

worker's ability to pursue collective solutions to health and safety problems and dissipate the collective confidence gained in a course such as ours.

We believe this kind of training is more effective where workers are supported and represented by an active and committed trade union—one that takes health and safety seriously. Health and safety training of this type also requires that government regulatory bodies (such as OSHA and various state agencies) pursue an active and interventionist strategy in American workplaces. Regulators should advise and provide information to employers, require and insure quality training programs for workers, and seek meaningful punishments for employers who fail to abide by regulations. In short, good training must be combined with strong government regulation that protects workers from health and safety hazards and empowers them to protect themselves without fear of reprisal.

Therefore, the sense of empowerment is fragile. Its fragility raises questions about the wider claims of empowerment made for this form of education in the arena of health and safety training. We feel, however, that it would be absurd to claim that a 1-week health and safety course could possibly lead to major changes in the workplace. Nor could a course motivate individuals to seek those changes, without a regulatory and workers' organizations committed to the protection of worker health and safety.

Last, but not least, we have found that the quality of the teaching materials and of the instructors are absolutely crucial. Written materials and any visual aids should be of the highest technical quality, and easily accessible to the nonspecialist and those with limited literacy skills. The instructors in courses such as ours are pivotal. Without teachers who are well-versed in empowerment training, confident in their skills and abilities, sensitive to the needs of students, and committed to worker education, no training course built on empowerment beliefs and using learner-centered techniques can ever hope to be anything more than a shallow imitation of true empowerment education.

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Problem-Solving in the Fields: An Action-Oriented Approach to Farmworker Education About Pesticides

Merri Weinger, MPH, and Mark Lyons, PA, MPH

This paper describes two educational programs initiated to address the problems of farmworker pesticide poisoning in Nicaragua and in the United States and Puerto Rico. Both programs utilize a participatory and action-oriented educational methodology known as popular education. The methodology is presented using examples to demonstrate its application to the planning, delivery and evaluation of pesticide education programs. Preliminary outcomes of using this methodology are also explored as well as implications for developing future training programs in the field. © 1992 Wiley-Liss, Inc.

Key words: popular education, health and safety training, health education, empowerment education

INTRODUCTION

In a community near Leon, Nicaragua, a 15-year-old boy was applying methyl parathion to his father's small parcel of cotton, using a backpack sprayer. He began to feel nauseous in the morning. When he returned home at the end of the day, he still felt ill and went to bed. By the time his father got home that evening, the boy was dead.

Forty farmworkers were working in a peach orchard in New Jersey, when they were sprayed by pesticide drift from a tractor rig in the next row. The foreman ordered them to continue working, and no handwashing facilities were provided for them to wash the pesticides off their skin. That evening most of them developed eye irritation, skin rashes, and a cough. Some developed difficulty breathing. They never learned the name of the pesticide that was used.

These are not uncommon stories. In Nicaragua, the incidence of human pesticide poisoning and deaths is one of the highest in the developing world. Historically, pesticide use in Central America has been concentrated in cotton production, and, as

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the region's leading cotton grower, Nicaragua has used the most pesticides—with dramatic consequences for the human population and the environment. Studies in the United States indicate that as many as 300,000 farmworkers are poisoned by pesticides each year [Wassertstom and Wiles, 1985]. Several studies indicate that over 40% of all farmworkers in the United States have been sprayed directly or by drift [Mentzer and Villalba, 1988; Florida Rural Legal Services, Inc., 1980; Sa-Lantic Health Services, Inc., 1984], and less than 16% of farms provide sanitary facilities in the fields as required by law [Lyons, 1991; Sweeney and Ciesielski, 1990].

This article examines two educational programs initiated to address the problem of farmworker pesticide poisoning, one in Nicaragua and the other in the United States and Puerto Rico. In 1985, Nicaragua launched a multidisciplinary pesticide health and safety project involving several governmental ministries, the largest farmworker organization, and the small farmers union. The project was financed by Nicaraguan, Canadian, and Norwegian government funding with assistance from several private voluntary organizations, including CARE Nicaragua, the American Friends Service Committee, and Oxfam. In addition to a strong educational component, the project developed improved methods to mix and load pesticides, a medical monitoring plan to screen workers for overexposure to pesticides, and a system to collect data for epidemiological investigation [Weinger, 1989].

