

North Carolina Growers' and Extension Agents' Perceptions of Latino Farmworker Pesticide Exposure

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Pesticide exposure poses a significant health hazard to everyone who works in agriculture. Growers have more control over their own exposure risk than do the farmworkers they employ. While growers are responsible for providing a safe work environment, their perceptions of the health risk of pesticides influence the amount and quality of safety training and protection they offer to workers. This paper analyzes growers' and cooperative extension agents' perceptions of farmworker pesticide exposure. Data are from in-depth interviews conducted with growers and extension agents who work in western North Carolina. Both groups indicated that the danger of pesticide exposure is exaggerated by the media and the public. They feel that workers are at little risk of exposure because they have received training and protective equipment as required by law and because they are not in direct contact with chemicals. Their perceptions are at odds with results of other research indicating many farmworkers have not received the required training and do not always utilize protective gear. Linguistic and cultural barriers contribute to this discrepancy in perceptions and must be addressed if measures to reduce farmworker pesticide exposure are to be effective.

Key words: pesticide safety, farmworker health, Worker Protection Standard, North Carolina

Agriculture is dangerous, and its workers are confronted with the possibility of injury or illness from an array of occupational and environmental health hazards on a daily basis (Myers and Hard 1995; NSC 2002). Agricultural chemicals, including pesticides, pose a significant risk both for acute injury and for long-term, often latent, health problems. Acute injuries from spills or accidental ingestion can have health impacts ranging from dermal and eye injuries to systemic poisoning and death (Reigart and Roberts 1999). Chronic exposure to low levels of pesticides or their residues (persistent active ingredients) on plants has been linked with serious health problems such as cancer, birth defects, infertility, and neuropsychologic deficits (Baldi et al. 2001; Garry et al. 2002; Oliva, Spira, and Multigner 2001; Savitz et al. 1997; Zahm and Ward 1998; Zheng et al. 2001). Agricultural pesticides have been implicated in surface water and groundwater pollution, which creates exposure routes for workers and nonworkers alike, often well into the future (Beach et al. 1995; Tucker and Napier 1998). The vast majority of commercial crops grown in the United States have chemicals applied to them at some point in the growing cycle (Arcury and Quandt 1998), making the issue of environmental contamination and personal exposure relevant to all sectors of the industry.

An increasing amount of the day-to-day labor on farms is being performed by hired labor as the number of "family farms" declines (Arcury and Quandt 1998). Farmworkers in the United States are frequently poor immigrants from Mexico or other Latin American countries, with limited literacy skills and English proficiency. They are likely to live in lower-income or more isolated areas with inadequate health care facilities, and they seldom have health insurance. They have insufficient economic and social resources to control their environment and maintain their health, and therefore tend to have poorer health status than the general population (Austin 2002; Villarejo 2003). This situation, when combined with the real or perceived lack of control over the workplace, puts them at significantly greater risk than the general population for negative health consequences from pesticide exposure.

Pesticide safety is not a simple matter of more safety education or increasing knowledge of the hazards of farmwork (Arcury and Quandt 1998). Workers and growers have widely differing perceptions of their control over their own work circumstances (Griehop, Stiles, and Villanueva 1996). When workers feel they do not have control, they are less likely to take workplace safety measures (Arcury, Quandt, and Russell 2002; Austin et al. 2001; Vaughn 1993a, 1993b). Therefore, they must first be convinced of their capacity to implement what they have learned if they are to act to reduce their exposure. Agricultural

employers need to be aware of the barriers workers face in trying to work safely and take measures to address these barriers. Optimal workplace safety is most likely to be achieved when there is commitment and a partnership of employees and employer (Arcury et al. 2001; Wallerstein and Rubenstein 1993). This article discusses the beliefs about and attitudes toward pesticides by a group of growers in North Carolina's Christmas tree industry, and the implications of these beliefs and attitudes for worker exposure. Because one role of the cooperative extension service is to educate and support growers in their pesticide safety efforts, this paper also addresses the attitudes and beliefs of cooperative extension agents who work with tree growers. This paper expands the literature on growers' perception of their workers' occupational risks from pesticides (Quandt et al. 1998) and contributes to the overall literature on occupational health risks of immigrant labor.

Pesticide Safety

Avoidance of acute injury from direct exposure to large amounts of a chemical ("poisoning") is the most obvious and immediate aspect of pesticide safety. However, evidence is mounting that long-term exposure to small amounts of pesticides in food, air, and water, may, in fact, present the greater health hazard in the general population (Eskenazi, Bradman, and Castorina 1999; GAO 2000). Working in treated crops presents an additional potential source of exposure for those involved in agriculture. Although data on acute pesticide poisonings among agricultural workers are not available, the additional accumulation clearly increases the risk of long-term problems.

