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Protective Apparel Survey of Agricultural Workers in Cotton Growing Regions

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Acute and chronic exposure to toxic chemicals is considered a national health problem (Morgan 1980). Increased pesticide usage in recent years parallels increased concern about safe use of agricultural chemicals (Rucker et al. 1988). The pesticide dilemma is that they protect us from insects, weeds, disease and hunger, but some pose a threat to humans and other non-target species. Researchers have studied dermal exposure to pesticides and confirmed that absorption through the skin is a more serious problem than inhalation or ingestion (Wolfe et al. 1972). Clothing choices of workers exposed to pesticides have been studied as a means of offering protection (Laughlin, 1986). Various designs and textile structures have been tested for penetration resistance and repellence, and have been shown to protect the agricultural workers from pesticide exposure (Freed et al. 1980; Orlando et al. 1981).

The overall purpose of this research was to identify roles in pesticide application and to investigate the relationships between roles and attitudes, (i.e. attitudes toward types of clothing and accessories worn for protection, exposure, disposable protective garments and their cost, and extent of toxicity of pesticides) roles and practices, (i.e. mode of application, presence in the sprayed fields, and awareness of pesticide exposure symptoms), and to assess the relationship of the level of education with roles, attitudes and practices. It was believed that climatic conditions, geographical location and types of crops grown might influence the pattern of clothing selection or behavior in management of pests in fields. The information generated from this survey will be of use to the extension service and other agencies in the cotton growing regions, since little is known about clothing patterns of cotton growers and their practices during pesticide usage.

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MATERIALS AND METHODS

A questionnaire was developed based on work by McLellan et al. (1982) on soybean field workers. The questionnaire included demographic information, type and extent of exposure in insecticide-treated fields, habits and attitudes related to protective wear, and types and combinations of garments worn in the field. The questionnaire was booklet form with illustrations. The questionnaire draft was pretested on seven Mississippi State University researchers to evaluate face validity and face reliability. The sample was randomly selected from certified pesticide applicators (Morgan, 1987) residing in the nine Mississippi counties which were identified as highest in quantity of pesticide used (Mississippi Agricultural Statistics Service). Additionally, six Mississippi State researchers who frequently handle pesticides were asked to participate. The survey form was sent during late fall to avoid planting and harvesting season when it was presumed farmers would be busiest. One follow-up was done after initial mailing and a total of 150 questionnaires returned out of 335 were deemed usable (44.8%) though some respondents did not answer all questions.

Frequencies and percentages were calculated for all variables. Cross-tabulations were used to determine relationships among variables. Chi-square analysis was used to test for significant relationships between variables such as education and knowledge and use of protective garments and accessories worn; role in pesticide application and inspection or hours spent in sprayed fields; role in pesticide control and attitude toward disposable protective garment (DPG) and price willing to pay for DPG; the mode of applying pesticides and attitudes toward clothing worn.

RESULTS AND DISCUSSION

Age distribution and the education level of respondents (Table 1) indicate that 59.6% of sample have some college education and 52.9% of respondents were under 44 years of age.

Of the sample (N=136), 58.8% were farmers who had their spraying done by professionals, 13.5% were applicators/ mixers/loaders/scouts and 27.7% were farmers who also have other roles (i.e., they mix, load and apply pesticides themselves). Of the respondents, 66.7% reported being present during spraying of fields. A total of 64% are involved in inspection of sprayed fields. More than half of respondents said they spend 10 hours or less per week in sprayed fields, 26% spend 11-40 hours/week, and 19% spend more than 40 hours a week.

Regarding DPG, 85% had knowledge while 15% had no knowledge of availability of DPG. Knowledge of DPG may have increased over the years. A survey of agricultural consultants in Louisiana (McLellan et al. 1982) showed less than 50% of the sample having knowledge of DPG, compared to 85% in the

Table 1. Distribution of respondents by age and education (N=141 respondents).

