THE PENNSYLVANIA STATE UNIVERSITY
SCHREYER HONORS COLLEGE

DEPARTMENT OF BIOBEHAVIORAL HEALTH

TRAINING AND PERSONAL PROTECTION EQUIPMENT USE AMONG HISPANIC FARMWORKERS: A QUALITATIVE ANALYSIS

SIENNA GEORGE
SUMMER 2014

A thesis
submitted in partial fulfillment
of the requirements
for baccalaureate degrees
in Chemical Engineering and Toxicology
with honors in Biobehavioral Health

Reviewed and approved* by the following:

Shedra Amy Snipes
Assistant Professor of Biobehavioral Health; Director of BioQual
Thesis Supervisor

Lori Francis
Associate Professor of Biobehavioral Health
Honors Adviser

* Signatures are on file in the Schreyer Honors College.

ABSTRACT

Objectives. Our overall objective was to explore factors associated with farmworkers' knowledge, training, and their attitudes surrounding pesticide safety and PPE use

Methods. We used semi-structured interviews to review information on training and pesticide knowledge from 20 farmworkers living in the Yakima Valley in Washington State

Results. Analysis revealed four major themes about how farmworkers use PPE. Overall PPE use was low. Both farmworkers who receive and did not receive training feel they lack knowledge about pesticides. However, some of the analysis may show that among the few farmworkers who wore PPE and expressed knowledge, they learned pesticide information from work. Also, farmworkers' personal experiences matter. Those who discussed being exposed to pesticides may be the most vulnerable, and discussed having little control, knowledge and training about pesticides. Farmworkers' vulnerability may explain very low PPE use.

Conclusions. Future researchers should look further into the specific components of training programs that influence their PPE usage. The pesticide industry, as well as policy makers might take note of these findings to design better pesticide training programs to increase PPE use for farmworkers

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACKNOWLEDGEMENTS

I would like to thank Dr Shedra Amy Snipes, my research adviser, for all her help and patience with me through the course of this thesis. I could not have asked for a more understanding adviser to a stretched senior. I would like to thank BioQual Project Associate Sandra L. Gonzalez De Del Pilar for her support throughout my thesis journey. I would also like to thank the participants of the study that made this study and future studies like it possible.

Chapter 1 Introduction

The United States is one of the highest producers of the world's food source. According to the USDA and Cornell's Mann Agricultural Library, the United States ranks 2nd of all countries for providing commodity crops to the 7 billion people on the globe. (USDA Foreign Agricultural Service, 2013; Census Bureau, 2013) For example, the US is the leading producer of corn but the third leading producer of wheat. Moreover, major commodity crops like, corn, soybeans, and cotton increased production by 28%, 8%, and 25% respectively in 2013 compared to 2012. (USDA, 2013) The United States is therefore a major component of the food resources for the world.

As the agricultural production in the United States has grown, two agricultural factors have grown as well. First, it is estimated that among the approximate 3 million farmworkers in the United States today, the vast majority of them identify as Mexican, or Mexican American as shown in Table 1 (NAWS, 2009).

According to the USDA's 2007 Census of Agriculture, the Hispanic farm operator population has grown by 14% from 2002 to 2007, and the Hispanic principal operators have grown 10% in that time. (USDA, 2007) Moreover, much data indicates that farmworkers of Mexican origin make a significant impact on food production in the United States. It is estimated that 70% of all hired US farmworkers are foreign-born. (Wainer, 2011) In the dairy industry, half of all dairy farms surveyed used immigrant labor, and 62 percent of the nation's milk supply comes from farms using immigrant labor. Other studies have found that a 50 percent reduction in foreign-born labor would result in the loss of 2,266 dairy and produce farms. (Parr Rosson, 2009)

This evidence shows the key role that migrant farmworkers fill in the agricultural production in the United States.

Table 1 ***United States Farmworker Sample Description (NAWS, 2009)***

Personal Characteristics		M (SD)	% (n)
Age		37.8(12.9)	
Sex (females=1)			17.3(639)
Educational Attainment, yr			
	<9		67.9(2504)
	10-12		25.3 (932)
	>12		6.9(254)
Unaccompanied			44.6(1630)
Ethnicity			
	Latino		83.4(3058)
	White, non-Latino		12.6(463)
	Other		4.0(146)
	Indigenous		7.3(271)
Reads English Well			23.0(847)
Unauthorized			51.3 (1883)
Years in Agriculture		14.6 (11.3)	
Days of Fieldwork in the Past Year		228.3(80.0)	
Interviewed in high season			50.6 (1868)
Health Outcomes			
	Fair/poor health		22.4(825)
	Depression (>10 symptoms)		8.7(320)

A second agricultural factor that has grown with crop production is pesticide use. Each year the Environmental Protection Agency, EPA, publishes the World and U.S. Pesticide Expenditures. The 2011 publication summarized the results of the data from 2006 and 2007, showing that the world expenditures for pesticides have increased in from $35.8 billion to $39.4 billion, with the United States increasing from $11.8 billion to $12.5 billion. As far as usage in the United States, in 2006, over 1,127 Million pounds of pesticides were used in commercial and private sectors (Grube, 2011). The total usage from the beginning of the decade is down however, from 948 million pounds in 2000 to 877 million pounds in 2007, which is about 1% decrease per year. (EPA, 2011)

Pesticides are defined by the Federal Insecticide, Fungicide, and Rodenticide Act as "any products intended to prevent, destroy, repel or mitigate pests that are any plant or animal endangering human food supply, health, or comfort" (FIFR Act, 2007). And their use is nothing new. If we use the Federal Insecticide, Fungicide, and Rodenticide Act definition of a pesticide as "any product" used to mitigate pests, Ancient Romans used pesticides as far back as 1000 B.C. to control weeds with salt to prevent grasses in unwanted areas (Delaplane, 1996). In the United States, farmers in the late nineteenth century used copper acetoarsenite to control insects in field crops (Delaplane, 1996). For example copper acetoarsenite was used to protect potato plants from the Colorado potato beetle. It was not until after World War II that inexpensive, effective, and popular pesticides such as dichlorodiphenyltrichloroethane (DDT), benzene hexachloride (BHC), aldrin, dieldrin, endrin, and 2,4-Dichlorophenoxyacetic acid (2,4-D) emerged in the United States. (Delaplane, 1996)

Today, pesticides have significant positive economic, environmental, and public health impacts. For example, pesticide usage helps improve human nutrition through greater availability, longer storage life, and lower costs of food. Pesticides also assist in the control of food-borne and vector-borne diseases, which affect millions of children and adults and kill thousands annually in the United States alone. (Evanston, 2004) In fact, a growing literature shows that pesticide use is directly linked to increased food production. In 1990, Knutson & Associates found that US food production would drop, raising food prices dramatically across the board if pesticide use ended (Knutson, 1990). Moreover, US corn, wheat, and soybean production would fall by 73% and their exports would drop by over 27% (Knutson, 1990). An estimated 132,000 jobs would be lost. (Knutson, 1990) If this study was performed again today, the losses would be even greater. More recently, it has been shown that without herbicides there would be an estimated US $13.3 billion loss in farm income in the US (Anon, 2003b). Yancy and Cecil (2005) put the figure for benefits of herbicide use even higher at $21 billion annually, against a cost of $6.6 billion for the product and application that reduced losses to weeds by 23% and avoided a loss of farm income valued at $8 billion.

Although pesticides increase production of food and have some positive benefits, they are dangerous to those exposed to them. The U.S. Environmental Protection Agency (EPA) estimates that U.S. agricultural workers experience 10,000–20,000 acute pesticide-related illnesses each year, based on extrapolation from physician-reported cases in California (Blondell, 1997) The agricultural workforce population faces a high risk of exposure to pesticides and harmful effects from that exposure and extreme field conditions. Some of the most common acute symptoms are vomiting, stomachache, headache, body ache, itching, nausea, rash, irritated eyes, fatigue, and difficulty breathing. (McCauley, 2002).

