

THOMAS A. ARCURY, PHD ■ SARA A. QUANDT, PHD ■ COLIN K. AUSTIN, JD MRP ■ JOHN PREISSER, PHD ■ LUIS F. CABRERA

Implementation of EPA's Worker Protection Standard Training for Agricultural Laborers: An Evaluation Using North Carolina Data

Dr. Arcury, Mr. Austin, and Dr. Preisser are with the University of North Carolina at Chapel Hill. Dr. Arcury is a Senior Research Associate with the Center for Urban and Regional Studies, an Adjunct Associate Professor of Anthropology, and a Lecturer in the Department of Health Behavior and Health Education, School of Public Health. Mr. Austin is a Research Associate with the Center for Urban and Regional Studies. Dr. Preisser is an Assistant Research Professor of Biostatistics, School of Public Health. Dr. Quandt is an Associate Professor of Epidemiology, Department of Public Health Sciences, Wake Forest University School of Medicine, Winston-Salem, North Carolina. Mr. Cabrera is the Director of the North Carolina Farmworkers' Project, Benson.

SYNOPSIS

The US Environmental Protection Agency has promulgated a Worker Protection Standard which requires that farmworkers receive pesticide safety training. The implementation of these regulations has not been evaluated. Using data collected through personal interviews with 270 Hispanic farmworkers recruited from 35 labor sites in an eight-county area, the authors analyzed the extent to which farmworkers received pesticide safety training, characteristics of the training, and variations in knowledge and safety behavior.

Approximately a third of the farmworkers reported having ever received information or training on pesticide safety, and 25.6% reported having received training in the year in which they were interviewed. Workers with H2A visas were significantly more likely to have received training than workers without these visas. The training received varied in location, duration, and language. Most included the use of a video, as well as verbal presentation, and most included printed materials. However, few workers knew the ways in which they could be exposed to pesticides or reported using any method to protect themselves from pesticide exposure.

Address correspondence to:

Dr. Arcury, Ctr. for Urban and Regional Studies, CB# 3410, Univ. of N. Carolina at Chapel Hill, Chapel Hill NC 27599; tel. 919-962-3512; fax 919-962-2518; e-mail <tom_arcury@unc.edu>.

Farmworkers are employed in one of the most hazardous industries in the United States.^{1,2} Their work places them at risk for injury and illness from many sources, including exposure to such agricultural chemicals as pesticides, fertilizers and fuels such as gasoline and kerosene.

At the same time, these farmworkers are medically underserved.³ Most farmworkers are immigrants; as of 1995, 69% of farmworkers were foreign born, with 65% born in Mexico.⁴ While migrant and seasonal farmworkers work in every region of the United States, their numbers and the conditions they face vary from state to state. Many do not speak English, and many lack the required documentation to work legally in this country, factors that increase their risks for occupational injury and disease.

To help reduce these risks, the US Environmental Protection Agency (EPA) has instituted the Worker Protection Standard (WPS) for agricultural workers.

The WPS regulations require that field laborers receive pesticide safety training.⁵ In the present article, we draw on data collected in the course of an ongoing community-based trial to test culturally appropriate pesticide training information for farmworkers. The larger project, PACE: Preventing Agricultural Chemical Exposure among North Carolina Farmworkers, is supported by the National Institute of Environmental Health Sciences. One component of the PACE evaluation was pre-intervention interviews with farmworkers; we used workers' responses to these interviews to determine the extent to which workers received the required training, the extent to which they were aware of pesticide-related risks, and the extent to which they used safety practices.

Below, we first review the WPS regulations for farmworker pesticide training. We then describe the PACE project and its study design. We present the study results that pertain to implementation of WPS training regulations, including a description of who received training, some characteristics of the training they received, farmworkers' knowledge about specific pesticide safety issues, and farmworkers' use of safety measures. Finally, we present our conclusions about farmworker safety training in the light of WPS regulations.

