Regulating Pesticide Use in United States Schools

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Nearly 60 million students, teachers, and staff spend substantial amounts of time in U.S. school buildings and on school grounds every year. The number of states enacting regulations specifically to protect school community members from risks related to pest management activities has grown to 39 since the first law was passed in Texas in 1991 (Table 1, Fig. 1). Here we examine this trend with the goal of identifying and explaining key elements of these regulations to help guide development of effective programs for the future.

Reducing pests in school environments is a worthy goal. Development of asthma, asthma attacks, and asthma-like symptoms have been conclusively associated with exposure to cockroaches, rodents, and dust mites (Bonnefoy et al. 2008, Gore and Schal 2007). Asthma is the number one cause of student absenteeism in the U.S., resulting in loss of 14.4 million school days per year (American Lung Association 2011, Akinbami 2006). The Centers for Disease Control and Prevention (CDC 2012) reported that in 2010, 9.4% of the nation's children were affected. Nichols et al. (2005) reported that between 2001 and 2003, more than 28% of children in one urban center were affected. An estimated $8 billion to $50 billion per year was spent caring for asthmatic children from 2006 to 2010 (CDC 2011, Soni 2009).

Pesticides are valuable tools to help reduce risks associated with pests. However, experience suggests their use generally, and especially in schools, childcare settings, and other sensitive environments, should be carefully managed and minimized. Children are especially vulnerable to pesticide exposure due to their increased consumption of air, food, and water relative to body size, as well as common hand-to-mouth, hand-to-ground, and hand-to-floor behaviors (Goldman 1995, National Academy of Sciences 1993, U.S. EPA 2003, U.S. GAO 1999). Surveillance data collected from 1998 and 2002 indicated nearly 3,000 reported acute illnesses resulting from pesticide exposure incidents in schools, including three severe illnesses and 275 of moderate severity (Alarcon et al. 2005). Sixty-nine percent of incidents resulted from pesticides applied on school property; 39% were associated with drift from neighboring properties. Alarcon et. al. indicated these numbers should be considered low estimates due to underreporting. Chronic health effects were not assessed in the Alarcon study, although potential for chronic illnesses exist. A number of pesticides commonly used in and around schools (Beyond Pesticides

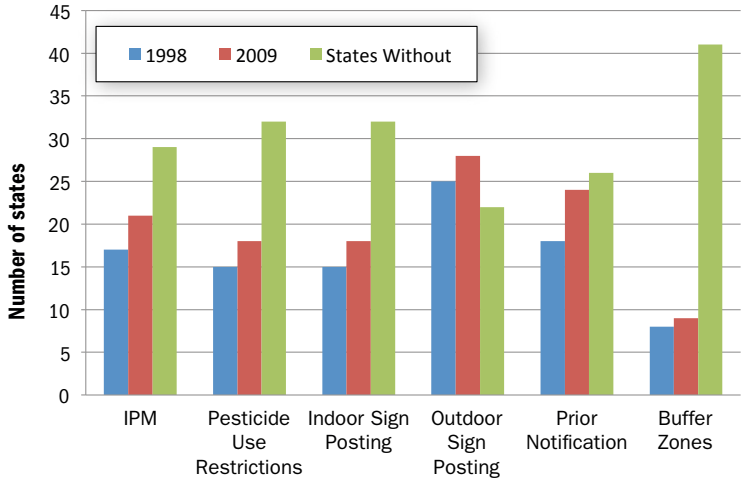

Fig. 1. Change in number of states with regulations addressing pest management in schools (Owens 2010).

2003, Green et al. 2007, Roberts and Karr. 2012, Vogt et. al. 2012) have been identified as neurotoxins, possible or known carcinogens, or developmental and reproductive toxins by the U.S. Environmental Protection Agency (U.S. EPA) and other authorities (U.S. EPA 2000a, 2006; California EPA 2006). Exposure to pesticides has been associated with asthma in children (Alarcon et al. 2005, Corsini et al. 2012, Hernandez et al. 2011, Salam et al. 2004, Salameh et al. 2003).

