

# Farmworker Reports of Pesticide Safety and Sanitation in the Work Environment

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**Background** *Migrant and seasonal farmworkers are at risk for occupational illnesses from pesticide exposure, and the effectiveness of pesticide safety regulations has not been evaluated. It is important to learn from farmworker safety experiences to develop effective measures to improve agricultural workplace safety.*

**Methods** *Formative research included in-depth interviews with farmworkers, farmers, extension agents, and health care providers. Survey research included interviews with 270 minority farmworkers during 1998, and 293 during 1999.*

**Results** *Farmworkers and farmers hold different beliefs concerning pesticide safety which affect sanitation practices. Farmworkers report in survey data that farmers do not adhere to regulations mandating training and basic sanitation facilities.*

**Conclusions** *Several points of intervention are available to improve pesticide safety and sanitation. Additional regulation by itself is not an advantageous starting point. The emphasis for intervention must include educating farmers as well as farmworkers.* Am. J. Ind. Med. 39:487–498, 2001. © 2001 Wiley-Liss, Inc.

**KEY WORDS:** *worker safety; minority workers; migrant workers; occupational health; agricultural health; pesticide safety; minority health; Latinos/Hispanics; cultural differences; qualitative methods*

## INTRODUCTION

Agriculture is one of the most dangerous industries in the United States [Cordes and Foster, 1988; U.S. Department of Health and Human Services, 1992]. Migrant and

seasonal farmworkers are at significant risk for occupational illness and injury [Wilk, 1986; Mobed et al., 1992; NIOSH, 1996; Arcury and Quandt, 1998a], particularly for illness and injury resulting from pesticide exposure [Coye and Fenske, 1988; Moses, 1989]. The greatest source of pesticide exposure for farmworkers is from dislodgeable residues [Fenske, 1997]. Reducing exposure from dislodgeable residues can be accomplished through several straightforward procedures if appropriate facilities are available, i.e., wearing clothes that cover the entire body, washing hands before eating, smoking or toileting, not wearing work clothing into the home, bathing immediately after work, wearing clean work clothing daily, and laundering work clothing separately from other clothing.

Latinos now comprise over 80% of the farmworkers in the United States, with the great majority coming from Mexico [Mines et al., 1997]. Communication barriers make providing general workplace safety information or specific pesticide safety information to farmworkers especially

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challenging. Farmworkers and employers often speak different languages, and farmworkers have limited literacy in Spanish or English.

Workplace safety is best accomplished through a partnership of employees and employer [Wallerstein and Rubenstein, 1993]. Farmworker pesticide exposure can be reduced when these workers are provided with (1) safety equipment and sanitation facilities, (2) safety behavior education and training (e.g., how and why to use equipment and facilities), and (3) a work environment conducive to safety behavior (e.g., employer encouragement to work safely).

There are few published data on the workplace pesticide safety and sanitation conditions for farmworkers. Regulatory programs [e.g., US-EPA 1992] have not evaluated workplace practices. Large national surveys [e.g., Mines et al., 1997] are directed at other issues and contain little information about workplace safety. Local studies have addressed individual aspects of workplace sanitation. These studies strongly suggest that workplace safety and sanitation conditions are inadequate to protect workers. For example, Arcury et al. [1999a] examined the implementation of pesticide safety training in North Carolina and found that only about one-third of the farmworkers had ever received this training. Ciesielski et al. [1991] found microbial contamination of water in farmworker camps. Vaughn [1993a, 1995] examined perceptions of risk to pesticide exposure among farmworkers and found more use of safety behaviors among those who perceive greater health risk from pesticide exposure. Grieshop et al. [1994] investigated knowledge among farmworkers of proper laundry procedures to reduce pesticide contamination. They found that there was a range of knowledge, but that those with the greatest potential for pesticide exposure used the least appropriate process.

At least two sets of regulations are part of the context for farmworker workplace safety. The Worker Protection Standard (WPS) of the U.S. Environmental Protection Agency is a Federal regulation enforced by the states. Other federal requirements [e.g., of the Occupational Safety and Health Administration (OSHA)] pertain to field sanitation and farmworker housing. Like the WPS, these requirements are enforced by the states. In North Carolina, the state Department of Agriculture enforces the WPS. The North Carolina Department of Labor enforces farmworker field sanitation and migrant housing regulations that are based on OSHA standards.

The US-EPA promulgated the Worker Protection Standard in 1992, with full implementation of regulations delayed until 1 January 1995 [Runyan, 1993; US-EPA, 1992]. Among other requirements, the WPS states that farmworkers who enter an area that was treated with a pesticide during the previous 30 days or that is subject to a restricted-entry interval must receive pesticide safety

training. This training must cover eleven specific topics related to pesticide exposure. Workers must be trained before they accumulate more than 5 days' work in a treated area. This training must be repeated at least every 5 years. Employers document training by having workers sign a form; workers who obtain training from a certified trainer are issued a card. There are additional training requirements for individuals who work in enclosed areas, such as greenhouses, and those who mix and apply agricultural chemicals. Farmworker training must be provided by an individual who meets criteria established by US-EPA and the state or tribal government where the training is conducted. Training must be in a language understood by the farmworker. The US-EPA has developed and distributed materials (including videos, manuals, and brochures) that can be used in a certified program [Quandt et al., 1999]. The WPS also requires that farmworkers be told about the application of pesticides where they are working. Employers must post in a central location the pesticides they have applied to any field, when these pesticides were applied, and the re-entry periods for these fields. Employers must also post warning signs at the entrances to fields that have been treated with pesticides; these signs must indicate when a field can be entered (the re-entry interval).

