

Use of Personal Protective Equipment and Laundry Practices By Nebraska Private Applicators and Launderers

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Abstract

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The purposes of this study were to determine Nebraska farmers' knowledge of potential pesticide exposure, their use of personal protective equipment, related laundering procedures of pesticide-soiled clothing, perceived health risks from pesticides and to determine areas of emphasis in future Extension pesticide education programs. Part I data provided information about private applicators' practices, their experiences in using pesticides, use of personal protective equipment and any signs and symptoms associated with the use of pesticides. Part II data provided information on practices used in laundering pesticide-soiled clothing. Educational efforts need to be aimed at certified pesticide applicators and launderers to insure reduced pesticide exposure and potential health risks. Emphasis needs to be made on wearing required personal protective equipment and to properly handle and clean pesticide-soiled clothing.

Keywords: farmers, Nebraska, pesticide, PPE, protective equipment, clothing, laundering

Introduction

Year in and year out, pests present a challenge to farmers. Insects, weeds and diseases often take their toll on crops. Pests often compete with a crop for sunlight, soil nutrients, and water, resulting in yield and quality reductions.

The use of a pesticide is one of several tools farmers and ranchers regularly use to contend with pests. Pesticides are used as herbicides, insecticides, fungicides, and various other forms. By their very nature, pesticides must be toxic at some level in order to control or manage these pests. This means there is the potential for personal exposure and potential health risk to the pesticide applicator. The toxicity of the product is not the only indicator of risk. Risk is based upon the interaction of toxicity and exposure and described as the risk formula:

$$\text{Risk} = \text{Toxicity} \times \text{Exposure}$$

Each pesticide label provides the PPE

requirements that must be followed during the mixing, loading and application activities. Potential pesticide exposure that may be present can be managed through the proper handling of the product, including the appropriate use of personal protective equipment (PPE) during the mixing, loading and application practices. The person who launders the pesticide-soiled clothing also has a potential pesticide exposure. Because of the potential human health hazard in handling pesticides or pesticide-soiled clothing, proper precautions need to be taken by the pesticide applicator and the launderer. Communication between the pesticide applicator and the launderer of the pesticide-soiled clothing is essential, but sometimes neglected. The launderer needs to be aware of precautions to ensure that proper laundry procedures are used. Most often, the simple use of chemical resistant gloves while handling pesticide-soiled clothing in preparation for laundering will protect the hands and greatly reduce any potential pesticide exposure.

Background

Studies have shown that educational programs for pesticide applicators and the person doing the laundering of pesticide-soiled clothing needs to be ongoing. As each new generation becomes involved with the use of pesticides, it is important to help them avoid risks associated with any serious health problems.

An Iowa study of farm families by Stone, et al (1986) indicated that the majority of those doing the laundry of pesticide-soiled clothing were following relatively safe procedures. This included machine washing the contaminated clothing separately, using hot water, a full water level, heavy-duty liquid detergent and line drying. The authors concluded that a continual effort needs to be made to educate families in pesticide safety and handling because pesticide exposure is always a potential problem.

The Agricultural Health Study (1996) is a large prospective study on the health of farmers in Iowa and North Carolina. Enrollment in the first year of a three-year study includes 16,535 farmer applicators, 6459 spouses of farmers and 3700 commercial pesticide applicators. The average farmer applicator mixed or applied pesticides for 16 years. The spouses generally do not engage in mixing or applying pesticides, but may be exposed by doing the laundry and being in proximity of pesticide storage. From monitoring studies that have been done, dermal pesticide exposure more commonly occurs on the hands.

According to Gianato (1997), who surveyed certified private pesticide applicators in one county in West Virginia, the applicators were following basic procedures and practices with regard to pesticide use and selection of appropriate clothing and protective items. Most applicators did not discontinue their use of any particular pesticide because of a concern for health-problems. Those persons who did the laundry needed to

improve their practices in handling and laundering contaminated clothing or other items worn during pesticide application.

