape plant nursery owners and managers. IPM scout and/or supervisor made biweekly in-

spections of designated nursery plantings during the growing season, and growers received follow-up scouting reports of troublesome plant health problems so that timely remedies could be applied. Nurserymen enrolled in the program also received the IPM newsletter. The typical seasonal charge for the inspection service ranged from \$150 for 2.5 hours of monitoring to \$300 for 4 hours.

The size and scope of the urban IPM program changed during its four-year existence. A description of the services offered and personnel used each year of the program follows:

1980—The institutional landscape inspection project and the ornamental and turf pest monitoring newsletter were initiated. One scout was hired and the county extension horticulture agent served as scout supervisor. The newsletter was written by the county extension agent with contributions from interested state specialists. Seven institutional grounds were monitored and 25 paying newsletter subscribers were enrolled.

1981—The program continued with few changes. The number of institutional grounds monitored was reduced to three with the scout only working part-time.

1982—The IPM program was implemented for all four clientele groups. A B.S. level experienced horticulturist was hired as scout supervisor and three scouts were hired; the scout supervisor controlled the day-to-day operations of the program and assisted in writing the newsletter. A part of the scout supervisor's salary was supported by IPM funds obtained from the University of Kentucky. Eight institutional landscapes, 378 residential landscapes and 7 nurseries were monitored and 20 subscribers received newsletters.

1983—Modifications to the 1982 program were implemented. The scout supervisor was retained and only one scout was hired. Eight institutional landscapes, 99 residential landscapes, and 3 nurseries were monitored, and 20 subscribers received newsletters.

## Results and Discussion

*Institutional Landscape Inspection Programs, 1980-1983.* The kinds of clients using this service were diverse (Table 1). The biweekly (triweekly in 1983) inspection service was well received by most landscape managers. This program was self-supporting, since the income derived paid for employee time, travel costs, and other expenses. The institutional clients also received educational benefits in the form of the IPM newsletter, monitoring reports of their landscape and direct client-IPM supervisor contact.

In 1984 and 1985, the scout supervisor incorporated this part of the IPM program into a commercial operation; consequently, the rest of the CES supported parts of the program were discontinued. He is currently head greenskeeper at Long Run golf course in Louisville. In 1986, the urban IPM county coordinator initiated an integrated landscape management program as a privately run commercial operation using many of the concepts developed in the IPM program. He is currently self-employed.

*The Newsletter Program for Professional Horticulturists, 1980-1983.* The persons who first enrolled in this

**Table 1. Institutional landscape IPM clients, 1980-1983.**

Year	Type of Client	Charge (\$)
1980	1 Apartment Complex	180
	3 Neighborhood Associations (street trees)	180 each
	1 Military Base (Ft. Knox)	360
	1 Water Company	180
	1 Public Open Space	180
1981	1 Military Base	360
	1 Water Company	180
	1 Public Open Space	180
1982	1 Neighborhood Association	150
	3 Golf Courses	130, 150, 300
	1 Distillery	150
	1 Church	75
	1 Office Complex	150
	1 Military Base	360
1983	3 Golf Courses	150, 170, 300
	1 Distillery	150
	1 Neighborhood Association	180
	1 State Fairgrounds	600
	1 Condominium Complex	125
	1 Shopping Mall	170

program consistently participated for the entire 4-year period. The decrease in subscribers from 1981 to 1982 is attributed to complimentary copies given to nursery IPM participants. Although a reader survey was not conducted, there appeared to be general satisfaction in the form and content of this publication. In its last season, the newsletter was improved with photographs. Several garden center managers indicated that the newsletter was circulated within their place of business as required reading to keep their employees informed. Complimentary copies were sent to appropriate extension specialists and educators. The contents were also made available to the news media resulting in widespread distribution of IPM findings.

Considering the time and effort put into pest monitoring and writing, this program did not pay for itself. However, it was the most educationally successful; the articles published in the newsletter were used by garden center personnel for training their employees, and most of the professional horticulturists receiving the newsletter used the advisements in their day-to-day activities. Several of the participants said that they had saved or earned money by using the newsletter information. Radio, television, and newspaper workers used the newsletter reports in their programs, and the information, therefore, reached thousands of potential IPM advisory users. The newsletter obliged us to monitor various pest situations and then disseminate our findings; consequently, the program enabled the CES to do a better job.