Because of the potential seriousness of the effects of pesticides on people and the environment, extensive government regulations exist to control how pesticides can be used and by whom. Pesticides have been defined by the United States Environmental Protection Agency (EPA) as any substance used to control or eliminate pests, which includes unwanted plants, insects, or animals (EPA 2003). Until the last decade, the majority of regulations focused on protection of those at risk for direct exposure (i.e., applicators). In the mid-1990s, policies were implemented by the EPA for the protection of individuals at risk for indirect exposure, primarily hired farmworkers who work in treated fields. Known as the Worker Protection Standard (WPS),¹ these regulations impose specific requirements on grower-employers for training, notification of applications, and provision of safety equipment to nonapplicator workers (EPA 1992). Evaluations of the WPS conducted in North Carolina in 1998 and 1999 revealed that only a third of the farmworkers recalled having received information or training on pesticide safety, and few workers could describe how they might be exposed to pesticides or reported taking any safety measures (Arcury et al. 1999). This level of training is similar to that reported in other regions of the country (GAO 2000; Larson 2000; Villarejo et al. 2000).

A number of studies have reported the perceptions of pesticide safety and farmworker exposure for farmers in a variety of crops. Quandt et al.'s (1998) study of workers and growers in central North Carolina revealed several inconsistencies in beliefs about pesticide safety. Growers believed that workers were not exposed as long as they did not mix or apply chemicals and did not enter the fields immediately after application. Neither growers nor workers considered residues to be a source of exposure. Furthermore, growers believed that currently used chemicals are less toxic than those used in the past and that smaller amounts are used today. They reported feeling overburdened by regulations and with the time and costs of dealing with safety programs for workers (Quandt et al. 1998). Perry and Bloom (1998) and Thu (1998) found that while growers may know the safety regulations, when under time or economic pressure, they take shortcuts and allow their workers to do so also. Thompson et al. (2001) found that growers tend to downplay the importance of pesticide safety and feel that people who know nothing about pesticides have a tendency to overreact. Furthermore, growers indicated that the workers often choose not to use protective equipment even when available. In all these studies, growers asserted that herbicides, the most commonly used category of pesticide, are not particularly harmful to humans.

Perry, Marbella, and Layde (2000) identified gaps in the safety knowledge of growers that conflicted with their perception of their ability to control risk. They found that safe handling behaviors did not increase unless pesticide safety knowledge was increased first. The message that exposure is not a problem if rules and regulations are followed is taught in EPA-required

courses for applicators. However, the EPA guidelines are intended to reduce exposure risk and severity; they do not necessarily eliminate it entirely (Woodruff, Kyle, and Bois 1994).

Although everyone who works in agriculture is at risk for exposure, the control individuals have over their workplace, and thus over their risk, can vary in important ways (Arcury, Quandt, and Simmons 2002; Austin et al. 2001; Vaughan 1993a, 1993b). Growers exert considerable control, directly and indirectly, over the exposure risks of those who work on their farms (Arcury, Quandt, and Russell 2002). Grieshop and colleagues (1996) found in a study of loci of control of workers and growers in California that growers placed more faith in their personal ability to control risk, while workers were more likely to attribute control over risk to external factors, such as God or luck. Growers' overall perception of pesticides is an important factor in the amount and quality of protection and training available to employees, as well as the stringency with which safety precautions are enforced.

Mountain Agriculture: Growing Christmas Trees in North Carolina

The mountainous topography of western North Carolina is well suited to such crops as Christmas trees and landscape products. Christmas tree production is an important industry for the state, bringing an estimated \$100 million into the state's economy annually. The most common tree is the Fraser fir, which requires six to ten years to reach its most popular size of six to seven feet. Between 900 and 2,700 trees can be grown on an acre of land, depending on spacing (McKinley 1997); two-thirds of the state's 1,500 producers operate on less than 10 acres (NCCE 1999). This land is often interspersed with housing in rural areas, and both workers and growers may live adjacent to fields.