Stone, et al (1989) studied pesticide exposure to farmers in California, Iowa, Michigan, Minnesota, and Oklahoma. The farmers realized the benefits of pesticide use, but were not always aware of the potential for exposure, its seriousness and the benefits of their clothing in preventing pesticide exposure. Data from the study indicated that even though many applicators followed recommended practices regarding selecting, use and storage of protective clothing, a sizeable number deviated from recommended practices. For example, 37% of the farmers in these five states wore the wrong type of gloves during pesticide applications. Respondents reported using only warm water (44%) rather than hot water (51%) in washing machines. Launderers of pesticide-soiled clothing said they did receive information on how to care for contaminated clothing, but many did not always adopt the recommended procedures.

Purpose of the Study

The purposes of this study were to determine Nebraska farmers' knowledge of potential pesticide exposure, their use of personal protective equipment, related laundering procedures of pesticide-soiled clothing, perceived health risks from pesticides and to determine areas of emphasis in future pesticide education programs.

- Part I of this study surveyed certified private applicators concerning their use of PPE when using pesticides.
- Part II of the study surveyed launderers about their practices used in the laundering of pesticide-soiled clothing.
- Both groups were asked about their perceived health risks from pesticide exposure.

Methods

There are more than 29,000 farmers and ranchers in Nebraska who are certified as private applicators. These certifications, as provided by the Nebraska Department of Agriculture, allow applicators to purchase and use pesticides classified as "restricted use" in their agricultural operations. A random sample of 1000 certified private applicators was obtained from the Nebraska Department of Agriculture's pesticide applicator database. A two-part survey instrument was mailed to these 1000 applicators in July 1997. Part I was oriented toward the adult private applicator and Part II was to be completed by the person who does the laundry of pesticide-soiled clothing. A reminder post card was sent one month later to individuals who had not responded to the survey. Ten surveys were returned with no forwarding address, undeliverable or unable to be forwarded. There was a 14% return rate of 139 usable surveys that were considered in this analysis. There were 135 respondents in Part II.

Results - Part I - Pesticide Applicator Practices

Ninety-seven percent of the applicators in Part I of the study were male. Those applicators aged 49 and under comprised 56% of the total sample. Forty three percent had some type of higher education. Of those, 22% completed college and 7% had a graduate degree. Sixty one percent of the applicators used pesticides for more than 15 years. Thirty nine percent have between 161 and 640-acre farms, 25% have between 1000-1999 acres.

The most often used pesticide reported was 2,4-D and was identified as the pesticide that most often gets on clothes. Liquid pesticide formulations came in contact most often with applicators' clothing 76% of the time. Most of the exposure was with the diluted liquid formulation (87%). When full strength pesticide spilled on their clothing, 62%

said they changed clothing within the hour. Ninety three percent of the applicators said they did not wear pesticide-soiled clothing again until it was laundered.

Sixty two percent wore the required protective clothing and equipment either often or almost always. The protective clothing usually worn included long sleeved shirts, jeans/work pants, long sleeved coveralls, chemical resistant gloves, goggles, and socks. Outerwear clothing was stored separately from the family wash before laundering by 88% of the respondents; underwear was stored separately by 61%.

Personal Protective Equipment

Glove Types: Sixty seven percent wore chemical resistant neoprene or nitrile gloves. Leather was worn by 16%, canvas by 1%. Four percent reported the wearing of other gloves such as cotton, rubber and latex and nine percent did not report the use of gloves. Twelve percent of the applicators did not report a glove type. These data exceed 100% because many applicators reported more than one glove type.

Footwear: Sixty-three percent of the applicators indicated they wore leather shoes or boots when applying pesticides. Twenty-nine percent wore chemical resistant footwear.

Headgear: Only one of seven of the most commonly reported pesticides used in this study required chemical-resistant headgear according to the Crop Protection Reference. Nineteen percent of 139 respondents reported the use of a pesticide that required protective headgear, but less than 1% of the farmers reported they wore chemical-resistant hard plastic headgear. Seventy three percent of the farmers reported wearing baseball caps when applying pesticides. Other hats (felt or straw) were worn by 11% of the applicators.