The North Carolina Department of Labor (1995) issues the field sanitation regulations for agricultural workers in North Carolina. These require that employers of agricultural workers provide cool, potable drinking water with individual cups (or a drinking fountain). One toilet and adjacent hand washing facility must be provided for every 20 workers or fraction of twenty workers. All facilities must be within a quarter mile of the location of workers. Facilities are not needed if work is scheduled to be completed in three or fewer hours.

Migrant and seasonal farmworker housing is also regulated by the North Carolina Department of Labor [1995]. These regulations encompass most aspects of the temporary housing that is provided by farmers, including the condition of the site on which the housing is located, the condition and space available in the housing, water supply, toilet facilities, kitchen facilities, and waste disposal. Facilities must include a shower head for every ten persons, a laundry tray or tub for every thirty persons, facilities for drying clothes, and an adequate supply of hot and cold running water must be provided for bathing and laundry purposes.

Federal and state regulations are often complementary. For example, the Federal WPS pesticide safety training teaches farmworkers to wash their hands before eating or toileting to reduce pesticide exposure; state regulations specify how many hand washing facilities need to be provided and at what distance from the work site.

PACE (Preventing Agricultural Chemical Exposure among North Carolina Farmworkers) is a 4 year community

participation health project designed to reduce exposure of migrant and seasonal farmworkers to pesticides and other agricultural chemicals by developing, testing and disseminating culturally appropriate interventions [Arcury et al., 1999b, 2000]. The North Carolina Farmworkers' Project (NCFP), a community-based farmworker advocacy organization, is a partner in PACE. Formative research based on in-depth individual and group interviews was completed in 1997 to collect information necessary for developing the intervention. Survey interviews were conducted in 1998 and 1999 to evaluate the intervention. Data for this analysis are drawn from both formative research and survey interviews. All research protocols were approved by the Institutional Review Boards of Wake Forest University School of Medicine and the University of North Carolina at Chapel Hill.

The PACE project is based in an eight-county region of central North Carolina with the state's highest concentration of farmworkers. Agricultural production in these counties includes tobacco, cucumbers, sweet potatoes, cotton, and a number of other fruit and vegetable crops. These crops are treated with a variety of organophosphate and carbamate pesticides applied with tractor sprayers [Cope et al., 1998a,b,c,d]. North Carolina ranks fifth in the nation in number of farmworkers. Recent estimates place the number of migrant workers and dependents at 140,000, with twice as many seasonal farmworkers [NC ESC, 1995]. The ethnic composition of the farmworker labor force has changed in the last decade from mostly African American workers to largely Latino workers.

The purposes of the present study are to delineate: (1) farmworker perceptions of pesticide-related workplace safety and sanitation; (2) differences among farmworker, farmer, cooperative extension agent, and health care provider perceptions of workplace pesticide safety; and (3) farmworker reports of the provision of basic sanitation facilities and pesticide safety training, and of the support of employers and coworkers in practicing workplace safety.

In the remainder of this paper we discuss data collection and analysis. The presentation of study results includes two major sections. First, the results of the qualitative analysis of textual data collected in in-depth individual and group interviews are reported. Second, the results of the quantitative analysis of evaluation survey interviews are reported. Finally, we discuss the study results in terms of how they can be used to improve workplace safety.

## METHODS AND MATERIALS

### Evaluation Data

*Sample selection and recruitment.* Data for this analysis come from pre-intervention interviews conducted with 270 Latino farmworkers during June and July 1998, and 293 Latino farmworkers during June and July 1999. In both

years a two-stage approach was used to locate and recruit participants [Arcury et al., 1999a]. The sampling and recruitment strategy design was based on the need to maximize the representativeness of the sample, while taking into account the exigencies of working with a largely undocumented, relatively "invisible," and highly mobile population. Because the number of farmworkers and their distribution in North Carolina, as in many states, is unknown, there is no available sampling frame. Based on information obtained during 1998–1999 formative research and that provided by the NCFP, we knew that workers could be located in a variety of residential sites, including on-farm labor camps, trailer parks, old farm houses, and apartments. Workers within housing sites were likely to be more similar to each other (e.g., same towns of origin, same current employer, same training) than to workers in other housing sites. Therefore, we first selected a broad range of sites to maximize representativeness of the sample. A site was defined as a residential locale in which all or most residents are farmworkers and their families. To identify as many sites as possible, community representatives connected with the NCFP helped to create a list of potential sites based on their knowledge of the area, by community reconnaissance, by interviewing farmers, and by talking with farmworker service providers. We visited each site to familiarize farmworkers with the existence of the study and ascertain if they would be willing to participate, if asked. Former or present Latino farmworkers were hired and accompanied the project coordinator on site visits. The PACE staff selected different kinds of sites from a variety of large and small labor camps, trailer parks, and rental housing.

The study sample included 35 sites in 1998, and 36 sites in 1999. During 1998, the residents at two sites who were workers with H2A visas stated that they would not participate due to concern about reprisals from their employer. These sites were replaced. In 1999, one site was replaced; the farmer who owned the site declined to have his employees participate.