The primary way workers are exposed is during fieldwork tasks. (McCauley, 2001). For example, Fenske (1997) found that dislodgeable residues that transfer from plants to farmworkers' bodies are associated with the highest exposures in farmworkers. (Fenske, 1997) Because pesticides are used extensively and widely, they are commonly stored in considerable quantities in or near human dwellings. Unintentional exposure to pesticides is a common cause of acute poisoning, which can result from indirect touching of pesticides around the home. Following contamination of the hands with pesticides, the eyes, digestive system, and face are particularly vulnerable. (Evanston, 2004) There have been different disorders connected to the routes of exposure to pesticides. Pesticides as a vapor, gas, dust, or fume can cause several respiratory and neurological disorders, whereas solvents and bulk solid exposure can be tied to dermatological and digestive disorders. (Jong, 2014)

Recent data has tied long-term pesticide exposure to several neurological disorders including Parkinson's disease. (Liew, 2014) The most common disease linked to pesticide exposure is dermatitis- chronic inflammation of the skin. (Villarejo, 1999) Other inflammation conditions like chronic obstructive pulmonary disease (COPD) are two to three times higher in workers exposed to vapors, gases, dusts, and fumes (Jong, 2014).

Protection from Pesticides- PPE Use and Pesticide Education Training

Protection from pesticides for those who work in agriculture is imperative. According to the US Dept of Labor Statistics (2008), agriculture is frequently ranked one of the most dangerous industries in the country. (DOL, 2008) Commonly reported injuries involve exposure to the elements, symptoms associated with pesticide exposure in parents and children, farm equipment injuries and heat stress. In order to prevent many of the injuries and illnesses to farmworkers in the United States, legal safeguards have been developed by the government. One method of prevention is the use of personal protective equipment or PPE. According to the

Occupational Safety and Health Administration (1970), personal protective equipment is specialized clothing or equipment worn by an employee for protection against infectious materials (OSHA, 1970). According to the EPA's publication How To Comply with the Worker Protection Standard for Agricultural Pesticides: What Employers Need to Know (2005), "Personal protective equipment is any apparel and devices worn to protect the body from contact with pesticides or pesticide residues, including: coveralls, chemical-resistant suits, gloves, footwear, aprons, and headgear, protective eyewear, and respirators. The labeling may require pesticide handlers or early- entry workers to wear PPE for some tasks, including the wearing of long- and short-sleeved shirts, long and short pants, shoes and socks, other items of regular work clothing. If such non- PPE attire is required, the employer must make sure that it is worn. "(EPA, 2005)

Through their work, OSHA and EPA (1992) have shown that PPE is important. Thus, employers must provide the appropriate PPE for the specific pesticide that is clean and operational, and these policies are mandated through the Worker Protection Standard, or WPS. There are five main protective measures that WPS enforces. First, the applicators of pesticides are prohibited from applying a pesticide that will expose other workers or persons. Second, there needs to be restricted entry to pesticide treated areas after application for a specified period of time. Third, PPE needs to be provided and maintained for pesticide handlers. Fourth, workers need to be notified of pesticide application areas to avoid. (US EPA, 1992)

Finally, as part of the standard, certain training elements are necessary to educate employees about the standards of protection. This training is to be completed at the beginning of employment and every 5 years after that.

This Study

The use of PPE ensures there is a primary layer of protection for farmworkers exposed to pesticides. Protecting farmworkers from being exposed to pesticides prevents or reduces the negative symptoms of pesticide exposure. PPE use is, then, essential. However, the use of PPE is not an intuitive practice and therefore training for PPE use by farmworkers is necessary. Therefore, the overall goal of this study is to explore beliefs and behaviors of farmworkers about training and PPE use.

It has been shown by Acosta et al. (2005) that pesticide-training programs can increase knowledge of pesticides and their hazards, increased risk perception, and is associated with increased cognitive decision-making about safety practices. (Acosta, 2005) Information provided to farmworkers about pesticide application has been shown to increase perceived pesticide risk and an increase in safety-related behaviors (Arcury, 2002).

Although training cannot remove all of the hazards that farmworkers encounter, it is needed to make workers aware of impending hazards associated with pesticide exposure and proximity. In some studies of pesticide training, the materials were found to lack connection to the farmworkers. For example, Rother (2008) found that what a farming employer, a corporate producer, and a scientist see as appropriate for pesticide safety labels are interpreted quite differently by farmworkers. (Rother, 2008) Also, Arcury (2010) found that the social norms and attitudes of the agricultural workers affect their willingness to accept and to use the health and safety training they do receive. The general health beliefs of the farmworkers also affect the ability to absorb the trainings (Arcury, 2010). Finally, Arcury (2001) found that workers that received training primarily received it from family, friends, and pesticide dealers (Arcury, 2001).

Some of the farmworker studies surrounding pesticide exposure have also identified particular groups of farmworkers and their families that are particularly vulnerable to pesticide exposure. Racial minorities are shown to be more vulnerable to the hazards environmental hazards. (Slovic, 2000) More specifically, Cabrera (2009) showed that the groups within the minority populations tend to see themselves as more vulnerable than others in their work group, particularly workers with children and those with pre-existing health conditions (Cabrera, 2009). In 2009, a study also found that a group of farmworkers also showed vulnerability to pesticide exposure due to economic reasons. Specifically, PPE use had on their productivity and therefore their compensation. Snipes et al (2009) also showed that farmworkers also believed that children, women, the elderly, and those with weaker body types were all more susceptible to the negative effects of pesticide exposure, and may be the most vulnerable (Snipes, 2009).

Theory of Planned Behavior

Our research is guided by the Theory of Planned Behavior. The Theory of Planned Behavior examines the relationship that attitudes, perceived behavioral control, and subjective norms, and intentions have on behavior (Ajzen, 2005). The Theory of Planned Behavior aims to rationally reflect the intentional health behaviors on an individual, like explaining the intentional health behavior of farmworkers toward pesticide exposure. The Theory of Planned Behavior has been used in several health behaviors, for example, to predict the intentions of eating habits and disorders (Conner, 2002) and oral health habits (Dumitrescu, 2011). Figure 1 shows the depiction of the Theory of Planned Behavior by Azjen. The first column is a depiction of the beliefs of the individual: behavioral, normative, and control. Each of the beliefs affects one another in an individual. Behavioral beliefs connect the health behavior to an expected outcome. Behavioral beliefs determine the attitude toward the behavior. Normative beliefs are the perceived expectations of significant groups or people surrounding the individual. Normative beliefs determine the subjective norm of the individual toward a behavior, where the subjective norm is the perceived social pressure on an individual toward a behavior. Control beliefs are the perceived factors that facilitate or impede performance of a behavior. Control beliefs determine the perceived behavioral control. The intention of the individual is the indication to perform or not perform a given behavior. The intention is determined by the social norm, the perceived behavioral control, and the attitude toward the behavior. The intention is considered the immediate precursor to the behavior itself. Finally, the behavior itself is the observable response to a situation or target. (Azjen, 2005)