Goggles: When asked which protective clothing or devices they wore when required; 81% said goggles were worn at some point. Of these, 21% wore goggles half of the time, 30% often, 28% almost always and 2% always. Nineteen percent seldom or almost never wore goggles.

Dust Masks: Applicators indicated that dust masks were worn only two percent of the time, even when the label required their use. Only 20% of the applicators wore the required dust mask half the time.

Face Shield: Only three percent of the applicators wore face shields when required by the label. Ten percent wore the required face shield half of the time.

Chemical Cartridge Respirator: Even when required by the label, 42% of the applicators reported almost never wearing a chemical cartridge respirator. Only three percent of the applicators wore a respirator when required.

General Usage of PPE: An assumption was made in advance that even when required, some private applicators may choose not to wear personal protective

equipment when applying pesticides. This prompted the question "*Do you wear required protective clothing and equipment?*" in the survey. Eight percent of the 139 respondents reported that they almost never wear protective clothing or devices when required.

Respondents were asked to rate (1 = very unlikely to 7 = very likely) their perceptions on how apt they were to get pesticides on their skin and cause an immediate health risk. The mean rating was 3.6, which is in the middle of the range. Their perception of the seriousness of that health risk was 3.9 (average). In terms of the pesticides causing long term harm, the mean rating was 4.6.

Applicators were asked if they experienced signs and symptoms after handling, mixing and/or applying pesticides. They were asked how often they experienced these signs and symptoms (almost never, seldom, about half the time, often or almost always). Table 1 presents these data for each health effect along with the percent of responses in the "almost never" and "often to almost always" categories.

Signs and Symptoms	Almost Never	Often to Almost Always
Vomiting	99	0
Nose bleeds	96	0
Fever	93	0
Blurred vision	91	1
Weakness	90	0
Difficulty breathing	89	1
Muscle twitches	89	0
Chest discomfort	88	1
Fast heart rate	88	1
Excess sweating	88	1
Stomach cramps	88	0
Diarrhea	84	0
Dizziness	81	5
Unusual tiredness	79	6
Nausea	79	0
Skin irritation	68	1
Eye irritation	63	2
Headaches	53	3

When applicators were asked if they stopped using pesticides because of perceived health problems, eight percent reported they did stop.

When asked about their perceived health risks associated with pesticide usage (1 = very low to 7 = very high), the mean was 2.7. The mean was 5.9 when applicators rated their crop yield benefit to pesticide usage.

Positive changes were reported by applicators concerning their practices since their last pesticide applicator training session. Sixty four percent reported they read the pesticide labels more thoroughly, 42% followed restricted entry intervals, 37% informed household members and 34% wore the required protective clothing. Forty nine percent said they always use pesticides safely.

Discussion - Applicator Use of Personal Protective Equipment

This study pointed out that even though private applicators are reading pesticide labels more thoroughly as a result of pesticide applicator training, they do not readily comply with the required personal protective equipment. A wide range of compliance was noted among different types of PPE usage.

Dermal exposure is often referred to as the most common exposure type and the easiest to prevent. In this study, 72% of the applicators wore chemical resistant gloves. In contrast, nine percent wore no gloves. Leather gloves were inappropriately worn by 17% of the respondents. When contaminated with pesticides, there is no known way to decontaminate these gloves and exposure can occur with continued use.

Nineteen percent of 139 respondents reported the use of a pesticide that required protective headgear. Less than one percent of the farmers reported they wore chemical-resistant hard plastic headgear. Because 73% of the farmers

reported wearing baseball caps, it is important to recognize that, in most cases, no PPE violation concerning protective headgear appeared to occur. Few of the reported pesticides required protective headgear. When headgear is required, compliance was low. Farmers would benefit from increased emphasis on this type of PPE during pesticide applicator training programs.

Two-thirds of the applicators wore footwear made of leather. Since leather cannot be decontaminated, dermal absorption is heightened with repeated usage of the same shoes.

