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INTEGRATED PEST MANAGEMENT FOR ARBORISTS: IMPLEMENTATION OF A PILOT PROGRAM[1]

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Abstract. During the 1982 growing season a Maryland arborist company cooperated with the Department of Entomology, University of Maryland to determine the effectiveness and commercial feasibility of an IPM program compared to a traditional arborist cover spray program. Over 11,000 plants on 26 client properties that previously had received yearly 3 cover sprays, were switched to a biweekly plant monitoring program. The 20 most common plants composed 70% of the total plants monitored. Of the many potential pests encountered (excluding plant diseases) only 25 types reached pest status and required treatment that consisted of spot spraying with pesticides or hand removal. Time spent monitoring, treating, and interacting with clients averaged 20 minutes for ¼ acre to 50 minutes for 4 acres. Pesticide volume sprayed was reduced by 94% compared to 3 general cover sprays. The accuracy of cover spray timing versus monitoring treatments for selected pests are discussed and figured for the gypsy moth (*Lymantria dispar*), Japanese weevil (*Pseudocneorhinus biifasciatus*), and azalea lacebug (*Stephanitis pyrioides*).

Integrated pest management (IPM) for landscape plants is based on environmentally sound and cost effective tactics utilizing chemical pesticides, biological control agents, and cultural techniques to maintain plant quality. The reasons for adopting the IPM approach, and the steps in developing an IPM program are discussed in detail in several books (2,6).

Although the effectiveness of the IPM approach was first demonstrated in agricultural crop systems about 25 years ago (15), only in the last decade have a few workers begun to apply this concept to the protection of urban (including suburban) lawns (7,8,14) and shrubs and trees (3,8,11). Considering the great esthetic and monetary value of landscape plants (9), and the surprisingly large volume of pesticides used in the urban area (16) where 74% of this country's population lives (13), it is important that IPM principles be used to solve urban pest problems.

The objectives of this study were: 1) to compare the effectiveness of shrub and tree protection provided by a traditional arborist cover spray program with an IPM program based primarily on plant monitoring and spot treatments, 2) to determin if pesticide use can be reduced while plant quality is maintained, 3) to evaluate client acceptance of a commercial arborist IPM program and 4) to determine if the IPM approach is commercially feasible for arborists.

Materials and Methods

In the spring of 1982 a Maryland arborist company provided us with 26 clients in the metropolitan area of Washington, D.C. whose properties (sites), ranging in size from ¼ acre detached homesites to 10 acres of townhouse common grounds, composed the study sites for the work reported here. All of the trees and some of the shrubs on these sites had received 3 contact, combination insecticide-miticide cover sprays for the previous 1 to 15 years.

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[1] Presented by Dr. Davidson at the annual conference of the International Society of Arboriculture in Indianapolis, Indiana in August 1983.

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The senior author was hired by the company as an IPM monitor. He visited each site every 2 weeks from mid-April to early September to examine plants for problems. Plants were visually inspected and records were made of insects, mites, diseases and cultural problems that were damaging plants and/or reducing their esthetic value, in the judgment of the monitor. During each visit problems were diagnosed, action decisions were made, and appropriate treatments were applied as needed. When uncommon plant problems, especially diseases, were encountered, samples were submitted for diagnosis to the Plant Diagnostic Clinic, Department of Botany, University of Maryland. Based on clinic recommendations, treatments were made at the next site visit, or if needed, a special visit was made.

When spray treatments were necessary the smallest appropriate sprayer was used to spot spray infestations. This meant whenever possible, only those plants with pests actually received pesticide applications. In other words, if 5 plants in a bed of 50 azaleas began exhibiting high damage levels from azalea lacebug, perhaps only 5 to 10 were actually sprayed to control the infestation.

Pheromone baited traps were used to attract the males of dogwood borer, rhododendron borer, peach tree borer, and lilac borer for the purpose of timing sprays with a residual insecticide.

Daily routes were organized to reduce distances traveled among sites. Site visits were made in a pickup truck equipped with side boxes containing pesticides, fertilizers, pruning equipment, spray application safety equipment, 1 and 3 gallon tank sprayers, and a backpack mist blower. For each site visited the mileage, monitoring time, treatment time, and amount of and type of pesticide used were recorded.

A post program survey was conducted by the arborist company to evaluate clients' perception of their landscape plants after 1 season of care under the IPM program versus previous seasons under a cover spray program.