The regulatory process for pesticides is not a guarantee of safety. U.S. EPA and state regulatory agencies have taken action to prohibit or restrict pesticide uses in and around schools and other structures, and even urban environments entirely, when additional risks discovered after initial registration were substantiated. Historical examples of post-registration use changes to reduce risks to humans and other non-targets include chlorpyrifos (U.S. EPA 2000b) and diazinon (U.S. EPA 2001), which, prior to voluntary withdrawal due to human health concerns, had been used extensively in schools and other structures to control insects. More recently, to reduce impacts on non-target organisms, U.S. EPA took action to restrict uses of rodenticides (U.S. EPA 2008) and pyrethroid insecticides (U.S. EPA 2013), and the herbicide aminocyclopyrachlor was voluntarily withdrawn (U.S. EPA 2011). Pesticides also have potential for intentional and inadvertent misuse (including by untrained or unlicensed staff) such as purchase and use of unregistered pesticides and failure of users to follow label restrictions. Finally, reducing repeated pest exposure to pesticides with the same mode of action also reduced selection pressure that can lead to development of pest resistance to pesticides (National Research Council 1986, Casida and Durkin. 2013, Changa et al. 2010, Crissman et al. 2010).

Fig. 2. Underneath a dry storage pallet: illegal placement of rodent bait blocks, evidence of American cockroaches, and general uncleanliness. Photo by Janet Hurley.

Integrated Pest Management (IPM) is a science-based decision-making process that identifies and reduces risks to human health and the environment from pests and pest management-related strategies (USDA 2004). U.S. EPA, the CDC (2010), and the American Lung Association recommend reducing pest infestations and adopting IPM in schools as an effective strategy to address asthma. IPM includes common-sense measures such as improving sanitation (Fig. 2) to reduce food sources and sealing openings to prevent pests from entering buildings. As part of an IPM approach, these measures can reduce pesticide use and pest complaints by 70% to 90% in schools (Gouge et al. 2006) and other public buildings (Greene and Briesch 2002) and have additional benefits including improved food safety, fire safety, and energy conservation (Chambers et al. 2011). Several states require elements of IPM to be practiced in schools. Regulations pertaining to IPM will be addressed in a subsequent article. Here, our focus is on pesticide safety regulations.

Methods

To develop this article, the authors compiled information on all state pesticide regulations pertaining to public schools. Resources included the National Pest Management Association (2011), National Association of State Boards of Education (2012), Beyond Pesticides (2012), and Owens (2009). The authors interviewed state lead agency staff and others to assess the effectiveness of specific provisions and identify modifications that state officials found preferable to their current statutes. E-mail and phone communication with members of the Association of Structural Pest Control Regulatory Officials (ASPCRO) were also used as a means to collect information.

Results

Federal roles in pesticide safety and IPM are addressed in the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA, 1947, 2007), which provides for federal regulation of pesticide distribution, sale, and use. Under FIFRA, all pesticides distributed or sold in the U.S. must be registered by U.S. EPA unless they meet specific criteria for exemption, such as containing ingredients generally recognized as safe (7 U.S.C. § 136e). U.S. EPA

Table 1. State School Pest Management Regulations as of October 31, 2013.

State	Restricted Spray Zone	Interior Posting	Outdoor Posting	Pre-Notification	Reentry or other Requirements Beyond label)	Min Requirements for Applicators (Training, Certification, Supervision, etc.)	Defines Types of Products to be Used	Exempt Products from Notification
Alabama	X[2]					X		
Alaska		X	X	X	X	X		
Arizona	X	X	X	X		X	X	X
Arkansas								
California		X	X	X	X		X	X
Colorado			X					
Connecticut	X		X	X	X	X	X	
Delaware						X		
Florida			X			X		
Georgia		X	X		X	X	X	X
Hawaii								
Idaho								
Illinois			X	X			X	X
Indiana			X	X	X	X		X
Iowa			X			X		
Kansas								
Kentucky			X	X		X	X	X
Louisiana	X[2]			X[1]	X	X		
Maine	X	X	X	X	X	X	X	X
Maryland	X	X	X	X		X		
Massachusetts	X	X	X	X	X	X	X	X
Michigan		X	X	X	X	X		X
Minnesota			X	X		X		
Mississippi								
Missouri								
Montana		X				X		
Nebraska								
Nevada								
New Hampshire			X	X[3]		X		
New Jersey	X	X	X	X	X	X	X	X
New Mexico		X	X	X	X	X		
New York			X	X		X	X	
North Carolina	X			X				X
North Dakota								
Ohio		X	X	X	X	X		X
Oklahoma								
Oregon		X	X	X	X	X	X	
Pennsylvania		X	X	X	X	X	X	X
Rhode Island			X	X	X	X	X	X
South Carolina						X		
South Dakota								
Tennessee						X		
Texas	X[2]	X	X	X[1]	X	X	X	X
Utah				X				
Vermont			X					
Virginia		X	X	X		X		
Washington		X	X	X				
West Virginia		X		X	X	X	X	X
Wisconsin		X	X			X		
Wyoming		X	X	X				
	10	20	30	28	17	31	15	16

