A Survey of California Public School Districts' Ant and Weed Management Practices and a Review of Their Use of IPM

Carole Barnes, PhD
Sandra Sutherland
Madeline Brattesani, PhD
Larry Wilhoit, PhD
Belinda Messenger, PhD

Abstract **The U.S. Environmental Protection Agency encourages school officials to adopt integrated pest management (IPM) to reduce children's exposure to potentially harmful pesticides. In California, the Healthy Schools Act of 2000 (HSA) establishes right-to-know requirements for pesticide use in public schools; requires school districts to designate an IPM coordinator; and requires the California Department of Pesticide Regulation (DPR) to collect pesticide-use information from pest control businesses, conduct IPM training workshops, and promote least-toxic pest management practices. DPR periodically surveys school districts statewide to measure compliance with the HSA and the use of least-toxic management practices compatible with IPM and to guide DPR's training and outreach efforts. Results from three surveys, conducted in 2001, 2002, and 2004, show that an increasing number of districts use ant management practices compatible with IPM; however, fewer districts use IPM-compatible weed management practices. DPR's California School IPM program plans to develop technical materials and to conduct training workshops that will provide districts with more information about how to use an IPM program to prevent and manage weeds.**

Introduction

School employees and children face the health risk of exposure to pesticides in the school environment (Alarcon et al., 2005; National Research Council, 1993). California passed the Healthy Schools Act of 2000 (HSA, 2000) to provide staff, teachers, and parents with information about pesticide use and encourage integrated pest management (IPM) in schools.

The HSA establishes right-to-know requirements (e.g., notification, registry, posting, and record keeping) for pesticide use in public schools and requires all districts to designate an IPM coordinator. The law also directs the California Department of Pesticide Regulation (DPR) to collect certain pesticide-use information from schools, conduct IPM training workshops, and support schools in their IPM efforts by providing a Web site and outreach information.

The HSA aims to reduce exposure to pesticides in schools by encouraging districts to voluntarily adopt IPM. IPM is a decision-making approach to managing pests that the law defines as preventing and suppressing pest problems using a combination of pest population monitoring, establishing pest-damage thresholds, and using cultural and mechanical practices. Pesticides that pose the least possible hazard to human health and the environment are used only after careful monitoring and pest-damage thresholds indicate their use is necessary.

Researchers have surveyed school districts' pest management practices in several states such as Indiana (Gibb & Fournier, 2006), Nebraska (Ogg, Ogg, Hygnstrom, Campbell, & Haws, 2003), New York (Braband, Horn, & Sahr, 2002), North Carolina (Williams, Linker, Waldvogel, Leidy, & Schal, 2005), and Tennessee (Vail, 2001). Researchers also have published baseline and follow-up surveys that describe changes in school districts' pest management practices and IPM use (Nalyana & Linker, 2006; Surgan, Enck, & Yu, 2000).

In California, DPR conducts the only statewide surveys to evaluate how public schools are implementing IPM. DPR conducted its first survey in 2001 (Babb, Hawkins, & Tootelian, 2002). Analysis of the 2001 survey responses led to clarifications in the 2002 survey and additional questions about ant and weed management practices (Geiger & Tootelian, 2005). The 2004 survey was further modified for clarity and to collect additional information about the respondent's role as designated IPM coordinator.

The 2004 and previous surveys had several objectives (Barnes & Sutherland, 2005)—this article focuses on two: (1) measuring use of various ant and weed management practices, and (2) measuring changes in those practices relative to prior surveys. This article focuses on management of ants and

TABLE **1**

Ant Management Practices (2001, 2002, and 2004)

Question	Response	2001	2002	2004	*p*-Value[1]
Did district do anything to manage ants inside school buildings?[2]	Yes	75%	83%	80%	**.015**
	No	25%	17%	20%	
	Total	100%	100%	100%	
	Number of cases	392	418	533	
Practices used to manage ants inside buildings[3]	Insecticidal spray	60%	38%	43%	**.000**
	Ant baits	50%	58%	69%	**.000**
	Soapy water spray	18%	38%	45%	**.000**
	Caulk in cracks to prevent entry of ants	25%	36%	50%	**.000**
	Improved sanitation	N/A	63%	80%	**.000**
	Other	18%	22%	6%	**.000**
	Number of cases	296	347	429	
One method used most frequently to manage ants inside school buildings[4]	Insecticidal spray	41%	21%	20%	**.000**
	Ant baits	32%	31%	36%	
	Soapy water spray	12%	12%	9%	
	Caulk in cracks to prevent entry of ants	4%	4%	2%	
	Improved sanitation	N/A	22%	21%	
	Other	11%	11%	12%	
	Total	100%	100%	100%	
	Number of cases	254	321	393	

[1]Significance of Chi-square. Probabilities ≤ .05 indicate statistically significant changes over the three survey years and are in bold for easy identification.