Unlike crops with short, intense growing seasons, Christmas trees require significant hand labor input during much of the year. Seedlings must be transplanted twice before being planted on the slopes where they will be allowed to mature. From mid-summer into fall the trees are sheared into the desired shape by hand. Harvest of mature trees begins in October and is completed by early December. Pesticides may be applied any time during the year, but are most often applied during the spring and early summer. Hand application with backpack sprayers is common when the hilly terrain is not suited for larger equipment. When the terrain permits, chemicals may be applied with tractor-driven mist blowers and hand-held high-pressure sprayers, which produce drift that can settle in and around nearby housing. Much tree work, including pesticide application, is performed by hired laborers, who are therefore at greater risk for exposure than workers in other crops.

As the number of Christmas tree farms has increased, the number of immigrant Latino workers, primarily from southern Mexico, has increased significantly. Some of these workers migrate between Mexico and North Carolina annually to work in the trees, while others have "settled out" with their families. Approximately 3,000 workers are employed in the mountain agriculture of North Carolina (NCFHA 1999). Farmworkers' wives and other family members often supplement the household income by making wreaths and garlands from the clippings removed in the shearing process. "Roping," as it is known, is another potential exposure pathway for farmworker families.

Methods

Data were collected during the initial phase of La Familia, a five-year project funded by the National Institute of Environmental Health Sciences. The goal of the project is to develop a health education intervention to reduce pesticide exposure in the home, particularly among children. The study is being conducted in several contiguous counties of northwestern North Carolina.

Fifteen in-depth interviews on tree production, pesticide use, and farmworkers in mountain agriculture were conducted with growers and state cooperative extension agents between January and July 2001. Participants were selected using an ethnographic sampling approach designed to include persons with varying experience growing trees and operations of

different size located throughout the study area. This entailed purposive selection of individuals whose experience and beliefs represent the range that would be expected in the larger group (Werner and Bernard 1994). Sample size was determined by the point at which theoretical saturation was reached; that is, additional interviews were uncovering no new, relevant information (Glaser and Strauss 1967).

Potential grower participants, all of whom hire farmworkers, were identified through local "Choose and Cut" guides, the North Carolina Christmas Tree Growers Association, and by referral. Growers were approached at trade group meetings or contacted by telephone using publicly available information. Attempts were made to contact 24 growers; of these, two declined because they were tired of being interviewed, another declined because he was too busy, and a fourth declined without providing a reason. Another 10 were either out of town or did not return phone calls, possibly a function of the timing of the interviews. Interviews were scheduled for the slow period for tree production (January through March) so that growers would be less busy, but many take vacation or do other traveling during that time. Two additional growers were willing to be interviewed but did not do so because of scheduling issues. Nine extension agents, including all those who worked in the study counties at that time or whose work was relevant to mountain agriculture, were contacted through the state office. Of these, two were willing to be interviewed but did not do so because of scheduling issues.

The final sample included eight growers and seven extension agents. The growers were all males over the age of 40. Their primary agricultural activity was Christmas tree production, and several also produced wreaths and garlands during the holiday season. Time spent working in trees ranged from 15 to 45 years. Acreage planted in Christmas trees ranged from 10 to several hundred, with production ranging from a few thousand to over 100,000 trees per year. The seven extension agents who participated specialized in research, education, production, or marketing of Christmas trees or ornamental products. Time spent with North Carolina's Cooperative Extension Service ranged from 5 to 30 years.

Interviews covered a range of topics regarding the participants' experiences with agriculture, including their perceptions of workers' exposure to pesticides. The concept of "pesticides" was defined for participants as including any chemical that is used to control or eliminate unwanted plants, insects, or animals, such as herbicides and insecticides (EPA 2003). Before the interview began, the study was explained and informed consent to participate was obtained in accordance with the requirements of the Wake Forest University School of Medicine Institutional Review Board. Interviewers emphasized their roles as health educators, hoping to reassure participants who might otherwise temper their responses because of potential liability or increased regulation.

Interviews lasted between 30 and 90 minutes and were conducted at a time and location convenient for the participant. Locations included the growers' homes and offices, which were often the same, and the extension agents' offices. The interviews took place during the slow period in the local agricultural season, which peaks during the November and December holiday season. All but two participants allowed the interview to be tape recorded for later transcription; the interviewer wrote comprehensive notes for the untaped interviews. All interviews were conducted by the same investigator, who recorded notes and observations on the interview setting and context. These notes and transcripts were reviewed and analyzed for content that reflected the participants' experience with pesticides and their perceptions of the issue of worker exposure to pesticides. Quotations are presented to illustrate major themes identified in the interviews. The code in parentheses following each quotation indicates whether the speaker was a grower (GR##) or extension agent (EA##).