As a second sampling stage, farmworkers were recruited at each site. For sites with fewer than 10 workers (24 in 1998, 33 in 1999), all site residents were asked to participate. In the others, the interview team leader identified at least 10 workers to be interviewed after a brief presentation to the group. The criteria were to first select any women present, and then a range of ages from those present. Using this system of multiple contacts familiarized farmworkers with the project; there were very few refusals at the stage of actual recruitment.

*Data collection.* The interview questionnaire used in the evaluation survey was similar in both years; however, a few items were added to the 1999 questionnaire. Both questionnaires collected information on personal background, farm work experience, agricultural chemical exposure experience, safety training received, knowledge and

behavior for work place chemical safety, and perception of exposure and health risk. All but two of the questionnaire items had fixed response answers. The questionnaire was developed in English as well as Spanish. Whenever possible, items were taken from existing instruments. A professional service translated all new items into Spanish; these items were then reviewed and edited by native Spanish speakers. The entire questionnaire was then pre-tested with farmworkers residing in the study area. The research protocols were approved by the Institutional Review Boards of Wake Forest University School of Medicine and the University of North Carolina at Chapel Hill.

Interview teams in both years consisted of a PACE staff member, college students, and former farmworkers. All were fluent in Spanish. The former farmworkers were originally from Latin America and currently live in the study area. Students and former farmworkers received interviewer training at two 3-hour sessions [see Arcury et al., 1999a]. Each interview took approximately 25 min to complete. Participants were given information about the study and interview, and asked for consent. At the end of the interview, participants were given a US \$10 long-distance telephone card [1998] or t-shirt [1999] as tokens of thanks. Incentives were not mentioned before the interview to ensure that they were not inducements to participate.

*Data analysis.* This analysis is largely descriptive. For the 1998 and 1999 surveys, we summarize worker background characteristics, including gender, ethnicity, age, years worked in agriculture in the United States, migrant status, and H2A visa status. An H2A visa allows an individual to enter the United States to work in agriculture for a specified period of time for a particular farmer, who is obligated to provide an average of 35 h of work per week, a specific hourly wage, inspected housing, and to meet all safety requirements, including WPS training.

We asked respondents about the availability of field sanitation facilities, if they received pesticide safety training, and their perceptions of employer and coworker safety attitudes and behaviors. Sanitation variables include whether drinking water, washing water, field toilets and showers are always or usually, sometimes, or seldom or never available, and if drinking water is separate from washing water. In 1999, we also asked if separate cups or a fountain were available for drinking water. For showers, we also asked workers how long they waited to shower after work. In 1999, we added questions on whether workers waited to shower to cool down, and how long they cooled down before showering. Finally, workers were asked where they did their laundry.

In 1999, we included four specific dichotomous questions on farmer behavior concerning pesticide safety: If the employer told workers when pesticides were being applied, if the worker knew the names of pesticides that were applied, if information on pesticide applications was posted where the worker could see it, and if standard signs indicating

pesticides had been applied were posted. Respondents were shown a copy of a standard sign.

We used two very general questions on pesticide safety training. The questions were introduced with a statement that introduced the concept of pesticide safety training, in which respondents were told, "Now I would like to ask you some questions about information or training you have received about how to work safely with pesticides. This information could be a poster, a brochure or a book someone has given you or told you to read. The training could be a video, a classroom presentation or a workshop that has instructed you about how to work safely." They were then asked, "Have you ever received any information or training on how to prevent or reduce your exposure to pesticides when you are working?" Those who responded positively to this first question were then asked, "Have you received information or training this year or season in how to prevent or reduce your exposure to pesticides when you are working?"

To assess worker perceptions of employer and coworker support of workplace safety attitudes, workers were asked if their employer always, usually, sometimes, seldom, or never (1) told them to dress for safety, and (2) told them to work safely. Workers were asked if their coworkers always or usually, sometimes, or seldom or never (1) talked about safety, (2) took safety precautions, (3) dressed for safety, (4) washed before eating, and (5) made fun of those who tried to work safely.

Frequencies of responses are reported for both years. Cross tabulations by H2A status were also calculated for several variables. Analysis is limited to H2A status, as we found in past analysis that this is the most important predictor of differences [Arcury et al., 1999a]. Other background characteristics which typically predict differences in workplace safety knowledge, attitudes and behavior have limited value with North Carolina farmworkers because they vary little in sex, ethnicity, educational attainment and years of work experience. Associations were assessed with large sample  $\chi^2$  methods using the SAS system; Mantel-Haenszel methods were applied where a test for trend was appropriate [Stokes et al., 1995].

## Formative Data

*Sample selection and recruitment.* The formative research included individual in-depth interviews (27 with farmworkers, 7 with farmers, 4 with county cooperative extension agents, and 5 with health care providers) and focus group interviews (7 with a total of 44 farmworkers). Farmworker interviews included both Latino and African American farmworkers of both genders. Efforts were made to include a diverse group of farmworkers to help understand the range of beliefs held. Farmers were recruited through contacts with health care providers and county cooperative extension agents. The farmers interviewed were

also a diverse group, including farmers with different size operations and from different counties. Seven of 10 farmers contacted agreed to be interviewed. The county extension agents came from four of the eight counties in the study area and included three agents involved with pesticide training as well as one county director. Recruitment of county extension agents involved contacting and visiting county extension offices and asking specific agents to participate. Half of the county agents contacted agreed to be interviewed. We recruited five health care providers who normally provide care to farmworkers, and all agreed to be interviewed. They included a physician assistant, nurses, and health outreach workers.

