Formal and Practical Knowledge of Pesticide Safety among Migrant Farm Workers in Michigan

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Abstract

A survey of residents of farm labor camps in Michigan shows that they bring different kinds of knowledge to bear on issues of pesticide safety. A survey of 188 migrant agricultural workers shows that those who are the most knowledgeable are specialists in farm work, favor Spanish over English, and participate in out-of-state migration to jobs in Florida and Texas. Those who know less about pesticide safety had worked outside agriculture as well as on farms in Michigan. Education and gender were not related to knowledge of pesticide safety, but they were dimensions of variation in different parts of the migrant stream. Statistical analysis and ethnographic information suggest that both formal and practical knowledge create the differences among workers in their levels of knowledge of pesticide safety.

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Introduction

This study assesses and analyzes knowledge about pesticide safety among 188 farmworkers living in farm labor camps in Michigan in 1995. We find that the patterning of knowledge among participants in the study varies strikingly. Generally, their knowledge is strongest in the area of avoiding pesticides and reducing contact with them. For example, they report routinely washing and changing clothes after working in areas where pesticides have been applied. On the other hand, their knowledge is relatively weak about how to respond to pesticide exposure; when presented with various scenarios involving pesticide exposure, they responded with little of the information given in pesticide safety education.

Levels of knowledge about pesticide safety vary considerably among farmworkers. The factors related to levels of knowledge about pesticide safety include training, exposure to pesticides, and sociocultural aspects of farmworkers' relationship to their work. We had expected that fluency in English would relate to greater knowledge of pesticide safety because of the wide availability of information about pesticides in English in the United States. The farmworkers who knew the most, however, were those who were least adept at understanding and speaking English according to two measures: they had attended school in Mexico and preferred Spanish as the language for the questionnaire. Workers who belonged to the Florida-Michigan migrant stream, and in general those who had worked in more states in the United States, also had greater knowledge than other workers.

We elicited information with a questionnaire including closed- and open-ended questions

on pesticide safety and a few questions on work history and other basic characteristics, such as education and household composition. More than one quarter of respondents had not received training in pesticide safety by the time we interviewed them in 1995 (29%). Virtually all participants in our survey were Latinos (99.5%), and most chose to answer our questionnaire in Spanish (79.8%), underlining the importance of Spanish as a necessary language for pesticide safety instruction.

The general results of the statistical analyses show that participants who had pesticide safety training, who had experienced accidental pesticide exposure, who favored Spanish as their language of communication, who attended school in Mexico, and who had done farm work in at least one other state besides Michigan tended to know more about pesticide safety. These findings suggest that specialization in farm work and fluency in Spanish may give workers greater access to information about pesticide safety compared with those who do not specialize in agricultural work and prefer to communicate in English.

On the basis of these and supporting findings reported in this paper, we conclude that a combination of formal training and informal exchange of information is responsible for most workers' learning about pesticide safety. A large, loose social network of Spanish speaking farm laborers appears to be a more effective source of information for its members than are sources in English for those who prefer English communication. In general, we find that although people who specialize in migrant farm work face many disadvantages--low wages, poor living conditions, and unsteady work--they do have the advantage of greater knowledge of pesticide safety (in terms of Environmental Protection Agency materials) compared with those who work both in agriculture and other sectors of the economy.

BACKGROUND

Theoretical Perspectives

This presentation draws from the work of Giddens and Bourdieu considering knowledge and practice and from the work of Chavez and Paredes concerning the identity of Latino migrant workers. In laying out his theory of structuration, Giddens discusses the importance of human agents as constructing social institutions through recurrent practices (1983: 8-9). To examine human agency, one must examine the intentions related to behavior, and Giddens asserts that, in the constitution of society, human agents operate with different levels of consciousness. One level involves "discursive consciousness," "holding something in mind in a conscious way" (1983:9). I take this level to include the kind of learning that one does in a classroom or in lessons given in pesticide safety education.

Another level is "practical consciousness," involving "tacit modes of knowing how to 'go on' in social life" (idem.). I take this level to involve the general frameworks and concepts for dealing with daily life that are inherent in culture and social class. That is, the mental activity that is at play in "practical consciousness" involves unquestioned assumptions and patterns of behavior into which a person has already been socialized, allowing a person proceed to act without really thinking about what to do. I take this kind of consciousness to be that involved in what has been termed "the household production of health," in which people use home remedies and rely on widespread notions about how to deal with health conditions that often contrast with

biomedical understandings. Regarding pesticide safety, when people act on what they consider common sense, they tend to be operating at the level of practical consciousness. A third level of consciousness according to Giddens is the level of the unconscious, which will not be dealt with here.

Like Giddens, Bourdieu emphasizes the recursive nature of human action in his concept of "habitus" as it characterizes individuals and constitutes social institutions (1990:57). Habitus is related to "social conditionings" that cause "practices and works to be immediately intelligible..., and hence taken for granted. The habitus makes questions of intention superfluous..." (ibid.:58). Bourdieu has thus developed a concept similar to Giddens's practical consciousness. Bourdieu also speaks of "practical sense," which is a notion of how to "play the game" in social interaction (ibid.: 80-81). The approaches of Giddens and Bourdieu lead us to expect that the effort to extend pesticide safety education to migrant workers will be affected by the cultural and class context involving educator, worker, the form of education, and its relationship to the cultural and class contexts of educator and worker. The most effective form of pesticide safety education might be seen as one that extends the lessons learned at the level of discursive consciousness to that of practical consciousness; however, there is little evidence of such a transition in our study.

In examining migrants from Mexico to California, Chavez compares their transition into the agricultural labor force and life in the U.S. as involving phases similar to those in ritual described by Van Gennep (19). First, they undergo isolation from their home community as they cross the border; then, they enter a liminal state as they begin to accustom themselves to their new context in the U.S. Finally, they go through incorporation into a new way of existence

to become members of U.S. communities.