Results

Participants' comments addressed their general perceptions of the issue of agricultural pesticides, the probability and severity of the risk of exposure, safety training, protective measures, and reasons to limit exposure.

General Perceptions of Pesticide Safety

Growers and extension agents feel that the danger of agricultural pesticides has been greatly exaggerated by the general public, the media, and the government.

The problem today with the chemicals are people that don't use it and don't know what they're talking about. They see some of my people up here in a field with those white suits on and they think they're gonna kill everybody.... It's not the people who use the material that you need to be working with. It's those people that don't use it.... I think they're making a big mountain out of a mole hill (GR01).

There are always concerns about pesticides. There seems to be such a negative idea about them just among the general public.... Most people think that growers are just poisoning the world (EA01).

Both groups stated that the majority of growers are conscientious, educated, and diligent about following guidelines. In fact, they pointed out that homeowners who buy weed killers and insecticides off the store shelf and use them without any training or protective gear are more likely to harm themselves, others, or the environment. Furthermore, they asserted that nonusers who have never received training on the subject have no basis for realistically assessing the true extent of the danger. Growers consider pesticide safety largely a matter of common sense: when applied in accordance with label instructions, pesticides are not dangerous.

Most of the misuse I see is in the home, houses and gardens. Everywhere you go this summer, you'll see someone dusting their beans with Sevin dust with shorts and no shirt on, and these homeowners are not trained. They can go to Wal-Mart and buy Disyston [disulfoton], You can go to Wal-Mart and buy Dursban granulars [chlorpyrifos], and you're going to see people putting that out with their hands (EA02).

The incidence of pesticide-related poisoning is believed to be exaggerated as well. Several participants said they had never been injured, nor had any of their workers complained of dizziness or feeling sick after applying or working near pesticides. Any incidents of which they were aware happened "on someone else's farm" and were the result of carelessness, such as working without a shirt.

There's never been a confirmed pesticide poisoning in the Christmas tree industry that I'm aware of, and this dates back to whenever NCDA [North Carolina Department of Agriculture & Consumer Services] first started keeping records on Christmas trees.... I've never heard of them finding one (EA02).

You hear of stories of people having problems, and the most stories you hear about are exposures to Disyston. Somebody got sick from Disyston. The stories that I have heard of, the NCDA has investigated and they haven't turned up with a problem that I am aware of (EA01).

I heard the other day that one fellow said he got sick himself, but I've never known of anybody to get sick with it. Never (GR01).

We've never had one [farmworker] even complain about anything, being dizzy or even feeling like they were exposed to it (GR02).

If things are done properly the way they're supposed to be done, [chances of exposure are] slim. So,...it would be certainly carelessness on somebody's part, but I think that would be very rare that it happened (GR08).

Participants pointed out that pesticides have been used for years without apparent negative repercussions, and a few suggested that the issue of possible pesticide dangers was only being raised now because of the growing immigrant labor force.

In fact, I have a friend that I was talking to the other day that is 89 years old and he says that he used to put Disyston in his pocket and go out and spread it with his hands. Then he would come inside, hug his wife and kids, and sit down to eat lunch. Heck, he told me that he was sure that he had even eaten a little bit of it over the years. He's 89 and he is in great health. We've been putting this stuff out for years. The only reason that anyone is getting worried about it now is because of these migrant workers. I just don't know what to think about that (EA03).

Some growers and extension agents believed the Christmas tree industry was being singled out unfairly. They pointed out that pesticides are applied to trees only three or four times per year, compared to the more frequent treatment of some fruit and vegetable crops.

I think overall as an industry, it's been misconstrued a lot on the amount of pesticides we use because we're so visible. We're applying pesticides two to three times, pesticides being herbicide or insecticide, compared to apples that get 10 to 12 applications of pesticide a year, and tomatoes and these other crops. We don't use that much pesticide (EA02).

Also, growers and extension agents noted that the strength of the odor given off by many of the pesticides used in trees is believed by the public to be an indicator of toxicity.

Then the Disyston...always runs up a red flag because it's got such a pungent odor. It draws attention from the public. You unload a truck with 10 or 12 workers in white suits going through the field, you know, and then after they leave it's a terrible stink (EA03).

Probability and Severity of the Risk of Exposure

Participants generally acknowledged that farmworkers may be exposed to some level of pesticides if they work in fields or nurseries that have been treated.

If they're working in trees, and there are pesticides being used, of course [they're] exposed to it (EA04).

I don't think you can really mess with chemicals without having some exposure (GR02).