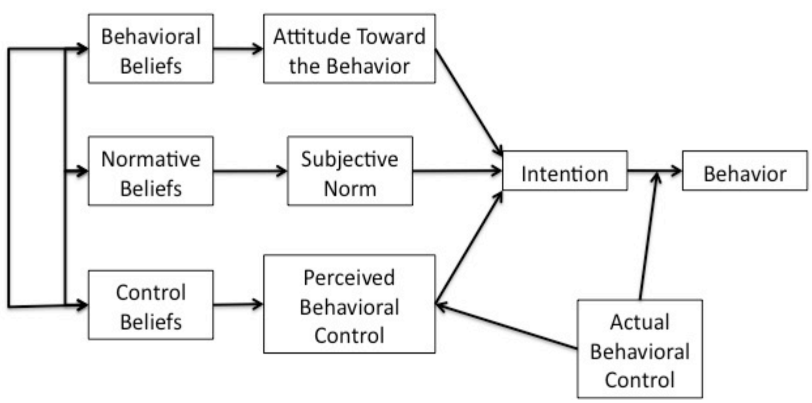

Figure 1 Theory of Planned Behavior Process Flow Diagram (Ajzen, 2005)

Attitudes, social norm, and control all prove important toward assessing the behaviors of agricultural workers toward protective behaviors. In this study, the intended health behavior is the use of protective PPE against pesticides. These pesticide prevention behaviors are assumed to be intentional and health related, therefore the Theory of Planned Behavior can be applied to the migrant farmworkers to describe and study their behavior. In the case of our study, the attitude toward the behavior would be how the individual feels about wearing PPE. The subjective norm in this study would be how the worker perceives how “normal” it is to wear pesticide protective

PPE in comparison to other workers on their farms. The perceived behavioral control in this study is the perception of the power and control the worker has to wear PPE. From this theory, I formed my research questions:

1) How are knowledge and beliefs of farmworkers about pesticides related to PPE usage? I hypothesize that knowledge and beliefs gained through training about pesticides will motivate farmworkers to use PPE.
2) How does the *source* of knowledge of farmworkers about pesticides relate to their PPE usage? I hypothesize that the training received from family, friends, and community sources will motivate PPE usage more than formal work-based training
3) Is exposure to pesticides related to PPE usage? I hypothesize that those exposed to pesticides will use PPE after their experiences of exposure.
4) Are some people more vulnerable to pesticide exposures than others? How does vulnerability affect PPE use? I hypothesize that vulnerable farmworkers will have more pesticide exposures, but may have less behavioral control and thus have less PPE usage, due to the feelings of lack of control.

Attitudes:

Acosta (2005) showed that the attitudes, beliefs, and knowledge of a farmworker influence his/her safety related behaviors. Information alone does not influence the behavioral outcomes of farmworkers. Participants are instead influenced to change their behavior on the basis of risk perception. Individuals with higher locus of control have been shown to improve their safety risk perception and adopt safety behaviors. (Acosta, 2005) Taking these prior studies into account, we also included an examination of the attitudes toward pesticides in our study to see if attitudes influenced our workers' behaviors as well. We conceptualize attitudes toward pesticides by asking questions of farmworkers like, "How do you feel about agricultural pesticides?" The answer is then conceptualized as a positive or negative attitude toward pesticides.

Social Norm:

Social norm is a set of beliefs toward the behavior of a group whether as large as a society or small as a team in a given situation. The social norm of the farmworkers is dependent on their family, culture, community, and influencers.

Many of the community based studies that have been performed in migrant farmworkers have noted the degree that social norm has affected the behaviors of workers. For example, McCauley (2001) showed that if pesticide decontamination behavior like washing hands and clothes after work is known to be present in the rest of the community, there is a much stronger correlation with the behavior in that individual (McCauley, 2001). We conceptualize social norm toward PPE use by locating parts of the farmworker transcripts that describe if other farmworkers wear or do not wear PPE. We can then conceptualize if the social norm of the other farmworkers is believed to be wearing or not wearing PPE to protect against pesticide.

Perceived Control:

Austin et al (2001) showed that the ability of farmworkers to engage in safe practices depended on their perceptions of control over pesticide health (Austin, 2001). We conceptualize perceived behavioral control by identifying in the farmworker interviews if they feel they have control or lack control toward pesticide exposure.

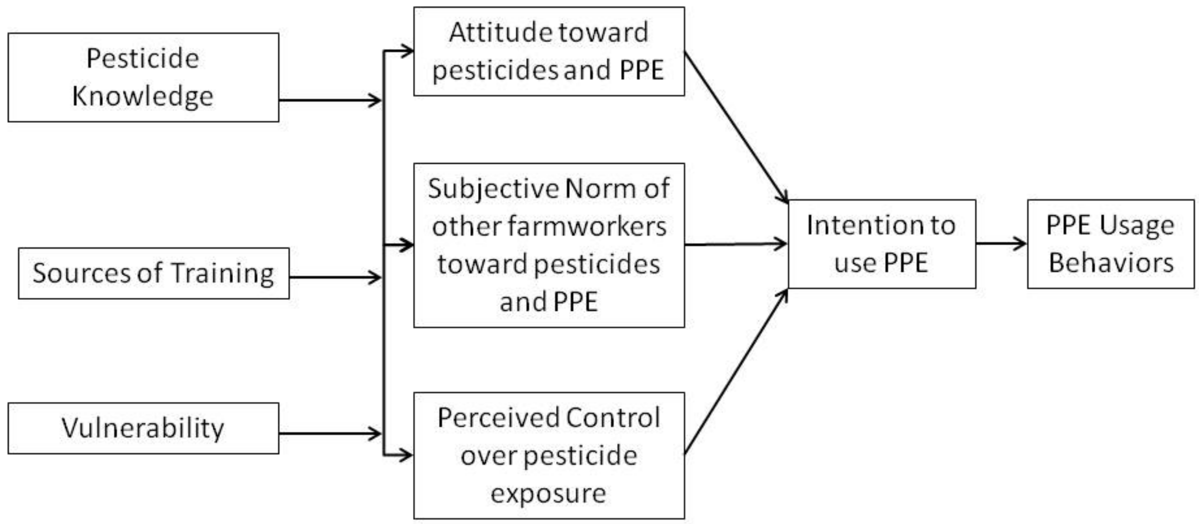

Figure 2 Thesis Hypothesis Process Flow Diagram

Reflected in the diagram above, the Theory of Planned Behavior was modified to examine the effect training of the farmworkers has on social norm, attitudes, and perceived control dealing with PPE use. As my research questions state, this study attempts to examine the relationship that pesticide knowledge, the sources of pesticide information, and the vulnerability expressed by farmworkers have on PPE usage. All three of these subjects could affect the attitude, subjective norm, and/or perceived control over pesticide exposure. Through the Theory of Planned Behavior, we will determine if these show a connection to PPE usage intention or behavior.

Chapter 2 Methods

Setting and Study Overview

This thesis was a continuing investigation using an existing data bank of interviews from a 2009 study in Washington State. The goal of that study was to assess beliefs about pesticide exposure risks among farmworkers in the Lower Yakima Valley of Washington State. Yakima Valley is the second largest county in Washington State, situated inland and near the Southern edge of the state. According to the 2010 census, Yakima Valley had a population of 243,231. Yakima County ranks first in the United States in the number of all fruit trees. It produces more apples, mint, winter pears, and hops than any other county. Additional agricultural products include peaches, apricots, cherries, beef, and wheat, and award winning wines. Yakima County has surpassed Whatcom County as Washington's leading county for dairy production and cow numbers. Yakima County covers an area of approximately 4,300 square miles. A sample of 99 Spanish-speaking, heterosexual, Hispanic, women and men from 25-34 years of age was utilized in that study.

For this thesis, a subset of 20 interviews from the parent study was used. Our overall objectives were to explore factors associated with farm workers' knowledge, training, and their attitudes surrounding pesticide safety and PPE use.

Recruitment and Human Subjects Protection

The Institutional Review Board as the sponsoring university (University of Washington) approved the research protocol for this study. Data are not identifiable, and there was no attempt to re-identify participants. Thus, the continuing analysis and bank of interviews was exempt from additional human subjects' approval at Penn State University and did not require second IRB approval.