*Data collection.* Interviews were conducted by trained interviewers using a standard interview guide. This guide included topics such as personal experiences with pesticides and beliefs about health effects of exposure for farmworkers and its prevention. All interviews were tape recorded. Most interviews lasted one to one-and-a-half hours. A few individual interviews with farmworkers new to the United States were shorter. Most of the Latino farmworker interviews were conducted in Spanish. All of the interviews with farmers, county cooperative extension agents and health care providers were conducted in English. In the process of obtaining informed consent we told each participant that at the end of the interview they would receive US\$ 20. Several of the non-farmworker respondents did not accept this incentive because they considered the interview to be part of their professional duties. All research protocols were approved by the Institutional Review Boards of Wake Forest University School of Medicine and the University of North Carolina at Chapel Hill.

*Data analysis.* Most interviews were transcribed verbatim. Spanish interviews were translated by a professional translation service and edited by bilingual project staff. A systematic text analysis plan was developed and implemented [Arcury and Quandt, 1998b]. The analysis was designed to derive common “themes,” or generalizations, from the interview sets. Codes were developed to label beliefs, knowledge, and practices related to chemical exposure. Each transcript was coded by more than one coder to reduce bias. After segments were identified and coded, segments were retrieved using The Ethnograph (v4.0) computer software [Seidel et al., 1995] and reviewed by the authors to identify common themes.

## RESULTS

### Formative Data

Farmworkers, farmers, county cooperative extension agents, and health care providers differ in perceptions of the safety and sanitation environment in which farmworkers work, and the causes of any shortcomings in the safety and

sanitation environment. These differences reflect cultural differences between farmworkers (mostly Latino) and farmers (mostly white), as well as differences based on employing workers versus being employed to work.

Among *farmworkers* there is some variability in discussions of workplace safety and sanitation, but most workers feel basic safety and sanitation facilities are not available to them in North Carolina. Most indicate that water for drinking is available. However, they report that there are often no separate cups for them to use and seldom separate water for drinking and washing. As one worker stated, “Cause usually in the fields, the water you wash your hands with is the water you drink with” (FW006); another stated, “Our boss has water for us all the time, but soap and everything else, no, not in the field” (FW001). When the water in the fields is to be used for both drinking and washing, the water usually is very cold, containing ice. This causes an additional problem for farmworkers who are largely Mexican. A commonly held belief in the humoral medicine system to which many rural Mexicans ascribe [Rubel, 1960; Weller, 1983] is that if something cold (water) is applied to something hot (a body that has been working in the fields) this will result in an illness. For example, one worker noted, “[The farmer] wanted to have [iced water], but it is my custom not to want it because, you know, when you are working and your hands are hot and you get them wet, that is when you can get rheumatism. So we do not wash our hands. We wait until we get to the house and use hot water and then nothing can happen to us” (FW012). Workers also noted that there are seldom toilet facilities available for them to use in the fields: “No, they don’t even have restrooms or nothing. You go to the bathroom, you know, when you’re working out there, you’re taking a chance of going in the woods and hoping no tick don’t fall on you” (FW002fg).

While a few of the workers made positive comments about their housing, most workers felt that it was inadequate, with crowded conditions, dirty beds, limited toilet facilities, lacking adequate water or any hot water, and often not having sufficient showers. Most workers also were negative about laundry facilities at camps. They described these laundry facilities as being limited and dirty. Most preferred to go to laundromats because there were only facilities for washing clothing by hand at their camps. For example, “[They] had like little tubs, you know. But everybody preferred to go to the laundromat because you’re dead when you get in from the field, you get in from the field 8, 9 o’clock at night” (FW019).

*Farmers* reported that they provided the required facilities. Sometimes these are in a building, away from the fields. They note that it is often difficult to move these washing and toilet facilities to all their different fields: “Well, sometimes its hard to keep up. Well, in my particular case, I’ve got 77 acres of tobacco. I’ve got that in 28 fields

which means I have a lot of traveling to do, a lot of different little small fields everywhere that I go to” (GR004). The farmers voiced universal frustration that when they do provide washing facilities in the field, the workers do not use them, “[Farmworkers] just don’t use them. And they know—I mean there’s water, there’s paper towels” (GR001). Finally, they stated that even if the workers do not use the washing facilities, there is no harm, as the workers are seldom exposed to anything dangerous: “. . . so I mean there’s nothing out there for them other than tobacco gum and I mean that’s not gonna hurt anybody” (GR002). When farmers provide field toilets, they report that workers will not use them. They complain that farmworkers create an unsanitary situation in field toilets and housing bathrooms by throwing used toilet paper in the trash, rather than flushing it down the toilet. Most farmers attribute such behavior to laziness and lack of concern for hygiene and property. At least one farmer reasoned that workers come from places where plumbing is of poor quality. Therefore, they put used toilet paper in the trash as they do not know they can flush it, and they would rather use the woods than the toilets that are provided. Farmers also feel that they provide adequate housing facilities for their workers. As one farmer reported, “But the migrants fare pretty decent now. Now they live in my camp for free. They furnish their bed clothes and the food. And I furnish everything else. In other words, so far as the building, the heat, the lights, the water, all that, they don’t have to pay for that” (GR003).