Writing of people in the Rio Grande Valley in Texas, Paredes discusses a process of "transculturation," involving the development of bilingualism and biculturalism plus resistance by Latinos toward the anglo Texan establishment (1993:8). That is, Paredes sees immigrants as learning anglo culture but under conditions of political and economic conflict with the anglo power structure. Similarly, Scott's analysis of the struggle between rich and poor in a village in Malaysia during a "green revolution" points to "everyday forms of peasant resistance" such as "foot dragging,""false compliance," and "feigned ignorance" as the "most significant and most effective over the long run" even though they tend to be little recognized as political actions (1985:xvi). The work of Paredes and Scott lead us to expect of migrant farmworkers resistance to the innovation of pesticide safety education. This study shows, however, that although pesticide safety education is not particularly effective, it may be leaping to a conclusion to say that the reason is resistance on the part of farmworkers.

Agriculture and Occupational Safety

As of January 1, 1995, people doing hand labor in agricultural fields in the United States were required to have education on how to work safely where pesticides have been applied. The Federal Worker Protection Standard (WPS) forbids producers to send people into the fields to work on crops unless the workers have training in pesticide safety (EPA 1993). In Michigan, farmers have taken on the responsibility of providing pesticide safety education to their workers to ensure that they meet the standard.

Policies to protect workers and minimize exposure to pesticide residues have reflected a regulatory approach mandating the time of reentry into fields after the application of certain chemicals and relying extensively on workers engaging in self-protective behavior, for example, wearing protective clothing, to minimize their risk of pesticide exposure. Worker education programs and safe work practices have been emphasized as key components in the strategy towards pesticide protection for workers (Stenzel 1991 and Terris 1990). Unfortunately, few if any migrant health clinics are capable, in terms of technology, diagnostic protocols, and logistics, of diagnosing pesticide-related illness (Ciesielski *et al.* 1994). California is the only state that requires reporting of pesticide poisoning; thus, the medical consequences of patterns of pesticide exposure are largely unknown.

Several studies agree on a problem related to pesticide safety education: while programs are designed to change farmworker behaviors, problems leading to serious exposure causing illness or death are not likely to be under workers' control (Ciesielski *et al.* 1994). In this context, the effectiveness of the policies is questionable for those who face environmental risks and have very limited socioeconomic resources. Poverty and unstable economic situations are conditions that may predict increased exposures to various environmental hazards (Williams 1990 and House, Kessler and Herzog 1990). These conditions may be associated with, or influence, personal and group processes that directly modify health or risk behavior.

In 1987, with 1,700 worker-related deaths (52 per 100,000 workers), agriculture became the most hazardous occupation in the United States (Department of Labor 1988:118-119, Table 48). In terms of injury and illness, the Bureau of Labor Statistics estimates that there are 12.7 cases per 100 full-time workers per year (*ibid.*). Common hazards include acute injuries (falling

from heights and farm machinery injuries), chronic low-grade back and joint trauma, lack of toilets and safe drinking water, chronic, acute and occasional pesticide exposures, and occupational dermatoses (*ibid.)*. Particularly, the EPA has ranked chemical exposures of agricultural workers as one of the most significant environmental hazards affecting human health in the United States (EPA 1990:13).

Exposure to pesticide residues can be substantial during an agricultural season; as many as 300,000 seasonal workers may experience pesticide-related illnesses during a given year (EPA 1992). Few studies are available on chronic or low-level pesticide exposure, but they suggest that limb-reduction birth defects (Schwartz and LoGerfo 1988), childhood leukemia (Lowengart and Peters 1987), brain tumors (Gold and Gordis 1979), sterility, spontaneous abortion (Moses 1989), adult lymphomas and lymphosarcomas (Alavanja *et al.* 1986) may be linked with occupational exposure to pesticides. Even prolonged low-level exposure to pesticide residues has been associated with an increased risk of various negative health outcomes, including anemia, asthma, Parkinson's disease, neurological disorders, developmental impairment in offspring, chronic dermatitis, and an increased risk for certain cancers (Coye 1985, Goldsmith 1989, Rust 1990 and Sakala 1987). In particular, exposure to cholinesterase-inhibiting pesticides such as organophosphates and carbamates is considered a major health problem for the 2.5 to 3 million farmworkers in the United States (Wilk 1986).

The farmworker population is comprised of an estimated 2.5 to 3 million individuals and their dependents (Department of Labor 1991:23-30). The National Agricultural Workers Survey (NAWS), conducted by the U.S. Department of Labor, surveyed over 2,500 agricultural workers employed in 72 counties in 25 states. In the 1989 NAWS report, researchers found that 38% of

the farmworkers interviewed had been born in the United States, and 62%, in other countries *(ibid.)*. Of all farmworkers, only 6% were working without legal authorization, comprising only 19% of those born outside the United States (*ibid.*). About one third of migrant farmworkers in the United States are younger than 30 years of age; few are older than 60 years (Department of Labor 1991: 11-21, 31). More than half have less than eight years of education. For over half of the workers, annual income is below poverty level (as defined by federal guidelines). Those who are living with family members and those who are foreign-born are more likely than others to be poor. Approximately two thirds of the workers are Latino, one fourth are white non-Latinos, and 3% are African American *(ibid.)*.

The number of migrant farmworkers estimated in Michigan varies between 20,000 and 45,000 (MCSSA 1995) depending on the basis for calculating their population. Michigan's hired farm work force can be divided into seasonal workers (employed less than 150 days in a year) and regular employees (employed 150 or more days in a year). In 1992, the number of seasonal workers, who would include migrant workers, was 83,923; there were 20,500 regular farm employees in the state (Rochin and Siles 1994). Rochin and Siles (1994) calculated that farm laborers who worked for 150 days that year (8 hours a day) had annual gross earnings of $7,824. For a family of four, this income falls below the poverty level, as is typical of migrant workers around the country.

Torres (1990) has described Latinos in the Midwest as having health problems that are characteristic of both "less developed" countries (e.g., high infant mortality rates and high prevalence of infectious disease) and "more developed" countries (e.g., high prevalence of cancer and heart disease). He concludes that the causes of major health problems of the Latino

population seem to be at the midpoint in a transition from infectious to chronic disease. A key problem for U.S. farmworkers is the fact that they are explicitly excluded coverage by some U.S. labor laws despite the dangerous, difficult working and living conditions that saddle them with health, educational, and social problems. Migrant workers live and work in the richest country in the world, but their marginal social and economic status reflects how alienated they are from the "First World."

