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THE CONCEPT OF KEY PLANTS IN INTEGRATED PEST MANAGEMENT FOR LANDSCAPES

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Abstract. Five integrated pest management (IPM) programs for landscape plants were conducted by extension specialists at the University of Maryland between 1980 and 1982. An analysis of the insect, disease, and cultural problems of more than 30,000 plants revealed certain genera to be far more problem prone than others. Genera such as *Malus, Pyracantha, Cornus, Prunus,* and *Rosa* tended to be problem prone in almost all programs while *Viburnum, Taxus,* and *Forsythia* were relatively problem free in the mid-atlantic United States. By identifying the problem prone "key plants" in a landscape within a region, the implementation of sound pest management programs can be facilitated greatly. Management activities such as monitoring pests and applying controls can be concentrated on relatively few plants. Furthermore, an awareness of the pest prone plants allows landscape designers to create landscapes with fewer pests and lower long-term maintenance costs.

Several recent articles have discussed the benefits of integrated pest management (IPM) programs for landscape plants in a variety of residential settings. Olkowski et al. (7) and Raupp et al. (9) demonstrated that communities could dramatically reduce pest control costs by adopting an IPM approach for their street trees and landscape plants. Integrated pest management can also reduce the unnecessary use of pesticides in residential settings. For example, Holmes and Davidson (5) found a 94% reduction in pesticide use when an integrated approach was substituted for traditional cover sprays in 26 homesites.

Although the need for IPM in landscape settings has been discussed (1,11) and methods for developing and implementing IPM programs have been described (3,4,5,8) several technical and operational impediments may delay or discourage the widespread adoption of the IPM approach by the plant management industry. One such impediment is confrontation of the apparent complexity of landscape plantings in residential settings. Several authors have emphasized that landscapes are far more diverse than typical agricultural systems in the kinds of plant materials found there (1). For example, many agricultural systems consist of a single plant species under management on large acreages. However, more than fifty species or cultivars of plant material may reside in a typical residential landscape of less than an acre. Compounding the plant diversity is the tremendous diversity of pests associated with those plants. A typical agricultural crop might have 2 or 3 primary or "key" insect pests that require control in any given growing season (10). If similar numbers of pest species are associated with each ornamental plant species or cultivar it is easy to see that the number of primary pests found in a homesite could exceed a hundred in a typical growing season. This potential diversity of plants and associated pests presents a baffling complexity of identifications, diagnoses, and control actions to be undertaken by the landscape plant manager.

Fortunately, the obstacle this complexity imposes to successful IPM programs is more apparent than real. For example, in five years of working with suburban Maryland homeowners we found the list of key pests to be remarkably cons-

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tant from year to year (2,4,8). Ten key pests or pest groups such as lacebugs, spider mites, and borers created more than three quarters of the insect problems for home landscapes in 1982 (8). By learning to identify and control a relatively small number of insects, homeowners could deal with a large proportion of their pest problems. Similar results were seen for insect and mite pests of landscape plants in institutional settings. Here 10 key pests accounted for more than 95% of the arthropod associated problems encountered at a university campus (8).

In this report we discuss yet another concept by which the complexity of managing problems in landscape settings may be simplified. Our preliminary observations indicated that certain plants in the landscape were much more likely to incur problems than others. Accordingly, certain problem prone plants become the foci for management programs. By concentrating monitoring and control activities on relatively few plants, landscape managers can optimize the use of the time and materials at each site. For a variety of landscape systems, we tested the hypothesis that a relatively small proportion of landscape plants harbor a relatively large proporation of problems.