Results and Discussion

A total of 11,115 individual plants composed of 133 species was monitored on the 26 study sites. It is important to note that the 10 most common species of plants accounted for 60% of the total, and the 20 most common plants represented about 70% of all monitored plants (Table 1). Plants should be the center of an IPM based arborist program (10). This means such a program can only be as good as the IPM monitor's knowledge of plants will allow. Since almost three quarters of all plants on the 26 sites were represented by only 20 plant species, this is not quite the problem one would suppose, judging by the long list of ornamentals actually available for landscaping properties. If monitors are first taught the identification, cultural requirements, and key pests for the 20 most common ornamental plants in their area, they will learn to deal with most problems rather quickly. This list of common plants is similar in content to those developed in earlier Maryland homeowner demonstration programs managed by Maryland Cooperative Extension Service specialists and county agents (3,4 8).

As Table 1 shows azaleas were the most common plant, occurring on all but one site, and representing over 20% of the total plants monitored. Boxwood, the second most abundant plant, composed about 9% of the total plants, and the number 10 plant (white pine) represented about 2% of the total. Many plants, however, were uncommon. For example, 44 plant species occurred on 5 sites or less and they represented only 3% of the total plants monitored.

Table 2 shows the 25 kinds of animals (all insects except for mites and slugs) that were found causing sufficient damage, in the judgment of the monitor, to require treatment. This list of pests is arranged in decending order based on the number of times treatments were required. The following discussion pertains to selected pests in Table 2.

Clearwing borers were the number 1 pest in this study. They were the only pests that could not be controlled by spot spraying because the larvae cannot be detected or sprayed once they are under bark. Therefore, pheromone baited traps were used to detect the emergence of males. All susceptile host plants growing under conditions predisposing them to attack (12) were sprayed with a residual insecticide 10-14 days after the first sustained catch of the males of each moth species. This spray treatment was repeated 1 month later for each species. Therefore, more

Table 1. Twenty most common plants monitored in a 1982 Maryland arborist IPM program.

Plants	*No. plants/No. sites*	*% of total*	
Azalea	2286/25	20.5	
Boxwood	973/14	8.7	
Japanese holly	946/20	8.5	
Juniper	625/15	5.6	
Hemlock	521/15	4.7	
Yew	362/21	3.3	
Rose	344/14	3.1	
Rhododendron	244/21	2.2	
Flowering dogwood	237/21	2.1	
White pine	206/13	1.8	—60.5%
Chinese holly	182/11	1.8	
Euonymus	165/ 8	"	
Viburnum	145/10	"	
American holly	129/19	"	
English holly	117/11	"	
Cherry laurel	116/4	"	
Arborvitae	98/10	"	
Barberry	91/ 7	"	
Ligustrum	83/ 9	"	
Hosta	83/ 9	"	—70.5%

Table 2. Pest importance as determined by number of treatments required in a 1982 Maryland arborist IPM program.

Pests	*Number of Treatments*
Clearwing moth borers	507
Lace bugs	230
Boxwood leafminer*	199
Boxwood psyllid*	164
Japanese weevil	91
Spider mites	81
Fall cankerworm*	53
Native holly leafminer*	37
Slugs	33
Fall webworm*	24
Gypsy moth*	13
Aphids	11
Japanese beetle	7
Juniper tip midge*	6
White prunicola scale	5
Eastern tent caterpillar*	5
Bagworm*	4
Spruce bud scale*	2
Cryptomeria scale	2
Roseslug	2
Oriental fruit moth*	1
A leafminer	1
Fletcher scale*	1
Juniper scale*	1
Imported willow leaf beetle*	1

* Common names of insect pest species approved by the Entomologial Society of America

treatments were applied for borers than any other pest.

Lace bugs were the number 2 pests encountered. Since azaleas were the most abundant plant, the azalea lace bug was the pest most often detected and found at damaging levels. Even so, only 9% of the over 2000 azalea plants monitored actually required treatment. Heavily infested plants were usually growing in high risk locations, i.e. in full sun, along foundations in sun, along roadways or on median strips, etc. The heat in these situations appeared to accelerate generation time, and possibly attract more lace bugs compared to infestations on plants growing in less stressed sites.

Boxwood was the second most common plant on study sites. More problems were detected on boxwood than any other plant in the study. In addition to heavy infestations of boxwood leafminer and boxwood psyllid, cultural stress factors, e.g. compacted soil, excessive mulch, poor drainage, etc. often were found to be the cause of unsightly decline and dieback on this prestigious ornamental.

Spider mites have been in the top 10 list of pests in all our ornamentals IPM studies in Maryland for the past 6 years. We did note however, they seemed to become a problem most often on those plants which had been sprayed with carbaryl to control early season defoliators.