The educational goals of the Nicaraguan program were to develop curricula and materials on pesticide health and safety and use them to train farmworkers and potential farmworker trainers (educators and physicians from the Ministry of Health, educators and inspectors from the Ministry of Labor, technicians, and union representatives). The project began by training trainers who then participated in farmworker training in the field. The educational activities described in this article were part of a 2-day training program which was conducted on-site for workers with potential exposure to pesticides on state and cooperative farms. These included storekeepers, mixers, loaders, applicators and those who washed the farmworkers' clothes.

The team of trainers was composed of representatives from the voluntary organizations, the Ministries of Health and Labor, and the agricultural workers union. To initiate the program, representatives from the union and voluntary organizations travelled to each farm to inform employers about the program and organize their participation. Training sessions were scheduled on Fridays and Saturdays for groups of about 30 workers who were paid for their attendance.

The second pesticide education program was sponsored by CATA (El Comité de Apoyo a los Trabajadores Agrícolas, or Farmworkers Support Committee), a grassroots farmworker organization which has worked in New Jersey, Puerto Rico and Pennsylvania since 1979, concentrating on farmworker organizing, advocacy, education, and social service. The CATA Pesticide Project, initiated in 1989, had six components which were integrated into a "campaign" to protect farmworkers from exposure to pesticides: 1) leadership development; 2) farmworker and health provider education; 3) legislative lobbying; 4) enforcement of existing laws; 5) coalition-building to achieve organizational goals; and 6) sharing of skills and resources with other farmworker organizations.

The CATA Pesticide Project hired and trained farmworkers to be pesticide educators. The contents of the pesticide training were developed in focus groups

which included farmworkers, the pesticide educators and other CATA staff. The educators developed a 1-hour training which could be done by a single trainer, and also developed a theater production which had a script and required four "actors." The style and contents of the training were refined over a 2-year period, through interviews with farmworkers who participated in the training, and critique and analysis by the educators and other CATA staff.

Although these two educational programs took place in different contexts, they were similar in many ways. They shared the objectives of teaching farmworkers about the hazards and safe use of pesticides, as well as empowering them to take preventive and protective action on the job. Both trained "multipliers"—farmworkers and other resource people—who in turn provided information and training to the target population. Trainers' manuals were developed in both programs after extensive fieldtesting. Training topics included the health effects of pesticides; symptoms of pesticide poisoning; routes of entry; how to prevent exposure; emergencies and first aid; worker rights and resources; and a problem-solving component which analyzed the obstacles to working safely and how to resolve them. For example, participants in the CATA program discussed how to file complaints without risking job loss, while Nicaraguan workers came up with strategies to address the shortages of personal protective equipment. The educational framework which was utilized is known as popular education, and has its roots in the methodology and philosophy of the Brazilian educator, Paulo Freire [Freire, 1970].

THE PRINCIPLES OF POPULAR EDUCATION

The methodology which shaped these programs, known as popular education, was a hallmark of Nicaraguan initiatives in health and education in the 1980s. The word "popular" derives from the urban and rural poor communities which form the "popular" base in Latin America, where this educational philosophy originated. Popular education is founded on the assumption that education is most effective when it 1) is based on real life experiences of the participants, and placed within the social reality of their lives; 2) draws on fears, feelings, and concerns which might be barriers to action, since people are more inclined to act on issues they feel strongly about; 3) incorporates dialogue between the teachers and students, in which they learn together, and the knowledge and experience of the students is the foundation for learning; 4) involves active participation of students in all phases of the learning process, including needs assessment, training, and evaluation; 5) is nonhierarchical, in which the teacher promotes dialogue and trust that help the group define problems, identify their causes, and develop action strategies; and 6) has as the ultimate goal, empowerment of the participants to make changes in their lives and the society at large [Weinger and Wallerstein, 1990].