[1] Schools must maintain a list of pesticide hypersensitive students

[2] Located under Ag Code

[3] Pre-notification for child care

is also charged with supporting IPM (7 U.S.C. § 136r-1). There are currently no federal laws specifically addressing pesticide use or IPM in schools. Several versions of the School Environmental Protection Act (2012), which included national standards regulating pesticides in schools, have been introduced beginning in 1999, but Congress has not addressed this proposed legislation.

Instead, each U.S. state and territory has laws governing pesticide sale, use, disposal, storage, and transportation, which vary widely by state. These laws are implemented by a variety of state and territorial agencies including departments responsible for agriculture, public health, education, and/or consumer protection.

Those applying pesticides in schools must follow both federal and applicable state laws. State laws may

be more restrictive than federal laws, but the sale or use of pesticides that are prohibited by federal law is not allowed. State laws generally control certification and recertification of private, commercial, and non-commercial pesticide applicators; provide restrictions in addition to those in federal law on pesticides registered for use in the state; and regulate businesses providing pesticide application services and/or selling restricted-use pesticides.

As of 28 February 2013, thirty-five states had some type of regulation specifically addressing pesticide use in schools (Table 1) in addition to regulations for pesticide use in general, including those applying to structural and landscape applications. The oldest state law specifically addressing pesticide use in schools was passed in 1991 (Texas Structural Pest Control Act 1991, 2003). The most recent law was passed in New York in 2011 (New York State Child Safe Playing Fields Act). Since 2000, thirty states have adopted laws requiring advanced posting for outdoor pesticide application. Since 2007, ten states have amended existing applicator training and licensing laws to address pesticide applications in schools. The following are descriptions of common provisions with frequencies of occurrence and profiles of how each of these provisions is enacted in specific states.

Minimum qualifications for applicators. In 16 states, any individual may apply a pesticide on school property without prior training, licensing, or certification. Thirty-one states have established a variety of minimum requirements for applicators on school or childcare property and, in some cases, other sensitive areas like nursing homes and hospitals.

In Maine, nearly all pesticide applications on public or non-public K-12 school property require a commercial applicator's license. Only routine cleaning, emergency stinging insect control, and non-powered application of wood preservatives are exempt from licensing requirements (Maine Revised Statute Authority 2003).

In Arizona, only licensed applicators are allowed to apply pesticides in a school or registered childcare facility. Similarly, in Texas, anyone making pesticide applications in a childcare facility or any type of educational institution, including private, public, and higher education, must either contract with a licensed commercial applicator or have the application made by an employee holding a non-commercial license in one or more categories (TAC 7.146, 2009).

Anyone applying "Class A" or "B" pesticides in Vermont schools or on Vermont school grounds must have a Vermont pesticide license (Vermont Regulations for Control of Pesticides 1991). Vermont defines Class A pesticides as those classified as restricted use by U.S. EPA or by the Vermont Agency of Agriculture, Food, and Markets. Class B, or "controlled sale pesticides" include those not in Class A or in Class C, those generally available for use in the home. Nearly all turf-care products are in Class B. Commercial pesticide licenses are required for contracted applicators. Class A or B pesticides may be applied by custodians or other school staff holding non-commercial licenses.