Materials and Methods

The data were compiled from five different IPM programs involving two types of landscape systems. The first data set was generated from an institutional IPM project conducted at the University of Maryland in 1981 (8). The management system consisted of several landscaped areas of the College Park Campus including a plant nursery. These areas were routinely monitored for problems by a trained scout who made control recommendations to the landscape maintenance division. The next three programs were conducted in 1980, 1981, and 1982 at 275 suburban Maryland homesites. Extension personnel supervised these IPM programs (3,4,8). Each homesite received regular visits by trained scouts. Recommendations were made to homeowners by scout supervisors under the direction of extension personnel (3,4,8). The fifth program was similar to the previous three in that it consisted of residential landscapes in suburban settings. It differed in that a scout employed by a commercial arborist conducted the routine monitoring and control activities (5).

Accurate record keeping enabled us to examine the relationships among the types of plants encountered in these systems and the frequency of problems encountered. For each program we report the relative abundance of the 20 most common genera of landscape plants encountered. Next, we indicate how much each common plant genus contributed to the total number of problems encountered in each program. This included all insect, disease, and cultural problems that required a control action. The susceptibility of each plant genus to problems is also reported. Within each program, plant genera were then ranked according to their propensity for problems of any kind. A one way analysis of variance (12) was used to determine if genera of landscape plants differed in their overall problem ranking.

Results and Discussion

The total number of landscape plants monitored in the five programs exceeded 30,000. A comparison of Tables 1-5 reveals a great similarity in the genera of landscape plants found common to each of the five programs. In all programs, the genera *Rhododendron, Juniperus,* and *Ilex* were the most abundant in the landscape. The most unique generic mix was at the University of Maryland where oaks planted in mass on campus and at the nursery were the dominant feature (Table 1).

In each program, a relatively small number of genera comprise a relatively large proportion of the total plant material. Twenty genera of plants accounted for 77 to 89% of the total material found in any of the five studies. These same twenty common genera of plants in each study accounted for 77 to 97% of the total problems encountered.

In 4 of the 5 programs evaluated, one genus of plant, *Rhododendron,* accounted for the greatest proportion of problems encountered. The reason for this is twofold. First, a moderately high percentage of the rhododendrons monitored had problems. For the genus *Rhododendron* the lowest problem rate (17%) was in homesites managed by an arborist while the highest proportion of afflicted plants was at the University where 63% of the

Table 1. The relative abundance and frequency of problems associated with the 20 most common genera of landscape plants found at an institution in Maryland in 1981. Landscapes were monitored by university scouts.

Plant genus	% of total plants	% of total problems	% of plants in genus with problems
Quercus	20.3	39.2	69.7
Ilex	19.6	2.2	4.2
Pinus	9.9	17.4	63.5
Acer	4.9	4.6	34.4
Juniperus	4.4	0.3	2.8
Taxus	3.4	0.0	0.0
Rhododendron	3.3	9.1	63.2
Malus	3.2	7.5	85.4
Prunus	3.1	2.8	32.8
Ligustrum	2.7	0.0	0.0
Pyracantha	1.5	3.7	85.0
Magnolia	1.4	0.0	0.0
Buxus	1.4	1.3	32.7
Viburnum	1.3	0.0	0.0
Salix	1.0	1.8	64.3
Abelia	1.0	0.0	0.0
Forsythia	1.0	0.0	0.0
Cornus	0.9	2.6	100.0
Cedrus	0.8	0.0	0.0
Tsuga	0.7	0.0	0.0
Total	85.8	92.5	

Table 2. The relative abundance and frequency of problems associated with the 20 most common genera of landscape plants found in 25 homesites in Maryland in 1980. Homesites were monitored by university scouts.