Reports by the *county cooperative extension agents* are similar to those of the farmers. For example one agent stated, “All of [the farmworkers] have a place provided [to wash in the fields]. Now, whether they all [wash], I doubt if they do, and I think it’s a matter of understanding” (EA003). In terms of toilet facilities, this agent noted, “for it to be effective it could be, but the person has got to be trained to use it. We have the problem with the bathrooms and portable toilets. Rather go to the woods” (EA003). Extension agents interact with farmers and rarely interact with farmworkers (most workers speak only Spanish, most agents speak only English), and so are not knowledgeable about workers’ conditions: “To tell you the honest truth, I’m not around migrant workers enough to really make a good answer to that” (EA004).

Many *health care providers* only have contact with farmworkers in clinics, and so do not have direct experience with farmworker work conditions or housing. Other health care providers, particularly outreach workers, regularly visit farmworkers where they live and work. The health care providers report that limited field sanitation facilities are available. They note that farmers feel that the requirements for field and housing sanitation are troublesome; this is consistent with the comments made by farmers. In terms of field washing facilities, this health provider stated, “Where we see it as a necessity, they [farmers] think it is a hassle . . . I

think though that it’s going to be real important to change the mind-set of the farmers and how things work” (HC001). Similarly, in terms of housing, another health provider reported, “It’s like one farmer told me. He said there are so many regulations on the farmer if he has a camp on his farm that farmers are doing away with camps. The workers are looking for their own housing” (HC005). The health providers also report that workers have a very limited access to laundry facilities. Farmworkers must go to a laundromat to do their laundry as, “when you go out to a camp, you don’t see a washer-dryer. I think they make a run to the laundromat . . . maybe every Saturday or every other Saturday. And there are bathrooms with big sinks and I think some of them just hand wash their clothes” (HC003).

In summary, the reports of farmworkers and health care providers indicated that farmworkers are often faced with inadequate workplace and housing sanitation. Farmers feel that they do provide what is necessary, but that the resources they provide are often ignored or improperly used. There are some obvious cultural differences (e.g., the unwillingness of Mexican workers to wash when their hands are hot), and some stereotypes (e.g., farmers’ perceptions that Latino workers are not familiar with, and therefore are uninterested in modern plumbing) that may result in some of the different perceptions reported.

## Evaluation Data

Characteristics of the participants in the 1998 and 1999 evaluation survey are reported in Table I. Farmworkers in both years were overwhelmingly male, and most were from Mexico. They were young, with almost 60% in each year being under 30 years of age. Almost 60% had worked in U.S. agriculture for two years or less. Most workers in each year considered themselves to be migrants. The proportion with H2A visas almost doubled from 1998 to 1999, reflecting the growth of the H2A program in North Carolina.

Ninety percent of farmworkers in both years stated that water is always or usually available for them to drink (Table II). In 1999, two-thirds of the farmworkers indicated that drinking cups are always or usually available. About one-third in each year indicated that water for washing is always or usually available, while 40% stated that water for washing is seldom or never available. When water is available in the fields, about 44% in each year indicated that water to wash and water to drink is always or usually in separate containers. This is important as drinking water is usually iced, and, as noted, many Latino farmworkers feel that it is imprudent to wash in cold water. Fewer than one-third noted that toilets are always or usually available; more than half of the workers stated that field toilets are seldom or never available for their use.

Almost all of the farmworkers indicated that a shower is available. In both years, many farmworkers reported that

**TABLE I.** Background Characteristics of North Carolina Farmworker Participants in Evaluation Survey, 1998 and 1999

Background characteristics	1998		1999	
	n	%	n	%
Gender				
Male	241	89.3	273	93.2
Female	29	10.7	20	6.8
Ethnicity				
Mexican	265	98.1	276	94.2
Other Latino	5	1.9	17	5.8
Age in years				
< 20	37	13.8	33	11.3
20–24	68	25.4	75	25.6
25–29	56	20.9	62	21.2
30–34	47	17.5	35	11.9
35+	60	22.4	88	30.0
Years worked in U.S. agriculture				
1–2	155	58.0	173	59.9
3–4	41	15.4	53	18.3
5+	71	26.6	63	21.8
Migrant				
No	76	28.1	103	35.2
Yes	194	71.9	188	64.2
Has H2A visa				
No	201	74.4	154	52.6
Yes	69	25.6	139	47.4

they wait substantial periods to shower after work. In 1998, 54.0% of the respondents stated that they waited at least 1 h before taking a shower. In 1999, while 5.5% showered within 10 min of arriving home, 30.4% waited 10–29 min,

33.7% waited 30–59 min, and 30.4% waited at least 1 h before showering. Waiting these lengths of time increases the risk of pesticide absorption of pesticides and the risk of contaminating other people with whom they have contact. To ascertain whether the long wait before showering indicated a lack of adequate bathing facilities or cultural beliefs, the 1999 survey followed up on responses volunteered to these questions in 1998, by asking farmworkers if they waited as long as they did to shower because they wanted to “cool down” before showering. For 1999, 91.8% of the respondents indicated that they wait to cool before showering, with 64.2% waiting at least 30 min to cool. Here again the humoral medicine cultural beliefs about exposing a hot body to water of any temperature prevents farmworkers from engaging in one of the most efficacious means of reducing their exposure to pesticides.