Native holly leafminer usually was found on fully exposed American holly. Because adults are active for at least one month, no attempt was made to control them. Instead, larval mine development was monitored. When mines were seen developing in the summer, heavily infested plants were sprayed with a systemic insecticide. Control was excellent.

Three pest species were controlled by hand removal in most cases. These were fall webworm and eastern tent caterpillar (nests) and bagworm. It is interesting to note that although suitable host plants were plentiful, bagworm ranked only number 17 in this study. In our earlier studies with homeowners (3,4,8) bagworm was usually among the top 5 pests detected. We attribute this to the good timing of the second and third early season cover sprays applied in previous years by the arborist company.

Thirteen species of scale insects were detected on the 26 study sites but only 5 species were abundant enough to cause damage, i.e. obvious chlorosis or dieback (Table 2). Two of the 5 pest scale species, both armored scales, merit discussion: cryptomeria scale (*Aspidiotus cryptomeriae*) and white prunicola scale (*Pseudaulacaspis prunicola*).

Cryptomeria scale is an enigma because although Borchsenius (1) recorded it from *Taxus, Torreya, Chamaecyparis, Keteleeria, Cryptomeria, Abies*, and *Pinus*, we have only seen it on *Abies, Pinus* and *Tsuga* thus far in Maryland, even though *Taxus* (yew) is abundant. During the last 2 or 3 years this scale has become a serious pest on *Tsuga* (hemlock) in Maryland, often in combination with the hemlock wooly adelgid (*Adelges tsugae*), which also has become a widespread and serious pest in the state during the same period. Cryptomeria scale is quite cryptic in light infestations. Covers of the young stages are almost transparent. Old covers are tan in color and not very obvious. This may explain why it often goes undetected by arborists.

White prunicola scale has been confused with white peach scale in the United States. Davidson et al. (5) recently distinguished these species and discussed the differences in their life history patterns. White prunicola scale attacks primarily *Prunus* species and it is a major pest of Japanese flowering cherry. It also attacks lilac and privet and a few other species. White peach scale is most common on mulberry and peach, but it has been recorded from plants in over 100 genera. White prunicola scale and cryptomeria scale were the only pests in this study which were not satisfactorily controlled with contact insecticides. In both cases the insecticides were applied when crawlers appeared.

In accordance with study objective number 1, a weekly treatment log was kept to record the name of each pest species, and the time(s) it reached pest status, in other words required treatment. These treatment times were then compared with the approximate time periods of the 3 typical cover sprays provided by the company; late April to early May, late May to early June and late June to early July. In general, cover sprays appeared to be most effective for single generation, early season pests such as the gypsy moth (Fig. 1). This insect usually hatches in central Maryland about mid-April and completes the caterpillar stage by late June. Thus, the first 2 cover sprays (barred columns) would control this pest, which the monitor did not detect and treat until mid-May (black column).

Cover sprays are less appropriate for multiple generation, mid to late season pests, such as the azalea lace bug (Fig. 2), which can fly in to reinfest an area. Here only the second cover spray would have been appropriately timed in 1982. The monitor found that most treatments were required after the third cover spray would have been applied.

Late season pests, such as the Japanese weevil (Fig. 3), appear to escape the effects of cover sprays. This flightless weevil apparently overwinters in the soil as eggs and young larvae,

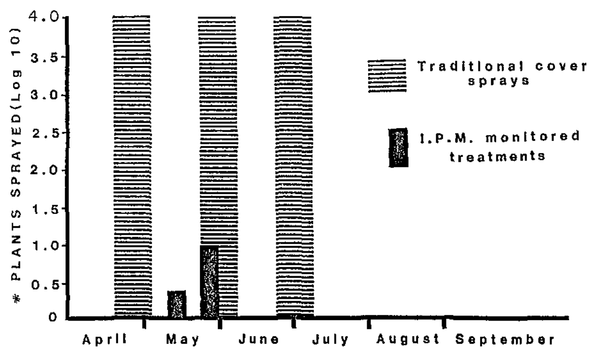

Fig. 1. Comparison of general cover spray timing versus timing of treatments determined by IPM monitoring for gypsy moth.