For recruitment of the original sample, a purposive network sampling strategy was used to identify 100 farm workers in the Yakima Valley of Washington State. Eligibility requirements for study participants included being 18 years or older, residence of Lower Yakima Valley in Washington State, and employment as a farmworker. In- person recruitment took place at local community organizations, churches, grocery stores, and work sites. Interested individuals were asked to provide their names and telephone numbers for later contact. Potential participants were contacted by telephone for in-home visits to discuss details of the study.

Interviews

The interview guide (see Appendix A) explored farm workers' attitudes, behaviors, and experiences working in the fields. Open-ended questions began to establish rapport and comfort at start of the interview, probing for story-like answers from participants about their family, their work style, their attitudes about the parts of their work, and their interactions with others. Next, the interview asked questions about pesticides and exposure. Additional probes included "Can you describe your morning to get ready for work?" Interviewers then asked, "Do you work with others around you?" "Do you have good feelings when you work?" "What is your task at work?" "How long have you worked here?" "Do you carry water with you?" "Do they provide water for you?" "What are the restrooms like at work?" "Where do you eat lunch?" "Did you receive any safety orientation when you started?" "Do you know what the pesticides are?" "How do you protect yourself from the pesticides?" "How do you protect your family from the pesticides?" The interviews typically lasted 1-2 hours at the individual's home or community center. Dr. Shedra Amy Snipes and her research assistant Bridgette Navarro conducted the interviews in Spanish.

Data

Digital audio recordings of the interviews were transcribed verbatim in Spanish, and then translated into English. Participants' assumed pseudonyms were used as identifiers in place of their names. Transcripts were loaded into the quantitative analysis software, NVivo for coding and analysis. For the twenty interviews that were selected for this thesis examination, words were coded, and called "nodes". Nodes are a collection of words, phrases or references in the interviews that were about a specific theme or area of interest for our research questions. Nodes were also created based on constructs of the Theory of Planned Behavior for example, we used nodes based beliefs and attitudes, behavioral control, and knowledge. Example nodes were pesticide risk, pesticides bad, and pesticides good have control, lack control, lack knowledge, and gain knowledge. A full list of nodes is available in Table 2.

NVivo was used to code, search for, and assign attributes to each interview. NVivo enabled organization, sorting information, and running reports. Each of the interviews was coded using "open coding", where a list of incidences was characterized as the text was read in its entirety. During the coding, weekly meetings took place with the advisor to discuss coding and theme direction. The nodes were then condensed and grouped into training, control, PPE usage, and pesticide exposure categories.

Table 2. *Complete List of Nodes used in NVivo Coding*

Node Name	Node Description
Coworkers	Farmworker describes the other people he/she works with
Family Important	Farmworker says that family is important to him/her.
Fear Disease	Farmworker says he/she fears getting sick or a family member becoming ill from the pesticides.
Field Worker	Farmworker is employed to work in the fields
Hand Washing	Farmworker washes hands at work.
Have Control	Farmworker has perceived ability to avoid harmful effects of pesticide exposure
Lack Control	Farmworker feels that they have no control over work environment, protecting themselves from pesticides, or change anything about their working conditions.
Lack Knowledge	Farmworker says that he/she has little/no knowledge of pesticides.
Mandated PPE	Farmworker says that they are required to wear PPE by the employer.
No Pesticide Exposure	Farmworker says that they are not heavily exposed to spray/pesticides at work.
Pesticide Exposure	Farmworker mentions how they are exposed to the pesticides.
Pesticide Hander	Farmworker is employed to mix, handle, and/or spray pesticides
Pesticide Knowledge	Farmworker knows what pesticides are/what they are used for.
External Safety	Farmworker learned pesticide safety information outside of work
Gain Knowledge	Farmworker says becoming more knowledgeable is important to protecting oneself from pesticides.
Learned at Work	Farmworker says he/she learned in the field how to perform certain task.
Learned from Others	Farmworker says he/she is aware of effects of pesticides from others.
Others Knowledge	Other Farmworkers have knowledge about pesticides.
Others No Knowledge	Farmworker says that other workers are not knowledgeable about

	pesticides/pesticide protection.
Personal Experience	Farmworker has learned about effects of pesticides from personal experience.
Pesticide Safety Info	Farmworker received some type of pesticide safety information/training
Pesticide Risk	Farmworker has beliefs about risks related to pesticide exposure.
Equal Risk	Farmworker feels that all people are at equal risk for developing symptoms to pesticides
Age Equal	Farmworker feels there is no difference in risk by age.
Missed Work Risk	Farmworker feels that people who are exposed to pesticides are at greater risk of missing work
Others Risk Behavior	Farmworker mentions other workers not taking appropriate measures to protect themselves from pesticides.
Unequal Risk	Farmworker feels that not everyone is affected the same way by pesticides, some more than others.
Child Risk	Farmworker feels that children are at a greater risk/more affected by pesticides
Exposure Risk	Farmworker feels that people who are exposed more to pesticides are at greater risk.
Men Risk	Farmworker feels that men are more at risk to pesticides.
More Sensitive	Farmworker says some people are more sensitive or weaker than others and this causes them to experience symptoms
Older Risk	Farmworker feels that older people are more susceptible to pesticides
Women Risk	Farmworker feels that women are more at risk to pesticides than men.
Unsure Risk	Farmworker is unsure if certain group is more at risk than others.
Pesticide Symptoms	Farmworker describes symptoms they feel are related to pesticide exposure.
Asthma	Farmworker says he/she suffers from asthma/respiratory problems.
Cancer	Farmworker mentions cancer as outcome from pesticide exposure.
No Other Farmworker Symptoms	Farmworker does not know of other farmworkers who experience symptoms due to pesticides.

No Symptoms	Farmworker says he/she has not experienced any symptoms due to pesticides.
Other Farmworker Symptoms	Farmworker knows that other workers have had reactions/symptoms due to the pesticides.
Pesticides Bad	Farmworker feels that pesticides are not good for or are harmful to people.
Harm People	Farmworker feels that pesticides are bad because they are harmful to people.
Pesticides Good	Farmworker feels that pesticides are good/beneficial.
Powder	Farmworker discusses what the powder is.
PPE Not Worn	Farmworker says he/she does not wear PPE (masks, gloves, glasses)
No Glasses	Farmworker says he/she does not wear glasses when working.
No Gloves	Farmworker says that gloves are not worn.
No Handkerchief	Farmworker says he/she does not wear a handkerchief.
No Mask	Farmworker says he/she does not wear a mask
No Others PPE	Farmworker mentions that other workers do not wear PPE.
Not Mandated PPE	Farmworker says that the employer does not require them to wear PPE.
PPE Not Allowed	Farmworker says they are not allowed to wear PPE.
PPE Not Provided	The owner does not provide PPE, workers must purchase own PPE.
PPE Problem	Farmworker mentions problems with using PPE
PPE Worn	PPE including gloves, masks, and glasses are used by the Farmworker
Boots	Farmworker says he/she wears boots or other closed toe shoes to work.
Buy PPE	Farmworker says that he/she buys own PPE.
Glasses	Farmworker says he/she wears glasses.
Gloves	Farmworker says that he/she wear gloves
Hat	Farmworker says he/she wears a hat when working in the field.

Long Clothes	Farmworker says that he/she wears clothes that cover the body when working in the field.
Mask Worn	Farmworker says he/she wears a mask
Others PPE	Farmworker mentions others wearing PPE (glasses, masks, gloves)
PPE Provided	Farmworker says that PPE is provided for them at work.
Vulnerability	Farmworker expresses the inability to withstand the effects of a hostile environment
Work Safety	Farmworker says they receive some type of safety information/ training at work.
No Signs	Farmworker says signs are not put up to warn about an area that has been sprayed.