Several questions were asked about the usage of PPE when required on the label. A comparison of several PPE types and the frequency of usage proposed some interesting trends. Typically, the applicators that responded were most likely to resist wearing respirators or face shields when required by the label. Goggles were the item they were most likely to wear when required. This usage indicates applicators' preference to protect their eyes if PPE is worn.

One fourth of the applicators (24%) indicated they almost never wore protective clothing or devices when required. Pesticide education programs need to continue to promote the importance of and the usage of personal protective equipment.

More than 90% reported they seldom or almost never experienced any health signs and symptoms while using pesticides. While the applicators rated their potential exposure associated with pesticide usage as low, headaches were the most common perceived health symptom identified followed by eye and skin irritation. It was not possible to determine if the headaches were caused by fatigue, stress, illness or exposure to a pesticide. Approximately eight percent of the applicators stopped using pesticides because of their perceived health concerns.

Results - Part II - Laundry Practices

Sixty-three percent of the launderers in Part II of the study were female. Those launderers aged 40 to 59 comprised 56% of the total sample. Forty one percent had some type of higher education. Of those, 21% completed college and five percent had a graduate degree.

Eighty one percent of the launderers "usually" to "always knew" when clothing was worn for pesticide applications. Launderers learned that clothing was soiled by pesticides in a variety of ways. Sixty-nine percent of the applicators told the launderers, 29% of the launderers determined by smelling the clothing and nine percent determined the presence of pesticides by appearance. Because multiple choices to this question were allowed, the sum of the percentages is greater than 100.

Eighty percent laundered the contaminated clothing separate from family wash. Seventeen percent said they mixed this clothing with like items and three percent laundered them with a general mixture of laundry. Washing was done at home by 95% of the people. When asked if they wore waterproof gloves to protect their hands when handling the pesticide soiled clothing, 20% indicated they did, while 80% did not. Fifty-two percent usually pre-rinsed the clothes while 48% did not. The pre-rinsing took place in the washing machine with a spin cycle (33%), outdoors in a tub (13%), used the washing machine without a spin cycle (4%), and rinsed the clothes outdoors with a hose and water (4%).

The normal machine setting (versus permanent press) was used by 93% of the respondents. Eighty two percent used a full water level, nine percent used the medium level and nine percent adjusted the water level to load size. Hot water was used by 52%, warm by 41% and cold by six percent. A cold water rinse was used by 47%, warm by 36% and hot by 18%. When asked if they washed their

items a second time, 69% said no, 31% said yes. The detergents most often used were powdered detergent (53%) and heavy-duty liquid detergent (47%). Seventy five percent used more than the amount of detergent recommended by the manufacturer. Additional products were used in laundering the process were fabric softeners in the washer (19%), water softeners (11%), pre-wash stain remover (11%), liquid bleach (10%) and fabric softener in dryer (10%).

Garments were line-dried outdoors by 66% of the respondents, 35% used the clothes dryer. Sixty eight percent said they did not clean inside the washer, 32% did clean it. Of those who cleaned the washer, thirty five percent cleaned the washer by running a second wash cycle without clothes.

The respondents were asked if they experienced any perceived health symptoms after washing the pesticide contaminated items, 98% said no. Two percent of the respondents indicated they had skin irritation and a cough.

Launderers were asked to rate their satisfaction level (1 = very unsatisfied to 7 = very satisfied) concerning the removal of pesticide residue from clothing. The mean rating was 5.0. The rating of their potential exposure to pesticides when laundering contaminated clothing was 2.8 on a scale of (1 = very low to 7= very high) and rating crop yield benefits with pesticide application was 5.6.

There are a variety of sources where information may be received on laundering pesticide-soiled clothing. Fifty six percent received information from the Extension Office, 27% from a chemical dealer/company, 17% from magazines with the remaining percent (33%) from a university, radio, television, pesticide class and family-community education lessons. Because multiple choices to the question were allowed, the sum of the percentages is greater than 100%.

