Achieving Adoption of Integrated Pest Management by Landscape Managers

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Summary. Achieving adoption of integrated pest management (IPM) practices by professional landscape managers is a common goal of university research and extension personnel, governmental and regulatory agencies, industry, and the public. IPM is developed and promoted through cooperation of university, state, and industry groups in research and educational programs. Publications and educational events are major means of promoting IPM to landscape professionals. While large theater-style seminars may provide the advantage of reaching as many as 500 people at one time, landscape clientele have shown favor for the small-group, hands-on type of seminar for application technology and IPM methodologies. The impact of research and educational programs on IPM adoption tends to be variable, depending on the pest, the potential for effective control, the control practices to be undertaken, and economic consequences. Adoption of several biological control programs has been indicated. The pesticide-use data collected from 1992 to 1994 indicate trends in reduced use of some pesticides and shifts to less toxic materials. Unfortunately, these data do not account for variability in pest activity from year to year, and not all pesticide applicators are reporting. Pressure from the public to control pests while minimizing the use of pesticides also indicates adoption of IPM. Additional evaluations are necessary to assess adoption of current and future IPM programs.

Achieving adoption of integrated pest management (IPM) practices by professional landscape managers is a common goal of university researchers, extension personnel, and others involved with pest management research and education. IPM is a control and management program developed from an understanding of a pest's biology, behavior, and potential for causing economic damage. It involves the informed selection and use of pest control strategies to achieve good economic, ecological, and societal consequences (Bottrell, 1979). Worker and environmental safety issues and a public, which has become more insistent for adequate landscape pest management with reduced amounts of pesticides, have fueled the demand for IPM. Thus, the public, industry, and governmental and regulatory agencies also have high interest in IPM in the landscape.

IPM practices are used by many in the landscape industry. These include personnel from municipalities and agencies who are subject to pressure from the public to minimize pesticide use, university and state personnel involved with establishing widespread pest management control measures such as exclusion and biological control, and landscape professionals who strive to give their customers the best service possible based on up-to-date practices.

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IPM programs include cultural practices, resistant plant materials, exclusion of pests, biological control, and the judicial use of pesticides when necessary. For landscape professionals to perform adequately in this arena, they must be provided with tools and methodologies that are sound and economical and must be well trained in their use.

There are many means for promoting and achieving IPM adoption. IPM is developed and promoted by university, state, and industry research and educational programs. Educational programs, which promote IPM adoption, are offered mainly through university and industry functions. Industry plays a major role in providing stewardship and the development of products that can be used in IPM programs. Adoption is also affected by the establishment and enforcement of laws and regulations governing pesticide use and licensing of pesticide applicators and by pressure from the public to control pests while minimizing the use of pesticides.

The registration and use of pesticides are governed by laws and regulations established by the California Dept. of Pesticide Regulation. The laws and regulations are enforced locally in the counties by the agricultural commissioner. Individuals in landscape pest control businesses must pass a laws and regulations exam as well as exams pertinent to their area of expertise (landscape, right of way, agricultural, research and demonstration, etc.) to obtain a pest control advisor (PCA) license, qualified applicator certificate (QAC), or qualified applicator license (QAL). Once certified, continuing education units (CEUs) or hours are required for license renewal. In addition, 100% of pesticides used must be reported to the county agricultural commissioner monthly. Improper use of pesticides, reporting errors, or other violations of regulations may result in civil actions by the county Dept. of Agriculture against landscape professionals. Laws and regulations promote IPM indirectly by regulating which materials are available for pest control and who can apply them.

University research and extension personnel and allied industries are often the source of IPM information and the extenders of this information to landscape professionals. IPM endeavors are proactive and reactive in nature and involve research and extension components. Proactive programs involve the introduction of new varieties, irrigation management, fertility, and other cultural practices as well as the development of improved pesticides. Reactive programs include the identification of pests, assessment of damage to landscapes, and studies on the biology of pests and effective, economical control. Proactive and reactive programs are exemplified in areas such as southern California, where a wide variety of species can be grown and new pests are encountered continuously. As new information is developed, it is extended to landscape architects, contractors, maintenance personnel, golf course superintendents, and other landscape professionals. The general public is an important clientele group as well and can be considered the final beneficiaries of IPM programs.