NEEDS ASSESSMENT

The first step in these popular education programs was the needs assessment using various strategies described below. This was the "listening phase" of popular education, which identified problems and obstacles to effective change, recognized factors which were conducive to change, defined values and beliefs held by the

farmworkers, and identified specific hazardous exposures and experiences which needed to be incorporated into the training.

The Walkthrough

In Nicaragua, the project team visited cotton farms to observe work practices and sources of worker exposure to pesticides. Photographs were taken of the work environment and work practices for documentation, analysis, and discussion during the training. The team also listened for emotional issues which might be barriers to action: worker frustration with inadequate personal protective equipment, lack of soap and water, or lack of safe alternatives to currently used pesticides.

Mapping

In Pennsylvania, CATA Project staff met with a group of mushroom workers to learn of the complicated steps of mushroom production and the hazards they faced. Each step of the growing process was written on a separate sheet on the wall, then chemical and physical hazards to workers were listed under each step in which they occurred. The farmworkers then identified the steps and hazards they felt were most dangerous, which were listed as priorities to be incorporated into the training.

Focus Groups

In New Jersey, Project staff met with focus groups of three to eight workers, to determine the essential contents of the training program for fruit and vegetable workers. Originally the staff had planned to include reading the pesticide label as part of the "basic training" for all farmworkers. However, the focus groups decided that reading the label should be eliminated from the training, because the labels were in English and too technical, and would be useless for most of the farmworkers who speak and read only Spanish. As a result of these discussions, the New Jersey Pesticide Safety and Right to Know Law, introduced into the state legislature in 1990, included a section requiring growers to distribute fact sheets about every pesticide used on the farm, written on a fourth grade reading level, in Spanish and English.

Informal Discussions

Often, informal discussions and listening in the fields or camps uncovered themes which should be incorporated into the training. In Nicaragua, such discussions revealed that many farmworkers believed that bathing after work caused flu, arthritis, and other maladies. These beliefs were obstacles to improving worker protection, since bathing at the end of the workday is a very economic and effective way to reduce the risk of poisoning after exposure to pesticide residues in the field. Following the listening phase, these key themes were translated into visual images for use in a flipchart and poster, and were incorporated into case studies, puppet shows, and role-plays for analysis by farmworkers. Similar informal discussions in the fields of New Jersey revealed that many farmworkers feared being fired if they asked for information or filed a complaint. A discussion of these fears, and possible ways farmworkers could work together and with agencies such as CATA and Migrant Legal Services to protect themselves, were incorporated into the training and written materials.

Farm Surveys

From informal discussions with farmworkers, CATA Project staff identified a consistent lack of field sanitation facilities, including toilets, drinking water cups, and handwashing facilities. A questionnaire was then developed and used to interview workers at 51 farms, revealing that only 16% of the farms complied with existing field sanitation regulations. Consequently, a specific section on field sanitation was incorporated into the pesticide training program. Based on this experience, CATA later developed a second questionnaire used to interview focus groups of farmworkers. The interviews identified problems related to health and safety, housing, wage violations, immigration, and the need for social services. The workers then determined which problems were priorities, and CATA provided educational programs and organizing support to address their identified needs.

Setting the Agenda

At the beginning of the training session, it is important for the workers to define what they want to learn, rather than the trainer presenting a pre-set agenda. In the CATA Project, a large plastic container labelled with a skull and cross-bones was presented to the group, and the contents were described as a very poisonous chemical which they work with all day. The workers were asked what they needed to know about the pesticide, in order to protect themselves. The responses were written on a large paper sheet, which became the agenda and was referred to throughout the training.

TRAINING METHODS

The next step in the training process was to identify the content areas to be covered utilizing information gained from listening to workers, and then to select appropriate training methods. The criteria for incorporating a particular method included the training goals and objectives and the extent to which the method was in keeping with the principles of popular education. The training in both projects had four objectives: providing information; identifying and changing attitudes/emotions; promoting healthy behaviors; and developing action/problem-solving skills. What follows are examples of methods grouped under the objective which they best achieved.

Methods for Information Objectives

Information objectives include the knowledge that participants will gain as a result of the training.