[2]There are differences in question wording across years for this item. In 2001, districts were asked whether, within the last two years, their district treated for ants inside school buildings. In 2002, districts were instructed to skip a block of questions if they had not treated for ants inside school buildings within the last year and the responses shown here were inferred from skip patterns. In 2004, districts were asked whether they had done anything to manage ants inside school buildings within the last 12 months. Because of differences in the wording of questions regarding insecticidal spray application methods, these items have been collapsed into one category for comparison across survey years. Exempt insecticidal spray from an aerosol can was a new practice added to the 2004 questionnaire, so data for previous years is not available.

[3]There are differences in question wording across years for this item. In 2001 and 2002, districts were asked to check off all the methods they typically use to control (2001) or manage (2002) ants in buildings. In 2004 districts were asked to answer yes or no regarding whether they used each practice to manage ants inside buildings.

[4]The 2001 questionnaire asked districts "which one method do you prefer to use for ants in school buildings?" The 2002 and 2004 questionnaires asked districts which they used most frequently. In 2004, 25 districts chose more than one answer. These responses have been dropped from the distribution shown here.

weeds from the 2004 survey because, in prior years, these were the most widely reported pest problems in California schools.

Methods

Questionnaire

In April 2004, surveys were mailed to IPM coordinators at all (972) school districts statewide. Follow-up mailings via e-mail and regular mail occurred in July and August, respectively, to improve the survey's response rate. The 2001, 2002, and 2004 surveys were conducted similarly. The survey contained 24 questions grouped into four sections. The first section covered general pest management practices and the last section captured information about the respondent. The focus of this article is the two middle sections that covered ant management inside school buildings and weed management on school grounds.

The two sections of interest asked whether a district did anything to manage ants (or weeds) within the last 12 months, which specific practices were used, and how effective these practices were. Both sections asked how a district decided when treatment for ants (or weeds) was necessary and which one practice the district used most frequently to manage ants (or weeds). The weed management section also asked districts to indicate the location where they had the most trouble with weeds.

School District Demographic and Geographic Variables

Geographic and demographic data describing the 972 school districts were obtained from a California Department of Education database for the 2002–2003 academic year (California Department of Education, 2003). This information was used to confirm that no systematic differences between responding and nonresponding districts existed.

Statistical Analysis

Responses to individual questions were compiled and relationships among these questions quantified. A Chi-square test was used to measure the difference between characteristics of the sampled school districts and all school districts. Trends in response rates occurring since 2001 were also analyzed. For more detail about data analysis, see Barnes and Sutherland (2005).

Results

Survey Response Rate

The survey response rate was 55% of 972 school districts, an increase from 39% and 42% in the 2001 and 2002 surveys, respectively. Survey responses were a representative sample of all districts, based on a comparison of characteristics between the responding districts and the surveyed population.

Ant Management in 2004

Eighty percent (n = 426) of school districts did something to manage ants inside school buildings within the 12 months before the survey (Table 1). Eighty percent of districts reported using improved sanitation to manage ants inside school buildings; 69% used ant baits; 50% used caulking; and 45% used soapy water (Table 1). All these practices are compatible with IPM. Forty-three percent used insecticidal sprays (i.e., sprays that were applied using an aerosol can or another application method). These practices are not considered compatible with IPM.

Districts were more apt to perceive the less-compatible IPM practices as very effective, however: 44% rated insecticidal spray from an aerosol can as "very effective," while 54% gave the same rating to insecticides sprayed using other application methods. Improved sanitation was a close third, with 42% rating this more IPM-compatible practice as "very effective." A distinct minority (roughly one-third) saw caulking and ant baits as "very effective," while 11% perceived exempt aerosol sprays and soapy sprays as "very effective."

Among the more IPM-compatible practices, respondents saw improved sanitation as more effective than ant baits, yet when asked what one practice school districts used most frequently, the largest percentage (36%) reported ant baits (Table 1). Improved sanitation was the second most frequently used method (21%) and insecticidal sprays the third (20%). It is not surprising that soapy water sprays were rarely the "one most frequent method used" because they were rarely perceived as very effective. Fifty percent of the districts used caulking to manage ants (Table 1), although only 33% of districts perceived it as "very effective." Caulking does not need to be done frequently, which saves districts time. This may explain why so many districts used caulking to manage ants, even though most did not perceive it as "very effective." Although 54% of districts perceived insecticides sprayed using another application method as "very effective," only 35% of districts used insecticidal sprays to manage ants (Table 1). When districts use insecticidal sprays, they are burdened by notification requirements of the HSA unless the spray is exempt, which may discourage districts from using them.