Within the Univ. of California (UC) system, there is a wide range of personnel involved in the research and extension of IPM practices. Programs are developed and extended by faculty, specialists, and county farm advisors. The UCIPM program is centralized at the Davis campus and plays a key role in IPM research, provides extension programs and publications, and is a vital link in the statewide program. IPM area advisors and farm advisors provide local research and extension activities. IPM is usually a part of a county advisor's program. University personnel work closely with industry in research and educational programs to promote IPM, especially as new pest control methodologies are developed.

Technical, semitechnical, and popular publications provide the foundation and substance for IPM educational programs. Publications are disseminated through educational seminars, newspapers, and trade magazines that target landscape managers and the public. Also, industry professionals further extend the information to colleagues and the public. The recently published landscape IPM guide, *Pests of Landscape Trees and Shrubs* (Dreistadt, 1994) has become an important tool for professionals involved in landscape pest management. This guide is an excellent example of a publication that encompasses landscape management from an integrated viewpoint, showing insect, disease, and weed pests; problems associated with specific plant species; and management methodology for building a sound IPM program.

Seminars and other educational events that promote IPM are offered through UC, the California Agricultural Production Consultants Association (CAPCA), the Pesticide Applicators Professional Association (PAPA), and various industry groups. These events contain educational presentations, often given by specific researchers, which focus on pest identification and biology, monitoring, biological control, cultural practices, pesticide use, application technology, and other topics relevant to IPM in the landscape. Generally, these educational events are held in a large auditorium with slides or overheads used in presentations to as many as 500 attendees. However, recent educational events have featured a small-group, hands-on type of format

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with samples, demonstrations, and increased interaction. In these seminars, the instructors teach 30- to 45-min sessions concurrently to groups of 10 to 20 attendees. Then the attendees move to the next presentation. Depending on the total number attendees, the instructor repeats the presentation from four to eight times during the entire seminar.

Although an enhanced educational experience, the small-group, hands-on seminars or workshops require increased organizational efforts, preparation, and number of instructors. Three large-scale hands-on seminars on pesticide applicator safety were cosponsored by UC Cooperative Extension and the UCIPM project in 1989. The seminars were held in Escondido, Chino, and Ventura, Calif. Preparations for these seminars involved developing the hands-on curriculum and demonstrations, identifying and training the 30 instructors needed for each seminar, and assembling the necessary equipment for the demonstrations. About 400 pesticide applicators attended the workshop in Escondido, of which half were Spanish speaking. An extensive evaluation of the program and comparison to a similar program presented theater style indicated that the hands-on, small-group workshop was more favored and more effective than the theater-style seminar (Greishop, unpublished data).

In 1994, two large hands-on seminars addressing IPM practices were sponsored by the UCIPM project: one in southern and one in northern California. More than 25 UC personnel served as instructors and *Pests of landscape trees and shrubs* was provided as a handout. About 375 people attended each seminar and their response was very positive. Over the past 4 years, the cooperative extension office in San Diego has cosponsored yearly pesticide applicator seminars for English- and Spanish-speaking clientele in the hands-on format for those involved with pesticide use. These seminars provide training on application technology topics such as nozzle selection, calibration, mixing and loading, drift and environmental contamination, cleanup, leaks and spills, labels and msds, personal protective equipment, safety, first aid, and laws and regulations. The hands-on format allows use of props and demonstrations that, according to audience surveys, have more educational impact. While large, theater-style seminars may provide the advantage of reaching as many as 500 people at one time, clientele have shown favor for the small-group, hands-on type of seminar for application technology and IPM methodologies (participant survey information, unpublished data).