Age		Education	
Years	Percent Response	Level	Percent Response
Under 34 yr	30.5	< 8th grade	12.1
35 - 44 yr	22.7	8 - 12th grade	26.2
45 - 54 yr	23.4	Trade school	2.1
55 - 64 yr	16.3	2 yrs college	13.5
> 64	7.1	>2 yrs college	46.1
Total	100.0	Total	100.0

Mississippi survey. This could be due to increased availability of DPG in stores and mail-order catalogs that receive wide distribution. Of the Mississippi sample, 50% knew stores that sold DPG, but 80% had never used DPG. This is not very different from the Louisiana sample and indicates that reasons may exist for not adopting DPG. Reasons could be discomfort and/or cost but it is not the lack of knowledge regarding availability. Of the 27 subjects who have used DPG, 19 were satisfied with protection offered but did not find the garment to be comfortable. Regarding willingness to pay for DPG, 40% would pay less than $1.00, 37% were willing to pay up to $3.00, and 23% were willing to pay more than $3.00 for each garment. Of the 30% who used special accessories, 70% wore boots, gloves, cap, and/or respirators; 20% wore gloves, cap and/or respirator; and 10% wore caps and/or respirators. The use of special accessories, such as boots, gloves, cap and respirators, though by only 30% of the respondents, does indicate that these subjects are aware of contamination.

Only 32% of the respondents reported experiencing pesticide exposure related symptoms. Of these, 47.5% had suffered headache and/or dizziness, 12.5%, vomiting and/or diarrhea and 37.5%, skin rashes and/or dilated pupils (Table 2).

Table 2. Respondents reporting of exposure and discomfort experienced

Exposure		Discomfort experienced	
Never Exposed	93	Headache, Dizziness	21
Have been Exposed	4	Vomiting & Diarrhea	5
		Skin rashes, pupils dilated	15
		Respiratory congestion	1
N=135 respondents		N=42 respondents	

Work garment profile indicates overalls, coveralls, and wearing two layers on the upper torso were not popular with workers in cottonfields in Mississippi (Table 3). The garment preferred by 78% of the sample was non-disposable while only 27 subjects preferred disposable protective garments. Out of 78% who preferred nondisposable, 72% thought laundry precautions are necessary which indicates that they are aware of potential contamination.

Table 3. Types and frequency of clothing worn (N=135).

Clothing items	Percent wearing Frequently or always
1. shortsleeve shirt	61
2. shortsleeve shirt and undershirt	8
3. shortsleeve shirt and tee-shirt	8
4. long sleeve shirt	20
5. long sleeve shirt and undershirt	8
6. long sleeve shirt and tee-shirt	6
7. overalls	2
8. coveralls	7
9. shorts	4
10. pants	61
11. jeans	59
12. overalls with long sleeve shirt	4
13. coveralls with long sleeve shirt	8

The common pesticides used were organophosphates (OP), followed by synthetic pyrethroids and herbicides. In the "other" category, chlordimeform, monocrotophos and esfenvalerate were among the more commonly used pesticides. The most harmful pesticides as perceived by the participants were: OP by 49%; synthetic pyrethroids by 18%; and herbicides, by 15%. The insecticidal materials of major concern were methyl parathion (OP) cypermethrin (SP) and fenvelerate (SP); while the herbicides of most concern were triflualin and fluometuron.

The significant relationships as determined by statistical analysis are shown in Table 4. There is a significant relationship between "higher level of education" and "knowledge and use" of protective garments of farmers. Of 136 respondents, 84.6% were aware of the availability of DPG and 47.9% knew where to buy or order DPG. Only 19.3% had used DPG and most of them belong to the "higher level of education" group. Of 134 subjects, only 29.1% said they wear special accessories (boots, gloves, cap, and/or respirator), and of these, 89.6% are educated above 12th grade. The few wearing coveralls or overalls with long sleeve shirt belong to the "higher level of education" category. This indicates that people with higher education may have a better understanding of risks involved and are more likely to take protective measures. This is contrary to a survey conducted by DeJonge et al. (1983-84), which surveyed only applicators. Respondents to this survey who indicated their role was that of farmer who did own spraying or hired professionals to do spraying made up 86.5% of the

sample and of these farmers, 46.1% had higher level of education (more than two years of college). Thus it is believed that just requiring pesticide applicators to wear tyvek coveralls will not be sufficient; extension agents and others must emphasize the need for protection in light of exposure and potential health hazard.

Table 4. Chi-square results on significant relationships between variables.