Plant genus	% of total plants	% of total problems	% of plants in genus with problems
Rhododendron	17.1	19.8	25.4
Juniperus	12.1	10.4	18.9
Forsythia	7.3	4.1	12.3
Taxus	6.8	0.0	0.0
Euonymus	6.6	3.5	11.5
Ilex	6.2	1.2	4.1
Pyracantha	4.5	5.8	28.6
Acer	4.2	1.2	6.1
Cornus	3.2	5.8	40.0
Pinus	3.1	1.7	12.5
Ligustrum	2.4	1.2	10.5
Picea	2.4	2.3	21.1
Prunus	2.3	7.0	66.7
Quercus	2.3	1.2	11.1
Malus	2.2	4.2	47.1
Thuja	1.5	4.1	5.8
Buxus	1.4	0.0	0.0
Rosa	1.4	3.5	54.5
Tsuga	1.4	1.7	27.3
Fraxinus	1.4	1.2	18.2
Total	89.8	79.9	

Table 3. The relative abundance and frequency of problems associated with the 20 most common genera of landscape plants found in 150 homesites in Maryland in 1981. Homesites were monitored by university scouts.

Plant genus	% of total plants	% of total problems	% of plants in genus with problems
Rhododendron	16.6	23.8	55.2
Juniperus	10.0	10.9	42.0
Ilex	6.2	2.6	16.5
Rosa	5.2	6.2	45.9
Pinus	4.7	6.6	54.4
Taxus	4.2	2.4	21.9
Acer	3.8	1.3	13.2
Euonymus	3.6	6.4	68.1
Ligustrum	3.3	1.2	14.7
Forsythia	2.9	2.0	27.2
Prunus	2.8	2.8	38.7
Thuja	2.6	2.9	43.7
Cornus	2.3	2.7	46.8
Buxus	2.1	2.2	40.3
Malus	2.1	8.6	100.0
Pyracantha	1.6	5.0	100.0
Tsuga	1.2	4.6	15.5
Quercus	1.0	4.6	17.9
Spirea	0.9	0.4	17.9
Picea	0.9	0.4	16.0
Total	78.0	97.6	

Table 4. The relative abundance and frequency of problems associated with the 20 most common genera of landscape plants found in 100 homesites in Maryland in 1982. Homesites were monitored by university scouts.

Plant genus	% of total plants	% of total problems	% of plants in genus with problems
Rhododendron	17.0	17.7	24.8
Cornus	6.9	7.5	25.9
Ilex	5.9	4.2	17.0
Juniperus	5.9	5.0	20.3
Quercus	5.6	1.4	6.1
Pinus	4.6	3.7	18.8
Taxus	4.2	0.1	0.8
Acer	4.2	2.5	14.2
Euonymus	3.8	5.8	36.3
Thuja	3.2	0.9	6.8
Prunus	3.1	6.1	47.5
Picea	2.9	1.9	15.7
Rosa	2.8	4.4	36.7
Forsythia	2.8	1.1	9.0
Malus	2.1	6.3	71.5
Tsuga	2.0	1.4	16.5
Buxus	1.8	3.4	43.5
Ligustrum	1.3	1.3	23.1
Pyracantha	1.1	3.0	66.7
Liriodendron	1.1	0.1	3.2
Total	82.3	77.8	

Table 5. The relative abundance and frequency of problems associated with the 20 most common genera of landscape plants found in 26 homesites in Maryland in 1982. Homesites were monitored by a commercial arborist.

Plant genus	*% of total plants*	*% of total problems*	*% of plants in genus with problems*
Rhododendron	22.8	25.0	17.1
Ilex	12.8	3.4	2.1
Buxus	8.8	24.0	42.7
Juniperus	5.6	0.0	2.0
Tsuga	4.7	1.8	6.1
Taxus	3.3	0.1	0.6
Rosa	3.1	8.4	42.4
Pinus	2.7	0.5	2.9
Cornus	2.1	14.2	100.0
Prunus	2.0	4.8	100.0
Euonymus	1.9	1.1	25.1
Viburnum	1.3	0.6	2.6
Quercus	1.2	0.7	9.8
Acer	1.1	0.9	12.2
Thuja	0.9	0.0	1.0
Berberis	0.8	0.0	1.0
Ligustrum	0.7	0.6	12.0
Hosta	0.7	1.9	39.7
Osmanthus	0.7	0.0	0.0
Pieris	0.5	1.3	41.0
Total	77.8	89.3	

plants in the genus had problems. The second and most important reason why rhododendrons comprise such a large proportion of the total problems is that they are so abundant in the landscape.