In Louisiana, the Department of Agriculture and Fisheries oversees the use and distribution of pesticides. Any person who applies a restricted-use pesticide must have a certified commercial applicator license (Louisiana Pesticide Law 1995). Districts with more than ten school campuses must have at least two certified commercial applicators; any district with fewer than ten campuses must have at least one certified commercial applicator. School staff trained by the commercial applicator may apply general use pesticides, which include baits, gels and pastes for crack and crevice use, sprayable liquids, and herbicides.

Pesticide application record-keeping. Several states have enacted specific requirements for record-keeping, including Arizona (S.B. 1350, 2006), California (Healthy Schools Act 2000), Georgia (Georgia School Pesticide Act 2003), Maine (Maine Revised Statute 22 Section 1471 Chapter 27, 2003), Michigan (Michigan Natural Resources and Environmental Protection Act 1994, 2004), Oregon (Oregon Revised Statute 634, 2009) and Texas (Texas Administrative Code 2008).

Texas requires IPM coordinators to keep records for two years of all applications including the reason for application and justification for any emergency application. Oregon requires the IPM plan coordinator to record and make available to the public the brand name or trademark and U.S. EPA registration number of the pesticide; the pest condition prompting the application; the site, amount, concentration, and type of application; whether the application was effective; the applicator's name and license or certificate numbers; dates of notifications; dates and times for placement and removal of warning signs; and copies of all notifications. These records must be kept for four years.

Restricted application zones. Eleven states restrict and/or require notification of pesticide applications near or adjacent to schools to reduce risks from drift, typically defined as off-target movement of pesticides through the air. Nine states have established buffer zones for ground and/or aerial applications around schools, ranging from 300 feet to two and a half miles. Applications are either prohibited or restricted within these buffer zones. Restrictions limit the types of pesticides that may be applied and/or application timing to periods when staff and/or students are least likely to be present. In some states that do not have specified rules for buffer zones, state regulatory officials follow the pesticide label guidelines.

Under the Texas Administrative Code, which applies to use of pesticides in agricultural settings, persons in charge of any childcare center, educational institution, hospital, or nursing home in Texas within ¼ mile of a field where any type of pesticide application is made can request advance notification (Texas Administrative Code 1997). However, the burden falls upon the institution to contact the producer by certified mail to request pre-notification. In many cases, schools are

unaware of this option.

Under the Louisiana Department of Agriculture and Forestry, if the school does not request notification, any parent of a student may request notification, but must provide a physician's signed confirmation of a medical condition that may be aggravated by pesticide exposure.

In California, applications of methyl bromide within 300 ft. of a school cannot be made within 36 hours prior to the start of a school day (California Code of Regulations 2010). As of March 2010, fourteen California counties had enacted a wide variety of additional restrictions including restricted application zones from 100 feet up to two miles. All of these counties restrict a specific subset of pesticides and only when students are present or expected within a specified time (Californians for Pesticide Reform 2010).

Pre-notification and posting of pesticide applications on school property. Advanced posting and notification to parents, teachers, and the public is considered part of a school IPM program focused on pesticide safety and community awareness. These notifications allow schools and, in some cases, childcare centers a way to alert parents to potential threats to their children's health.

Twenty-six states require schools to notify parents and staff before a pesticide application is made on campus property. Most of these states require annual notice to all parents and guardians indicating which pesticides are likely to be used. Interested individuals may contact the school to be placed on a registry to receive advance notification. Several states allow each district to choose either "opt-in" or universal notification. Arizona, Maine, Oregon, and Wyoming require universal notification. Massachusetts requires universal notification for outdoor applications only. Maryland and Texas require universal notification for schools and childcare facilities; e.g., alerting parents to the notification process in student registration forms or student handbooks. Louisiana requires medical verification of sensitivity to pesticides in order for parents to be placed on the pre-notification registry.

Nineteen states require posting of impending or completed indoor application, either by the applicator or by the school where the application is being made. Seventeen states require posting for both indoor and outdoor applications. In some cases, posting requirements are met by a "blanket posting" displayed at a main entry point, which states that pesticide applications may be made at the school.