*Residential Landscape Inspection Program, 1982-1983.* In 1982, 378 homeowners signed up for the program, paying \$25 for three landscape visits. During 1982 the three landscape visits by scouts and/or scout supervisors were used for the following activities: 1) a landscape sketch and a corresponding plant inventory were made, and notes were taken on any obvious landscape problems; 2) all landscape plants were carefully

examined for indications of poor health. Soil and plant samples were taken as needed for laboratory analysis. Homeowners having pest problems requiring immediate attention were notified by mail; and 3) reinspection of the landscape and delivery of a packet containing the landscape sketch and inventory, a brief report on problems found and suggested remedies, and selected extension literature. Each scout made all three landscape inspections, enabling them to become familiar with "their" landscapes. When unusual or difficult problems were observed by the scout, some landscapes were inspected a fourth time by the scout supervisor and the owners were informed of the findings.

In 1983, 99 homeowners signed up for the program. The procedure was similar to that used in 1982, with a few important differences: 1) An on-site consultation was made by the scout supervisor at a time agreed upon by the homeowner. These 30-45 minute meetings enabled the homeowner to have answered directly or through follow-up communication any gardening or landscape topic of concern; 2) subscribers paid \$50 and resubscribers from 1982 paid \$40; 3) and the final packet of information was supplied by mail. The residential landscape program generated significant operating funds, but required a great deal of work and time, especially with record keeping and travel. No paying residential clients were refused this IPM service, consequently, monitored landscapes were located throughout the Louisville area in neighborhoods having a wide range of property values.

This program was only partly successful. Subscribers dropped from 373 the first year to fewer than 100 the following year, but even in the first year, the program did not pay for itself. The number of homeowners subscribing to this program declined markedly for several possible reasons. The charge of \$50 may have been too high for our clientele, even with the extra consultation service. In 1983 the program was not advertised as well as in 1982. Extremely rainy weather prevailed in 1983 (13 consecutive rainy, spring weekends), perhaps resulting in less enthusiasm for yard work, and therefore less attention to landscape plant problems by the clientele. The lack of severe turf problems the previous year due to relatively mild weather may have also reduced numbers of potential clients. Most of the problems encountered in these urban landscapes involved long-term problems such as shade tree pruning and fertilization, turfgrass soil testing, and turf weed control and fertility needs. Assuming that these needs were successfully met in 1982, it was expected that very little repeat business would occur in 1983, and this proved to be the case. The decision not to discriminate against clients based on location was costly to the program because of excessive travel time and expense. Developing clusters of clients limited to specific neighborhoods (5) would have been more efficient.

*Nursery Inspection Program, 1982-1983.* Wholesale nurseries enrolled in this program received biweekly inspections from mid-May through August for a cost of \$150-300/season. Inspections lasted 4 and 2.5 hours per visit in 1982 and 1983, respectively. Plant and soil specimens were collected as needed. The IPM service kept the nurseryman informed by telephone, letter, or personal

visit. A written summary of plant problems detected was submitted to each nurseryman at the end of the season. Each year, several of the nursery clients were located in counties some distance from Louisville. To make 24 hours of inspections biweekly in 1982, 9.5 hours of driving time was required, and in 1983, 7.5 inspection hours required 4.5 driving hours. The number of plant pest problems found as a result of these visits ranged from 13-30 per nursery per season. Perhaps as many as 25% of these required some kind of treatment by the nurseryman.

Most of the nurserymen who signed up for the program really did not need it; they already had a good idea of their potential pest problems and were inspecting their holdings regularly. Because the nurseries were widely scattered throughout the central part of Kentucky, too much time and expense were allocated to travel, and therefore, the program was not cost effective. One nurseryman, who had rather large holdings and a relatively progressive attitude, did benefit from the program, especially since extra pesticide applications were avoided through timely applications. A research project was initiated by the University of Kentucky to solve one intractable problem uncovered by the program.

*IPM Program Evaluation.* Several criteria were used to evaluate the four phases of the Urban IPM program in Louisville. One was profitability; for an IPM program to gradually be assumed by private, commercial interests, it would have to be demonstrated that the program could be financially self-sufficient. Another criterion was educational value; CES programs of educational value that reach large numbers of clients can

usually be considered successful. Other criteria included: what was learned from the program that could benefit succeeding programs, the identification of urban landscape research needs, and the collection of data on urban landscape plantings and pest problems.

During 1980 and 1981, the IPM program operated near the break-even point (Table 2). During 1982 and 1983, income exceeded expenses (not including the scout supervisor's salary) by \$5,400-5,500. Money allocated from University of Kentucky IPM funds was used to supplement the scout supervisor's salary so that his income during the 18 months of employment was approximately \$1000 per month. Without the supplement the IPM program would have fallen short by \$7,000 during the last 18 months.