EPA'S WORKER PROTECTION STANDARD TRAINING FOR FIELD WORKERS

The EPA promulgated the Worker Protection Standard in 1992, with full implementation of regulations scheduled to be in place by April 15, 1994,⁵ which was then delayed

until January 1, 1995. 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 worker safety training. (A restricted entry interval is a period of time after application of pesticides or other chemicals during which a person may not enter a treated field without wearing personal protective equipment.) This training must cover 11 specific topics related to pesticide exposure (Figure). Workers must be trained before they accumulate more than five days' work in a treated area. This training must be repeated at least every five years. There are additional training requirements for individuals who work in enclosed areas, such as greenhouses, and those who mix and apply agricultural chemicals. Trainers must meet criteria established by EPA and the state or tribal jurisdiction where the training is conducted. WPS regulations further state that training must be in a language understood by the farmworker. The EPA has developed and distributed materials (including

Figure. Information required in farmworker training by US Environmental Protection Agency Worker Protection Standard:

1. Descriptions of where and in what forms pesticides may be encountered during work activities.
2. Hazards of pesticides resulting from toxicity and exposure, including acute and chronic effects, delayed effects, and sensitization.
3. Routes through which pesticides can enter the body.
4. Signs and symptoms of common types of pesticide poisoning.
5. Emergency first aid for pesticide injuries or poisonings.
6. Instructions on how to obtain emergency medical care.
7. Routine and emergency decontamination procedures, including emergency eye flushing techniques.
8. Hazards from chemigation and drift.
9. Hazards from pesticide residues on clothing.
10. Warnings about taking pesticides or pesticide containers home.
11. Requirements of the WPS designed to reduce risks of illness or injury resulting from workers' occupational exposure to pesticides, including application and entry restrictions, design of warning signs, posting of warning signs, oral warnings, the availability of specific information about applications, and protection against retaliatory acts.

Only 35.2% of this sample of farmworkers reported ever having received any information or training on pesticide safety.

videos, manuals, and brochures) that may be used in WPS-mandated training.⁶

Although the EPA held a series of public meetings to elicit comment on the provisions of the WPS,⁷ neither the implementation of WPS training requirements nor the effectiveness of WPS training has been directly evaluated. The Center for Urban and Regional Studies has developed an annotated bibliography of WPS training materials from the EPA and other sources⁶ and has critically reviewed these materials.⁸

THE PACE PROJECT

PACE is an intervention study to develop, implement, and evaluate culturally appropriate ways of reducing farmworkers' exposure to chemicals in the workplace. A community-based organization, the North Carolina Farmworkers' Project, a nonprofit advocacy organization, is a full partner.⁹ In addition, PACE has reached out to other stakeholder groups, including farmers, health care providers, and the North Carolina Cooperative Extension Service. Seven members of the PACE staff have become certified WPS trainers for agricultural workers. In addition to being used in a critical review of WPS materials,⁸ PACE data have been employed to look at the issues surrounding accurate measurement of chronic exposure to agricultural chemicals among farmworkers¹⁰ and to analyze farmworkers' and farmers' perceptions of farmworkers' exposure to agricultural chemicals.¹¹

PACE is being conducted in an eight-county area of eastern North Carolina, the region with the state's highest concentration of farmworkers. The intervention focuses on farmworkers engaged in tobacco or cucumber production, as these crops require considerable hand labor. The office for the North Carolina Farmworkers' Project is centrally located within this eight-county area, in the town of Benson.

PACE sampling and recruitment strategy. A two-stage approach was used to locate and recruit participants.

The design of the sampling and recruitment strategy 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 the state of North Carolina, as in many states, is unknowable, there was no available sampling frame. Based on information obtained during our formative research¹¹ and provided by the North Carolina Farmworkers' Project, we knew that workers could be located at residential sites that included on-farm labor camps, trailer parks, old farmhouses, and apartments. We also knew that workers at a given housing site were likely to be similar to each other in terms of towns of origin, current employer, and training experience. Therefore, the first stage of the sampling plan was intended to maximize representativeness of the sample through selection of a broad range of sites. A site was defined as a residential locale in which all or most residents were farmworkers and their families. Community representatives connected with the Farmworkers' Project helped to create a list of potential sites, based on their knowledge as area residents and on community reconnaissance, interviews with farmers, and conversations with farmworker service providers. The next step was to visit each site and ascertain that the farmworkers present would be willing to participate in the study, if asked. This visit was primarily intended to familiarize farmworkers with the existence of the study. Community members—all Hispanic and former or present farmworkers—were hired and accompanied the project coordinator on site visits. The PACE staff then selected a variety of sites from among those visited, including large and small labor camps, trailer parks, and rental housing, for a total of 35 sites. The residents at two sites were workers with H2A visas who did not want to participate due to concern about reprisals from their employer; these two sites were replaced with two others. (An H2A visa allows an individual to enter the US to work in agriculture for a specified period of time for a