Variables	X^2	df
Higher level of education vs Knowledge and use of protective garments	13.26*	5
Higher level of Education vs Type of special accessories worn	25.75*	15
Higher level of Education vs Wearing overalls	19.27*	10
Higher level of Education vs Wearing coveralls	21.35*	10
Higher level of Education vs Wearing overall with long sleeve shirt	21.28*	10
Role in Pesticide Application vs Inspection	9.64*	4
Role in Pesticide Application vs Hours Spent	16.26**	2
Hours Spent in Field vs Exposure	5.89*	1
Use of DPG vs Role in Pest Control	15.69*	7
Use of DPG vs Buying DPG	15.31**	2
Application methods		
Airplane vs Overalls	7.24*	1
Airplane vs Overalls w/ Long Sleeve Shirt	3.88*	1

*$p<0.01$; **$p<0.001$

The role of the respondent in pesticide application was significantly related to inspection and hours spent in fields (Table 4). Though nearly 60% of the farmers in the sample got professionals to spray, of these 44.8% still spent more than 10 hours per week inspecting sprayed fields. The relationship between role in pesticide application and hours spent in field is highly significant ($p<0.001$) and may increase chances of exposure to pesticide. There is a significant relationship between hours spent in fields and exposure (Table 4). Cloud et al. (1988) also showed that

consultants working in row crops are vulnerable to pesticide exposure due to constant transfer of pesticides from the plants to their clothes and finally to their skin. DeJonge et al. (1983-84) suggested that farmers raising field crops take less protective measures compared with fruit growers because perhaps it is felt that once the spray mist settles down on row crops, it is harmless or is not able to reach their skin.

Sixty-nine percent of the respondents had not experienced any discomfort from pesticide exposure. Since spraying is done by airplane or tractor-mounted sprayers, the perceived risk is much lower. This was found to be the case when comparing air-blast applicators' perception of risk to airplane or tractor applicators' perceptions of risk. The air blast applicators reported more exposure (Rucker et al. 1988). Spear (1985) and Rucker et al. (1986) also suggested that the pesticide applicators often have difficulty in assessing the extent of exposure or they may "minimize extent of exposure as a psychological defense mechanism." Exposure seems to be notable for those who do not wear special accessories. In the survey, special accessories were not worn by 75.8% of the respondents, and of those, 38.3% said they had been exposed. However, exposure does not seem to have a bearing on willingness to pay for the disposable protective garment. This indicates that cotton growers view the overall risks as being very low. The garment preferred was of a nondisposable type, regardless of whether or not the individual had been exposed. Interestingly, 70% of the respondents who were exposed to pesticides felt that laundry precautions are necessary. This suggests, tentatively that those who have suffered discomfort or illness due to exposure to pesticides realize the consequences of contamination and secondly, comfort will be an important criteria for protective clothing in the cotton crowing regions.

The use of DPG was also significantly related to the role in pest control. Farmers who mixed, loaded, and applied pesticides themselves did take protective measures, although only 20% of the sample had used DPG. University researchers were among this group and they may be required to take prescribed precautions.

Tractor rigs were used for spraying the fields by 48% and airplane were used by 52% of the respondents. The significant relationship between those wearing overalls with long sleeve shirt and applying pesticides by airplane indicated that at least a few are taking protective measures. The airplane applicators were also among those who reported discomfort due to exposure possibly because they are in direct contact with the drift due to high speed and wind. This might also emphasize the possibility that exposure results in changed attitudes towards risks involved in airplanes spraying or tractor-mounted sprayers. DeJonge et al. (1983-84) also suggests that risk-related information must be emphasized in order to increase the acceptability of protective clothing.

More work on deposition patterns of pesticides under different mixing, loading, and spraying conditions have been suggested, which would emphasize the risks involved in pesticide application and contamination (Rucker et al. 1988). In addition information on acute and chronic toxicity of the pesticides, the ease of dermal absorption of the pesticides at the exposed body sites, total dermal exposure and deposition patterns may be necessary to convince the agricultural worker of exposure during pesticide application. These may be very significant in protecting them.

This study shows that though knowledge regarding disposable protective clothing has increased, most of the respondents still do not wear disposable protective clothes while applying pesticides. This may be due to the fact that the risks are perceived to be lower in field crops, the discomfort factor, the cost of disposable protective garments, or a combination of all these factors. The study also indicates that farm workers in cotton fields may be vulnerable to exposure, especially because very few wear protective clothing and special accessories. There is a need to make farmers and other field workers realize the risks involved and advantages of protection and disposable protective clothing, since contamination is a possibility with regular clothing. The advantages of special accessories must also be emphasized.

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