Theater. CATA often used theater as a teaching tool. Farmworker camps in New Jersey and Puerto Rico became a stage set with props, and trainers became actors with a set script. Farmworkers were asked to participate in the scene, and dialogue with the audience occurred. In one example, farmworkers analyzed the routes of entry of pesticides into the body and hazards of residue exposure. As the scene opened, the "farmer" (a trainer) asked a farmworker from the audience to come up and pick fruit from a papier-maché tree covered with fruits and giant insects. The "farmer" noticed the insects, exited, and returned dressed in a flyer's cap and goggles and sprayed the crop as well as the farmworker. The "pesticide" (a second trainer) entered dressed

in a black cape and a vegigante mask (the traditional papier-maché mask found in Puerto Rico) shaped in the form of a skull and crossbones. The "pesticide" engulfed the farmworker in his cape and asked the audience how pesticides enter the body. Following a discussion of routes of entry, the "pesticide" covered the fruits with talcum powder, and asked the farmworker to pick an apple. The powder which fell on the farmworker's hands and clothing was used to initiate a discussion of pesticide residues. The scene ended with a dialogue between the "pesticide" and the audience about how workers can protect themselves.

Planning deck. The planning deck was a game which involved participants identifying and ordering the components of a task or procedure to be learned. In Nicaragua, a training goal was to empower farmworkers to conduct pesticide inspections where they worked. To prepare for the activity, trainers listed each step in conducting an inspection on a large card. Multiple decks were then created to allow for working in teams. In the class, teams were asked to reach a consensus on the steps following the lifecycle of a pesticide in the workplace. The first team which considered its deck to be well-ordered explained its inspection approach to the group. Groups with a different order justified their positions, followed by discussion and confirmation of a desired order for the inspection.

Methods for Attitude-Emotion Objectives

Attitudes and emotions may effectively block learning and influence how health and safety practices are implemented back on the job.

Scripted role-play. In the CATA training, a scripted role-play was used to explore attitudes and trigger discussion of the problems of exposure to pesticides. The following script was given to three workers, who read their roles to the entire group.

Antonio: Look at this rash on my hands. It started yesterday after working in that field that was sprayed. We've got to do something before these pesticides cause us some real problems.

Raul: Take it easy. I bet that rash was caused by the tomatoes we were picking, not pesticides.

Jorge: I'm with Antonio. I think it's the pesticides, but I'm not going to stick my neck out. I came here to work and send money home, not to get myself fired.

Antonio: Well, what if we got together and filed a complaint?

Jorge: What good would it do? The agencies are all in bed with the farmers anyway.

In the the discussion which followed, the facilitator asked the group if they shared any of the attitudes expressed by the farmworkers in the role-play, about obstacles they had identified to resolving the problems portrayed, and strategies for overcoming them.

Worksheet questionnaire. In addition to serving as an excellent discussion starter and providing factual information, a questionnaire can also be a vehicle for eliciting attitudes. Sample questions for a farmworker group in Nicaragua were:

1. Drinking milk before work is effective in preventing pesticide poisoning.

Agree

Disagree

All pesticides have the same effect on your health.

Agree

Disagree

A discussion of attitudes was encouraged by inviting participants with conflicting viewpoints to present and justify their opinions. Rather than affirming the "correct" answer, the instructor acknowledged useful elements in the variety of attitudes that were expressed.

Methods for Behavioral Skill Objectives

Behavioral skills are the desired competencies that workers will acquire as a result of training. The most effective way to achieve objectives for behavioral skill development is to provide participants with opportunities to practice in the class, to see an activity in the class, and to perform it.

Demonstrations

Personal protective equipment demonstration. CATA originally used a flip-chart to discuss safe work clothing, asking the group to analyze the drawing of an inappropriately dressed farmworker working in the field. More recently, CATA trainers shifted their approach to make the program more theatrical. A similar "scene," representing the farm workplace, was set by stretching a clothesline in front of the group, hung with an array of appropriate and inappropriate clothing. The trainer (dressed as a farmer) asked for a volunteer from the audience to work on his farm. The farmworker was told to get dressed for work and reminded that it would be 90°F that day. The farmworker chose clothing from the line, put it on, and the audience was asked to comment. A discussion followed concerning appropriate protective clothing, exposure to residues, attitudes about wearing different clothing, and alternatives to uncomfortable clothing.