We cannot be sure if the training that the workers reported met WPS requirements.

particular farmer. The farmer is obligated to provide workers an average of 35 hours of work per week, a specific hourly wage, and inspected housing and is required to meet all safety requirements, including WPS training.)

As a second sampling stage, up to 10 farmworkers were recruited at each site. At 24 of the 35 sites, 10 or fewer workers were present at the time of the visit. At the other sites, after a brief general presentation to the group, the interview team leader identified 10 workers to be interviewed. The criteria used were to first select any women present and then to select a range of ages from those present. This system of multiple contacts leading up to recruitment familiarized farmworkers with the project; there were very few refusals at the stage of actual recruitment.

Characteristics of the sample. The 270 individuals in this sample were all Hispanic immigrants; all but five were from Mexico. Most participants were male (89.3%). They ranged in age from 18 to 61 years, with a mean of 28.7 years and a median of 27.0 years. The majority (53.9%) had worked in agriculture in the US one or two years; 4.1% had worked in agriculture for less than 1 year, 15.4% for 3 or 4 years, and 26.6% for 5 or more years. All had worked for more than five days on a crop to which a pesticide had been applied, with most having worked in tobacco (84.4%) or cucumbers (52.6%), both of which had a number of chemicals applied by the time these interviews took place. Therefore, all of these workers should have received WPS certified training. One-quarter of the respondents had H2A visas.

Interviews. Pre-intervention interviews were conducted with the 270 Hispanic farmworkers in the PACE sample during June and July, 1998. Interview teams consisted of a PACE staff member, a college student fluent in Spanish, and one or more former farmworkers. The former farmworkers, all originally from Latin America, lived in the study area. Students and former farmworkers received interviewer training at two three-hour sessions at

the North Carolina Farmworkers' Project office.

Each interview took approximately 25 minutes to complete. Participants were given information about the study and interview and signed consent forms. At the end of the interview, participants were given a \$10 long distance telephone card as a token thank-you; no mention was made of the telephone cards before the interview to ensure that it was not an inducement to participate.

Questionnaire. Interviewers used a standard questionnaire to collect information on personal characteristics, farm work experience, exposure to agricultural chemicals, safety information or training received, knowledge of and use of safety procedures, and perception of exposure and health risk. All but two of the questionnaire items had fixed response answers; the two open-ended questions asked respondents to name the chemicals used in the fields where they worked and ways that farmworkers can be exposed to chemicals in the workplace. English and Spanish versions of the questionnaire were developed. A professional service translated all items not taken from existing questionnaires into Spanish; these items were then reviewed and edited by native Spanish speakers. The entire questionnaire was then pretested with farmworkers living in the study area.

Respondent characteristics elicited with the questionnaire were ethnicity, gender, age, years worked in agriculture in the United States, and H2A visa status.

Whether a farmworker had received training was assessed based on responses to two questions. Respondents were asked, "Have you *ever* received any information or training on how to prevent or reduce your exposure to pesticides or other agricultural chemicals when you are working?" If a worker answered yes, he or she was then asked, "Have you received any information or training *this year (or/season)* in how to prevent or reduce your exposure to pesticides or other agricultural chemicals when you are working?" Those who stated that they had received information or training this year or season were asked a series of questions about the characteristics of

this information or training. These included the location, time, duration, and language of the training, the media used in the training, and whether material on the WPS, employers' responsibilities, and workers' legal rights were included in the information or training. The definition of training was intentionally liberal to capture all types of training opportunities available to these workers.

Responses to the two open-ended questionnaire items were reviewed by Spanish-speaking project staff and categorized. For one of the items, "Do you know the names of chemicals used in the fields in which you work?" answers were grouped into "Any chemical names known" or "No names known." The other open-ended item asked workers for the ways that farmworkers can be exposed to chemicals in the workplace. Responses to this question were grouped into seven categories.