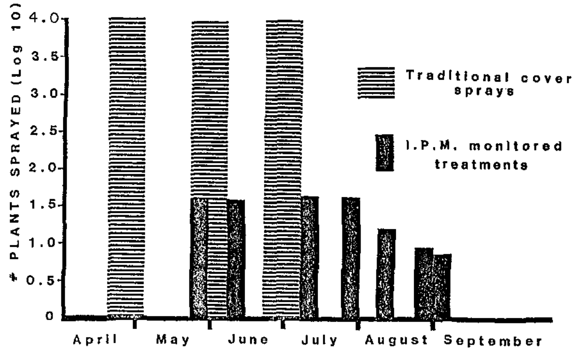

Fig. 2. Comparison of general cover spray timing versus timing of treatments determined by IPM monitoring for Azalea lacebug.

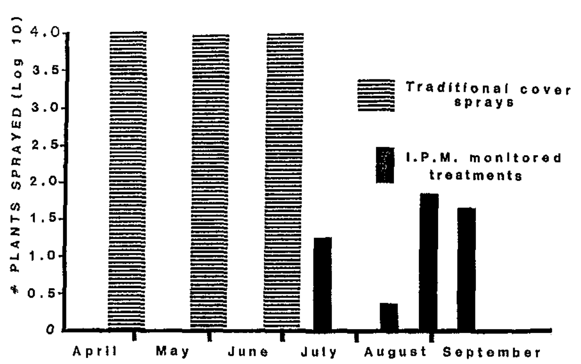

Fig. 3. Comparison of general cover spray timing versus timing of treatments determined by IPM monitoring for Japanese weevil.

adults begin to appear in late June, and they are active until frost. Since populations were often localized on a few shrubs on a site, spot treatments were an effective method of control.

The 7 pesticides used in this study were those used by the arborist company in previous years, and currently in stock. In order of gallons sprayed they were acephate, carbaryl, lindane, diazinon, dicofol, benomyl, and dimethoate. A total of 169 gallons of mixed pesticides were sprayed as spot treatments in this IPM program. The arborist company estimated that 3099 gallons of mixed pesticide would be required to complete 3 cover sprays on the same properties. Therefore, in 1982 this IPM program reduced the gallons of mixed pesticides sprayed by 2930 gallons for a 94% reduction.

About ⅓ of the clients returned a pest program evaluation questionnaire. Most were pleased with the IPM monitoring service they received and the appearance of their plants compared to previous years. We found that many clients liked to inspect their plantings with the monitor. This did not consume excessive amounts of the monitor's time, and it may well have been a strong point in this program. Good rapport should help create long term customers.

As Table 3 shows, most study sites were detached homesites between ¼ acre and 4 acres in size. The 10 acre site was a newly planted townhouse project. The routes between sites were organized to provide the shortest driving time. The average time spent on each site of similar size varied according to the number and types of plants present. For example, a ¼ acre site with 50 boxwods would require more time than a ¼ acre site with 50 yews because boxwoods have several problems requiring attention in this area while yews have few problems. Accordingly, Table 3 shows one ¼ acre site only required an average of 10.6 minutes to service (monitor, treat and interact with client if necessary), while another ¼ acre site required an average of 21.6 minutes to service.

Assuming similar plant materials, sites averaging 1 acre, and a daily driving distance less than 40 miles, this study indicates that about 15 properties can be serviced daily in central Maryland. In a full time, biweekly IPM program then, about 150 client properties totaling about 150 acres could be serviced in 1 season by 1 monitor.

We believe an experienced monitor should be able to estimate the time and cost required to service a new client's property by evaluating 5 factors: 1) property size, 2) types of plants with

Table 3. Time spent on sites monitoring, treating, and interacting with clients in a 1982 Maryland arborist IPM program.

Clients	*Acres*	*Avg. in minutes*	*Range in minutes*
1	10	89.2	50-124
2	4	64.4	41-119
3	4	53.5	30-130
4	4	44.0	15- 79
5	3	36.5	20- 66
6	2½	33.1	17- 80
7	2	31.6	9- 72
8	1½	16.6	11- 20
9	1	16.7	8- 33
10	1	33.0	17- 65
11	1	30.0	20- 63
12	¾	26.0	12- 67
13	½	31.5	13- 46
14	½	27.6	9- 73
15	½	26.9	16- 37
16	½	24.7	12- 50
17	½	22.0	14- 49
18	½	21.6	11- 50
19	½	21.4	11- 40
20	¼	21.6	13- 42
21	¼	20.6	5- 37
22	¼	19.1	10- 45
23	¼	15.3	10- 22
24	¼	10.6	5- 19
25*			
26*			

* Sites less than 1/8 acre were added to adjacent common grounds of client 2 for time monitoring.

respect to pest and cultural problems, 3) current condition of plants, 4) number of plants, and 5) size of plants.