However, growers and extension agents both consider the likelihood and degree of exposure to be mitigated by several factors. First, workers who do not apply pesticides are thought to be unlikely to be exposed as long as they are not on site during the actual application, and reentry intervals (a period of time after application during which no one is permitted to enter the field without special protective gear) are enforced.

And in those cases [where high pressure sprayers or mist blowers are used], it is usually not the farmworker who is doing that. It is the grower himself, or the foreman, or they are hiring somebody else to do that, and so then these other materials, people wouldn't have as much chance at being exposed to (EA01).

Participants acknowledged that workers who do apply might be exposed when working with the concentrated forms of the pesticides; that is, while mixing or loading, although that risk is reduced by wearing the proper protective equipment and following label guidelines. Growers indicated that once a pesticide has been diluted, the danger it poses is minimal; once the reentry interval has passed, the active ingredients have dissipated and no longer pose a significant health risk.

If people are simply in the field, I think their risk of exposure is very, very low, you know, if they're not actually putting out the material. We've got good reentry intervals [and] I don't think those reentry intervals are being violated. I think a lot of the residues break down fairly quickly...and for somebody to be coming in later, I think exposure's very limited (EA05).

Growers and extension agents pointed out that changes in the industry are also reducing the potential for exposure. Growers are using smaller amounts of less dangerous pesticides, and regulations concerning training and protective gear are being more strictly enforced by growers.

People started using Disyston for the twig aphid control, and it also controlled the spider mites at the same time.... You ended up doing a lot less spraying, so you're exposed to less chemicals (GR02).

We use real low rates [of chemicals for weed control]. It doesn't kill it, it stunts it (GR03).

Farmers have become educated [about the importance of pesticide safety] too, where they didn't realize it 10 or 15 years ago (GR08).

While workers were said to be at limited risk of exposure because the growers do most of the applying, descriptions of the division of application responsibilities varied. Pesticide safety guidelines restrict the type and amount of applying that can be done by unlicensed workers, but workers can be trained as handlers and permitted to apply pesticides under the supervision of a licensed applicator. The deciding factor for individual growers was generally the equipment needed to apply the particular pesticide. Chemicals that require the use of heavy equipment were reported to be applied only by the grower. Those applied with backpack sprayers or spread manually were more likely to be reported as applied by workers. However, as long as someone else was responsible for mixing, the workers were not considered at risk for exposure even in these situations.

Well, [the workers] are never around when the mist blower [is in use] (GR02).

My son will supervise, fill the tanks, and they'll be actually running the hoses, the Mexicans will (GR03).

[Farmworkers'] involvement with chemicals would be actually on the farm during either down time, or the season when something needed to be applied to the plants outside. There will be a licensed operator with them, you know, to supervise, make sure everything is mixed correctly, sprayed correctly and disposed of correctly (GR05).

Most of the people who are [using heavy equipment] is the owner, or the owner's son or daughter. It's not the Hispanic worker. Most of the exposure that the Hispanic people or Latinos are exposed to is through the use of backpack sprayers, and the majority of things they're going to be putting out there in a backpack sprayer is probably going to be herbicides. Most of your fungicides, insecticides and miticides are going to be put out with the air-blast sprayer, so probably, I'd say 90,95 percent or more of the Hispanic population is not going to be exposed to anything other than herbicides (EA06).

The chemicals themselves are thought to be less toxic than in the past, and several participants consider herbicides to be generally nontoxic to humans.

We're talking about herbicides. Herbicides, they don't need no training on herbicides.... It's not a dangerous chemical as far as people are concerned (GR01).

RoundUp [glyphosate, an herbicide] is 100 percent biodegradable. When it hits the soil, it disappears.... It's just a salt (GR02).

We don't wear a respirator or anything else like that when we are putting out RoundUp because it's not that bad. We wear rubber gloves (GR04).

As noted, few participants reported knowledge of any pesticide-related injuries. The fact that they were not personally aware of any poisonings, hospital admissions, or emergency department visits was considered evidence of the minimal risk. While

acknowledging the possibility that long-term exposure might be harmful to health, several participants nonetheless voiced skepticism that exposure is an important health problem. Some even questioned the true level of toxicity for wildlife. They did not always believe the physical effects of exposure were caused by the chemical itself; for example, the odor might be responsible for the reaction.

I don't buy into... [the idea of a] low dosage chronic effect (EA07).

But you don't see them, dead birds [or other animals] from the use of chemicals (GR01).

Part of the problem, you know, I think is not necessarily the chemical, but that odor. I mean, some people have got a quick stomach and it's very-it's very obnoxious (EA03).