In contrast, other very common genera of plants such as *Ilex* and *Taxus* accounted for a small portion of the total problems observed. For example, *Ilex* was the second, third, or sixth most common plant genus in all studies. However, it never accounted for more than 4.2% of the total problems. The same was true for the genus *Taxus.* Although it was never less than seventh in abundance it accounted for only 0 to 2.4% of the total problems.

The importance of these results is clear. Although certain plants in the landscape are common, it does not necessarily mean that they will be the most pest prone. The landscape manager must be able to identify plants in the landscape that are the most likely to incur problems year after year. These key plants will form the focus for a management program. A casual examination of Tables 1-5 suggests that certain genera of plants are much more pest prone than others. For example, members of genera such as *Prunus* and *Cornus* frequently had problems while genera such as *Taxus* and *Thuja* did not.

To determine if some common genera were indeed more pest prone than others over different years and management programs, the following analysis was performed. Within each program, plant genera were ranked according to the frequency with which they were observed to exhibit problems. These rankings were then compared across all programs with an analysis of variance. Significant differences were found in the rankings (F-test, $P < .01$).

The results of this analysis are summarized in Figure 1. Several genera such as *Malus, Pyracantha, Cornus, Prunus,* and *Rosa* were found to be highly problem prone in most programs. This is undoubtedly the result of their extreme susceptibility to a wide variety of insect, disease, and cultural problems. The opposite extreme included plants such as *Viburnum, Taxus, Thuja, Ilex, Forsythia,* and several others which were never found to be among the most problem prone plants. This finding does not mean that genera such as *Viburnum* or *Taxus* are free of problems. For example, *Taxus* is susceptible to insects such as Fletcher scale black vine weevil, mealybugs and cultural problems such as poorly drained soils and dicamba sensitivity. However, over a variety of years and management approaches several plant genera were found to be relatively problem free.

Summary

The concept of key plants as used in this report takes its precedent from two important pieces of literature. In their classic article on integrated control Smith and van den Bosch (10) defined key pests as "serious, perennially occurring, persistent species that dominate control practices...". In a later article Nielsen (6) applied the term key plant to "those that provide aesthetic or functional attributes that contribute significantly to your pleasure and the value of your property." We believe that the concept of key plants combines both of these ideas. Furthermore, this concept has great utility for landscape managers of all types.

As mentioned earlier, the diversity of plants and pests in a managed landscape appears to impose a barrier to the implementation of IPM programs, especially those that involve the routine monitoring of plants in the landscape. However, we have shown that certain genera of plants are much more likely to incur problems than others. These key plants will require more thorough monitoring, and also intervention to alleviate problems. They form the focus of the management program. Many genera are relatively pest free. These should require less rigorous monitoring and fewer treatments. However, they must not be totally neglected for the following reason. If one of these relatively problem free plants is a "key plant" by virtue of its location or prominance in a client's landscape, the alert plant manager will ensure that this favored plant receives adequate attention. Even an infrequent problem caused by a pest may cause serious damage if it goes unnoticed.

The concept of key plants has important implications for landscape planners as well as managers. By substituting problem free genera for problem prone ones, landscape planners will greatly reduce the long-term problems and costs associated with maintaining the landscape. Landscape planners at all levels should take full advantage of published accounts rating the susceptibility of plants to problems and incorporate this information into their design decisions.

In summary, we have demonstrated that some genera of plants are much more likely than others to engender problems under a variety of management conditions and landscape settings. The results discussed here represent problems associated with common landscape plants in the Mid-Atlantic region. Caution should be exercised in attempting to generalize from specific conclusions reached here. For example, under different climatic conditions, soil types, and insect and disease complexes, genera such as *Rosa* or *Rhododendron* may be less prone to problems. Other genera may be more problem prone. However, regardless of where the managed landscape is located, certain types of plants will be more problem prone than others. Once these key plants are identified the task of the landscape planner and manager will be simplified and the prospects for effective IPM will be greatly enhanced.