METHODS

Collecting and Coding Data

This presentation deals with the findings from a survey administered in 1995. We developed a questionnaire that deals with three areas: pesticide safety, basic background information on each respondent (e.g., age, education, location of schooling, household composition, and location of "home"), and employment characteristics of each respondent (years of farm work in Michigan, other states where the respondent worked on farms during the previous year, and any jobs held by the respondent outside agriculture during the previous year). The questions on pesticide safety are based on pesticide education materials adapted from the Environmental Protection Agency for use in Michigan. Michigan State University Agricultural Extension staff (Sandy Perry) developed most of the materials used in the state--a video and a flip chart with pictures and a narrative. All materials are available in English and Spanish.

The questions on knowledge of pesticide safety were closed- and open-ended. The

closed-ended questions dealt with issues such as familiarity with the term, "pesticide," work as a pesticide handler (e.g., mixing or applying pesticides) and potential means of pesticide exposure (from plants, soil, irrigation water, work clothes, work equipment, and during the harvest). All these questions were to be answered "yes" or "no." Other closed-ended questions asked how dangerous it was to work with pesticides and how comfortable the respondent was about the amount of pesticide exposure he or she had, both rated on a five-point scale.

A combination of closed- and open-ended questions asked about past exposure to pesticides by getting them on the skin or in the eyes, breathing them in, or swallowing them. The questionnaire asked whether the participant had experienced a specific kind of exposure (e.g., to pesticides on the skin). A response of "yes" led to an open-ended question asking what the participant did as a result of the exposure. The interviewer continued asking "What else did you do?" until a participant offered no further response.

Other questions asked about lessons from any training the participant had received. They began, "If you have received any pesticide safety training, what did the training recommend you do if you get pesticides on your skin [in your eyes, breathe them in, swallow them]?" Each of these questions was followed by prompting ("What else?") until no more responses were forthcoming. Another open-ended question asked for the symptoms of poisoning from pesticides, and prompting also followed this question until the responses were exhausted.

The questionnaire is most detailed in the area of what one should do upon being exposed to pesticides. This focus encompasses most of the questions on exposure to pesticides and pesticide safety. The questionnaire asks, "Do you know how to keep from getting pesticides on your skin?" An affirmative response is followed by, "How would you do it?" Another series of

questions begins, "If a person gets pesticides on their skin, what should they do first?" "When?" "Where?" Interviewers were instructed to continue asking questions on the actions taken in response to exposure continue there was no further response. The questionnaire continues with the topics of prevention and responses to exposure for getting pesticides in the eyes, breathing them in, and swallowing them.

The last section of the questionnaire deals with personal description and is preceded by a reminder that participants need not answer if they feel uncomfortable. The section deals with personal description, including age, education, where the person attended school, the location of places identified as home, preferred language for posting information about pesticides, and household composition. Last, each interviewer completed a final list of questions involving observation rather than interviewing. The questions included the participant's gender, ethnicity, and language chosen for the interview (English and Spanish were offered).

Sampling and Field Methods

We interviewed people by drawing an opportunity sample from farm labor camps located in central southern Michigan. The region was chosen because of proximity to project headquarters and budgetary limitations. The counties were Clinton, Gratiot, Ingham, Ionia, Livingston, Montcalm, and Ottawa. The region provided a good range of different kinds of farms in the state according to size and crop, although our sample of farms and farmworkers is not statistically representative.

We worked with an opportunity sample because of the almost insurmountable difficulties

of drawing a random sample for a study of this nature. It would be nearly impossible to make a roster of the farmworkers in Michigan, as the population of farm labor camps is in constant flux because of the many dynamic aspects of living and working as migrant agricultural laborers in a state such as Michigan with seasonal agricultural production. These aspects include weather conditions that determine the timing and amount of hand labor to be done, conditions on specific farms, farmworkers' family and employment situations, public policies affecting living conditions in farm labor camps and requiring outlays by farmers (farmers respond by complying, not complying but trying to avoid any penalty, or closing their labor camps), changes in welfare and other publicly provided benefits that enhance workers' low standard of living, technology (affecting the demand for farmworkers), and market conditions for specific crops. These factors and others shape the number and quality of farm labor camps and the timing and number of people arriving for work. Farmworkers tend to return to camps where they have done well in the past, but the residents of any one camp cannot be predicted on a yearly, monthly, or weekly basis. Moreover, there is no list of farmworkers in the state and the list of farm labor camps is updated at the end of the season, making it a year out of date when used for sampling purposes. All of these obstacles can be overcome to construct a random sample, but at a cost that would have exhausted our budget. In view of these problems, an opportunity sample was the best choice.

Interviews were carried out in the labor camps after the residents had returned from the fields, beginning about 6 p.m. and continuing until about 9:00 p.m. on most nights, depending the size of the camp and availability of people to interview. Upon arriving at a camp, members of each interview team would divide up to approach each dwelling (house, trailer, or apartment)

to ask for interviews. The interviewers introduced themselves, explained the project, and gave information on the rights of human subjects. They took some time to build rapport and took breaks during the interview if the respondent was getting tired or bored. Upon completing a questionnaire, the interviewer gave the respondent $5 as a token of appreciation for his or her cooperation. We decided to offer money to encourage people to participate, but we made it a small amount to avoid overcoming any serious reluctance. The cost per questionnaire for this study, about $55 including developing, translating, and duplicating the questionnaire, training and fielding interviewers, and coding open-ended questions, was so high that the $5 gift was not prohibitively expensive. Generally, residents of the camps welcomed the interviewers and were cooperative; a number expressed reluctance to accept the gift. Finally, interviewers handed printed copies of pesticide safety materials and a form that summarized the purpose of the questionnaire and that included phone numbers in case they had further questions or comments.