Farmworkers do not have adequate access to laundry facilities. Although there are differences between 1998 and 1999 survey results, most farmworkers must go to a laundromat to wash their clothing. Only about one-quarter in each year use a washing machine where they live. Almost 20% in 1999 indicated that they wash their clothes by hand; this method is the least likely to remove pesticides and other environmental contaminants [Grieshop et al., 1994]. This method also increases the likelihood that farmworkers will absorb pesticides through the skin when they place their hands in the water contaminated with pesticides from their clothing.

Fewer than half of the workers (48.1%) report that their employer tells them when pesticides are applied. Very few of the workers (11.3%) stated that they knew the names of pesticides applied where they worked. This is significant because one of the most important pieces of information required for treating someone suspected of acute pesticide poisoning is the name of the pesticide to which the person is

**TABLE II.** North Carolina Farmworker Perceptions of the Presence of the Elements of Field Sanitation

Field sanitation		Always or usually		Sometimes		Seldom or never		Total	
		n	%	n	%	n	%	n	%
Water to drink	1998	241	89.6	25	9.3	3	1.1	269	100.0
	1999	272	92.8	16	5.5	5	1.7	293	100.0
Separate drinking cups	1999	204	69.9	29	9.9	59	20.2	292	100.0
	1998	105	39.0	57	21.2	107	39.8	269	100.0
Water to wash	1999	104	34.5	58	19.8	131	44.7	293	100.0
	1998	119	44.1	35	13.0	116	42.9	270	100.0
Separate drinking & washing	1999	132	45.1	22	7.5	139	47.5	293	100.0
	1998	76	28.2	51	19.0	142	52.8	269	100.0
Field toilet	1999	92	31.4	46	15.7	155	52.9	293	100.0
	1998	267	98.9	2	.7	1	.4	270	100.0
Shower	1999	284	97.0	6	2.0	3	1.0	293	100.0
	1998	267	98.9	2	.7	1	.4	270	100.0

**TABLE III.** North Carolina Farmworkers Who Have Ever Received Pesticide Safety Training or Information and Who Have Received Pesticide Safety Training or Information This Year for Total 1998 and 1999 Samples and by H2A Visa Status

	Ever received pesticide safety training or information			Received pesticide safety training or information this year		
	n (of total)	%	$\chi^2$	n (of total)	%	$\chi^2$
<b>1998</b>						
Total sample	95 (of 270)	35.2		69 (of 270)	25.6	
Without H2A visas	55 (of 201)	27.4	$\chi^2 = 21.023, df = 1$ $P = .001$	35 (of 201)	17.4	$\chi^2 = 27.309, df = 1$ $P = .001$
With H2A visas	40 (of 69)	58.0		34 (of 69)	49.3	
<b>1999</b>						
Total sample	156 (of 284)	54.9		129 (of 284)	45.4	
Without H2A visas	66 (of 149)	44.3	$\chi^2 = 14.268, df = 1$ $P = .001$	45 (of 149)	30.2	$\chi^2 = 29.191, df = 1$ $P = .001$
With H2A visas	90 (of 135)	66.7		84 (of 135)	62.2	

exposed. Thirty-seven percent of the workers report that their employer posts information on pesticides that have been applied in locations where workers can see them. Finally, about half of the workers (48.3%) stated that their employers post standard warning signs around fields in which they have applied pesticides. With one exception, the proportions of workers giving these responses did not vary by H2A visa status. More workers without H2A visas (15.0%) than with H2A visas (7.3%) stated they knew the names of pesticides used where they worked ( $\chi^2 = 4.360, df = 1, P = .037$ ).

The percentage of farmworkers reporting that they had received "training or information" on pesticide safety

increased from 1998 to 1999 for both total sample and by H2A status (Table III). Regulations for those employing workers with H2A visas require (beyond general WPS regulations) that all workers receive pesticide safety training. However, the improvement in the proportion who report receiving training is impressive for all workers, regardless of visa status.

Workers report receiving greater support in practicing workplace safety behaviors in 1999 than 1998 (Table IV). In 1998, only 20.9% of employers told their workers to dress for safety usually or always, and 24.9% to work safely. In 1999, these proportions rose to 38.7 and 53.2%, respectively. Substantially more workers in 1999, compared to

**TABLE IV.** North Carolina Farmworker Perceptions of Employer and Coworker Pesticide Safety Behaviors

Pesticide safety behaviors		Always or usually		Sometimes		Seldom or never		Total	
		n	%	n	%	n	%	n	%
Employer									
Tells workers to dress safely	1998	59	20.9	39	14.6	170	63.5	268	100.0
	1999	113	38.7	41	14.0	138	47.3	292	100.0
Tells workers to work safely	1998	67	24.9	54	20.0	148	55.1	269	100.0
	1999	156	53.2	47	16.0	90	30.7	293	99.9
Co-workers									
Talk about safety	1998	58	21.8	86	32.3	122	45.9	266	100.0
	1999	121	41.4	96	32.9	75	25.7	292	100.0
Take safety precautions	1998	87	34.7	73	29.1	91	36.3	251	100.0
	1999	170	58.2	71	24.3	51	17.5	292	100.0
Dress safely	1998	126	49.2	71	27.7	59	23.1	256	100.0
	1999	195	66.5	67	22.9	31	10.6	293	100.0
Wash before eating	1998	151	58.6	74	28.7	33	12.8	258	100.0
	1999	181	63.1	55	19.2	51	17.8	287	100.0