One can decide to control ants by several criteria: at regular time intervals, when ants are first noticed, when ant populations exceed a preestablished threshold, or after a certain number of complaints. According to an IPM philosophy, the best approach among these is to do something only when the pest population is above some threshold. Only 21% of the school districts that used any ant control method used a pest threshold, however. Seventy-nine percent of the districts decided to control ants when they first noticed ants; 45% did so at regular time intervals; and 24% did so after a certain number of complaints were made.

TABLE **2**

Weed Management Practices (2001, 2002, and 2004)

Question	Response	2001	2002	2004	*p*-Value[1]
Did district do anything to manage weeds?[2]	Yes	91%	91%	94%	.063
	No	9%	9%	6%	
	Total	100%	100%	100%	
	Number of cases	394	418	533	
Location where district typically has the most trouble with weeds[3]	Athletic fields/ playgrounds	32%	22%	17%	**.000**
	Landscaping	23%	29%	33%	
	Rights of way	7%	4%	2%	
	Fencerows	33%	32%	39%	
	Other	4%	14%	8%	
	Total	100%	100%	100%	
	Number of cases	357	298	374	
Practices used to manage weeds[4]	Broadcast treatment with herbicides[5]	30%	23%	38%	**.000**
	Spot treatment with herbicides[6]	69%	61%	82%	**.000**
	Use of mulches[7]	25%	26%	55%	**.000**
	Physical controls such as hand pulling, cultivating, mowing	61%	68%	91%	**.000**
	Flaming	8%	7%	8%	.934
	Irrigation management	N/A	17%	41%	**.000**
	Other	9%	10%	22%	**.000**
	Number of cases	359	379	503	

[1]Significance of Chi-square. Probabilities ≤ .05 indicate statistically significant changes over the three survey years and are in bold for easy identification.

[2]There are differences in question wording across years for this item. In 2001, districts were asked whether, in the last two years, their district treated for weeds. In 2002, districts were instructed to skip a block of questions if they had not treated for weeds within the last year and the responses shown here were inferred from skip patterns. In 2004, districts were asked whether they had done anything to manage weeds within the last 12 months.

[3]In 2004 athletic fields and playgrounds were included as separate categories. For this comparison, they have been combined. In 2004, 25% of the districts answering this question selected more than one location. Since multiple responses were not coded in the 2001 and 2002 data files, the 124 districts that selected more than one location in the 2004 survey were dropped from the distribution presented in this table.

[4]There are differences in question wording across years for this item. In 2001 and 2002 districts were asked to check off methods typically used to control weeds. In 2004 districts were asked to answer yes or no regarding whether they used each practice to manage weeds.

[5]In 2001 and 2002 the description for this practice was "regular broadcast treatment of turf and/or landscaping with herbicides." The label shows question wording for 2004.

[6]In 2001 and 2002 the description for this practice read "regular spot treatment of turf and/or landscaping with herbicides." The label shows question wording for 2004.

[7]In 2004 the description for this practice was "use of mulches, ground covers, barrier cloth, or plastic." The label shows question wording for 2001 and 2002.

Trends in Ant Management 2001–2004

More districts did something to manage ants in 2002 and 2004 than in 2001 (Table 1). When asked which one practice was used most frequently to manage ants inside school buildings, 41% of districts in 2001 identified insecticidal spray as the most frequently used practice. In subsequent survey years, that percentage was halved. Dependence on ant baits has remained relatively constant over

the three surveys (31% to 36%), making this the dominant approach in 2002 and 2004 (Table 1).

It is important to point out, however, that with IPM, districts probably will use multiple strategies, at least initially, to manage pests. School districts are adopting IPM-compatible practices more rapidly than they are letting go of the less-compatible practices. This results in a mix of pest management strategies in the near term, which may gradually give way to a more consistent IPM-compatible approach with more training and experience.

Weed Management in 2004

In 2004, 94% of districts managed weeds (Table 2). Ninety-one percent of districts reported managing weeds by physical controls, including hand pulling, cultivating, and mowing; 82% used spot treatment with herbicides; 55% used mulches; 41% used irrigation management; 38% used broadcast treatment with herbicides; 22% used other practices (including turf selection); and 8% used flaming.

Seventy-seven percent of districts responded that spot treatment with herbicides was "very effective." Perhaps for this reason (and to save labor), spot treatment with herbicides is the method so many districts used to manage weeds. Most districts did not perceive the nonchemical practices as "very effective."