We pretested the questionnaire three times. Pretests were carried out by members of the research team (Millard and Flores) and by four people working in the fields. During the pretests, we worked to improve the clarity of questions and the adequacy of the Spanish translation, particularly regarding vocabulary commonly used by workers of Mexican descent, who comprise most labor camp residents in this part of the country .

In the data analysis, we dealt with several dimensions of knowledge of pesticide safety and how knowledge was distributed. The answers to the open-ended questions were all listed, then grouped into categories, and then recorded in the data base. We used factor analysis to identify clusters of migrants regarding social characteristics and analysis of variance and multiple regression to identify characteristics related to knowledge of pesticide safety.

PARTICIPANTS IN THE SURVEY

During a five-week survey from August 21 to September 30, the interviews were carried out with 188 respondents at 17 farms. We excluded camp residents under the age of 18 years, and the average age of participants was about 32 years of age (see Table 1). The proportion who were Latinos was 99.5% and 79.8% of participants chose to answer the questionnaire in Spanish. Regarding household composition, 70.2% were living with family members, and the 30.3% of participants who were women all lived with family members.

Nearly all participants considered working by hand in the fields their main job (92.6%). The proportion of pesticide handlers (those who worked mixing or applying pesticides or cleaning equipment used in pesticide application) was 17.6%. We exclude them from most of our analyses because they are not the typical recipient of pesticide safety training for those who work in weeding and harvesting; pesticide handlers are required to have licenses that are granted if they pass a test based on information that is more detailed that that given in ordinary pesticide safety education. Those who had worked at the same farm the previous year included 62.2% of participants; the average number of years spent working on farms in Michigan was 5.5 years.

Of all participants, 75% had worked in agriculture in other states during the previous year. They had worked in 30 other states altogether, most often Florida (35.1%) and Texas (23.9%). These patterns relate to the two main streams of migrant agricultural workers who come to Michigan -- one with workers wintering mainly in Florida and the other, mainly in Texas. Camp residents who did not leave the state for agricultural work during the previous year accounted for 25% of all participants in the survey; while 35.7% had at least one non-agricultural

job in the last year.

Table 2 shows the characteristics of members of the four branches of the migrant stream: Florida-Michigan, Mexico-Michigan, within Michigan, and Texas-Michigan. This is a rough basis for division, as it is based on a question asking what places the worker called home, and some people named several places. In most cases, we think the worker was returning to the place designated as home annually but not necessarily spending much time there.

ASSESSMENT AND ANALYSIS OF KNOWLEDGE OF PESTICIDE SAFETY

Most farmworkers had at least some knowledge of pesticides and how exposure can occur in routine field work (Table 3, questions 1 and 2). They reported nearly universally that they engaged in washing when working in areas where pesticides had been applied. Nearly everyone reported washing hands before eating, wearing freshly laundered clothes to work, and washing work clothes separately from other clothing (93.8% to 97.3%). Fewer reported washing hands before using the toilet (72.6%), and some participants laughed when asked this question, not realizing that the skin of reproductive organs is more absorbent of pesticides than skin on much of the rest of the body. Training might be more effective if this point is emphasized.

One reason for the positive responses to questions about washing is that Mexican Americans in the migrant stream highly value cleanliness. Pesticide safety training would have complemented all their patterns of washing except for washing hands before using the toilet. In ethnographic observations, we found that workers always bathed and changed clothes at the end of the work day, even in camps with few showers per capita and insufficient hot water to go

around. We also know, however, that workers could not always change their work pants from one day's work to the next, because they lacked sufficient clothing. Also, people sometimes ate in the fields without washing their hands first for lack of washing facilities. Practical constraints thus interfered with people's ability to wash as they preferred. Responses to the questions on washing did not reflect this kind of interference, however; the questions on washing thus overestimate the amount of washing and use of clean clothes actually done by workers.

A number of farmworkers reported having been exposed to pesticides on the skin (19.4%) or in the eyes (4.5%) or through breathing them in (33.5%); none reported having swallowed pesticides (Table 3, question 6 a, c, e, and g). We asked those who had been exposed what they did in response, and we continued probing until no further answers were offered. The responses were scored by giving points for those that approximated EPA information. As shown in Table 3 (number 6 b, d, and f), average scores were quite low, ranging from an average of only 0.35 on a 4-point question to 0.83 on a 5-point question. About one-third of the respondents had not yet been trained in pesticide safety when they responded to our questionnaire. Also, some of the exposures to pesticides could have occurred before pesticide safety training was required for farmworkers. Nonetheless, the farmworkers apparently did little that is taught by EPA materials in response to pesticide accidents.

We pursued questions on responding to pesticide exposure with those who had been trained in pesticide safety. We asked them what they learned to do in response to accidents that involve getting pesticides on their skin or in their eyes, breathing pesticides in, or swallowing them. We scored the answers in the same way as the above questions. Compared with reports on what farmworkers in general had done when exposed to pesticides (Table 3, question 6 b, d, and

f), averages on questions about what to do in case of pesticide accidents among trained farmworkers were considerably higher (Table 3, question 7 a through d). Scores ranged from an average of 0.49 on a 4-point question to 1.37 on a 5-point question. Although these scores are higher than those on the previous survey questions, they still show that farmworkers have a lot to learn about dealing with pesticide accidents.

In summary, farmworkers' knowledge about pesticides is strongest regarding where they could encounter pesticides in their work (Table 3, question 2) and routine washing done when they are working where pesticides have been applied. Their knowledge is weakest in the area of actions taken in response to exposure to pesticides.

Different Kinds of Knowledge of Pesticide Safety

Our analysis examines two different kinds of knowledge about pesticide safety and their patterning among farmworkers. The kinds of knowledge were general knowledge (formed by questions asked to all participants) and knowledge about dealing with pesticide accidents (questions asked only to those who received some kind of training). We constructed composite variables to measure each kind of knowledge by scoring responses to questions that were grouped for each variable and scored as shown in Table 4. Next, we examined the relationships of these variables to characteristics of farmworkers to see how knowledge is patterned and to explore how it is created and consolidated.