Many states allow specific exemptions to pre-notification and posting for specified reduced-risk pesticides and for emergency applications to address public health risks such as vector-borne disease. Reduced-risk designations are typically based on reduced potential for exposure and include self-contained, pre-manufactured bait stations, gels or pastes, and/or reduced-toxicity products, products with a "CAUTION" signal word, or pesticides containing active ingredients generally recognized as safe and specifically exempted from U.S. EPA registration (FIFRA section 25(b)). Exemptions also allow some states to make applications when children will not be present for a specified minimum amount of time.

The New York State Neighbor Notification Law (2000), administered for schools by the Education Department, applies to all public and nonpublic K-12 schools and requires all parents, guardians, and staff to be notified in writing at the start of each school year that pesticide products may be used periodically, that they may request 48-hour advance notice, and that they may contact a named school representative for further information. Those on the registry must receive the date and location of the upcoming application, the pesticide product name and EPA product registration number, the school representative to contact for further information, and the following statement:

> This notice is to inform you of a pending pesticide application to a school facility. You may wish to discuss with the designated school representative what precautions are being taken to protect your child from exposure to these pesticides. Further information about the product(s) being applied, including any warnings that appear on the label of the pesticide(s) that are pertinent to the protection of humans, animals, or the environment, can be obtained by calling the National Pesticide Telecommunications Network Information phone number 1-800-858-7378 or the New York State Department of Health Center for Environmental Health info line at 1-800-458-1158.

Notification is not required if the school remains unoccupied for 72 hours after the application; for aerosols in 18 oz. containers or less used for imminent threat from stinging or biting insects; anti-microbials; biopesticides; products exempt from EPA registration; boric acid or disodium octaborate tetrahydrate; or for nonvolatile rodenticides in tamper-resistant bait stations, nonvolatile insecticidal baits in tamper-resistant bait stations, or silica gels and other nonvolatile ready-to-use pastes, foams, or gels used in areas inaccessible to children. Schools must make a good faith effort to notify those on the registry 48 hours prior to emergency applications.

Finally, all schools in New York must provide written notification to all parents, guardians, and staff three times a year to inform them of all pesticide applications that have occurred. Notification must occur within ten days of the end of the school year; within two school days of the end of winter recess; and within two school days of the end of spring recess. The notification must include the dates and locations of pesticide applications, products applied, emergency applications, and a reminder about the registry option.

Since 2005, Arizona has mandated pre-notification and posting in all schools and childcare facilities (S.B. 1350, 2006) under Office of Pest Management and Department of Health Services (DHS) statutes for all non-exempt applications. Posting and notification

laws existed previously for schools but not childcare facilities. The Office of Pest Management was granted appropriations for an additional two full-time equivalent positions for inspection and enforcement. DHS was tasked with annual childcare facility inspections, including training inspectors, but was not provided additional appropriations to cover these costs. Pesticide applicators must notify the school or childcare facility at least seventy-two hours in advance of any pesticide application, and the school or childcare facility must notify parents, guardians, children, and staff at least forty-eight hours prior to a pesticide application. Applicators are required to maintain written records of notifications for at least three years after the application.

Arizona schools and childcare facilities must also notify parents or guardians, children at the time of registration, and personnel upon hiring, of their pesticide use and notification. The notification must include a list of pesticides and EPA registration numbers for all pesticides used during the previous calendar year. It must also list any additional pesticides anticipated for use in the current year.

California's Healthy Schools Act (2000) requires public kindergarten, elementary, or secondary schools and public childcare facilities to provide annual notification to parents, guardians, and staff, including a list of all pesticide products these institutions expect to apply. Schools and childcare facilities must maintain a registry of those who request pre-notification and notify those individuals 72 hours in advance of application. Warning signs must be posted 24 hours in advance of application at indoor and outdoor sites where a pesticide treatment is scheduled. Warning signs must be visible to anyone entering the treated area and must remain in place for 72 hours after the application. Self-contained baits, gels or pastes, and pesticides exempt from registration are excluded from pre-notification and posting requirements. Emergency applications are exempt from pre-notification.