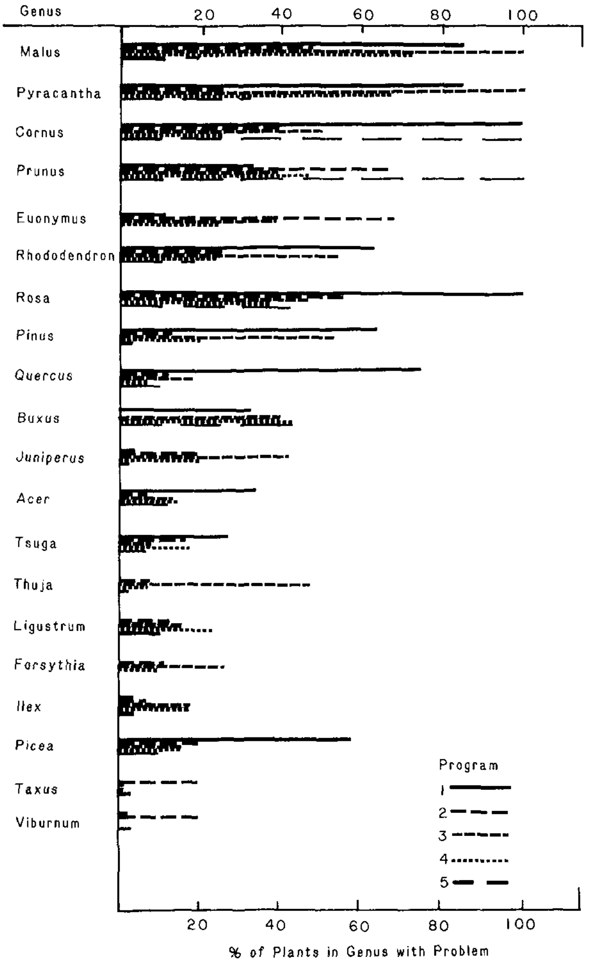

Figure 1. The frequency of problems caused by insects, diseases, or improper culture associated with 20 common genera of landscape plants monitored by 5 IPM programs. Program 1 was conducted at a university campus and the remaining 4 programs were conducted with suburban homeowners.

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ABSTRACT

LONSDALE, D. **Available treatments for tree wounds: an assessment of their value.** Arboric. J. 8: 99-107.

It is interesting to compare progress in tree wound treatment with the evolution of medicine and of agricultural plant protection. In these other disciplines it has long been routine for all products and practices to be evaluated by stringent tests. In contrast, the modernization of tree wound treatments has involved little more than the introduction of synthetic sealing materials and various fungicides in proprietary dressings. The main intended effect of the treatments: the prevention of decay, has not been investigated to any satisfactory extent in the testing of materials and practices. In view of the difficulties in the evaluation of wound treatments, and bearing in mind the increasing realization that trees can defend themselves against decay fungi, it is no easy matter to discuss the efficacy of dressing materials. The reality is, however, that these products are available and that the user wishes to know if they are worth the cost of buying and applying them. A further complication in Britain is the existence of British Standard 3998 which stipulates the use of wound dressings, and perhaps this alone justifies some discussion. No evidence exists by which currently available wound dressings can be recommended for long-term protection against decay. Some treatments can delay colonization by decay fungi, perhaps to a useful degree in the case of the biocontrol agent *Trichoderma viride*. Some treatments can prevent infection of wounds by aggressive, "fresh wound parasites". Wound closure is enhanced by many types of treatment, particularly where thiophanate methyl is an ingredient, and is perhaps a worthwhile consideration in the case of moderate-sized wounds.