General Knowledge of Pesticide Safety

We defined "general knowledge of pesticide safety," to include information from questions asked to all participants. The information included responses to questions 1 through 5 in Table 3 (under A). For example, if someone responded "yes" to the question, "Where can you come in contact with pesticides?...In the soil?" (question A2, Table 4), a point was added to his or her score for general knowledge of pesticide safety. If the person responded "no" or "I don't know," no points were added. The total number of points possible for the variable were 24; scores of survey participants had an average of 11.5 with a range from 3 to 17 points (Table 5, number 1).

We examined general knowledge of pesticide safety in relation to the amount of training given to residents of farm labor camps. We grouped labor camp residents into three categories, farmworkers without training, those with training, and pesticide handlers. To qualify for work as a pesticide handler, one is required to obtain a license that depends on passing a pesticide safety test administered by the state. As we had expected that nearly all handlers would be farmers or other permanent residents of Michigan, we were surprised to find as many as 33 handlers out of 188 people living in farm labor camps. (To maintain good rapport, we did not ask to see their licenses, and we do not know how many were licensed pesticide handlers.)

We examined levels of general knowledge in relation to the amount of training workers had been given in a one-way analysis of variance (Table 6). As we hypothesized, untrained farmworkers knew the least about pesticide safety; trained farmworkers knew more, and pesticide handlers knew the most ($F=9.66$; $p=0.000$). Our findings indicate that current training programs, especially the training of pesticide handlers, are effective in informing workers of pesticide safety.

Characteristics of Farmworkers in Relation to General Knowledge

The focus of our study was knowledge of farmworkers, and we excluded pesticide handlers from the remaining analyses. Among farmworkers, we identified six characteristics significantly related to different levels of general knowledge of pesticide safety (Table 8). First, those who had worked in Florida during the previous year had a higher level of general knowledge than others. On the other hand, people who had done farm work only in Michigan had a lower level of pesticide safety knowledge.

A third characteristic showed that having attended school in Mexico rather than in the U.S. was related to possessing greater knowledge. Fourth, those who chose Spanish to answer the questionnaire had more knowledge. Fifth, those who had been exposed to pesticides had greater general knowledge of pesticide safety. Finally, those farmworkers who had received some kind of training also knew more about pesticide safety than those who were not trained. These findings indicate that some workers were specialists in migrant agricultural work in the sense that they worked year-round on farms and migrated in order to do so. Those who had attended school in Mexico had Spanish as a first language and many may never have developed fluency in English, weakening their access to jobs outside agriculture.

The relationship between exposure to pesticides and knowledge of pesticide safety is complex. Our results show that those who had been exposed also had more knowledge of pesticide safety. Their experience may have motivated them to learn more about pesticide safety when the occasion for doing so arose. On the other hand, exposure to pesticides is more likely with increasing time spent working in the fields; thus, exposure may be unrelated to any cause of

the accumulation of general knowledge about pesticide safety. In summary, it is clear that greater experience in agricultural work was linked to more extensive knowledge of pesticide safety. Nevertheless, training seems to have evened out the discrepancy in knowledge between those who had been exposed to pesticides and those who had not (bottom of Table 8). This finding suggests that training in pesticide safety increased knowledge and ended the significant difference between workers who had been exposed to pesticides and the rest of the sample.

We infer that those who tended to remain in farm work seem to be part of a large, loose Spanish-speaking network that was passing around information of various kinds about farm work, including information about working with pesticides. Dependency on Spanish may have been an advantage in gaining pesticide knowledge and dependency on English may have been an impediment.

Table 9 shows the results of a regression analysis of farmworkers' characteristics in regard to general knowledge of pesticide safety as the dependent variable. The results are consistent with those of the analyses of variance, although they do not contain the same amount of detail. Spanish as the preferred language for the questionnaire was the first variable to enter the stepwise regression, followed by pesticide safety training and, finally, exposure to pesticides. The three variables were the only ones to enter the equation.

These results imply that information passed among Spanish speaking farmworkers is an important source of pesticide safety information. The high percentage of questionnaires chosen in Spanish in this study is consistent with our observations of residents of migrant camps in this part of Michigan in the last decade. Most adults are monolingual in Spanish or have considerable difficulty with English. It thus appears that the migrant stream includes a core of workers whose

employment is restricted to agricultural work, partly because of their reliance on Spanish, and that these experienced workers have greater knowledge than others partly because of their familiarity with agricultural work.

Knowledge about Dealing with Pesticide Accidents

Of the 155 farmworkers who participated in this survey, 110 had had training in pesticide safety. To measure knowledge that came from training, we constructed a composite variable reflecting knowledge about dealing with pesticide accidents. The variable included questions that began, "If you have received any pesticide training, what did the training recommend you do if you get pesticides on your skin [in your eyes, breathed them in, swallowed them]?" Responses that resembled instructions published by EPA (1993) were given one point each, and other responses received no points (bottom of Tables 4 and 5).

The farmworkers' characteristics that related to significantly greater knowledge about accidents included: having worked at the same farm the previous year, having worked outside of the agricultural sector in the previous year, living with family members at the time of the survey, and having Texas or the United States as home (see Table 10). These findings suggest that workers who knew more about dealing with accidents were different from those with greater general knowledge. Specifically, those who had greater knowledge about dealing with pesticide accidents belonged to the Texas-Michigan migrant stream. They were not solely dependent on employment in agriculture and they also included a very high proportion (71%) of people who call the United States their home.

The workers with Texas as a home state tended to have been educated in Texas. Previous experience in the U.S. educational system may have given Texas-Michigan migrant workers a basis for learning more from training about pesticide safety, as the training probably drew from educational approaches generally used in the United States. The workers in the Texas-Michigan stream also knew the most English, which may also have facilitated better learning under the circumstances. Many workers are trained by their bosses (for example, by showing a Spanish-language video on pesticide safety), but most farmers speak little Spanish, leaving little possibility for the boss to answer questions or participate in any discussion of the safety materials.