Illinois school districts must either maintain a registry of parents, guardians, and employees who request pre-notification or provide written pre-notification to all parents, guardians, and employees (Illinois S.B. 529, 2000). Pre-notification may be included in newsletters, bulletins, calendars, or other correspondence published by the school district. Pre-notification must be made at least two business days prior to the application and should identify the intended date of the application of the pesticide and the name and phone number for the school or childcare center staff person responsible for the pesticide application program. Prior written notice is not required for pesticide applications that address an imminent threat to health or property, in which case the appropriate school personnel must sign a statement describing the circumstances that gave rise to the health threat and ensure that written notice is provided as soon as practicable. Exemptions from pre-notification requirements are allowed for antimicrobials and insecticide and rodenticide baits.

Vermont Regulations for Control of Pesticides (Section IV(8), 1991) require certified commercial and non-commercial applicators to post signs at the commencement of a turf and ornamental application made to "public non-residential properties." Signs are to remain posted for 24 hours. Fenced areas require posting in the visitor reception area and the main employee entrance. Application details must be made available upon request.

Reentry requirements. Eighteen states require that students be kept out of the area of treatment for a specified time after certain pesticides are used inside a school building.

In Texas, the original school IPM law adopted in 1991 prohibited student reentry into treated areas for 12 hours for all indoor applications (Texas Structural Pest Control Act 1991, 2003). In 2007, the delayed reentry requirement was removed for those defined as least risk, or "Green" category products. For Yellow Category products, the reentry time was reduced to four hours, and reentry time is eight hours for Red Category products. Treated areas must be clearly posted with reentry times. Texas defines "Green" pesticides as products in EPA toxicity categories III or IV with a "CAUTION" or no signal word, and includes any product that "consists of the active ingredient boric acid; disodium octoborate tetrahydrate or related boron compounds; silica gel; diatomaceous earth; or belongs to the class of pesticides that are insect growth regulators"; it also includes "microbe-based insecticides; botanical insecticides containing no more than 5% synergist (and does not include synthetic pyrethroids); biological (living) control agents; pesticidal soaps; natural or synthetic horticultural oils; or insect and rodent baits in tamper-resistant containers, or for crack-and-crevice use only" (Texas Administrative Code 1997). "Yellow" products are EPA toxicity III or IV and carry a CAUTION or no signal word, and do not meet the definitions of Green or Red products. "Red" products fall under the EPA toxicity category I or II and carry a WARNING or DANGER signal word or include those products that are considered restricted use, state-limited use or a regulated herbicide under the Texas Administrative Code.

Prohibited or restricted applications. In Texas, schools must use non-chemical or low-impact products first, with other pesticide applications made only after the first-resort options do not provide adequate control. "Green" products may be used at any time at the discretion of any licensed applicator. Use of "Yellow" products requires school IPM coordinators to request written approval from a certified applicator. "Red" product use must have written approval by both a certified applicator and the school IPM coordinator.

New York passed Education Law 409-k for schools and Social Services Law 390-g addressing pest management for childcare centers in 2010. The laws ban applications of most pesticides on playgrounds, turf, athletic, or playing fields, including playground equipment (New York State Child Safe Playing Fields Act 2011). Family childcare centers are exempt, as are emergency

applications and six types of pesticides including antimicrobials; aerosol sprays in 18 oz. containers or smaller; non-volatile insect and rodent baits in tamper-resistant containers; products containing boric acid or disodium octaborate tetrahydrate; horticultural oils or soaps not containing synthetic pesticides or synergists; and EPA Minimum Risk Pesticides exempt from registration. Connecticut passed a similar law (Connecticut S.B. 1020) in 2009.

Enforcement. Generally, state resources for compliance assistance and enforcement are extremely limited. Enforcement actions typically result from complaints or pesticide exposure incidents, as reported by interview through e-mail and phone.