After all twenty of the interviews were coded, several metrics were run. The prevalence of each of the nodes was analyzed for frequency, duration, depth and context. NVivo was used to analyze a node-by-node matrix that listed all the nodes listed in Table 2 for all of the metrics listed above (frequency, duration, depth, and context). To do this, a matrix was created with cells where the rows and columns of nodes intersect, representing the number of times those two nodes overlapped. This resulting matrix showed us which overlapping relationships in the overall dataset occurred most frequently.

Finally, we reduced the matrix to include nodes with the greatest significance and salience. First, we identified nodes with the highest frequencies (occurring at least 50 times or more in the dataset). They were: Pesticide Symptoms, Pesticide Knowledge, Vulnerability, Lack Knowledge, Pesticide Exposure, Coworkers, Unequal Risk, Lack Control, Pesticides Bad, Family Important, Personal Experience, Powder, Pesticide Safety Info, Learned at Work, Work

Safety, and Other Farmworker Symptoms. Next, we identified pervasive nodes (nodes occurring across at least half of all participants or more). The pervasive nodes included: Pesticide Symptoms, Pesticide Knowledge, Vulnerability, Lack Knowledge, Pesticide Exposure, Coworkers, Unequal Risk, Lack Control, Pesticides Bad, Family Important, Personal Experience, Powder, Pesticide Safety Info, Learned at Work, Work Safety, Other Farmworker Symptoms, Child Risk, Hand Washing, No Pesticide Exposure, Harm People, Learned from Others, Unsure Risk, PPE Not Worn, Have Control, More Sensitive, PPE Worn, No Gloves, Equal Risk, Gain Knowledge, No Mask, No Symptoms, No Glasses, Pesticides Good, and PPE Not Provided. Our subsequent analysis included only pervasive and frequent nodes and concepts.

To further refine the data, some nodes were combined because of overlap in meaning. For example, the nodes No Clothes, No Glasses, No Gloves, No Handkerchief, and No Mask, were combined into No PPE. In another example, nodes called “PPE Falls Off”, “PPE Hinders”, PPE Hot and PPE Not Allowed were combined into PPE Problems. Also, node labels “No Pesticide Symptoms and No Symptoms were combined under No Symptoms. Finally, the nodes “fieldworker” and “pesticide risk” were removed from the analysis due to their overlap with several other more descriptive nodes.

Further Analyses of Nodes for Creating Themes:

In order to narrow the findings and to cull the most significant findings to the top of the study, we identified high frequency and high pervasive nodes. In this study, we define a *high frequency node* as one that was identified over fifty times in the interview data set. We also define a *pervasive node* as those that are identified in over ten of the twenty interviews. Only the highly frequent or pervasive nodes were significant to the results of the study. The nodes that were neither highly frequent nor pervasive were excluded from the results of the study because they were not considered significant.

The high frequency nodes that had 50 and greater node counts are: Pesticide Symptoms, Pesticide Knowledge, Vulnerability, Lack Knowledge, Pesticide Exposure, Coworkers, Unequal Risk, Lack Control, Pesticides Bad, Family Important, Personal Experience, Powder, Pesticide Safety Info, Learned at Work, Work Safety, and Other Farmworker Symptoms. The pervasive nodes that were in over 10 interviews were: Pesticide Symptoms, Pesticide Knowledge, Vulnerability, Lack Knowledge, Pesticide Exposure, Coworkers, Unequal Risk, Lack Control, Pesticides Bad, Family Important, Personal Experience, Powder, Pesticide Safety Info, Learned at Work, Work Safety, Other Farmworker Symptoms, Child Risk, Hand Washing, No Pesticide Exposure, Harm People, Learned from Others, Unsure Risk, PPE Not Worn, Have Control, More Sensitive, PPE Worn, No Gloves, Equal Risk, Gain Knowledge, No Mask, No Symptoms, No Glasses, Pesticides Good, and PPE Not Provided. Of the 16 nodes with high count and 34 nodes with high pervasiveness, all 16 of the high count appeared in the high pervasiveness. So the nodes with high frequency and pervasiveness are: Pesticide Symptoms, Pesticide Knowledge, Vulnerability, Lack Knowledge, Pesticide Exposure, Coworkers, Unequal Risk, Lack Control, Pesticides Bad, Family Important, Personal Experience, Powder, Pesticide Safety Info, Learned at Work, Work Safety, and Other Farmworker Symptoms. Only the high frequency and pervasive nodes are considered for the remainder of the study.

Chapter 3 Results

Demographic characteristics

All farmworkers interviewed were women who were married or living with a partner. The majority of the women were aged 26-35 yrs old (65%). See Table 3 below for other demographic characteristics.

Table 3 *Sample Characteristics of Latino Farmworkers: Lower Yakima Valley, Washington, March 2005-February 2006*

Personal Characteristics	Number of Farmworkers	Sample Study, %
Gender		
Women	20	100
Age, y		
≤25	4	20
26-35	13	65
36-45	2	10
>45	1	5
Marital Status		
Married or living with a partner	20	100

Formation of Themes

When the entire set of interviews was coded, a list of most influential nodes arose. Below in Table 4, the list of these nodes is listed with the number of times they were coded and the number of interviews they appeared in out of 20.

Table 4 *Node Summary from NVivo coding of sample interviews*

Node	Number Of Coding References	Number Of Sources Coded
Pesticide Symptoms	164	20
Pesticide Knowledge	133	20
Vulnerability	127	19
Lack Knowledge	122	19
Field Worker	110	20
Pesticide Risk	105	19
Pesticide Exposure	101	18
Coworkers	92	20
Unequal Risk	85	18
Lack Control	83	20
Pesticides Bad	80	19
Family Important	61	19
Personal Experience	60	18
Powder	60	17

Pesticide Safety Info	57	17
Learned at Work	54	17
Work Safety	51	14
Other Farmworker Symptoms	50	17
Child Risk	42	15
Hand Washing	41	18
No Pesticide Exposure	40	15
Harm People	37	18
Learned from Others	36	14
Unsure Risk	36	12
PPE Not Worn	35	13
Have Control	32	15
More Sensitive	31	14
PPE Worn	27	16
Exposure Risk	27	9
No Gloves	21	14
Equal Risk	21	11
Gain Knowledge	20	10
No Mask	19	11
No Symptoms	17	12
Older Risk	17	8
No Glasses	16	11

No Other Farmworker Symptoms	16	9
Pesticides Good	15	11
PPE Not Provided	13	12
Others No Knowledge	13	9
Pesticide Hander	13	4
Mask Worn	12	8
Long Clothes	12	8
Glasses	11	8
Gloves	11	8
External Safety	10	8
PPE Provided	10	8
Others Risk Behavior	10	8

Analysis revealed four major themes about how farmworkers use PPE. Overall PPE use was low. Both farmworkers who receive and did not receive training feel they lack knowledge about pesticides. However, the analysis may show that among the few farmworkers who wore PPE and expressed knowledge, they learned pesticide information from work. Also, farmworkers' personal experiences matter. Those who discussed being exposed to pesticides may be the most vulnerable, and discussed having little control, knowledge and training about pesticides. Farmworkers' vulnerability may explain very low PPE use.