To assess fully the effectiveness of educational programs and IPM adoption, it is necessary to evaluate changes in pest management practices and to document the acceptance of laws and regulations, the amounts and types of pesticides used, changes in plant materials, change in pest activities, environmental and landscape quality, worker health and safety, and public satisfaction. Thus, evaluating the overall adoption of IPM practices is very difficult. However, evaluation of individual research and extension programs can be performed and if the IPM program is overwhelmingly successful, adoption and impact can be measured.

The impact of research and educational programs on IPM adoption tends to be variable, depending on the pest, the potential for effective control, the control practices to be undertaken, and economic consequences. Often single factors, such as pest activity, are assessed to evaluate the impact of a program. An example would be the virtual eradication of the ash whitefly [*Siphoninus phillyreae* (Halliday)] through establishment of two biological parasites (Bellows et al., 1992). A key to this success story was to get landscape pest control personnel to abandon chemical control efforts. Pesticide applications were somewhat futile due to lack of coverage of the large trees and the tremendous numbers, mobility, and wide host range of the whitefly. Landscape pest management personnel were instructed not to apply pesticides to trees to promote establishment of the introduced biological agents. The resulting biological control program was so successful that, currently, the ash whitefly is very difficult to find and no pest management measures are necessary. In this case, landscape managers were asked to refrain from action—an easy practice to adopt!

Table 1. Pesticide use data in total pounds applied per year, for 1992, 1993, and 1994 in landscape maintenance in California (California Dept. of Pesticide Regulation, 1992–1994).

Pesticide	Pesticide applied (lb)		
	1992	1993	1994
Acephate	8068	7263	7619
Bacillus thuringiensis (all)	200	122	349
Benomyl	982	694	319
Carbaryl	29,254	21,573	20,500
Chlorpyrifos	51,440	58,944	30,718
Diazinon	91,483	36,675	40,220
Dicofol	829	1212	1244
Fenbutatin oxide	315	119	177
Petroleum distillates (all)	83,000	88,700	105,800
All landscape pesticides	1,252,116	1,315,511	1,324,890

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Other biological control efforts demand that landscape professionals monitor pest activity. An example is the biological control of the Eugenia psyllid (*Trioza eugeniae* Froggatt) in southern California through the release of a parasitic wasp (*Tamarixia* sp.) The activity and rapid spread of the wasp has drastically reduced psyllid populations, resulting in healthier eugenia or Australian bush cherry (*Syzigium paniculatum* Gaertner) in the landscape and elimination of pesticide applications (Dahlsten, et al., 1995). Until success of this biological control strategy, many eugenia were being removed, nursery stock was limited, and the use of eugenia in the landscape was discouraged. Now the species is again a viable landscape selection. However, maintenance personnel are urged to monitor the pest and take action, especially in the spring, if psyllid numbers increase and damage to plants is significant. Recommended management practices include partial shearing of the plant material and leaving prunings at the base of plants. This allows the biological agent to continue development, emerge, and protect new growth.

Unfortunately, the impact of many proactive programs, such as irrigation management or cultural practices, is difficult to measure. We have seen reduction in the planting of some pest susceptible species, such as Leyland cypress (*Cupressocyparis leylandii* A.B. Jackson & Dallim.), which is very susceptible to cypress canker caused by *Seiridium cardinale* (W. Wagener) Sutton & I. Gibson. Although we know that pines and eucalyptus trees under proper water management are more resistant to attack by boring insects, there have been no studies indicating the scope of savings or benefit to this practice. The application of mulch for weed control has been well documented, but weed control savings or reduction in pesticide use has not been documented on a large scale.