Hands-on practice. Both trainers and farmworkers in Nicaragua learned to interpret pesticide labels by reading them in small groups during the class. In this activity, the class was divided into groups and given the task of reading different labels as a group. For low-literacy groups, volunteer participants were recruited to read the label aloud and lead their group through a worksheet questionnaire on the label which emphasized visual cues to determine the level of toxicity. Back in the large group, volunteer spokespeople introduced their pesticide to the group with instructions for potential users.

Methods for Action/Problem-Solving Objectives

A primary goal of popular education about pesticides is to provide farmworkers with the information and skills to make changes back on the job. The training session is used to pose problems or potential obstacles to change. These problems are learned during the needs assessment or listening phase then translated into triggers or discussion starters for analysis by the group. A discussion trigger can take any form: a role-play, picture, case study, a song. To lead a dialogue or a trigger, there is a five-step questioning process which invites participants to identify the problem, project themselves into the situation being presented, share their personal reactions, analyze the causes of the problem, and suggest action strategies [Weinger and Wallerstein, 1990].

Flipchart. In Nicaragua, the project staff needed visual education tools which were easily portable and independent of electricity for use during field training or with

medical screening on the farms. A flipchart was designed and then assembled by participants in one of the train-the-trainer workshops. The flipchart included 18 drawings which were designed for use as discussion starters. Each picture had specific objectives and key questions that were outlined in an accompanying guide for instructors.

The flipchart could be used both to provide information and to promote problem analysis leading to action planning. For example, Drawing 1 was used to provide information on the routes of entry by asking "How do pesticides enter the body?" To generate analysis of the problem of pesticide poisoning, the instructor would ask participants: "What's happening here? Is this scene familiar? Why does this occur?" If lack of gloves were mentioned, the instructor would proceed with, "Why isn't he wearing gloves? What can he (you) do about it?"

Pictures are most effective when they mirror the reality of the learners. Participants are more likely to analyze and identify with situations that portray scenes, actions, and characters that are similar to themselves. Drawing 2 was inspired by a photograph of two children bathing in an old pesticide barrel, a familiar scene in Nicaragua. The introduction of two or more people into a drawing (Drawing 3: two people entering a recently sprayed field) encourages discussion of suspected motivations and feelings. "Why is she reading the sign? Why did he go right in?" With effective visual images, the same picture may trigger a variety of discussions, depending upon the group.

Modelled after the Nicaraguan program, similar flipcharts were developed by the CATA Project for fruit/vegetable and mushroom workers. Although pictures should ideally be tailored to the target population, many of the pesticide scenes can be generalized. The Nicaraguan flipchart has been used effectively with farmworkers in Ecuador and California.

Slides. Slides which portray familiar images or problems were used in the same way as the flipchart. Using photos taken during the needs assessment phase in Nicaragua, a slide show was created following the path of pesticide use from selection and purchase to disposal and clean up at the end of the work day. To encourage dialogue, a script was developed in a chart-like form with four headings: **Slide** (including a description of the slide); **Theme** (the topic for discussion, e.g., pesticide storage); **Question** (e.g., What do you think of this storeroom? Have you seen storerooms that looked like this?); and **Text** (the content to be covered for this theme, e.g., guidelines for proper storage). The role of the facilitator was to listen to all participant observations, clarify areas of uncertainty, and summarize the principal points for each theme. If the content was well expressed by participants, the facilitator simply affirmed the correct response and continued.

Case studies. Cases were drawn from real and familiar situations that occurred in Nicaragua and the United States and problems that were identified in the planning process. If multiple cases were used in a training session, they most commonly illustrated problems such as employer noncompliance, worker noncompliance with safety precautions within their control, and the dilemma of a worker with symptoms that may be related to pesticide exposure. For example:

Several workers from Juan Garcia's farm were taken to the hospital suffering from pesticide poisoning. They had been applying Furadan by hand without using any protective equipment. Some were barefoot.

