AGRICULTURAL WORKPLACE COMPLIANCE WITH THE ENVIRONMENTAL PROTECTION AGENCY'S WORKER PROTECTION STANDARD

AN IDAHO ANALYSIS

by

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ABSTRACT

Agricultural workers are at high risk for occupational pesticide exposure and pesticide-related illness. The Worker Protection Standard (WPS) is the primary federal regulation aimed at reducing pesticide exposure among agricultural workers. Agricultural employers are responsible for complying with the nearly 100 WPS requirements, including the provision of pesticide safety training, personal-protective equipment, and decontamination supplies to employees.

Despite the potential health implications of WPS violations, information is limited regarding compliance levels in Idaho. We aim to fill this gap by describing compliance trends according to WPS inspection results archived by the Idaho State Department of Agriculture (ISDA). We analyzed 557 WPS inspections conducted on Idaho farms between 2001-2019 using SAS and STATA statistical software. Descriptive statistics and regression analyses were used to describe the frequency and characteristics of violations observed collectively and during each inspection.

According to inspection reports, approximately 46% of inspections (n=266) resulted in at least one WPS violation. An average of 3 of 55 (5.4%) requirements were violated during Tier 1 inspections (SD=7.22), and an average of 7 of 55 (12.7%) requirements were violated during Tier 2 inspections (SD =9.08). Farm employers most frequently violated the sections of the WPS pertaining to pesticide safety training and the central location (an accessible area where pesticide information is to be displayed).

Nearly 50% of WPS inspections resulted in at least one violation, suggesting that WPS noncompliance is common across farms in Idaho. Training and central location requirements may have been most frequently violated due to the logistical challenges of complying with these sections, or because of the relative ease in which they could be accurately monitored. Additional WPS research, education, and outreach is needed, not just for the purpose of improving reported compliance rates, but in fact to better protect farmworkers from pesticide exposure and related illness.

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LIST OF ABBREVIATIONS

AHS	Agricultural Health Study
EPA	Environmental Protection Agency
ISDA	Idaho State Department of Agriculture
NAWS	National Agricultural Workers Survey
NWCOHS	Northwest Center for Occupation Health and Safety
PPE	Personal Protective Equipment
PTOP	Professional Training Opportunities Program
REI	Restricted-Entry Intervals
SENSOR	Sentinel Event Notification System for Occupational Risks
USDA	United States Department of Agriculture
WPS	Worker Protection Standard

CHAPTER ONE: INTRODUCTION

Pesticides

A pesticide is a substance, or mixture of substances, used to prevent, destroy, repel or mitigate a pest (Environmental Protection Agency, 2018a). Pesticide is an umbrella term that includes insecticides, fungicides, herbicides, rodenticides and others, which are named according to the type of pest they target (Environmental Protection Agency, 2018a). Pesticide products contain both active and inert ingredients; the active ingredients are intentionally lethal to the pest, while inert ingredients – usually more than 95% of the pesticide formulation – can act as emulsifiers, solvents, carriers, aerosol propellants, fragrances, and dyes (Environmental Protection Agency, 2016).

The benefits of pesticides are numerous; they can improve the quality of food crops, act as public health defenses against human and livestock disease vectors, and repel nuisance organisms in and around homes and gardens (Cooper & Dobson, 2007; Whiford et al., 2009). As such, pesticides provide a variety of environmental and economic advantages on the local, national, and global scale (Cooper & Dobson, 2007). The use of pesticides has contributed to the growing global food supply, which has increased by 170% since 1948 (Wang, Nehring, & Mosheim, 2018; Whiford et al., 2009). In the US, about 90% of all pesticides applied in the US are used in the agricultural sector (Atwood & Paisley-Jones, 2017).

Total pesticide use has remained extensive over the past several decades despite varying application rates across specific classes of pesticides – for example, pyrethroid

insecticide use has grown while organophosphate insecticide use has declined (Barr et al., 2004; Environmental Protection Agency, 2019; Fernandez-Cornejo, Osteen, Nehring, & Wechsler, 2014). According to market estimates generated by the US Environmental Protection Agency (EPA), annual pesticide usage in the US has totaled over 1 billion pounds each year from 2006 through 2012 (2012 being the most recent year from which data are available) (Atwood & Paisley-Jones, 2017).

In terms of agricultural pesticide use, the United States Department of Agriculture (USDA) calculated the total quantity of pesticides applied to 21 crops in the US and found that pesticide use in agriculture peaked in 1981, followed by a slight downward trend into the 2000s driven in part by improved pesticide formulations and application methods (Fernandez-Cornejo et al., 2014). More recently, however, agricultural pesticide use in the US has increased from 606 million pounds in 2005 to 762 million pounds used in 2012 (Marquez, 2018).

Human Exposure to Pesticides from Non-Occupational Sources

Measurable concentrations of pesticide residues can be found in air, water, soil, and food, and consequently, humans can be exposed to pesticides in a number of ways (Aktar, Sengupta, & Chowdhury, 2009; Damalas & Eleftherohorinos, 2011). Most commonly, residential pesticide use and dietary exposure to agricultural pesticides contribute to both acute and chronic pesticide exposure among non-occupationally exposed populations (Damalas & Eleftherohorinos, 2011; Kim, Kabir, & Jahan, 2017; Nicolopoulou-Stamati, Maipas, Kotampasi, Stamatis, & Hens, 2016). Residents of agricultural communities also have an increased risk of exposure to agricultural pesticides from pesticide drift from fields near their homes, as well as the potential for

exposure from family members who work in agriculture via take-home pathway (Bradman et al., 2011; Curl et al., 2002; Strong, Thompson, Koepsell, Meischke, & Coronado, 2009).