Table 5 *Overview of Major Themes Derived From Qualitative Interviews with Latino Farmworkers: Lower Yakima Valley, Washington*

Theme	Representative Quote
Both farmworkers who receive and did not receive training feel they lack knowledge about pesticides	Interviewer: "Where you work they do not give you some type of orientation before you start to work in a job?" Farmworker1: "Yes well sometimes yes..." Interviewer: "Do you know what the pesticides are?" Farmworker1: "I am not sure just what they are" Interviewer: "Where you work they do not give you some type of orientation before you start to work in a job?" Farmworker2: "No" Interviewer: "Do you know what the pesticides are?" Farmworker2: "No one knows what it is that they spray"
Among the few farmworkers who wore PPE and expressed knowledge, they learned pesticide information from work	Interviewer: "And do they give you some type of training before you put the sprays before you do it?" Farmworker: "Oh yes they give me instructions like how we are supposed to do things and everything. But I am very protected with my gloves that they give me my mask yes. Yes we have a suit of plastic …"
Those who discussed being exposed to pesticides may be the most vulnerable, and discussed having little control, knowledge and training about pesticides. Farmworkers' vulnerability may explain low PPE use	Farmworker: "Yes that sometimes they are dangerous… And sometimes when they are spraying and one hour and sometimes they put us in there to work sometimes in an hour and a half. They put us in to work sometimes they are spraying on one side and close to where we are working." Interviewer: "When you are working do you wear protection?" Farmworker: "No."

Pesticide Knowledge

Both farmworkers who received pesticide training and those that did not receive pesticide training felt they lacked knowledge about them. Almost all of the farmworkers did not know what the pesticides are or could describe what they do. Many of the farmworkers that received training could not express even that pesticides kill some things to help increase the harvest.

The group of workers that received training did not feel they knew enough to talk about pesticides even at a basic level or could describe what they do. When one interviewer asked, “Where you work they do not give you some type of orientation before you start to work in a job?” One farmworker responded, “Yes well sometimes yes...” And then when asked, “Do you know what the pesticides are?” The same farmworker said, “I am not sure just what they are”

The group that did not get training about pesticides knew little to none about the pesticides as well. When an interviewer asked, “Where you work they do not give you some type of orientation before you start to work in a job?” The farmworker said, “No” Then the interviewer asked, “Do you know what the pesticides are?” The same farmworker said, “No one knows what it is that they spray”

Of the group of farmworkers that received pesticide knowledge, the largest group of them had beneficial attitudes toward pesticides. Of the 19 comments about pesticides having a positive impact on health, environment, or living, 12 of them (63%) expressed also having pesticide knowledge. One farmworker explained, “But for the fruit it is good no so that it will grow good. Well yes it is what they put on the trees right. So that they will give the fruit right.” Understanding that the pesticides have a purpose and serve to positively impact the harvest shows that this farmworker was shown the benefits of pesticides. Interestingly, the group of farmworkers that received pesticide information and felt a positive side of pesticide use were also users of PPE. The interviewer asked, “Do you think that there are bad things about the pesticides?” The farmworker said, “Well no, no, no I do not know I feel that there are.” When later asked, “Do you wear gloves? And do you wear the glasses?” The worker responded, “Yes cloth ones. And yes.” This farmworker understands the importance of the pesticides and this has impacted his behavior of PPE usage.

Sources of Training

Overall PPE use was low, but the analysis may show that among the farmworkers who wore PPE, they learned pesticide information from work.

Of those farmworkers who did wear PPE, they learned about pesticides from pesticide safety training. They learned about pesticides much fewer times from personal experiences and stories of others symptoms than from the workplace. For example, when asked, “Have you been to trainings about the pesticides? One worker explained, “There are some [employers] that put on a video sometimes…[it shows] what is good and what is not good for us to get close to and everything.” Videos are one way that farmers are allowed by the EPA to train their workers on pesticides. Videos shown for training can describe the types of PPE, the reasons to wear PPE, and the dangers of pesticides. The intention is that this can give them the information they need to be safer on the job.

The farmworkers receiving pesticide information from work rather than from other farmworkers’ stories wore PPE more often or regularly. For example, one farmworker was asked, “And do they give you some type of training before you put the sprays before you do it?” The worker responded, “Oh yes they give me instructions like how we are supposed to do things and everything. But I am very protected with my gloves that they give me my mask yes. Yes we have a suit of plastic …" This shows that the farmworkers receiving in-work training are the ones wearing the PPE in the field to protect themselves from the pesticides.

In considering that the farms with more formal pesticide safety programs might also have the resources to provide PPE, we compared looked to see if formal training was linked to PPE provision and use. However there was no difference in being provided or not provided PPE between the farmworkers who had been given formal pesticide safety training. When asked, "Where you work they give you some type of orientation before you start to work in a job?" One farmworker said, "Yes well sometimes yes well that is what I have seen only. Do they provide the gloves for you? No I buy them." This shows that it is not necessarily the farms that provide the PPE that have workers who wear the most PPE. Farms that do not provide PPE but have in-work training could see higher PPE usage in their workers.

The workers receiving this informal training about pesticides discussed wearing PPE 47% of the time. For example, one farmworker recounted, "There was a program that they would tell you about the pesticides. It was outside the… video store…one day training on how to protect us from the effects of the pesticides." When that farmworker was asked, "Do you protect your body before you go to work?" The worker responded, "Well the truth no that about protecting you would have to 'plasticize' yourself so that the sprays do not hit you… The truth is that I do not think that there is such a thing to protect us." The farmworker even after attending training on pesticides does not wear PPE or know of protection against the PPE.

Vulnerability

In examining the vulnerability of farmworkers, farmworkers who felt vulnerable toward pesticide exposure had little perceived control over their pesticide safety, and showed very low PPE use.

Those who discussed being exposed to pesticides may be the most vulnerable, and discussed having little control, knowledge and training about pesticides. Farmworkers' vulnerability may explain low PPE use. One farmworker said, "Well sometimes I think that because we work daily we do not even feel them anymore…" Another farmworker said, "Yes that sometimes they are dangerous… And sometimes when they are spraying and one hour and sometimes they put us in there to work sometimes in an hour and a half. They put us in to work sometimes they are spraying on one side and close to where we are working." The interviewer asked that same farmworker, "When you are working do you wear protection?" The farmworker responded, "No."

Chapter 4 Discussion

In this study, a sample group of migrant farmworkers in the Yakima Washington Valley was asked questions about their beliefs, perceived control, and PPE behaviors. Themes emerged about training that the farmworkers had received and its influence on different beliefs and attitudes that contributed to different PPE behaviors.

Pesticide Knowledge

Farmworkers who were trained or untrained in pesticides both felt they lack information about the topic. The farmworkers who were identified as lacking knowledge also corresponded to less PPE usage. In other earlier studies, farmworkers received training on pesticide exposure and prevention from their work. After the training, they were given a comprehension exam to measure their knowledge and few farmworkers could describe ways to protect themselves after the presentation. One study showed that not all training is effective at making the farmworkers understand the concepts of pesticide danger and prevention (Arcury, 1999). In another study, Austin found that North Carolina farmworkers engagement in safe pesticide behaviors was contributed by their communication with their employer and positive work relationships. They found that these work factors were much more effective to trigger PPE behavior than private outreach training programs (Austin, 2001). Perhaps this positive work relationship influenced their social norm beliefs of PPE usage, leading to greater PPE usage. This agrees with our findings that workplace training, rather than out-of work pesticide training and information, contributes to higher PPE usage. Perhaps the farms that provide effective training programs are also more likely to have these positive work relationships that Austin found.

Farmworkers that showed they have knowledge of the benefits of pesticides also showed a greater tendency toward PPE usage. Those that indicated the pesticides had a positive impact on the harvest or the farm had a higher indication of using their PPE. If we examine this within the modified Theory of Planned Behavior in Figure 2, the pesticide knowledge is influencing the attitude, social norm, or perceived control of the farmworker that is then influencing their intention and eventually their PPE behavior.

We hypothesized that the greater overall knowledge of pesticides would lead to greater use of PPE. This would lead us to believe there would be greater intention to use PPE. In this study we found that those who received training at work did use more PPE. We also showed that within pesticide knowledge, the workers who know the benefits of wearing PPE had greater PPE usage.