An investigation of the case revealed that their employer had never provided the necessary equipment for the workers. Soap and showers were also unavailable.

Those who were poisoned had left the field to eat their lunch without washing their hands. The workers had requested protective equipment on many occasions but their employer responded that it was too expensive and he couldn't afford it.

Participants read the case in small groups and responded to a series of questions such as: What are some of the causes of this pesticide poisoning incident? Who's benefiting? Who's being harmed? What steps would you take to prevent a similar problem in the future? CATA used a similar questioning process following theater productions and scripted role-plays, which like case studies, created situations which were used to depict obstacles to working safely for analysis by the group.

Face the people ("De Cara al Pueblo"). Essential to problem-solving in pesticide health and safety is the ability to present the problem effectively to employers and resource people, to request specific changes, and to negotiate workable solutions. In Nicaragua, the Sandinista government established a tradition of town meetings in which community people met with their elected representatives and agency officials to air grievances about government programs and offer opinions about problems or new community needs.

This type of meeting, known as "De Cara al Pueblo," was recreated during the training session by inviting representatives from management, the union, and the Ministries of Health and Labor to meet and confer with the farmworkers. During the training, workers drew from the problem analyses conducted during the training to pose their most pressing problems and suggested solutions. One outcome of these sessions was negotiated agreements for follow-up activities between representatives of the union and the state enterprises. Another positive outcome was the opportunity for workers to practice confronting authority figures collectively in a relatively non-threatening environment to negotiate for safer working conditions.

DEVELOPMENT OF EDUCATIONAL MATERIALS

In keeping with the principles of popular education, the educational materials were developed in these projects with active involvement of farmworkers, trainers, and resource people. Based on the needs assessment, an effort was made to portray key problems and concerns with images which fit the culture and traditions of the community, and were specific to the farmworkers' work environment.

Local artists, familiar with community issues and key cultural images, visited farms and illustrated flipcharts, comic books, and posters. One artist sculpted a traditional vegigante mask, worn during carnival in Puerto Rico, to represent the evil pesticide in the CATA educational program. Focus groups of farmworkers in New Jersey and Puerto Rico met with the artist and project coordinator to develop the story line and drawings of the pesticide comic book; trainers in Nicaragua created their own flipcharts, posters, puppet shows and games for use in their communities; the Agricultural Workers Union in Nicaragua designed a poster using photographs of farmworkers to tell the story of pesticide poisoning and how to prevent it.

Finally, the materials were field-tested in individual and group interviews to

assure effectiveness, and revisions were made before the final versions were used in pesticide trainings.

EVALUATION

To what extent did these educational programs meet their objectives? Was the use of popular education methodology instrumental in determining the outcome of the programs? These are some of the questions the projects attempted to answer in their evaluation, which was incorporated into the planning process, the training sessions, and the assessment of outcomes.

Evaluation of Information Objectives and Training Process

During the training sessions, both programs did formal and informal evaluations, and made refinements in the program based on what was learned. Post-tests were administered, and participants were interviewed to measure information objectives and opinions about the training. In the CATA Project an evaluation checklist was developed by the educators to give each other constructive feedback on the content and process of the training, including audience participation, dialogue between trainer and students, and identification of problems.

In Nicaragua, a simulated TV game show was used to evaluate information objectives during the training, and was especially useful when participants had limited literacy skills. The instructor prepared a series of questions and case studies which reviewed principal messages in the training (e.g., "Name the ways pesticides enter the body," or "You observe your co-worker smoking in the field, and not using protective equipment—what do you do?"). The class was divided into small groups. Acting like a TV commentator, the instructor used a (tin foil) microphone to direct a question to each group. The instructor then asked the other groups if the response was correct or incorrect, and they had the opportunity to respond to incorrect answers. The group that got the greater number of questions right was the winner.

Evaluation of Behavior Change and Increase in Worker Activism

Outcome measures in both programs were aimed at evaluating the impact of the training on farmworker behaviors to prevent exposures to pesticides, on farmworker activism to promote changes in working conditions, and on the incidence of pesticide poisoning. These measures were more difficult to assess with the tools currently available in the field of evaluation research. For example, CATA's pesticide training was not isolated from other elements of their campaign to protect workers from pesticides, such as field sanitation surveys, legislative and enforcement strategies, and leadership training. Given that education was integrated into other elements of the pesticide program, it was difficult to attribute activities such as participating in hearings or filing complaints solely to the formal pesticide training.