When respondents were asked to rate how satisfied they were with the laundering of pesticide-soiled clothing, the mean rating was 4.99 where 1 = very unsatisfied to 7 = very satisfied. Only two percent indicated they experienced some perceived health symptoms after washing pesticide clothing. They rated their health risk with laundering clothing as low with a mean rating of 2.8 where 1 = very low and 7 = very high. Rating the benefits to crop yield with pesticide usage had a mean rating of 5.6 where 1 = very low and 7 = very high.

Discussion - Laundering Practices

A majority of the launderers of pesticide-soiled clothing were women. Although, women may not commonly engage in the mixing or application of pesticides, they may be exposed to pesticides by doing the laundry.

University research supports the proper handling and laundering of pesticide-soiled clothing. This study indicated that the launderers need to improve their procedures to properly clean pesticide-soiled clothing.

Since 80% of the launderers handled pesticide-soiled clothing without PPE, encouragement is needed to promote the use of chemical resistant gloves. Pre-rinsing is a recommended step in removing pesticide residue from the clothing. Only half of the launderers pre-rinsed pesticide-soiled clothing. Research in the use of pre-treatment products has been shown to be effective in helping remove some pesticides from clothing. Only 11% of launderers reported the use of this kind of product. Ninety five percent of the launderers reported the pesticide-soiled clothing was washed at home and 80% stated the clothing was laundered separate from the family laundry. This is important to prevent transfer of pesticide residue to other clothing.

Research recommends using hot water and a full level of water in the washing machine. The majority (82%) of launderers used a full water level, but only 52% of the launderers used hot water to wash the contaminated clothing. Washing contaminated garments a second time assures greater removal of pesticides. One third of the respondents said they rewashed garments a second time before drying. Research also recommends cleaning the washer a second time after washing contaminated clothing to prevent further transfer of any pesticide residue. The majority of the launderers (68%) did not clean the washing machine after the soiled clothing cycle was completed.

Two thirds of the respondents hung the garments outside to dry and one third used a clothes dryer. Line drying provides ventilation and sunlight to further remove pesticide residue if present. Even though the launderers said they were satisfied with their laundering of pesticide-soiled clothing, many procedures need improvement.

Proper procedures for the laundering of pesticide-soiled clothing have been incorporated into Extension pesticide education programs in Nebraska for more than 20 years. However, this study confirmed the importance of emphasizing specific laundering practices. Extension programming needs to reinforce proper laundering procedures. Over half of the launderers said they got educational information on the care of pesticide clothing from their Extension office. As new generations use pesticides, educational programs produced by Extension need to emphasize wearing of chemical-resistant gloves, pre-rinsing, using hot water, washing the clothing a second time, and doing a complete hot water wash with detergent without the clothes. Families need to use methods that minimize their exposure to pesticides and reduce health concerns.

Recommendations for Pesticide Education Programs

The use of personal protective equipment and laundering of pesticide-soiled clothing in this study has impact for pesticide education programs. Applicators and their families will benefit from increased emphasis on the following points in pesticide education programs:

- Wear chemical resistant gloves (applicator and launderer).
- Avoid wearing absorptive materials such as leather footwear or gloves and baseball caps.
- Increase educational efforts on the importance of using eye protection when handling pesticides.
- Emphasize using the hottest water setting while laundering pesticide-soiled clothing.
- Stress the importance of cleaning the washer tub after a wash cycle.
- Heighten the communication between applicator and launderer.
- Recognize the value of following pesticide label requirements for PPE.

Summary

Exposure to a pesticide can be anticipated. Protective clothing and equipment, when used as required by the pesticide label, will minimize exposure. Continued emphasis on the importance of protective clothing and equipment is crucial. As long as pesticides are used there will be the need to wear appropriate personal protective equipment to minimize exposure and potential health risks. Steps also need to be taken to prevent pesticide exposure during the laundering of protective clothing. Extension pesticide education will continue to serve an important role whenever pesticides are used as a tool in pest management.

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