Weeds are such a problem for districts that a quarter of the respondents listed multiple areas when asked for the one location where they had the most trouble with weeds. Fencerows and landscaping were the most common locations where districts had trouble with weeds (Table 2). Relatively few of the respondents (17%) mentioned athletic fields and playgrounds. These locations are where the most contact between students and pesticides could occur. The department's workshops have focused training on weed management in athletic fields; however, based on this survey's results, DPR broadened its subsequent workshops to include information for fencerows and landscaping, in addition to athletic fields.

On both athletic fields and playgrounds, at least 40% of districts reported spot treatment with herbicides—an IPM-compatible practice—as the practice they used most frequently to manage weeds. One-third of districts reported physical controls as the most frequently used weed management method, even though this IPM-compatible practice was not perceived as "very effective" by a large percentage of the sample. Broadcast treatment with herbicides, which was perceived as more effective than the two IPM-compatible practices mentioned above, was a less-common choice for the most frequently used method of managing weeds (14% for athletic fields and 6% for playgrounds). Very few districts (≤3%) reported using the four remaining IPM-compatible practices (mulches, flaming, irrigation, and turf selection) as their most frequently used method on either athletic fields or playgrounds.

When asked how districts decided when herbicide treatments for weeds were necessary, the largest percentages responded that they used herbicide treatments at regular time intervals, whether broadcast (71%) or spot treatments (42%) were employed. Treatment at regular time intervals is not part of an IPM approach, however. Districts also used spot treatments when weeds are first noticed (30%) or when they exceed a preestablished threshold (25%), which are decisions that are compatible with IPM.

Trends in Weed Management 2001–2004

In 2001, 32% of districts identified athletic fields and playgrounds (combined) as the location where a district typically had the most trouble with weeds (Table 2). In 2002 and 2004 that percentage dropped to 22% and 17%, respectively. The percentage of districts that identified landscapes as the location where they typically had the most trouble with weeds increased, however, from 23% in 2001 to 33% in 2004, and fencerows rose from 33% in 2001 to 39% in 2004.

Over the three survey years, use of broadcast and spot treatment with herbicides increased slowly, while use of mulches and irrigation management more than doubled and use of physical controls such as hand pulling, cultivating, and mowing increased one and a half times. In 2001, spot treatment with herbicides and physical controls were the dominant methods of weed management. In 2004, most districts continued to use physical controls and spot treatment with herbicides, but over half of all districts also used mulches.

Discussion

Ants are one of the most universal indoor pests in California schools and prevention is a critical component of an ant IPM program. A comparison of the three surveys shows that California schools are making progress toward using less-hazardous pest management practices in accordance with IPM and the goals of the HSA for managing ants. The use of baits, soapy water sprays, caulking, and improved sanitation—practices compatible with IPM—all increased significantly between 2001, 2002, and 2004, while the use of insecticidal sprays decreased. These changes reflect significant improvements in ant management practices.

From 2001 to 2004, the percentages of districts using the practices to manage weeds increased as follows: broadcast treatment with herbicides, spot treatment with herbicides, use of mulches, physical controls, irrigation management, and other. Physical controls (such as hand pulling, cultivating, and mowing) and using mulches—both of which are IPM-compatible—increased, however, more than the other practices used to manage weeds over the three survey years. Managing weeds can require a lot of labor, especially at rural schools with extensive turf and landscape areas. The only practice that did not show a significant change over the survey years was flaming.

Survey results from Indiana are similar to the trends reported in this survey: the use of baits and crack and crevice treatments increased between 2002 and 2006 (Nalyanya & Linker, 2006). Survey results from New York from 1993 to 1999, however, show little change in use of pesticides indoors or outdoors (Surgan, Enck, & Yu, 2000).

Conclusion

This 2004 survey shows that California schools have continued to increase the use of ant management practices that are compatible with an IPM approach. The survey's picture of weed management practices is less clear; improving weed IPM by avoiding calendar treatment schedules may require additional attention. Increased training in methods such as weed flaming and wider use of weed barrier technologies such as cloth or mulches could improve some districts' weed management success. The locations where weeds cause

problems for schools has shifted from athletic fields and playgrounds to fencerows and landscaped areas. In the past, DPR had focused its training on athletic fields and playgrounds, since these locations are typically areas with the largest potential use of pesticides and most frequent contact with children. This shift indicates that schools would benefit from more information on how to manage weeds using IPM in these locations. Therefore, DPR has changed its training to address this need.

DPR plans to continue to survey school districts since the surveys provide valuable information about school IPM programs and how DPR's School IPM program may best meet the needs of school districts through its outreach and training.

Corresponding Author: Larry Wilhoit, Research Scientist III, Department of Pesticide Regulation, Pest Management & Licensing, 1001 I Street, P.O. Box 4015, Sacramento, CA 95812. E-mail address: lwilhoit@cdpr.ca.gov.

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