Data analysis. Associations between pairs of variables were assessed with large sample chi-square methods using the SAS system; Mantel-Haenszel methods were applied to nominal data and Wilcoxon Rank Sum Tests to

ordinal data.¹² When appropriate due to small *n*'s, exact tests were also performed; these results were in good agreement with the large sample tests and are not reported.¹³

IMPLEMENTATION OF WPS TRAINING

Our analyses revealed a shocking lack of compliance with the WPS farmworker training requirements. A minority of workers reported ever having received pesticide safety training—even when broadly defined—and much of the training received was short in duration and provided little opportunity for workers to ask questions. Nor surprisingly, workers had inadequate knowledge of sources of pesticide exposure and most reported that they did not take steps to protect themselves against exposure.

Number receiving training. Even with the liberal definition of training used ("any information or training"), a minority of the workers interviewed reported having

Table 1. Number of farmworkers reporting having received information or training about pesticide safety, by personal characteristics, North Carolina, 1998 (N = 270)

Characteristic	Number	Ever received information or training		Received information or training during current season or year	
		Number	Percent	Number	Percent
Total sample	270	95	35.2	69	25.6
Visa status ^{a,b}					
Without H2A visas	201	55	27.4	35	17.4
With H2A visas	69	40	58.0	34	49.3
Age (years) ^c					
< 20	37	7	18.9	6	16.2
20–24	68	22	32.4	17	25.0
25–29	56	28	50.0	17	30.4
30–34	47	18	38.3	13	27.7
≥ 35	60	19	31.7	15	25.0
Not known	2	1	—	1	—
Years worked in US agriculture					
< 1	11	3	27.3	3	27.3
1–2	144	43	29.9	38	26.4
3–4	41	16	39.0	11	26.8
≥ 5	71	32	45.1	17	23.9
Not known	3	1	—	—	—

^aSignificant difference by H2A visa status in proportion of workers who ever received information or training ($X^2 = 21.101$, $df = 1$, $P < 0.001$)
^bSignificant difference by H2A visa status in proportion of workers who received information or training during current season or year ($X^2 = 27.411$, $df = 1$, $P < 0.001$)
^cSignificant difference by age in the proportion of workers who ever received information or training ($X^2 = 10.461$, $df = 4$, $P = 0.033$)

received training or having received training during the current season or year (Table 1). Little more than one-third reported ever having received training, and one-quarter reported having received training in the current season or year.

There are some important differences between the farmworkers who had received pesticide safety training and those who had not. Significantly more workers with H2A visas than workers without these visas reported ever having received training and significantly more reported having received training during the current season or year. (Employers who recruit workers through the H2A visa program guarantee that they will enforce all state and federal regulations.) The differences across ages in the percentages of workers who received training was significant, with the highest percentage among workers ages 25–29.

Characteristics of training. We analyzed the characteristics of the training that workers received for workers who reported being trained in the interview year. Because of the difference in the percentages of workers with and without H2A visas who reported having been trained, we compared the characteristics of the training received by these two groups of workers.

The location of information or training sessions varied; workers received training at farms where they worked, at facilities of organizations that recruited workers, and at other organizations (Table 2), including clinics, county extension offices, the US Forest Service office (for those who worked in Christmas trees), and at the North Carolina Farmworkers' Project office (this training was not associated with PACE). A higher percentage of workers with H2A visas received training at the office of the recruiting organization. A higher percentage of the workers without H2A visas were trained at the farm on which they worked or through other organizations.

Almost two-thirds of the workers said that they had received training at least two months before they were interviewed in late June or early July. Two months before the interviews would have been an appropriate time to receive training, as many of these workers would have worked setting tobacco plants or setting and harvesting cucumbers at that time. A higher percentage of workers with H2A visas received training more than two months before the interviews, possibly indicating an earlier start to their working season.

Although almost 20% of farmworkers reported attending training sessions that lasted only 15 minutes, training sessions for most farmworkers lasted at least 30 minutes.

Only about a quarter of respondents reported that the sessions they attended were of one or two hours' duration.