DISCUSSION AND CONCLUSIONS

This study has assessed and analyzed different kinds of knowledge possessed by farmworkers about pesticide safety. Those who knew most about pesticide safety tended to rely more on Spanish and to be more dependent on the agricultural sector for employment. It would make sense that their greater knowledge about pesticide safety would be related to greater knowledge about farm work in general, which would result from their specialization in that sector. Among farmworkers in general, those in the Florida-Michigan migrant stream knew more than others; again, we would expect that if specialization in farm work were related to greater knowledge about pesticide safety, those who migrate interstate to work on farms would know more than those who either stay in Michigan, where most farm work stops for the winter, or winter in Texas, where there is little farm work available.

The experience of having been exposed to pesticides was related to greater knowledge

about pesticide safety and may have been responsible for motivating farmworkers to learn more about pesticides. This finding suggests knowledge on the level of "practical consciousness" that is part of a specialization in field work, involving knowledge and skill not often recognized in society at large. This type of knowledge is picked up as part of life in the fields rather than being taught in a formal setting. Several findings in this study suggest that this "practical knowledge" may be an important basis of knowledge about pesticide safety for farmworkers. In addition to having theoretical importance in regard to concepts of different types of knowledge, social networks, and ethnic enclaves, the base of practical knowledge may be worth considering in designing and refining pesticide education programs.

Training in pesticide safety has removed some differences in levels of knowledge. On the other hand, training has benefitted workers in the Texas-Michigan migrant stream more than others. Whether this finding results from different kinds of workers belonging to different migrant streams or different kinds of training given to them we cannot say from our data (although we know that the Texas Employment Commission tried to train the agricultural work force in the state).

It is striking that in general, farmworkers who prefer to communicate in Spanish have greater knowledge of pesticide safety than do other workers. In this analysis, we have attributed the difference to a linking of choice of Spanish with employment only in the agricultural sector; that is, we have attributed the gaining of greater knowledge about pesticide safety to longer and more intense experience in agricultural work. The finding suggests that, in the migrant streams reaching Michigan, there are different kinds of workers. Those migrating to Florida and depending on Spanish may be virtually locked into agricultural work, which would have the

consequence of low wages and poor living conditions, while also exposing workers to more information about pesticide safety.

References Cited

Alavanja, M.C.R. et al. 1986. Proportionate Mortality Study of Workers in the Grain Industry. Journal of the National Cancer Institute 78(2): 247-252.

Bourdieu, Pierre. 1990. The Logic of Practice. Stanford: Stanford University Press.

Chavez, Leo. 1991. Outside the Imagined Community: Undocumented settlers and experiences of incorporation. American Ethnologist 18: 257-278.

_____. 1998 Shadowed Lives: Undocumented Immigrants in American Society, 2nd ed. Fort Worth: Harcourt Brace.

Ciesielski, Stephen; Dana P. Loomis, Susan Rupp Mims, and Anella Auer. 1994. Pesticide Exposures, Cholinesterase Depression, and Symptoms among North Carolina Migrant Farmworkers. American Journal of Public Health 84(3): 446-451.

Coye, M.J. 1985. The Health Effects of Agricultural Production: The Health of Agricultural Workers. Journal of Public Health Policy. 6:349-370.

Department of Health and Human Services. 1992. Setting the National Agenda for Injury Control in the 1990s. Papers from the 3rd National Injury Control Conference. Atlanta: Center for Disease Control.

Department of Labor. 1991. A Demographic and Employment Profile of Perishable Crop Farmworkers (DL Report No.1). Washington, DC: Office of Program Economics, Office of the Assistant Secretary for Policy.

Department of Labor. 1988. Occupational Injury and Illness Incidence Rates by Industry. Monthly Labor Review: 118-19.

EPA (Environmental Protection Agency). 1990. Reducing Risk: Setting Priorities and Strategies for Environmental Protection. September 1990 report of the Science Advisory Board.

_____. 1992. Hired Farmworkers: Health and well-being at risk. Washington, D.C. U.S. General Accounting Office.

_____. 1993. The Worker Protection Standard for Agricultural Pesticides—How to Comply: What employers need to know. Washington, D.C.: U.S. Government Printing Office Superintendent of Documents.

_____. 1994. Protect Yourself from Pesticides- Guide for Agricultural Workers. Washington

D.C.: U.S. Government Printing Office, Occupational Safety Branch.

Featherman, David Lee and Gillian Stevens. 1982. A Revised Socioeconomic Index of Occupational Status: Applications in analysis of sex differences in attainment. In Mary G. Powers (ed.) Measures of Socioeconomic Status, Current Issues, pp. 83-127. Boulder, CO: Westview Press.

Giddens, Anthony. 1983. Profiles and Critiques in Social Theory. Berkeley: University of California Press.

Gold, E. and L. Gordis. 1979. Risk factors for Brain Tumors in Children. American Journal of Epidemiology 109: 309-319.

Goldsmith, M.F. 1989. As Farmworkers Help Keep America Healthy, Illness May Be Their Harvest. Journal of the American Medical Association 261: 3207-3213.

House, J.S.; R.C. Kessler and A.R. Herzog. 1990. Age, Socioeconomic Status, and Health. The Milbank Quarterly 68: 383-411.

Lowengart, R. and J. Peters. 1987. Childhood Leukemia and parents' occupational and home exposures. Journal of the National Cancer Institute 79(1): 39-46.

MCSSA (Michigan Commission of Spanish Speaking Affairs). 1995. Michigan's Hispanic Community: A profile. Lansing, MI: Department of Civil Rights.

Meister, J.S. 1991. The Health of Migrant Farmworkers. Occupational Medicine: State of the Arts Reviews 6: 503-518.

Montejano, David. 1992. Anglos and Mexicans in the Twenty First Century. JSRI Occasional Paper # 3. East Lansing: The Julian Samora Research Institute, Michigan State University.

Moses, M. 1989. Cancer in Humans and Potential Occupational and Environmental Exposure to Pesticides. American Association Occupational Health Nursing Journal. 37:131-136.

Paredes, Americo 1993 Folklore and Culture on the Texas-Mexican Border. Austin: Center for Mexican American Studies, University of Texas.