Sources of Training

Farmworkers indicated that overall, their PPE use was extremely low. Those that did have training from their workplace indicated greater intentions to wear PPE. The farmworkers who had received training at work about pesticides and safety had a higher sense of pesticide knowledge, but wore PPE more commonly then their non-trained work counterparts. The farmworkers that had received pesticide information from the community, outside-of-work, had felt a lack of perceived control, and did not know the benefits of pesticides.

In those receiving work training, results showed that more knowledge about pesticides would influence the attitudes, social norms, and perceived control of the farmworkers to influence greater intention that leads to greater PPE usage. This was shown in that formal training at work was associated with more conversations about wearing PPE.

A recent study also showed that a formal pesticide training programs can increase knowledge of pesticides and their hazards, increased risk perception, and is associated with increased cognitive decision-making about safety practices like PPE use (Acosta, 2005). According to the Arcury study in 2001, workers were receiving training from family, friends, and pesticide dealers two-thirds of the time. This study also found that those receiving that informal training from family and friends had increased PPE use (Arcury, 2001). Our findings show that this could be a detriment to the usage of PPE. Specifically, our data shows that those receiving pesticide information from work are the ones with greater PPE usage, not the ones receiving information from family, friends, and community sources. Our data disagrees with this Arcury study, in that we found many more farmworkers received training from work rather than community sources.

Vulnerability

In this study, farmworkers felt vulnerable and had little control over their pesticide safety, which may explain very low PPE use. In this study we also found that farmworkers' personal experiences of pesticide exposures and symptoms had a greater connection with the farmworkers having little perceived control, knowledge and training of pesticides.

Vulnerability also had a strong correlation to a decreased feeling of perceived control toward exposure or lack of exposure toward pesticides. The attitudes and perceived control influence the intention toward behaviors like PPE usage.

In other studies, farmworkers in the region were found to have unjust feelings toward their employers (Snipes, 2007). There are also studies to show that the farmworkers believe that there is a vulnerability that they have toward their compensation. They are pushed to produce more and work more effectively, and are thus pushed to wear less PPE because it slows them down or impedes their work. (Snipes, 2009). This vulnerability that was shown in the workers influenced their attitudes and perceived control toward wearing less PPE as well. So this agrees with the previous research that vulnerable workers wear less PPE.

Chapter 5 Conclusion

In conclusion, migrant farmworkers face many challenges surrounding their close relationship with pesticides on the crops they work with. When migrant farmworkers were interviewed about their five major themes about how the farmworkers knowledge, attitudes, and beliefs affect their intentions and behaviors surrounding pesticide prevention PPE. Themes found in this study can help identify areas for more effective health and safety missions surrounding farmworker populations and their potential exposure with pesticides on the job**.**

There are several strengths and weaknesses in this study. Looking at the sampling population, over 85% of those surveyed are women. The real population of farmworkers has a much greater majority of males. It is unclear if this distortion of the sampling gender affected the outcome of the data in this study. A strength was that within this study, the racial breakdown of the sample population being 83% Latino is a representative population of the migrant farmworker population (NAWS, 2009).

This study's unique connection between training and PPE usage amongst farmworkers can help researchers and farmers better understand the mechanisms to help protect their workers. This study showed that the farmworkers receiving any at-work training rather than out-of-work had higher PPE usage. This reinforces the fact that workplace training is so important and that interventions should be focused in the workplace rather than targeting farmworkers out of work. Concentrated efforts to help farmworkers should point toward the farm rather than community centers or neighborhood venues.

Over the last three years of working for Dow Chemical and Dow Agrosciences, I have seen the development and manufacturing side of the pesticide industry. Findings from this study show that sources of training at the farmworkers place of employment are much more influential in persuading the workers to use PPE. The companies that produce the pesticide products could be more involved in the training development process to produce stronger materials that are more widely available to all the farms that use their product.

Appendix A

Interview Guide

INTERVIEW/QUESTIONNAIRE

ENTER RESPONDENT'S SEX: Male= 1 Female= 2

ENTER LANGUAGE USED FOR INTERVIEW: English=1 Spanish=2

SECTION 1: OPEN-ENDED INTERVIEW

I am going to ask you a series of questions about your feelings about pesticides. You may answer each question however you wish. Please, however, do NOT mention the names, like that you your employer or place of employment. You may refuse to answer any question, at any time, for any reason and that will be ok. If you wish to stop participating at any time, tell us.

1. Describe to me your feelings about pesticides?
2. How do pesticides affect people, if at all?
   i. How do pesticides affect different parts of the body?
   ii. How do pesticides affect men vs. women?
   iii. How do pesticides affect adults vs. children?
3. Tell me about why pesticides affect different people in different ways?
4. What kind of people should never be exposed to pesticides?
5. What kind of people can stand to be exposed more than others?
6. What should a person who is heavily affected by pesticides do to

lesson the affects of pesticides?

7. What should a person who is heavily affected by pesticides do to protect themselves from being affected in the future?

8. Should a person who is NOT heavily affected by pesticides do any of the same things as a person who IS heavily affected by pesticides to protect themselves from being affected?

9. What kind of things might make a person change from being someone who is NOT heavily affected by pesticides into someone who IS heavily affected by pesticides?

10. Are you at risk of being heavily affected by pesticides?

11. What kinds of this should ANY person do at work vs. when they get home to protect themselves from being affected by pesticides?

BIBLIOGRAPHY

Snipes, S. A., Thompson, B., O'connor, K., Godina, G., Ibarra, G., (2007). Anthropological and psychological merge: design of a stress measure for Mexican farmworkers. *Cult Med Psychiatry*, *31(3).*

Snipes, S. A., Thompson, B., O'connor, K., Shell-Duncan, B., King, D., Herrera, A. P., et al. (2009). "Pesticides Protect the Fruit, but Not the People": Using Community-Based Ethnography to Understand Farmworker Pesticide-Exposure Risks. *American Journal of Public Health*, *99*(S3), S616-S621.

Dumitrescu, A. L., Wagle, M., Dogaru, B. C., & Manolescu, B. (2011). Modeling the theory of planned behavior for intention to improve oral health behaviors: the impact of attitudes, knowledge, and current behavior. *Journal of Oral Science*, *53*(3), 369-377.

Slovic, P. (2010). The Psychology of risk. *Saúde e Sociedade*, *19*(4), 731-747.

Cabrera, N. L., & Leckie, J. O. (2009). Pesticide Risk Communication, Risk Perception, and Self-Protective Behaviors Among Farmworkers in California's Salinas Valley. *Hispanic Journal of Behavioral Sciences*, *31*(2), 258-272.

Rother, H. (2008). South African farm workers' interpretation of risk assessment data expressed as pictograms on pesticide labels. *Environmental Research*, *108*(3), 419-427.

Glanz, K., Rimer, B. K., & Lewis, F. M. (2002). Health behavior and health education: theory, research, and practice (3rd ed.). San Francisco: Jossey-Bass.

Ajzen, I. (2005). *Attitudes, personality, and behavior* (2nd. Edition). Milton-Keynes, England: Open University Press / McGraw- Hill.

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). (2007, October 9). EPA. Retrieved June 29, 2014, from http://www.epa.gov/agriculture/lfra.html

Parr Rosson, et al. (June 2009), The Economic Impacts of Immigration on U.S. Dairy Farms, National Milk Producers Association.

Andrew Wainer (December 2011), "Farm Workers and immigration Policy," Briefing Paper 12, Bread for the World Institute

World Agricultural Production. (2013, August 12). USDA Foreign Agricultural Service. Retrieved September 10, 2013, from usda01.library.cornell.edu/usda/current/ worldag-production/worldag-production-08-12-2013.pdf

U.S. Department of Agriculture, Economic Research Service. Farm Income and Costs, 2010.