All of the participants were immigrants from Latin American countries, with most speaking only Spanish. It is not surprising that most of the training provided to these workers was conducted in Spanish. For about 30% of workers without H2A visas, training sessions had been conducted in a combination of Spanish and English. Most of the workers received training in a mixed media format. For almost 85% of the workers, training involved the use of a video; the training of workers with H2A visas was more likely to include a video presentation than was that of workers without an H2A visa. For most of the workers, the video was supplemented with a verbal presentation about the video; again, the training of workers with H2A visas was more likely to include verbal presentation about the video. However, fewer than half of the workers said that they were given the opportunity to ask questions about the information they received, with fewer workers with H2A visas than those without these visas saying they could ask questions, although the difference was not statistically significant. Approximately two-thirds of the trained workers reported having received printed materials.

Three questions assessed the content of the training; workers were asked whether the training had included information about: WPS, employers' responsibility for safety, or workers' legal rights with regard to pesticide safety. In answer to each of these questions, about half of the workers who had been trained said they had been given the information. Higher percentages of workers with H2A visas than without H2A visas reported that their training mentioned employer responsibilities and workers' legal rights.

Knowledge of pesticides used and safety in the workplace. An analysis of the answers to several other questions allowed us to further evaluate the influence of WPS training on farmworker safety. These questions addressed: sources of information about pesticides, ways in which workers could be exposed to pesticides, the types of pesticides used where respondents worked, and methods used to protect themselves from pesticide exposure. For this analysis, we included frequencies for the total sample and compared workers by H2A visa status and by whether they reported receiving training during the current season or year.

Interviewers asked the question "From where do you get information about pesticides or other agricultural chemicals that may be used on the job?" and then read

Table 2. Characteristics of pesticide safety training received during current season/year, by H2A visa status of workers, North Carolina, 1998 (N= 69 workers)

Characteristic	All workers		Workers without H2A visas n = 35		Workers with H2A visas n = 34	
	Number	Percent	Number	Percent	Number	Percent
Location^a	(n = 64)		(n = 31)		(n = 33)	
Farm where employed	15	23.4	14	45.2	1	3.0
Office of labor recruiter	31	48.4	1	3.2	30	90.1
Office of other organization	10	15.6	10	32.3	0	0
Other	8	12.5	6	19.4	2	6.1
When held^b	(n = 67)		(n = 34)		(n = 32)	
Past 2 weeks	13	19.4	12	35.3	1	3.0
Past month	11	16.4	5	14.7	6	18.2
2 or more months ago	43	64.2	17	50.0	26	78.8
Duration	(n = 66)		(n = 33)		(n = 33)	
15 minutes	12	18.2	10	30.3	2	6.1
30 minutes	22	33.3	7	21.2	15	45.5
60 minutes	15	22.7	5	15.1	10	30.3
1-2 hours	17	25.8	11	33.3	6	17.5
Language^c	(n = 65)		(n = 33)		(n = 33)	
Spanish only	51	73.9	23	69.7	28	82.3
English only	4	5.8	0	0.0	4	11.8
Spanish and English	11	15.9	10	30.3	1	2.9
Video used in training^d	(n = 69)		(n = 35)		(n = 34)	
Video used in training	58	84.1	26	74.3	32	94.1
Verbal presentation about video	52	75.4	23	65.7	29	85.3
Could ask questions at training	33	47.8	19	54.3	14	41.2
Given printed materials	47	68.1	23	65.7	24	70.6
Mentioned WPS	31	44.9	17	48.6	14	41.2
Mentioned employers' responsibilities	37	53.6	16	45.7	21	61.8
Mentioned workers' legal rights	33	47.8	13	37.1	20	58.8

^aSignificant difference by H2A visa status in location where training was provided ($X^2 = 49.595$, $df = 3$, $P < 0.001$)

^bSignificant difference by H2A visa status as to when training was provided ($X^2 = 10.613$, $df = 1$, $P < 0.001$)

^cSignificant difference by H2A visa status in language in which training was provided ($X^2 = 11.674$, $df = 2$, $P = 0.003$)