Rochin, Refugio and Marcelo E. Siles. 1994. Michigan's Farmworkers: A status report on employment and housing. Statistical Brief #2. East Lansing: The Julian Samora Research Institute, Michigan State University.

Rust, George S. 1990. Health Status of Migrant Farmworkers: A literature review and commentary. American Journal of Public Health 80(10): 1213-1217.

Scott, James C. 1985. Weapons of the Weak: Everyday Forms of Peasant Resistance. New Haven: Yale University Press.

Sakala, C. 1987. Migrant and Seasonal Farmworkers in the United States: A review of health hazards, status, and policy. International Migration Review 21: 659-687.

Schwartz, D.A. and J. P. LoGerfo. 1988. Congenital Limb Reduction Defects in the Agricultural Setting. American Journal of Public Health 78:654-657.

Stenzel, P.L. 1991. Right-to-know Provisions of California's Proposition 65: Naivete of the Delaney Clause Revisited. Harvard Environmental Law Review 15: 493-528.

Terris, M. 1990. Public Health Policy for the 1990s. Annual review of Public Health 11: 39-51.

Torres, Roberto E. 1990. Health Status Assessment of Latinos in the Midwest. JSRI Working Paper #5. East Lansing: The Julian Samora Research Institute, Michigan State University.

Van Gennep, A. 1960 The Rites of Passage. Chicago: University of Chicago Press.

Vaughan, Elaine. 1995. The Socioeconomic Context of Exposure and Response to Environmental Risk. Environment and Behavior 27(4): 454-489.

Wilk, V.A. 1986. The Occupational Health of Migrant and Seasonal Farmworkers in the United States. Washington, DC: Farmworker Justice Fund.

Williams, D.R. 1990. Socioeconomic Differentials in Health: A review and redirection. Social Psychology Quarterly 53:81-99.

Table 1. Description of people drawn in the sample (N = 188)

Characteristic	Mean ± s.d., or [median] and (range) or percentage
Age (years)	31.7 ± 10.5 (18 to 64)
Gender	69.7% men 30.3% women
Education	
Grades completed, those who attended school in:	
United States	9.6 ± 3.0
Mexico	5.6 ± 3.0
All participants	6.4 ± 3.8 (0 to junior year in college)
Where educated[1]	
United States	29.2%
Florida	4.3%
Michigan	3.7%
Texas	20.2%
Mexico	62.2%
Place considered to be home[2]	
Florida	16.5%
Michigan	13.8%
Texas	31.4%
Mexico	31.0%
Ethnicity, Latino	99.5%
Language of questionnaire chosen by participant:	
English	20.2%
Spanish	79.8%
Living with family members when interviewed	70.2%
Work experience in farming	
Working by hand in the fields is their main job	92.6%
Pesticide handlers	17.6%
Had worked at the current farm in a previous year	62.2%
Number of years had worked on farms in Michigan	5.5 [4] (0 to 35)
Percent who had worked:	
0 years (it was their first year)	6.9%
1 to 6	62.9%
7 to 35	30.2%
Total	100.0%
Farm work in other states	
Farm work outside Michigan	75.0%
In California	9.6%
In Florida	35.1%
In Texas	23.9%
Total number of states other than Michigan	30 (0 to 7 states per worker)
Work other than farm work, previous year	35.7% (69/188, 7/9/97)
Trained in pesticide safety	71%

[1] Responses total more than 100% because some attended school both in Mexico and the United States.
[2] Responses total more than 100% because 2% mentioned two places as home.

Table 2. Characteristics of farmworkers in different parts of the migrant stream

Characteristic	Mean ± s.d., [median] or percentage			
	Florida (n = 29)	Mexico (n = 44)	Michigan (n = 21)	Texas (n = 52)
Age (years)	31.0 ± 10.9	28.8 ± 9.2	36.4 ± 11.0	34.2 ± 11.8
Gender, men	31.0%	95.5%	47.6%	57.7%
women	69.0%	4.5%	52.2%	42.3%
Education (grades completed)	5.89 ± 4.1	5.6 ± 2.9	6.2 ± 4.0	7.9 ± 4.0
Language of questionnaire chosen by participant:				
English	20.7%	2.3%	14.3%	42.3%
Spanish	79.3%	97.7%	85.7%	57.7%
Living with family members when interviewed	89.7%	29.5%	85.7%	98.1%
Work				
Number of years had worked on farms in Michigan	5.5 [3]	2.8 [1]	6.7 [5]	8.0 [5]
Worked at the current farm in a previous year	51.7%	40.9%	90.5%	82.7%
Work experience in farming in other states, average number of states	1.4 [1]	1.8 [1]	0.7 [0]	1.0 [1]
Pesticide experience, training, and knowledge				
Trained in pesticide safety	72.4%	70.5%	95.2%	78.8%
Exposed to pesticides	48.3%	54.5%	42.9%	23.1%
General knowledge	11.7 ± 2.3	11.6 ± 2.8	11.5 ± 3.5	11.2 ± 2.9

Table 3. Pesticide safety knowledge, farmworkers (N = 155)

Questions	Distribution of responses to questions mean ± s.d. or %
1. Familiar with the term, "pesticide"	85.7%
2. Where can pesticides be found? (percent responding "yes")	
a. On plants in the field	92.3%
b. In the soil	75.5%
c. On work clothes	81.9%
d. On work equipment	62.6%
3. When working in areas where pesticides have been applied, I often or always:	
a. wash hands before eating	91.3%
b. wear freshly laundered clothes to work	98.0%
c. wash work clothes separately from other clothes	94.0%
d. wash hands before going to the toilet	72.7%
4. Number of symptoms known that can indicate pesticide poisoning	1.9 ± 1.4
Most listed symptoms*:	
Stomach problems	53.5%
Dizziness	32.3%
Headaches	31.6%
Skin irritation	25.2%
Pain	16.8%
Tiredness	9.7%
Trouble breathing	6.4%
Drooling	5.8%
Muscle pains	3.9%
Other (psychological changes, sweating, pupil changes, etc.)	14.2%
5. In general, how safe is it to work with pesticides?	
Very safe	5.2%
Somewhat safe	9.0%
Somewhat dangerous	36.8%
Very dangerous	38.7%
Don't know	10.3
6. Had been exposed to pesticides (n=155 farmworkers)	40.6%
a. on the skin	19.4%
b. actions taken, average of 4 points possible	0.83 ± 0.65
c. in the eyes	4.5%
d. actions taken, average of 3 points possible	0.71 ± 0.49
e. had breathed them in	33.5%
f. actions taken, average of 2 points possible	0.35 ± 0.48
g. had swallowed them	0.0%
7. Among those who had been trained, number of actions to take in case of exposure to pesticides (n = 110):	
a. if on his/her skin (5 points possible)	1.37 ± 0.70
b. if in his/her eyes (6 points possible)	1.16 ± 0.72
c. if breathed them in (4 points possible)	0.49 ± 0.55
d. if swallowed them (5 points possible)	0.57 ± 0.64