Pesticide use reporting data from the California Dept. of Pesticide Regulation may provide insight on the impact of these IPM recommendations and the overall adoption of IPM. Since 100% use reporting was initiated in 1992, there has been much data collected and summarized through the reporting system. Table 1 contains selected data from the pesticide use reports for the state. It shows reduction in the application of acephate, benomyl, carbaryl, chlorpyrifos, diazinon, and fenbutatin oxide over the 3-year period. Benomyl and fenbutatin oxide are no longer registered for landscape use. The reduction in these materials is probably representative of the using up of existing supplies. Diazinon has also lost its registration for use on golf courses, which may be the reason for the >50% reduction in use from 1992 to 1994. *Bacillus thuringiensis* Berliner and petroleum distillates show an increase, which may be indicative of a shift to the less toxic materials by landscape pesticide applicators. Dicofol also shows an increase in pounds applied, which may be related to the loss of registration for fenbutatin oxide since both of these materials are miticides. The total amount of pesticides applied has actually increased slightly.

Unfortunately, there are many variables that govern the amount and type of pesticides used in the landscape and cast doubt on the pesticide use data. For example, pest activities vary yearly with weather, pesticide registrations change, applicators may shift to different materials, and new materials may be effective at much lower rates. These variables will make it difficult to assess reasons for flux in pesticide use from year to year. Although the 100% reporting information indicates tends, it is probably too soon to assess if this indicates the adoption of IPM strategies for pest control.

Another major factor affecting the accuracy of the use report data is the lack of reporting by many landscape maintenance personnel. While many landscape professionals have maintained credibility by following procedures set forth in the laws and regulations, others have ignored the licensing and reporting requirements. For example, maintenance gardeners in San Diego County who apply pesticides as part of (not exclusively) their business are required to have a QAC, register with the county agricultural commissioner, and report monthly pesticide use. There are only 67 registered QACs in the county. This is a very small fraction of the professional landscapers working in the county, so it appears that many may be violating the law. The only way for regulators to limit this activity is to catch them in the act and pursue civil actions. While there have been some civil actions taken, there are far too few regulators to cover the amount of activity in the county, especially since these pesticide users can readily buy pesticides from home supply warehouses. Alternatively, the commissioner is considering dealer audits to find out who is purchasing pesticides. In the near future, when registrations stabilize and more dealers and applicators are reporting pesticide use, the 100% use reporting data may indicate a reduction in pesticide use.

Public pressure to control pests while minimizing pesticide use is probably a major factor in forcing landscape professionals to consider IPM. The negative attitude toward pesticides is apparent in the many objections to the spraying of landscape trees. This has led to a drastic reduction in tree spraying even though honeydew, ants, and other pests are

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considered unacceptable. Further, since whiteflys, psyllids, fungi, and bacteria are mobile and ubiquitous, clients have observed that the benefits of pesticide applications (even if coverage is good) are limited. Hence, the public is becoming less critical of minor damage such as that from infections of anthracnose or powdery mildew on landscape trees. Some landscape professional maintenance firms view this as a benefit, since leafdrop of deciduous trees is spread throughout the season instead of just in the fall.

The public also pressures landscape professionals to be knowledgeable and responsible, as well as economical. The simple economics of pest management also plays an important role in IPM adoption. IPM centers around economic thresholds that determine actions to be taken. Damage from pests may be minor, it may be too expensive to apply pesticides, or the problem may be solved by changing cultural practices. However, economic success of landscape companies also relates to public pressure in that IPM may be too time-consuming and hard to sell. Monitoring programs cost money and are effective if pest problems occur. However, if pests do not occur or threaten the health of the landscape, clients may view monitoring efforts as a waste of money (Dreistadt, 1994).

Clearly, the adoption of IPM by landscape professionals is affected by research and education, pesticide laws and regulations, and public attitude. It is fortunate that university, state, and regulatory agencies, and industry are cooperating to develop and implement IPM programs for landscape maintenance. Perhaps more research is needed to identify trends and indications of the degree of adoption of IPM practices. Such research may provide insight into economic savings resulting from IPM programs undertaken by landscape professionals.

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