Safety Training

Since growers who apply restricted-use pesticides must be recertified every three years, they are generally current on safety information, both for themselves and their workers. Both growers and extension agents say applicators are more educated now than they were in years past. Meeting the Worker Protection Standard guidelines for training workers has been a greater challenge, primarily because of the large number of Spanish-speaking workers. Growers must either hire bilingual trainers, seek the assistance of a worker who speaks some English, or rely on EPA-approved Spanish videos (e.g., University of Idaho 1997). Taking time away from the field for training is problematic for growers. Some participants dealt with this problem by training only that subset of workers who they think may be at risk of exposure because of their specific activities. In fact, WPS requires training for all workers who accumulate five days of work in areas to which pesticides have been applied in the last 30 days, regardless of activity.

If we get some new workers, I'll just get them in there some day, on some rainy day or something, say, "You know, take this video and show these guys this." Most of the time I get them to sign off that they saw it (GR02).

I don't know how much they pay attention to the video, but I'm 100 percent confident in my son and the people that they're out there with, that they have to follow the rules. You know, we've got the water for washing hands (GR03).

Personal Protective Equipment

Most participants emphasized the importance of personal protective equipment (PPE). As one informant said, "Anyone who uses pesticides has the potential to be exposed if they do not wear the right equipment (EA02)." They noted that if an exposure problem existed, it was because PPE was either not provided or not used. The latter was considered the most likely scenario, as growers and extension agents believe that all necessary equipment is being supplied. In fact, some growers said they require the use of protective clothing beyond what is specified on the label. It is simpler to use the same gear for all pesticides, plus it provides added protection from liability.

Now with the Disyston they wear the Tyvek suits, which isn't necessarily required on the label. I think it just required long sleeves and long pants. In that case, if the person just went out in their street clothes, they would have to launder their clothes separately from the family clothing or the grower would be responsible for that. So they just figure it would be easier to use the disposable Tyvek suits, which is a good choice for granular Disyston (EA01).

We're, you know, pretty cautious about it because of all the press and everything, and from the liability standpoint (GR02).

Workers may choose not to use full PPE because it is hot and uncomfortable and can interfere with work (Elmore and Arcury

2001), and growers agreed that PPE can pose its own health risk from heat stress. Extension agents were more likely to say worker compliance with the use of PPE is a problem. Growers felt more certain their workers were taking all the appropriate precautions, even when not under direct supervision, and especially if the pesticide has a strong odor.

They're a little more careless with [pesticides that don't have a strong odor] than they would with like, Disyston, [which] has a strong smell (GR02).

I hardly ever catch them, you know, without their stuff.... They're not doing it because they're worried about me catching them, they're doing it because it's right (GR03).

As I said, the laws have become stricter, and the fine is too great to take a risk of what little minimal things has to be done to get them ready. So, I'd say the majority of the farmers are very strict about that (GR08).

Implications and Reasons to Avoid Exposure

Reduction of liability was the most commonly cited reason for adhering to WPS and other pesticide safety guidelines, followed closely by the need to maintain a healthy work force. Growers feared losing their applicators' license or being fined in the event of an incident, and, therefore, they did what was necessary to comply. But beyond such primarily economic concerns, growers voiced a feeling of responsibility for the health of the workers and their families.

These farmers come through me every three years to get recertified, so it's constantly in their face about protecting themselves, their family, and their workers. What's going to happen if they get a worker sick? They're going to go to them and fine them or take away their license or something (EAO2).

They are sort of like young-uns, and since the grower is responsible for his workers, he has to constantly watch everything they do (GR06).

Disyston

Comments on the common Christmas tree pesticide, Disyston, exemplify many of the issues described above. Disyston is an organophosphate that targets highly destructive insects and is considered crucial to the continued existence of the Christmas tree industry. As an organophosphate, Disyston can have severe acute effects on the nervous system that can lead to coma and death. It can also have delayed, cumulative neurological effects. Disyston is applied by crews of workers and growers who carry it in buckets and toss it by the teaspoonful at each tree. The EPA has considered banning Disyston but has delayed its decision to allow time for a better application method to be developed.

We want to keep Disyston if we can because if you have a real bad infestation, Disyston will take it out with the least effect to the [beneficial] predators, and the least exposure to the workers (GR03).