* percentage reflects people listing each symptom

Table 4. Construction of the variables measuring knowledge of pesticides

Variables and survey questions	Possible points
A. General knowledge of pesticide safety	
1. Are you familiar with the term "pesticide"? "Yes" =	1 point
2. Where can you come into contact with pesticides: On plants in the field? In the soil? Harvesting fruits and vegetables? In irrigation water? On work clothes? On work equipment? (6 questions, each "yes" = 1 point)	6 points
3. Which of the following do you do when working where pesticides have been applied? (4 questions on a scale, each "often" or "always" = 1 point)	4 points
4. What are the symptoms of pesticide poisoning? (12 possible, each "yes" = 1 point)	12 points
5. In general, how safe is it to work with pesticides? "somewhat dangerous" or "very dangerous" =	1 point
Total possible	24 points
B. Knowledge about dealing with pesticide accidents	
What did the training recommend you do if you:	
1. Get pesticides on your skin (5 actions were taught, each one mentioned = 1 point)	5 points
2. Get pesticides in your eyes (6 actions were taught, each one mentioned = 1 point)	6 points
3. Breathe in pesticides (4 actions were taught, each one mentioned = 1 point)	4 points
4. Swallow them (5 actions were taught, each one mentioned = 1 point)	5 points
Total possible	20 points

Table 5. Composite Variables on Knowledge about Pesticide Safety

Composite variables	N, Farmworkers	Distribution of responses to questionnaire items: mean ± s.d.
Variables dealing with knowledge and experience in pesticide safety		
1. General knowledge of pesticide safety among farmworkers (of 24 points total)	155	11.5 ± 2.8
2. Knowledge about dealing with pesticide accidents among trained workers (of 20 points total)		
Trained farmworkers	110	3.6 ± 1.6
Pesticide handlers	31	3.5 ± 1.6

Table 6. Level of training and amount of general knowledge about pesticide safety, all survey participants, analysis of variance

	General knowledge of pesticide safety		
	N	Mean ± s.d.	(Range)
Untrained farmworkers	45	10.4 ± 3.3	(3-16)
Trained farmworkers	110	11.9 ± 2.4	(4-17)
Pesticide handlers	33	13.0 ± 2.3*	(9-18)
total	188	11.8 ± 2.8	(3-18)

* In a one-way analysis of variance, the F = 9.66; Significance = 0.000

Table 8. General knowledge about pesticide safety and characteristics of farmworkers, analysis of variance

Characteristic	General knowledge of pesticide safety (N = 155)		
	N	Mean ± s.d.	(Range)
Has worked on farms in Florida in the last year?*			
No	95	11.1 ± 3.0	(3-16)
Yes	60	12.1 ± 2.4	(7-17)
Has done farm work only in Michigan**			
No	120	11.8 ± 2.5	(3-17)
Yes	35	10.4 ± 3.3	(4-16)
Attended school in Mexico*			
No	61	10.9 ± 2.9	(3-16)
Yes	94	11.9 ± 2.6	(4-17)
Language of questionnaire***			
English	32	9.8 ± 3.3	(3-16)
Spanish	123	11.9 ± 2.5	(4-17)
Exposed to pesticides*			
No	92	11.1 ± 2.7	(4-16)
Yes	63	12.1 ± 2.8	(3-17)
Trained farmworkers**			
No	45	10.5 ± 3.1	(3-16)
Yes	110	11.9 ± 2.6	(4-17)
Trained farmworkers only (N = 110): Exposed to pesticides (n.s.)			
No	65	11.7 ± 2.5	(4-16
Yes	45	12.4 ± 2.2	(4-17)

Differences are statistically significant at the following levels:
n.s. results not statistically significant
* $0.01 < p \leq 0.05$
** $0.0001 < p \leq 0.01$
*** $p \leq 0.0001$

Table 9. Farmworkers' characteristics related to general knowledge of pesticide safety, regression

Variables	B ± s.e.	Beta	T	Sig T
Language of questionnaire Spanish (+)	0.399 ± 0.133	0.234	3.007	.003
Received training	1.330 ± 0.467	0.219	2.847	.005
Exposures to pesticides	0.607 ± 0.269	0.173	2.260	.025
Constant	8.193 ± 0.734		11.160	.000

Multiple r=0.404; r square = 0.163; adjusted r square = .146; F = 9.471; signif. = .000

Table 10. Trained Farmworkers' knowledge about dealing with pesticide accidents, analysis of variance

Characteristic	N	Knowledge from Training (N = 110) Mean ± s.d.
Worked at the current farm last year*		
No	40	3.1 ± 1.6
Yes	70	3.9 ± 1.6
Number of jobs outside farm work in the past year**		
None	72	3.2 ± 1.4
One	32	4.3 ± 1.9
Two	5	4.6 ± 1.1
Living with family*		
No	27	3.0 ± 1.5
Yes	83	3.8 ± 1.7
Home country is United States		
No	32	3.0 ± 1.4
Yes	78	3.8 ± 1.7
Home state is Texas**		
No	71	3.3 ± 1.5
Yes	39	4.1 ± 1.8

n.s. results not statistically significant
* $0.01 < p \leq 0.05$
** $0.0001 < p \leq 0.01$