^dSignificant difference by H2A visa status in whether video was for training ($X^2 = 5.961$, $df = 1$, $P = 0.015$)

each of the possible sources listed in Table 3. Respondents could select more than one response. Almost half of the workers reported that they had no source of information. For the remainder, the most common source of information was the workers' supervisors. However, only 25.6% of the sample reported getting information from supervisors. Other than "other workers" and "other

source," no source was mentioned by at least 10% of the respondents. There were few important differences by visa status and by having received training during the year or season of the interviews. A higher percentage of workers who reported having received training than of workers who did not report having received training indicated that they got information from supervisors. Although few

Table 3. Farmworkers' self-reported sources of pesticide information and knowledge of exposure sources, by H2A visa status and by whether received training in current season/year, North Carolina, 1998 (N = 270)

Responses to open-ended questions	Number	Percent	H2A visa status				Received training current season or year			
			Without n = 201		With n = 69		Yes n = 69		No n = 201	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent
Sources of pesticide information										
Supervisors	69	25.6	55	27.4	14	20.3	24	34.8	45	22.4 ^a
Other workers	31	11.5	28	13.9	3	4.3 ^b	9	13.0	22	11.0
Friends.	26	9.6	24	11.9	2	2.9 ^b	5	7.3	21	10.5
Union officials	12	4.4	2	1.0	10	14.5 ^c	8	11.6	4	2.0 ^a
Clinic personnel.	23	8.5	17	8.5	6	8.7	9	13.0	14	7.0
Other organizations.	10	3.7	9	4.5	1	1.4	7	10.1	3	1.5 ^a
Other source.	36	13.3	9	4.5	27	39.1 ^d	24	34.8	12	6.0 ^c
None.	130	48.1	116	57.7	14	20.3 ^d	9	13.0	121	60.2 ^c
Modes of pesticide exposure										
Don't know any.	94	34.8	80	39.8	14	20.3 ^c	18	26.1	76	37.8
Spray	51	18.9	39	19.4	12	17.4	10	14.5	41	20.4
Entering a treated area	28	10.4	15	7.5	13	18.8 ^c	14	20.3	14	7.0 ^b
Breathing air or dust	50	18.5	38	18.9	12	17.4	13	18.8	37	18.4
Ingesting contaminated food	19	7.0	11	5.5	8	11.6	6	8.7	13	6.5
Skin in contact with plant	32	11.9	20	10.0	12	17.4	9	13.0	23	11.4
Not taking precautions	37	13.7	26	12.9	11	15.9	13	18.8	24	11.9

^aSignificant difference by whether training received in current season/year in proportion of respondents giving positive response ($P < 0.05$)

^bSignificant difference by H2A visa status in proportion of respondents giving positive response ($P < 0.05$)

^cSignificant difference by H2A visa status in proportion of respondents giving positive response ($P < 0.01$)

^dSignificant difference by H2A visa status in proportion of respondents giving positive response ($P < 0.001$)

^eSignificant difference by whether training received in current season/year in proportion of respondents giving positive response ($P < 0.01$)

^fSignificant difference by whether training received in current season/year in proportion of respondents giving positive response ($P < 0.001$)

workers reported obtaining information from fellow workers or friends, a higher percentage of those without H2A visas than of those with H2A visas said they got information from these informal sources. Workers with H2A visas were more likely than those without H2A visas to report getting information from an "other source." This reflects the fact that H2A workers are trained on their arrival in North Carolina by the organization that coordinates their recruitment.

A major component of the WPS training is information on the ways workers can be exposed to pesticides. The workers interviewed in this study had little knowledge of these modes of exposure. In response to an open-ended question on ways of being exposed to pesticides, approximately a third of the respondents answered that they knew of no way that they could be exposed. Almost 20% of the workers stated that they could be exposed by being sprayed directly, and almost 20% said they could be

exposed by breathing contaminated air or dust. Each of the following was mentioned by more than 10% of respondents: having skin directly contact treated plants, entering a treated area, or not taking precautions such as dressing properly or washing before eating. A few workers noted exposure could result from eating contaminated food. There were few differences among the workers by training or visa status in their knowledge of modes of exposure. Workers without H2A visas were more likely than those with H2A visas to lack knowledge of any source of pesticide exposure. More workers with H2A visas knew that they could be exposed by entering a treated area. More trained than untrained workers also knew that they could be exposed by entering a treated area.