**TABLE V.** North Carolina Farmworker Perceptions of Employer and Coworker Pesticide Safety Behaviors, 1999 Workers with and without H2A Visas

Pesticide safety Behaviors	Always or usually		Sometimes		Seldom or never		Total		Mantel-Haenszel $\chi^2$
	n	%	n	%	n	%	n	%	
Employer									
Tells workers to dress safely	51	33.1	23	14.9	80	51.9	154	100.0	$\chi^2 = 4.228, df = 1; P = .040$
	62	44.9	18	13.0	58	42.3	138	100.0	
Tells workers to work safely	68	44.2	31	20.1	55	35.7	154	100.0	$\chi^2 = 9.324, df = 1; P = .004$
	88	63.3	16	11.5	35	25.2	138	100.0	
Co-workers									
Talk about safety	48	31.4	49	32.0	56	36.6	153	100.0	$\chi^2 = 19.453, df = 1; P = .001$
	73	52.5	47	33.8	19	13.7	139	100.0	
Take safety precautions	71	46.4	41	26.8	41	26.8	153	100.0	$\chi^2 = 22.834, df = 1; P = .001$
	99	71.2	30	21.6	10	7.2	139	100.0	
Dress safely	82	53.3	47	30.5	25	16.2	154	100.0	$\chi^2 = 26.590, df = 1; P = .001$
	113	81.3	20	14.4	6	4.3	139	100.0	
Wash before eating	85	57.4	38	25.7	25	16.9	148	100.0	$\chi^2 = 2.154, df = 1; P = .142$
	96	69.1	17	12.2	26	18.7	139	100.0	

1998, also report that their coworkers support workplace pesticide safety. Proportions increased of coworkers who always or usually talk about safety (from 21.8 to 41.4%), take safety precautions (34.7 to 58.2%), dress for safety (49.2 to 66.5%), and wash before eating (58.6 to 63.1). While these are impressive numbers, they are far from what is needed to have a safe workplace.

In almost every comparison, workers with H2A visas were more likely to report that there was support for safety in their workplaces than were workers without H2A visas (Table V). Workers with H2A visas were significantly more likely to report that their employer told them to dress for safety and work safely, and that their coworkers talked about safety, took safety precautions, and dressed for safety. Although more workers with H2A visas reported that their coworkers were more likely to wash before eating, this difference is not statistically significant.

Seventy-seven (29.3%) of the workers in 1998, and 94 (32.1%) of the workers in 1999, stated that their coworkers make fun of those who try to work safely. The proportions did not differ by H2A status in 1998. However, in 1999, it was significantly lower for workers with H2A visas (23.0 vs. 40.3% without H2A visas,  $\chi^2 = 10.185, df = 2, P = .001$ ).

## SUMMARY AND DISCUSSION

Combining the results of the qualitative and quantitative analyses indicates farmworkers as a whole are not benefitting from the current safety and sanitation regulations designed to reduce exposure to pesticides and other agricultural chemicals. From one-third to over one-half of the farmworkers interviewed in North Carolina in two successive years indicated that they do not regularly have separate water for washing and drinking, or separate cups available for drinking water (1999 only); that there are no field toilets; that they do not have adequate laundry facilities; and that they have not received pesticide safety training. Fewer than half of the workers interviewed in 1999 indicated that their employer tells them what pesticides have been applied where they are working, posts information on pesticides that have been applied in a central location accessible to workers, or posts warning signs around fields to which pesticides have been applied. Few workers could name any pesticide used where they work.

It is apparent that some farmworkers do work in environments in which the safety and sanitation culture is geared toward a safe and responsible workplace. This reflects employers who meet all workplace safety and sanitation regulations, and in which workers and farmers try to protect each other. Our findings indicate that some components of the safety and sanitation requirements are being met by the majority of agricultural employers. Almost all farmworkers state that there is water for them to drink when they work (if not separate cups for individual use), and

that there are showers for them to use when they finish working. However, even in instances in which farmers are doubly required to meet safety and sanitation regulations, as in the case of those employing workers with H2A visas, some are not meeting these regulations.

It is also apparent that some Mexican farmworkers in North Carolina are not availing themselves of some of the most basic safety and sanitation accommodations that are available to them—water to wash in the fields and showers for bathing immediately after work—because of their health beliefs. Based on their health belief system, humoral medicine [Rubel 1960; Weller 1983], the individual does not apply substances classified as “cold” to those classified as “hot” because it this can cause illnesses. Therefore, these workers were reluctant to wash with drinking water, and they were reluctant to shower until after they had a chance to cool down. Hot and cold in humoral medicine do not necessarily refer to temperature, but rather to inherent qualities of a substance.