Many of our states reported that education to schools is lacking, as there is no easy way to relay messages to school personnel without a lot of additional support from other agencies and change agents. The Georgia Department of Agriculture (GDA) revised its rules in 2003 after a pest management professional (PMP) was found to have violated the Georgia School Pesticide Act (2003). The act includes a three-hour reentry requirement, additional restrictions on residual and exterior applications, and extensive record-keeping. In 2007, a routine annual paperwork inspection by GDA identified common PMP performance deficiencies including incomplete, illegible, or vague records; failure to follow contract requirements and school IPM policies; illegal applications including use of pesticides too close to food handling areas; and falsification of records, including changing items on a form after the customer had signed it. GDA has implemented "self-reporting meetings" between PMPs and regulators to discuss practices and review service and application records for compliance. A warning letter is often generated in response to non-compliance. Additionally, between August 2008 and August 2011, $218,250 in monetary penalties was imposed and 15 certified operator certifications surrendered or revoked (GDA 2012). All 72 cases were settled without formal action, most by phone. GDA has also worked closely with the pest management industry to create a standard pesticide use form that helps them comply with state regulations. Compliance has improved dramatically.

When revised legislation was passed in Arizona addressing childcare facilities, an education and outreach effort revealed that many schools and PMPs had not complied with prior legislation, which required pre-notification and posting in schools. Arizona Office of Pest Management inspectors have rarely cited schools, choosing instead to focus on compliance assistance.

Discussion

Policymakers in 35 states have acknowledged the special risks posed by pesticides to children's health by approving specific restrictions on pesticide use in schools and, in 38 states, childcare facilities. Nevertheless, we estimate that in more than 5,000 of the nearly 14,000 school districts in the U.S., any individual may make a pesticide application without prior training, license, or certification. In many other districts, an unlicensed individual may apply under the "supervision" of a licensed applicator without the licensed applicator present on site at the time of the application.

Minimum standards for pesticide safety training of individuals applying pesticides in schools may have the greatest potential to reduce pesticide risks to children, given that untrained applicators may be least likely to be informed of basic pesticide safety practices, legal requirements, or other rules to protect children and staff in schools or childcare.

Licensing requirements for any individual on school or other sensitive property make sense to those who understand pesticide use and misuse. However, licensing of school employees or hiring a pest control contractor can mean additional expenses for many small school systems. Evidence has shown that requiring additional licensing and certification helps to reduce the chance of pesticide exposure to humans and non-target organisms. Pesticides are important tools that, in the hands of the skilled applicator, offer numerous benefits and are important factors in an IPM program or any pest control program. As with any powerful tool, proper and effective use of pesticides depends upon the judgment of the trained applicator. The pesticide applicator license represents recognition of an individual's qualifications to use pesticides properly.

Best practices also include complete written records for all applications made by contractors or district employees, including date, time, specific location, applicator name and license/certificate number (if any), application method, target pest, product, amount applied, and EPA registration number. Records of outdoor applications can also include wind speed and direction at the time of application to document conditions in the event of a drift incident.

Keeping accurate records of pesticide use makes good sense. In most cases, schools are required by state law to maintain records on pesticide use, but having records available at one location on school property is not always the case. Requiring access to application records for both the applicator and end user can aid in communication and in avoiding overreaction or overapplication. Application use records are important documents that state when a chemical is used, how much is used, why it is used, and where and by whom it was applied. When made available to a parent, coach, teacher, or anyone else who needs it, this information helps convey public information and trust to the community. Many of the state rules regarding record-keeping on school or childcare property were adopted to help inform parents in the event that they feel their child has been exposed to something toxic.

All pesticide products stored on school property should be properly secured and inaccessible to children. Promptly and properly disposing of pesticides that are no longer used, or no longer legal for use, is a best practice. Three of the first ten school systems evaluated for IPM STAR® Certification had no-longer-registered

Fig. 3. An example of how pesticides often stored on school grounds, in a closet or area with additional types of supplies. Photo by Janet Hurley.

"legacy" pesticides in storage (Green et al. 2007). In some states, the combination of poor storage practices and a lack of requirements for applicator training could have potentially harmful consequences (Fig. 3).

Laws and rules can prohibit the storage on school property of pesticides for which no future use is planned and pesticides that are not labeled for use on school property. In addition, state environmental quality agencies should also allow school districts to dispose of unneeded or inappropriate pesticides and other chemicals at annual household chemical disposal events to facilitate proper and economical disposal.