Although a small net return to management (not including scout supervisor salary) was generated by this program, there were a number of expenses absorbed by the CES. The county extension office was used as the headquarters for the program, providing working space for the scouts and scout supervisor as well as providing clerical and technical assistance. A privately run landscape IPM service would have to make up these costs. Despite these expenses, the Jefferson County CES reached more clients with better educational information because of the program. This program also benefited from being associated with the University of Kentucky College of Agriculture. In addition to some financial backing, association with the University assured clients that the program was unbiased, having no vested interest in the treatments recommended. Although much of what was being done amounted to consulting, very few private consultants are free from the treatment

**Table 2. Income and expenses associated with the IPM program for landscape plantings 1980-1983.**

Year	Program type	Income	Expenditure	Cost
1980	Institutional <sup>z</sup>	\$ 1440	Scout salary	\$2240
	Newsletter <sup>y</sup>	1250	Scout travel	252
			Supplies	200
	Totals	2690		2692
1981	Institutional	750	Scout salary	1500
	Newsletter	1250	Scout travel	170
			Supplies	200
	Totals	1970		1870
1982	Institutional	1465	Scout salaries	6720
	Newsletter	1000	Travel	1008
	Residential <sup>x</sup>	9450	Supplies	200
	Nursery <sup>w</sup>	1500		
	Totals	13415		7928
1983	Institutional	1845	Scout salary	2240
	Newsletter	1000	Travel	504
	Residential	4950	Supplies	200
	Nursery	600		
	Totals	8395		2944

<sup>z</sup>Institutional landscape inspection program

<sup>y</sup>Pest monitoring newsletter for professional horticulturists

<sup>x</sup>Residential home landscape inspection program

<sup>w</sup>Nursery inspection program

phase of the landscape business and thus may be perceived as less trustworthy. Interestingly, landscape consultants in Louisville were not displeased with the potential "competition" because in many cases the IPM program influenced landscape managers and homeowners to have work done that resulted in increased need for these individuals to provide the needed service. However, although the need for woody plant services may have increased because of this IPM program, our surveys (unpublished) indicate that the need for lawn care services would decrease because the clients learned to do it for themselves.

It became apparent through all phases of the program that more than just integrated pest management was needed to maintain urban landscape plant health and beauty. Clients were eager for advice in such non-pest plant maintenance matters as fertilization, pruning, watering, and cultivar selection and placement. Monitoring of several cultural practices needed to be integrated into pest monitoring. Perhaps the term integrated landscape management (ILM) would better describe what is really needed for these urban clients and their landscape plants. It is possible that as a commercial enterprise, ILM might have greater use and profitability than IPM. In addition, based on our experience, institutional landscape pest management programs should prove to be more profitable than residential, newsletter, or nursery programs.

## Significance to the Nursery Industry

Individuals and organizations contemplating using an IPM approach to benefit urban landscape plantings can benefit from our experience. A great deal of data on types of plant materials, their performance, and their problems can be obtained from a landscape plant IPM program (unpublished). Successful variants of the program reported here may be developed.

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# Influence of Fertilizer Briquette Placement and Irrigation Regime on Container Medium Nutrient Content and Growth of 'Mrs. G.G. Gerbing' Azalea<sup>1</sup>

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## Abstract

'Mrs. G.G. Gerbing' azaleas were grown for 1 year in a pine bark:Canadian peat:builders' sand (2:1:1 by vol) medium amended with 3 kg/m<sup>3</sup> (5 lb/yd<sup>3</sup>) of dolomitic limestone and fertilized with 4 Woodace 14N-1.5P-2K (14-3-3) briquettes placed either below the root ball, 4 briquettes placed in the growth medium surface or 2 briquettes in the surface and 2 below the root ball. After one year, shoot and root dry weights were greatest for the surface placement and these plants were less chlorotic than for the other placements. The 460 ml (1 in) per irrigation rate resulted in the smallest plants with more chlorosis than the 150 or 230 ml (0.3 and 0.5 in) rates. Leaf tissue, N, P and K levels were generally lower than optimal levels for azaleas. Data from this experiment indicate Woodace briquettes should be placed in the growth medium surface and the medium should be amended with supplemental micronutrients even though the briquettes contain micronutrients.

**Index words:** nutrition, container production, *Rhododendron*

## Introduction

Slow-release fertilizers are frequently used in container production of woody plants (2, 4, 7, 11, 12) be-

cause of reduced fertilizer application frequency and waste from leaching compared to other fertilization systems (6, 7). However, nutrient release may not be adequate for optimum plant growth or predictable under different environmental conditions (11, 12, 13).

The release rate of some slow-release nutrient carriers is predictable and relatively constant over a range of environmental conditions. Isobutylidene diurea (IBDU) is a slowly soluble compound (0.1g/100 ml H<sub>2</sub>O) in which rate of dissolution is determined by particle size and

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