Finally, it is apparent that farmers also have stereotypes about Latino workers and about safety regulations that affect their willingness to meet safety and sanitation requirements. Farmers feel they are over-regulated, and that while they try to follow these regulations, farmworkers disregard their efforts. It is clear that farmers do not understand pesticide risks faced by farmworkers who are not applicators. Farmers also feel that Latino workers do not want to use safety and sanitation facilities for which the farmer pays. Finally, farmers feel that many Latino workers come from a backward society, are not accustomed to the modern facilities the farmer provides, and so the farmworker does not appreciate or use these facilities.

These results indicate that additional regulation by itself is not the most advantageous starting point. Numerous health and safety regulations already exist, and farmers and farmworkers are not adhering to them. It will be no more possible to enforce new regulations than it has been to enforce existing regulations. Over 10,000 farms in North Carolina employ migrant and seasonal farmworkers; the agencies empowered to enforce regulations have fewer than thirty staff. The creation of more regulations that farmers feel are unwarranted, unworkable and financially devastating will only further alienate agricultural employers.

Several points for intervention to improve the workplace pesticide safety of farmworkers are suggested by these results. One point to start is to provide the information that we have on farmworker beliefs to farmers. Knowing why many workers will be hesitant to wash their hands with iced water and that workers' hands are the vehicles for pesticide exposure as well as the risk of communicable disease will more likely result in farmers providing separate non-iced water for hand washing in the fields. However, we also need to change farmer knowledge and beliefs about farmworker pesticide exposure. If farmers do not perceive a risk for

farmworkers, they are unlikely to change their practices or care if workers follow sanitation guidelines. The issue is how to educate farmers. The obvious place to get information to farmers (if not farmworkers) is through county cooperative extension agents. It will, of course, require that county cooperative extension offices acknowledge that there is a problem. A natural point at which almost all farmers will come into contact with county cooperative extension agents is when farmers who are certified pesticide handlers sit for recertification tests (every 3 years). Agents on their regular encounters with individual farmers and with groups of farmers could also convey portions of this information.

Another point at which this information can be provided to farmers is through county and state Farm Bureau offices. The Farm Bureau provides insurance for most farmers, and it would appear natural that reducing farmer liability would be important to the Farm Bureau. An additional point to bring safety information to farmers is through clinic outreach workers. Most migrant clinics include outreach workers who go to labor camps to provide health education and tell farmworkers where they can obtain health care. It is very appropriate for these outreach workers to invest some of their efforts (which many already do) in talking with the employers and educating them on ways to protect the health of their employees.

Appropriate safety information must also be included in the safety training that farmworkers do receive. If the information is relevant to farmworkers, as is information on field sanitation, farmworkers are more likely to listen and learn [Arcury et al., 2000]. Information for farmworkers should explain why certain behaviors are important rather than simply listing appropriate behaviors. For example, Quandt et al. [1999] found that most of the safety training materials developed to meet WPS requirements for farmworkers only list what farmworkers should do without telling farmworkers why they are being asked to do it. Our experience is that farmworkers, like most people, ignore information that does not fit their belief system if no substantial reason for the behavior change is provided. Information for farmworkers on such points as *why* they need to wash their hands in the fields, shower as soon as possible after work, and launder work clothes in a washing machine should be included in all WPS training programs. This information can be reinforced at residential sites by outreach workers, and in clinics used by farmworkers through the clinical staffs.

Information on cultural differences and stereotypes must be provided to farmworkers and farmers. It is not possible to teach all farmers Spanish, or all farmworkers English, and so there will always remain a cultural gap between these two groups. However, providing some information to each group about the beliefs of the other will reduce misunderstanding and distrust. Just as it is important to find ways to include farmworkers in community-based

occupational pesticide safety programs, it is important to find ways to convince farmers that it is in their interest to be involved with these programs.

This study does have some limitations that we must acknowledge. Data were collected only in North Carolina, and the situation in this state may differ from that in others. However, our communications with colleagues conducting farmworker safety research in New Jersey, Florida, Texas, Washington, Oregon, and California indicate that our results are very applicable to the situations that they have observed in their states.

The sample is representative, but not totally random. There are no feasible procedures for selecting a random sample of farmworkers in North Carolina. No lists exist of farmworkers, nor of farms that employ farmworkers. There is a partial list of farms that provide housing for farmworkers; however, this list is estimated to include only about half of these farms on a state-wide basis. There is no financially reasonable procedure for using a block cluster-like design for locating and selecting a random sample. Therefore, it is possible that our sampling procedures introduced some biases. This is particularly the case as help in locating the sites included in the sample was provided by a community-based organization that advocates for farmworkers. However, we feel any potential bias is minimal. There was no overlap in the survey participants over the 2 years of the study and many of the participants were new to North Carolina (almost 60% had worked in U.S. agriculture for two years or less) so they could have had little time to develop a relationship with the community-based organization and be influenced by this organization's activism. Yet, the responses from the two surveys were remarkably similar.

This study relies on self-reports of behavior. It would have been better to actually observe or in some other way independently measure farmworker safety behavior or the availability of workplace safety and sanitation facilities. We acknowledge the limitations of self-report data. However, we were largely denied access to farms in this study (a circumstance that supports our interpretation of farmer perspectives), and had to rely on self-reports.

Given these limitations, the results of this analysis indicate that much work remains to be accomplished to make the agricultural workplace safe for farmworkers. At the same time, analyses such as this show points at which the agricultural workplace and the culture of safety and sanitation within this workplace can be affected.

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