Given that 31% of pesticide incidents on school property were related to drift (Alarcon et al. 2005), improvements to reduce drift from nearby applications are also a priority. Currently, eleven states require neighboring agricultural operations, golf courses, or other broadcast applicators of pesticides to notify neighboring schools prior to pesticide applications. Best practices may include limiting applications to times when children are not present in areas subject to drift and improving communications before these applications are made. The most difficult task of any restricted zone is communication with persons that need protection.

Information about options for pre-notification of pesticide applications can be communicated to parents and guardians directly and separately from the typically large packet of information distributed at the start of the school year. Respondents indicated that participation in optional pre-notification registries has been higher when this option is communicated separately from other notices. This information can include details on how to be added to the pre-notification registry, list all pesticides the school anticipates using during the year for both buildings and grounds, indicate availability of product labels and material safety data sheets (MSDS) for listed pesticides, and provide contact information for the district's IPM coordinator or other individual responsible for communicating with parents and guardians about pest management.

All applications can be posted before or immediately following the application at entrances to the application site, at a central location in the school building (such as the entryway or main office) and electronically on the district's Web site for pest management information. Children should not be present during any applications or until the reentry period has expired. Reentry intervals of a minimum of twelve hours for all applications may be practical, with extended intervals if required by the pesticide label.

When reasonable non-chemical interventions do not provide an adequate resolution to a pest problem, the use of reduced-risk pesticide products can be encouraged by allowing exemptions from pre-notification and posting for these pesticides. Reentry intervals may also be reduced for low-risk products. Effective criteria for reduced risk have been established in several states including Texas (Texas Administrative Code 2009), West Virginia (West Virginia Department of Agriculture 1996), New Jersey (New Jersey Pesticide Control Code 2008), and Oregon (Oregon Revised Statute 634, 2009). Exemptions in New York, for example, allow applications of reduced-risk products including insecticide baits during a service visit focused on inspection. Non-exempt product applications must have 48-hour pre-notification, requiring a separate visit two days later to make the application, providing a strong incentive to limit applications to reduced-risk products.

Exemptions for emergency applications can be specific to situations in which public health is at risk as determined by a recognized authority. Anti-microbials can be addressed by separate legislation or guidance, and are often addressed in green cleaning programs and provisions.

The vast majority of pest problems typically encountered in schools can be addressed by pesticides within EPA toxicity categories III and IV (Green and Gouge 2011), thereby relegating the use of category I and II pesticides only to emergency situations. Regular inspection, ongoing monitoring, and effective sanitation and exclusion practices help prevent pest problems and reduce overall need for pesticide applications. While health risks associated with pesticide use can be further reduced by prohibiting use of specific high-risk pesticides or pesticide classes, limiting pesticide use to minimum risk products (FIFRA section 25(b)) is not necessary or effective. Many of the new and existing pesticides are now formulated so that human exposure is extremely limited; e.g., in self-contained baits or gels

that can be applied in accessible areas.

Sufficient funding is essential for ongoing outreach, education, training, compliance assistance, and enforcement. Several states reported substantial declines in support in these essential components within a few years of passage of new or revised legislation, resulting in low program awareness and poor compliance of enacted laws in schools and childcare facilities. Cooperative Extension, often the educator of choice for unbiased, science-based outreach, education, and training, has been particularly hit hard by budget cuts in several states in recent years. This funding reduction has led to fewer "boots on the ground" educators reaching out to schools, childcare centers, and public citizens to help educate them about the proper use of pesticides and IPM.

New research is needed to update incidence and severity of pesticide-related illnesses and injuries, and the incidence of asthma and other illness associated with pests among schoolchildren. Analyses of correlations with state legislation would help document any impacts of these provisions on student health.

Finally, requirements for IPM practices are increasingly being incorporated into new and revised legislation. Most recently, laws that feature IPM provisions have been passed in Oregon and Indiana. These include provisions restricting pesticide applications to situations in which reasonable non-chemical measures have proven inadequate, thus mandating use of IPM techniques before a pesticide can be applied. These provisions will be discussed in a subsequent article.

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