There was, however, suggestive evidence in both programs of a correlation between training and subsequent outcomes. In Nicaragua, the more quantitative measure of program impact on incidence of pesticide poisonings emerged from the medical surveillance component of the project. The study included cholinesterase monitoring (an indicator of exposure) accompanied by a detailed questionnaire which addressed illness history, work practices, and whether training had been received. The amount of potential exposure was assessed using the weight of organophosphates

applied during the 2 weeks prior to the study. An analysis of the results showed a statistically significant correlation between training and the likelihood of having a depressed cholinesterase level, indicative of exposure to pesticides. Although baseline cholinesterase levels were unavailable, the study demonstrated that workers with prior training had cholinesterase activity 0.83 I.U. (95% C.I. 0.30, 1.36) higher than untrained workers, when controlling for potential confounders such as the weight of organophosphates sprayed, use of protective equipment, use of closed systems for mixing and loading; and access to soap [McConnell, et al., 1990].

Another positive outcome which can be attributed, at least in part, to training was an increase in the level of farmworker activity to effect changes, in response to problems they identified. In New Jersey, 30 farmworkers who had been trained attended a field sanitation hearing, and six testified about unsanitary working conditions in the fields. Six months later, the state government developed field sanitation regulations protecting farmworkers. In another legislative campaign, 20 workers attended the proposed pesticide right-to know law Senate hearings, and three testified. In both cases, local newspaper articles focused on the impact of the farmworkers' testimony.

In New Jersey, another concrete measure of the impact of the pesticide training was the number of farmworkers who filed complaints to enforcement agencies when violations were discovered. On one farm, five farmworkers who were sprayed directly and were fired for filing a complaint, filed a lawsuit and were awarded \$10,000. On another farm, owned by a state senator, 14 farmworkers filed complaints concerning pesticide and field sanitation violations: the farmowner was fined and obliged to take corrective action. In the CATA field sanitation surveys, 42 farms were found in violation. Farmworkers on 13 (25%) of the farms filed complaints requesting agency inspections. Over half of the farms were cited and fined for being in violation, and subsequently made the required improvements. Thus, learning about the hazards of pesticide exposure and their rights under the law had a positive impact on workers' ability to act collectively, and even with a risk of being fired, to effect change in their workplace.

In Nicaragua, the media were used to put the pesticide issue on the public agenda. Widespread concern about the pesticide problem resulted in a coordinated community effort to move an airfield away from the city of Leon. Community pressure resulted in a key meeting of government representatives, the private sector, and unions to discuss the problem.

Recommendations for the Future

In spite of the apparent increase in worker activism following training efforts, CATA staff and farmworker educators felt they could do more in training sessions to encourage such activity. They were critical of their tendency to focus on providing information and identifying problems, rather than on developing collective solutions. The educators sometimes felt that they were merely using interesting participatory training methods while passing up opportunities to organize farmworkers. In late 1991, CATA obtained foundation support for a proposal to train educators and organizers to more effectively identify leaders on the farms, analyze problems, organize farm committees, and develop collective strategies for change. These skills will be incorporated into the training of trainers during 1992.

After the first round of training in Nicaragua, educators were critical of their

lack of follow-up to assess whether workers were implementing changes on the farms and of the lack of emphasis on farm-based committees to coordinate ongoing safety activities. During the second phase of the training, participants were encouraged to form health and safety committees at the end of the 2-day session. These committees became involved in identifying hazards on the farms and proposing remedial actions—an excellent vehicle for institutionalizing post-training follow-up activities.