If they lost [Disyston] and didn't come up with something that would take its place, you can put the Christmas tree business out of business. So, that's a very serious matter to [growers], and you can understand that because it's-and in my opinion it's one of the-probably the least dangerous ones they use, and I don't know what's been the big discussion over it. Now, it can be dangerous if you don't handle it correctly, but it loses its effect within hours after it's put out. It's not like some of the others that they use that can last for days and days. But it's the only one they can use that takes care of the twig [aphids] and so on that they have here. Without it you don't have a Christmas tree to sell. You're talking about putting-well, these big farmers that have multimillion dollar businesses, you're talking about putting them out of business, and that gets to be a serious matter (GR08).

Despite its widely acknowledged toxicity, Disyston is believed to pose minimal risk because it is applied only once during the growing season, it is in granular form rather than spray, and it is assumed to dissipate fully during the restricted entry interval, especially if it rains. There is generally no need for workers to go into a field during the restricted entry period, but if necessary, gloves and suits provide adequate protection. Its granular form is considered less hazardous than sprays that can drift or liquids that can spill. Application takes place over a short period of a few half days, which growers indicated limits the exposure of individual workers.

For Disyston their idea of short term would be seven days or less that they would put it out eight hours a day. A more moderate application would be anyone who would put it out more than seven days, and we only had one grower who put it out more than seven days, and nobody puts it out eight hours a day (EA01).

Disyston granules do produce some fine dust that can be inhaled, but growers and extension agents consider the risk of that happening to be minimal when applied as described. Earlier methods, such as the use of handheld cyclone spreaders, produced more dust. Because of its strong smell, growers have no difficulty convincing workers to wear full PPE when applying Disyston. But the smell also raises a red flag for the public and the media.

I scare them enough that they pretty well wear everything they're supposed to (GR02).

One grower told me that they always got calls whenever they sprayed Disyston because it smelled so bad (GR01).

Discussion and Implications

Growers and extension agents alike said they want workers to be safe and the environment to be protected. They do not knowingly put their workers at any greater risk than they face themselves. Nonetheless, the results of this study demonstrate the tendency to downplay the risks workers face from pesticide exposure. These findings mirror those of Thompson et al. (2001) in Washington State and Quandt et al. (1998) and Arcury et al. (2001) in central North Carolina. Other studies of growers' perceptions of their workers' exposure to a variety of occupational hazards have yielded findings with similar implications. For example, Arcury et al.'s (2001) study of field sanitation revealed that growers generally believe they provide all the facilities required by regulatory agencies, but that workers choose not to use them out of laziness or lack of concern for personal hygiene. But this is not perceived as a serious problem because growers do not consider workers to be at significant risk of exposure in the first place. Arcury, Quandt, and Sitnmons's (2002) study of growers' perceptions of green tobacco sickness, an occupational illness of tobacco workers, found that growers tend to downplay its impact on workers as well.

The fact that growers do not perceive exposure as a major problem for workers, and that extension agents are only somewhat more concerned, may inhibit implementation of safety measures for workers. Growers may fail to reinforce appropriate preventive measures and only recognize problems the workers experience after they become serious enough to interfere with work. If growers remain convinced that exposure is only an issue for those who are in direct contact with pesticides and consider media reports of the danger to be overblown, they will be less likely to pay serious attention to the warnings being raised about possible long-term effects. Neither growers nor extension agents are entirely convinced about the possibility of negative health outcomes in the distant future because of the perceived lack of empirical evidence linking pesticide exposure to specific problems. Their tendency to give more credence to personal experience and anecdotal evidence than to "scientific" findings also works against acceptance of the notion of long-term danger. Many of the growers in this study said that for years they have used more toxic pesticides with fewer safeguards without negative repercussions.

Numerous barriers operate against full compliance with the WPS requirements. The economic realities of farming today increase resistance to implementation of the more expensive and time-consuming safety measures. The required equipment for full protection costs several hundred dollars per person, which makes it cost-prohibitive for many smaller growers. Growers

often must complete cultivation and harvest within a narrow time window, and foregoing the use of safeguards that are seen as unnecessary to begin with only makes sense. Stress and fatigue can encourage shortcuts and mistakes (Thu 1998). Time spent by workers in training is time spent not working, but it is still an expense to the grower. Furthermore, growers tend to share a culture of independence and conservatism that makes them suspicious of "excessive regulation" and "outside interference" with their means of livelihood.