Washington State Crop Production Totals. (n.d.). *USDA/NASS QuickStats Ad-hoc Query Tool*. Retrieved August 28, 2013, from http://quickstats.nass.usda.gov/ results/0BE3CC25-04DD-3BF6-A226-F7B814C31247

National Agricultural Workers Survey (NAWS) 2009: A Demographic and Employment Profile of Perishable Crop Farm Workers. (2009). Washington D.C.: US Dept of Labor.

Hawkins, Daniel. Monograph Series: Introduction. National Center for Farmworker Health, Inc., 2001.

Federal Insecticide, Fungicide, and Rodenticide Act, Section 2(u)

Knutson, R. D., C. R. Taylor, J. B. Penson, & E. G. Smith, 1990. Economic impacts of reduced chemical use. Knutson & Associates, College Station, TX

Delaplane, K. S. (n.d.). Pesticide Usage in the United States: History, Benefits, Risks, and Trends. *North Carolina State University Factsheets*. Retrieved August 28, 2013, from http://ipm.ncsu.edu/safety/factsheets/pestuse.pdf

Kandel, William. Profile of Hired Farmworkers, A 2008 Update. Economic Research Report No. 60, U.S. Department of Agriculture, 2008.

Agricultural statistics- Crop Production. (2013). Washington, D.C.: United States, Dept. of Agriculture.

U.S. Bureau of Labor Statistics. Census of Fatal Occupational Injuries. U.S. Department of Labor, 2008.

How to comply with the Worker Protection Standard for agricultural pesticides what employers need to know (Rev. Sept. 2005. ed.). (2005). Washington, D.C.: U.S. Environmental Protection Agency, Office of Prevention, Pesticides, and Toxic Substances.

United States Department of Labor, Wage and Hour Division. Fair Labor Standards Act. Available online: http://www.dol.gov/whd/flsa/

United States Department of Labor. The Migrant and Seasonal Agricultural Worker Protection Act. Available online: http://www.dol.gov/compliance/laws/comp-msawpa.htm

United States Department of Labor. Occupational Safety and Health Act of 1970. Available online: http://www.osha.gov/pls/oshaweb/owasrch.search_form?p_doc_type=oshact

United States Department of Homeland Security. Immigration and Nationality Act. http://www.uscis.gov

Worker Protection Standard for Agricultural Pesticides | Agriculture | US EPA. (1992). US Environmental Protection Agency. Retrieved August 29, 2013, from http://www.epa.gov/agriculture/twor.html

Grube, A. H. (2011). Pesticides industry sales and usage: 2006 and 2007 market estimates. Washington, DC: Biological and Economic Analysis Division, U.S. Environmental Protection Agency.

2007 Census on Agriculture. (2007). Washington, DC: US Department of Agriculture.

Liew, Z., Wang, A., Bronstein, J., & Ritz, B. (2014). Job Exposure Matrix (JEM)-Derived Estimates of Lifetime Occupational Pesticide Exposure and the Risk of Parkinson's Disease. Archives of Environmental & Occupational Health, 69(4), 241-25.

Jong, K. D., Klauw, M. V., Hillege, H., Harst, P. V., Franke, L., Boezen, H. M., et al. (2014). Pesticides and other occupational exposures are associated with airway obstruction: the LifeLines cohort study. Occupational and Environmental Medicine, 71(2), 88-96.

Fenske R. 1997. Pesticide exposure assessment of workers and their families. Occup Med: State Art Rev 12:221±237.

Von Essen SG, McCurdy SA. Health and safety risks in production agriculture. West J Med 1998 Oct;169(4):214-20.

Villarejo D, Baron SL. The occupational health status of hired farm workers. Occup Med 1999 Jul-Sep;14(3):613-35.

Blondell, J. (1997). Epidemiology of pesticide poisonings in the United States, with special reference to occupational class. Occupational Medicine State of the Art Reviews, 12, 209-220.

Kandel, W. A., & Donato, K. M. (2009). Does Unauthorized Status Reduce Exposure to Pesticides? Evidence From the National Agricultural Workers Survey. *Work and Occupations, 36*(4), 367-399. doi: 10.1177/0730888409347599

Public Workforce System Dataset (PWSD). (n.d.). US Department of Labor. Retrieved September 24, 2013, from www.doleta.gov/reports/pwsd/19952008%20Public%20Workforce%20System%20Dataset.xls

(2004-04-01). Pesticides. Pediatrics (Evanston), 113(4 suppl), 1030-1036.

Anon, 2004b. The State of Food Insecurity in the World: 2004. FAO/ Economic and Social Department. Food and Agriculture Organization, Rome, Italy.

Yancy, J., Cecil, H., 2005. Study Touts Herbicide Benefits, Vol. 32 (no.11). Southeast Farm Press, p. 16.

Pest Management Practices. (n.d.). *USDA Economics and Statistics System*. Retrieved September 26, 2013, from http://usda.mannlib.cornell.edu/MannUsda/viewDocumentInfo.do?documentID=1452

Worker Protection Standard for Agricultural Pesticides. (n.d.). EPA. Retrieved November 4, 2013, from http://www.epa.gov/oecaagct/twor.html#Who%20and%20What%20Are%

ACADEMIC VITA

Sienna K. George

skg5073@psu.edu

OBJECTIVE: To obtain a full-time quality and reliability engineering position beginning August 2013 in a biomedical or pharmaceutical industry.

EDUCATION:

Bachelor of Science in Chemical Engineering and Toxicology, Minor in Global Health — August 2013
The Pennsylvania State University, University Park, PA
Schreyer Honors College Scholar

EXPERIENCE:

Co-op: Dow Agrosciences — May-August 2012
Dow Agrosciences, Indianapolis, IN
- Led a team of supply chain specialists and business managers to re-evaluate and design a bulk terminal network for a new product that included an inventory and rail fleet optimization.
- Created best practices recommendations for the inventory reconciliation and certificate of analysis processes that included IS map development, root cause analysis, and work process development.

Internship: Translational Research Sciences, Genetics — May-August 2010
Hoffman LaRoche, Nutley, NJ
- Contributed to a hands-on wet-bench whole genome Single Neucleotide Polymorphism (SNP) genotyping project using Illumina Beadchips for a pharmacogenetics study of Rheumatoid Arthritis patients from a phase III clinical study.
- Performed novel statistical method for a Genome Wide Association Study (GWAS) consisting of genotyping more than 3000 variants identified in 1800 Rheumatoid Arthritis patients treated with Actemra using an Illumina assay.

Research Assistant: Rhoto-cop Project — August 2009 - May 2010
Chemical Engineering Laboratory, University Park, PA
- Helped to produce medically important human proteins in bacterial membrane imvaginations.
- Researched development of wet-bench bacterial growth reactor including procedure writing.
- Analyzed statistics of plasmid isolation to transfer genes into Rhotobacter.

INVOLVEMENT:

American Institute of Chemical Engineering
Sophomore Representative, Vice President, President, THON Dancer
College of Engineering
Reverse Career Fair Co-founder
Global Brigades Team Engineer
Water Brigades - Honduras 2012
Medical Brigades - Nicaragua 2013
Society of Women Engineers
Semiformal Chair, Social Director
Omega Chi Epsilon- Chemical Engineering Honors Society
Corporate Relations Chair

AWARDS:

President's Freshman Award, President's Sparks Award
Pruscilla Guthrie World Class Engineering Award Recipient
Hana M. Helfferich Scholarship In Chemical Engineering
Dow 1-Carat Employee Award
Dr. James Slick Cooperative Education Student of the Year Award

Current Address: 514 That Way #615 Lake Jackson, TX 77566 • Mobile: (570) 955-9141
Permanent Address: 44 Cabin Corner, Honesdale, PA 18431 • (570) 253-7897