It would be useful for future training efforts to more effectively measure and document the impact of training on these follow-up activities. For example, trainers could implement pre- and post-training observation of work practices, such as the use of protective clothing, handwashing, or safe mixing and application procedures. Using the CATA experience, evidence of collective action resulting from the training could include numbers of complaints filed, numbers of farm committees formed, or farms providing field sanitation facilities before and after the training. It would also be useful to interview the farmworkers who filed complaints or who participated in public hearings to find out if they could attribute their actions to participating in the educational programs or to some other influence. Likewise, testing cholinesterase levels of participants pre- and post-training could measure the impact of the training on reducing exposure to organophosphate poisoning.

CONCLUSIONS

The success of the popular education approach in Nicaragua's cotton fields, the migrant communities of Puerto Rico, and the fruit and vegetable farms in New Jersey demonstrates its adaptability to a variety of work settings and target groups. In Nicaragua, the institutional structures under the Sandinista government were most supportive of popular education objectives, allowing for greater participation at the local level in effecting changes in pesticide policies and practices. In contrast, New Jersey farmworkers were specifically excluded from the otherwise progressive State Right-to-Know law because of the strong opposition of the Farm Bureau and the Department of Agriculture. Thus, in New Jersey, farmers and state and federal agencies were obstacles to farmworkers gaining a safer workplace, rather than partners seeking solutions.

However, whatever the social context, the ultimate goal of popular education is to empower people to act to improve health and safety for themselves, their co-workers, and their communities. The benefits of this action-oriented approach were not achieved without some level of risk for both trainers and students. As co-learners with the students, the trainers shared control of the training. No longer seen as the expert, the possibility of seeming foolish or experimenting with activities which fail increased. By encouraging workers to pose problems for discussion, trainers also ran the risk of raising issues for which solutions were not readily available. In CATA, trainers were often frustrated by trying role-plays in which no one would play, or attempting dialogues which felt more like monologues, or identifying serious problems during the training and being told by the workers that they would rather risk exposures than risk losing their jobs. Learning to be effective popular educators meant taking these risks, often failing, and gradually developing the skills to facilitate the popular education process.

For trainers and participants to take those risks, they had to develop a trusting relationship with one another. One training session was usually insufficient to de-

velop the necessary trust for farmworkers to strategize with an "outsider" about filing complaints which might jeopardize their jobs. CATA trainers began to think of the training as a series of sessions which moved from providing information and identifying problems to discussing solutions and developing strategies for change. This series might include one or two formal training sessions followed by less formal camp visits. It was also clear that training farmworkers as trainers helped foster trust by decreasing the distance between trainers and participants.

An essential part of the multidisciplinary approach includes training not only farmworkers, but "multipliers" or resource people (clinicians, technicians, inspectors, educators, lawyers, unionists) as well as growers and policy makers. In Nicaragua, the term "multiplier" was used to describe individuals and groups, such as those listed here, who would multiply the impact of the training by serving as information providers and advocates for worker health and safety.

One must be clear, however, that education alone cannot resolve the problems of pesticide use and abuse. A multidisciplinary approach which includes farmworker organizing, legislative and enforcement strategies, engineering controls, medical monitoring, and investigation into alternatives to pesticides is essential to effect comprehensive changes in pesticide practices. Simply understanding the risks without the organizational capacity, and the legal, technical and medical support to prevent them will only lead to increased frustration. In Nicaragua, the multidisciplinary model involved engineering controls, medical surveillance, and the establishment of a pesticide commission to address changes in policy, as well as education. An integrated pest management component was incorporated into the project and into the training efforts to reduce pesticide use and demonstrate alternative approaches to pest control. In the United States, CATA's goal of improving farm sanitation for workers was part of a larger campaign which included training farmworker trainers and health providers, using the media to increase public awareness, conducting formal field sanitation surveys, meeting with state and federal agencies, developing new regulations, and using legal action when enforcement was inadequate.

CATA's and Nicaragua's comprehensive pesticide health and safety programs provided an excellent opportunity to apply popular education to the field of pesticide health and safety. Given that pesticides and the hazards inherent in their use remain an integral part of the agricultural systems of developed and developing countries, and that farmworkers are usually poor and powerless, farmworker protection continues to be an ongoing struggle. Popular education offers an important vehicle for change by providing workers with information to protect themselves and the skills and confidence to take action on what they've learned.

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