The requirement that training be offered in a language understood by the worker also creates a barrier in North Carolina, where the hired labor pool is increasingly foreign-born and non-English speaking. Communication between English-only growers and Spanish-only workers can cause conflict and frustration, not to mention confusion about recommended procedures and safety measures. Growers are also often unfamiliar with aspects of their workers' cultural backgrounds that may make them reluctant to adopt safety or health behaviors that are contrary to their beliefs. For example, the practice of humoral medicine or "hot-cold theory" commonly found in Latin America (Foster 1994; Logan and Morrill 1979; Weller 1983) proscribes, among other behaviors, washing with water when the body is overheated because it can cause health problems. Workers with this belief system often choose not to use hand-washing facilities even when provided (Arcury et al. 2001). This behavior may then be interpreted by the grower as laziness, lack of concern about sanitation, or a shared belief in the low danger of pesticides.

Parallel research with farmworkers shows that their experience and perceptions of the safety measures provided and the potential health effects of pesticide exposure are different from those of growers. Several studies (Arcury et al. 1999, 2001; GAO 2000; Larson 2000; Villarejo et al. 2000) have found that a significant proportion of farmworkers are not afforded the full protections mandated by the WPS. Furthermore, other research (Arcury et al. 2001; Quandt et al. 1998) has identified how farmworker beliefs interfere with recommended safety procedures. Workers may be reluctant to explain, for example, their preference to defer washing if they believe the grower will simply dismiss their beliefs as illogical. Another study of farmworkers in Christmas trees (Elmore and Arcury 2001) found them to be generally aware that pesticides are hazardous, but less clear on the severity, source of the risk, or whether there are long-term effects from exposure.

As with growers, economic pressures on workers tend to override health concerns when a choice must be made between working and being safe. Worker reluctance to report acute illness if it means a loss of pay contributes to growers' and agents' impression that workers are not experiencing health effects. The erroneous notion that odor is a reliable marker of pesticide presence and that stronger smelling pesticides are more toxic is consistent with findings from other research with both farmworkers and growers (Elmore and Arcury 2001; Quandt et al. 1998).

To be successful, steps to improve pesticide safety must bridge this gap between the realities of the farmers and the realities of the workers. Interventions must consider the protective stance farmers and extension agents have adopted as a result of strong criticism from environmental and farmworker advocates and the media. For example, recent newspaper articles in North Carolina have accused the Christmas tree industry of mistreating workers (Cuadros 2001) and placing all farmworkers at risk from pesticide exposure (Yeoman 2001). The hyperbole often contained in presentations that support only one side of the issue leads growers and extension agents to dismiss the entire discussion as misleading and misguided. Effective interventions should approach growers as responsible business people and community leaders and present the facts in terms of risk and safety. At the same time, growers and extension agents should realize that constructive criticism is intended to benefit agriculture as a whole, rather than deny it needed inputs, including pesticides.

The tendency of stakeholders to downplay the danger of pesticides and other occupational hazards perpetuates disparities in health between farmworkers and the general population. Cultural and linguistic barriers and the economic realities of farming exacerbate the problem. When growers are not mindful of the implications of their attitude toward safety, and workers do not fully appreciate the importance of taking precautions, the risk of exposure increases dramatically for those with the least control over the situation—the workers. As evidence continues to accumulate of the dangers posed by pesticide exposure

(Eskenazi, Bradman, and Castorina 1999; GAO 2000), it becomes increasingly important for all who have a stake in health and safety on the farm to take the problem seriously. Progress is most likely to occur when growers and workers act as partners to improve workplace safety. Growers, who control the information and resource flow, need to be aware that what is common sense and obvious to them may be understood very differently by workers. Workers' training needs to emphasize actions they can take to control their own well-being and the implications of following potentially risky traditional practices (Grieshop, Stiles, and Villanueva 1996). Training and implementation that are approached cooperatively rather than imposed by growers on workers has a better chance of being accepted. Ultimately, all stakeholders—workers, growers, extension agents, the media, and the public at large—need to reach a common perspective on the issue of pesticide safety from which to interpret information, improve communication and education, and reduce the risk of injury from at least this one realm of agricultural work.

Notes

¹ The Worker Protection Standard mandates that workers receive pesticide safety training before working more than five days in areas where restricted-use pesticides have been applied within the past 30 days. Eleven content areas must be covered, such as exposure routes, symptoms of pesticide poisoning, and emergency first aid. Training must explicitly address the employers' obligations to provide safety equipment, to arrange for medical treatment in case of emergency, and not to penalize workers who assert their right to work safely. These regulations pertain to workers who do not apply pesticides or who apply (but do not mix or load) under the direct supervision of a licensed applicator. Regulations require more extensive training for individuals who work in enclosed areas or who mix or load pesticides ("handlers"). All training must be conducted in a language understood by the worker.

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