Although a complete cost analysis of this program by the arborist company was not made available to us, the following generalities were. The company charged the clients in the IPM program about the same amount as if they were in a preventative spray program. Thus, the IPM program cost more in labor for about 10 IPM monitoring visits per site versus 3 spray rig visits. The differential between spray rig maintenance, operation costs, and pesticide costs versus pickup truck operation would favor the IPM program. Regardless, the company did realize a profit from the IPM program.

A point worth mentioning here is that IPM monitors could generate additional work for companies. Since they are in the field for an entire growing season they are in a good position to notice large scale pruning, fertilizing, tall tree spraying jobs, etc. that they could not perform, but could help sell.

Conclusions

This study shows that an IPM program for landscape plants controls pests more effectively than a cover spray program, reduces pesticide use while maintaining plant quality, is acceptable to many landscape maintenance clientele, is logistically manageable, and is financially feasible as a commercial venture.

This program indicated insects were the major problem encountered by the monitor, however time was spent in light pruning, and in the detection and treatment of diseases and nutrient deficiencies.

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Literature Cited

1. Borchsenius, N.S. 1966. A catalog of the armored scale insects of the world. Akad. Nauk USSR Zool. Inst., Leningrad. 499 pp. (in Russian).
2. Bottrell, D.G. 1979. Integrated Pest Management. Council for Environmental Quality. U.S. Gov't. Printing Office, Wash., D.C. 20402. 120 pp.
3. Davidson, J., S. Gill. 1978. *Integrated pest management for the urban public.* Ornamental Plant Entomologists' Newsletter 16(6): 2-4.
4. Davidson, J.A., S.A. Gill. 1980. Urban Integrated Pest Management. Chemical Times and Trends. July: 29-31.
5. Davidson, J.A., D.R. Miller, S. Nakahara. 1983. *The white peach scale, Pseudaulacaspis pentagona (Targioni-Tozzetti): evidence that current concepts include two species.* Proc. Entomol. Soc. Wash. 85(4): 753-761.
6. Flint, M.L., R. van den Bosch. 1981. Introduction to Integrated Pest Management. Plenum Press, N.Y. 240 pp.
7. Fothergill, J. 1982. New Directions in Lawn Care — A Working IPM Program. **In** Niemczyk, H.D., B.G. Joyner (eds.), Advances in Turfgrass Entomology. Hammer Graphics, Inc., Picqua, Ohio. 149 pp.
8. Hellman, J.L., J.A. Davidson, J. Holmes. 1982. Urban Ornamental and Turfgrass Integrated Pest Management in Maryland. **In** Niemczyk, H.D., B.G. Joyner (eds.), Advances in Turfgrass Entomology. Hammer Graphics, Inc., Picqua, Ohio. 149 pp.
9. Kielbaso, J.J., K. Ottman. 1976. Municipal tree care in the United States. **In** 1976 Municipal Yearbook. Dept. of Forestry, Mich. State Univ., East Lansing, Michigan.
10. Nielsen, D.G. 1981. *Alternate strategy for arborists — Treat the tree, not the customer.* Weeds, Trees and Turf. 20 (7): 40-42.
11. Olkowski, W., C. Pinnock, W. Tuney, G. Mosher, W. Neasbitt, R. van den Bosch, H. Olkowsi. 1974. *An integrated insect control program for street trees.* Calif. Agr. 28(1): 3-4.
12. Potter, D.A., G.M. Timmons. 1983. *Biology and management of clearwing borers in woody plants.* J. Arboric. 9(6): 145-150.
13. Pinto, L.J. 1981. The Structural Pest Control Industry, Description and Impact on the Nation. National Pest Control Association, Vienna, VA. 26 pp.
14. Short, D.E., J.A. Reinert, R.A. Atilano. 1982. Integrated Pest Management for Urban Turfgrass Culture — Florida. **In** Niemczyk, H.D., B.G. Joyner (eds.), Advances in Turfgrass Entomology. Hammer Graphics, Inc., Picqua, Ohio. 149 pp.
15. Stern, V.M., R.F. Smith, R. van den Bosch, and K.S. Hagen. 1959. *The integration of chemical and biological control of the spotted alfalfa aphid. I. The integrated control concept.* Hilgardia 29(2): 81-101.
16. von Rumker, R., R.M. Matter, D.P. Clement, F.K. Erickson. 1972. The use of pesticides in suburban homes and gardens and their impact on the aquatic environment. Pesticide Study Series No. 2, E.P.A., Office of Water Programs, Wash., D.C., U.S. Gov't. Printing Office.

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