Only 10 (3.7%) of the workers could name any chemicals used where they worked. This lack of knowledge did not differ by training or visa status. The WPS requires

Table 4. Farmworkers' self-reported use of any method to protect against pesticide exposure, North Carolina, 1998 (N = 270)

Used any method to protect against exposure	Total sample		Received training current season or year ^a			
			Yes		No	
	Number	Percent	Number	Percent	Number	Percent
Always	59	22.3	19	28.4	40	20.3
Usually	19	7.2	7	10.4	12	6.1
Sometimes	47	17.8	14	20.9	33	16.7
Never	139	52.6	27	40.3	112	56.9

^aSignificant difference in frequency of use of any method to protect against exposure by whether training received this season or year ($\chi^2 = 4.573$, $df = 1$, $P < 0.05$)

that employers post in a central place accessible to workers the chemical applied to each field, when it was applied, and the length of the restricted entry interval. This employer responsibility should be presented in all WPS-certified training (see Figure). While workers may have no reason to know the names of chemicals if they do not need medical treatment, the exceedingly small number who could name even one chemical is striking.

Most respondents (52.6%) stated that they never used any method to protect themselves from exposure to pesticides or other agricultural chemicals, and only 22.3% stated that they always tried to protect themselves from exposure (Table 4). Workers differed significantly in this self-reported behavior by whether they reported having received training during the current season or year. A striking 56.9% of workers without recent training said they never used any method to protect themselves from exposure.

IMPLICATIONS

Overall, only 35.2% of this sample of farmworkers reported ever having received any information or training on pesticide safety. Those with H2A visas were more likely to have received training than those without such visas. Only a small percentage of agricultural workers in the US have H2A visas, and only approximately 60% of this group reported having received any training.

We cannot be sure if the training that the workers reported met WPS requirements. We do know that fewer than half of the workers recalled that the WPS standards were mentioned in the training they received, and that only about half of the workers recalled that employer responsibilities and workers' legal rights were mentioned. Further, few of the workers had knowledge of important areas such as sources of exposure that are required in

WPS training.

Video presentations were the medium for the great majority of workers who received training. The use of a video is understandable in providing information to a group of workers who usually do not speak the same language as their employer. Importantly, at least some verbal presentations and printed materials accompanied the videos. The specific videos used are not known; three of the present authors and two colleagues have reviewed the available pesticide training videos and find that most of these have major shortcomings if used as the sole source of information.⁸

This study relies on farmworker self-reports of training and training content. The definition of training we used was intentionally liberal to include any training that might meet the WPS requirements. It is therefore impossible to know whether the training received by any given farmworker would actually meet WPS regulations if objectively assessed. Thus, the percentage of respondents who said they had participated in training sessions probably overestimates the WPS training being provided to this population. Our assessment of workers' knowledge and of the protective actions taken indicates that, whether or not the training met WPS standards, those who had been trained did not have the level of knowledge and did not take the protective measures that the WPS is intended to produce. Together, these self-reports of training, knowledge, and behavior indicate that greater WPS compliance is needed in North Carolina.

The individuals interviewed for this study may not be statistically representative of farmworkers in North Carolina. The sampling plan employed was designed to avoid the well-known biases of convenience or snowball sampling. Because it included both workers with H2A visas and those without, and because the sites varied in loca-

tion and size, we suggest that our overall findings of inadequate training are probably representative of conditions in North Carolina. Other states, with different monitoring and enforcement regulations, may be doing a better or worse job of complying with WPS standards.

The Pesticide Branch of the North Carolina Department of Agriculture is responsible for implementing the WPS in North Carolina and for certifying trainers. The staff of this agency has been extremely helpful and supportive of our efforts to develop and test culturally appropriate training materials for farmworkers. The inspection staff for this agency includes 24 supervisors and inspectors, who are responsible for monitoring the thousands of farms in North Carolina for compliance with state and federal regulations on pesticide storage, emergency plans, chemigation, licensing, record keeping, as well as protection for farmworkers, pesticide handlers, and applicators—an impossible task. Farmers need to understand the importance of training their employees about pesticide safety; however, many farmers in North Carolina,¹¹ and probably elsewhere,¹⁴ do not see the need for training because they do not believe that the workers they employ are exposed to pesticides. Therefore, to ensure that farmworkers receive the information they need to work safely, and to ensure that their work environment allows them to use this information, education must be provided to farmers about the risks that farmworkers face from pesticide exposure.

Farmworkers need more information to help them

work safely. Establishing regulations that require the training of farmworkers is an important, though insufficient, step. The next step is to ensure that workers receive and understand the necessary information. In North Carolina, information about potential exposures and the need to provide training for farmworkers is included as a topic in the two-hour workshop that private pesticide applicators must attend once every three years to renew their certification. This is insufficient. We need to systematically evaluate the implementation of these regulations. In addition, the content of the required training must be reviewed to determine whether it is appropriate and adequate for the needs of these workers.

This study was conducted in North Carolina, where the number of Hispanic farmworkers has increased dramatically in the past decade. Further research is needed to find out if the deficiencies in WPS training noted here are similar in areas of the country where there is a longer history of large numbers of Hispanic farmworkers and where legislation has established more thorough monitoring of pesticide exposure.

This study was supported by the National Institute of Environmental Health Sciences, under grant R21 ES08739.

The authors thank Freya Kamel, PhD, National Institute of Environmental Health Sciences, Richard S. Mines, PhD, US Department of Labor, and Elaine Vaughan, PhD, University of California, Irvine, for sharing their interview questionnaires.

References

- Myers JR, Hard DL. Work-related fatalities in the agricultural production and services sectors, 1980–1989. *Am J Ind Med* 1995;27:51-63.
- Donham KJ, Horvath EP. Agricultural occupational medicine. In: Zenz C, editor. *Occupational medicine: principles and practical applications*. 2nd ed. Chicago: Year Book Medical Publishers; 1998. p. 933-57.
- Rust GS. Health status of migrant farmworkers: a literature review and commentary. *Am J Public Health* 1990;80:1213-17.
- Mines R, Gabbard S, Steirman A. Office of the Assistant Secretary for Policy, prepared for the Commission on Immigration Reform. A profile of U.S. farm workers: demographic, household composition, income and use of services: based on data from the National Agricultural Workers Survey (NAWS). Washington: Department of Labor (US); 1997.
- Environmental Protection Agency Pesticide Worker Protection Standard Training. 40 C.F.R. Part 70.130 (1992).
- Quandt SA, Austin CK, Arcury TA, Summers ME, Martinez HN. Pesticide safety training materials for farmworkers: an annotated bibliography. Center for Urban and Regional Studies Working Paper 98-01. Chapel Hill (NC): University of North Carolina at Chapel Hill, Center for Urban and Regional Studies; 1998.
- Langner G. A national dialogue on the Worker Protection Standard. Washington: Environmental Protection Agency (US), Office of Prevention, Pesticides and Toxic Substances, Office of Pesticides Programs; 1997. Pub. No.: EPA 735-R97-001.
- Quandt SA, Austin CK, Arcury TA, Summers ME, Saavedra R. Agricultural chemical training materials for farmworkers: review and annotated bibliography. *J Agromedicine* 1999;6:3-24.
- Arcury TA, Austin CK, Quandt SA, Saavedra RM. Enhancing community participation in a public health project: farmworkers and agricultural chemicals in North Carolina. *Health Educ Behav* 1999;26:563-78.
- Arcury TA, Quandt SA. Chronic agricultural chemical exposure among migrant and seasonal farmworkers. *Soc Natural Resources* 1998; 11:829-43.
- Quandt SA, Arcury TA, Austin CK, Saavedra RM. Farmworker and farmer perceptions of farmworker agricultural chemical exposure in North Carolina. *Human Organization* 1998;57:359-68.
- Stokes ME, Davis CS, Koch GG. Categorical data analysis using the SAS System. Cary (NC): SAS Institute; 1995.
- Preisser JS, Koch GG. Categorical data analysis in public health. *Annu Rev Public Health* 1997;18:51-82.
- Grieshop JI, Stiles MC, Villanueva N. Prevention and resiliency: a cross cultural view of farmworkers' and farmers' beliefs about work safety. *Human Organization* 1996;55:25-32. ■