While non-occupational exposure to pesticides is common via dietary, residential, and agricultural pathways, most pesticide exposures are unlikely to result in a measurable adverse health effect. Human health risks are largely determined by the magnitude and duration of exposure, as well as the toxicity of the particular pesticide, defined by the equation: *Risk = Toxicity x Exposure* (Damalas & Koutroubas, 2016; Lorenz, 2017). Pesticides range from relatively non-toxic to highly toxic, but when handling pesticides, humans can minimize their risk of exposure by adhering to the handling instructions on each pesticide product label and wearing appropriate protective clothing or personal protective equipment (PPE) (Damalas & Koutroubas, 2016; Lorenz, 2017).

If preventive measures to reduce pesticide exposure are not taken, or if exposure in the environment is unavoidable, one-time and/or repeated pesticide exposure of sufficient magnitude and toxicity among non-occupationally exposed populations can result in acute and/or chronic adverse health outcomes (Damalas & Eleftherohorinos, 2011; Nicolopoulou-Stamati et al., 2016; Sarwar, 2015). Some pesticides are highly toxic to humans and can pose immediate health consequences following even small exposures (Damalas & Koutroubas, 2016). Other pesticides are less toxic, but accidental or intentional overexposure to them can still be harmful (Damalas & Koutroubas, 2016). There is also emerging evidence linking chronic exposure to certain pesticides to long-term health effects such as cancer, leukemia, and asthma, as well as neurological and

reproductive adverse effects (Damalas & Eleftherohorinos, 2011; Deziel et al., 2017; Nicolopoulou-Stamati et al., 2016; Curl, Spivak, Phinney, & Montrose, 2020).

Despite the varying degree of potential human health risks associated with non-occupational pesticide exposure, this thesis focuses on the risks associated with occupational sources of pesticide exposure among agricultural workers.

Occupational Pesticide Exposure among Agricultural Workers

Agricultural workers experience more frequent and more intense agricultural pesticide exposures compared to their non-occupationally exposed counterparts (Arcury et al., 2014). Simply due to the nature of agricultural labor, they experience more pesticide exposure compared to other workforces, with the possible exception of pesticide applicators in other industries who work with pesticides year round (Damalas & Koutroubas, 2016). Agricultural workers can be exposed to many different pesticides consistently across the agricultural season, in high quantities, over a sustained period (Arcury et al., 2014; Damalas & Eleftherohorinos, 2011). Exposure can be through dermal, oral, or inhalation pathways, and can occur through direct contact with residues on treated crops or soil, spills, splashes, and by drift from nearby application (Damalas & Koutroubas, 2016).

Although agricultural workers have a high risk of occupational pesticide exposure, they can reduce their risk by handling pesticides properly and following directions on the pesticide label (Lorenz, 2017). It is important to note that this thesis is not intended to debate the merits of pesticide use in agriculture (or to argue either for or against such use). Instead, we focus on regulatory efforts to help agricultural employers

provide their employees with tools to avoid exposure to pesticides that may potentially cause harm.

For the purpose of this thesis, the term “agricultural worker” is used to refer to either of two types of employees: workers and handlers. The EPA defines a worker as any employee who performs tasks “related to the production of agricultural plants on an agricultural establishment such as harvesting, weeding, carrying nursery stock, repotting plants, pruning or watering” (Environmental Protection Agency, 2018c). Handlers are defined as any employee who performs tasks such as mixing, loading, transferring, applying, or disposing of pesticides, handles open containers of pesticides, acts as a flagger, handles application equipment, or enters a treated area after application to make adjustments or operate equipment (Environmental Protection Agency, 2018c). An agricultural employee can be designated as a worker, handler, or both, and they are usually employed by someone who owns or is responsible for an agricultural establishment (a farm, nursery, greenhouse, or forest), or by a labor contractor, who employs workers or handlers to perform tasks on an agricultural establishment for an employer (Fults, 2017; Pesticide Educational Resources Collaborative, 2019).

There were approximately 2,050,000 full-time workers employed in agricultural production in the US in 2017 (National Institute for Occupational Safety and Health (NIOSH), 2019b), and in the highly agricultural state of Idaho alone, there are nearly 25,000 active farms, 12 million acres of farmland, and more than 10,000 seasonal farmworkers (National Agricultural Statistics Service, 2018).

Pesticide-Related Illness & Agricultural Workers

Agricultural workers are vulnerable to acute pesticide poisonings and injuries, both of which result from exposure to pesticides within 48 hours (Thundiyil, Stober, Besbelli, & Pronczuk, 2008). Poisonings are the consequence of exposure to a pesticide that affects the internal organs or systems and can manifest as mild symptoms, such as dizziness and nausea, to more severe symptoms, such as convulsions, coma, or even death (Damalas & Koutroubas, 2016). Pesticide injuries are caused by pesticides that are external irritants and can result in allergic symptoms like skin and eye irritation (Damalas & Koutroubas, 2016).

In addition, chronic illness among farmworkers, such as carcinogenic, neurologic, and reproductive effects, can be caused by repeated or continuous low-dose exposure to pesticides (Andreotti et al., 2015; Curl et al., 2020; Damalas & Eleftherohorinos, 2011; Koutros et al., 2010; Lerro et al., 2019). For conciseness in the remainder of this thesis, chronic and acute illness, as well as local and/or systemic poisonings and injuries, are collectively referred to as *"pesticide-related illness."*

The true burden of pesticide-related illness among agricultural workers is difficult to measure due to a lack of surveillance and underreporting. Academic journal articles commonly cite an estimate that comes from an EPA analysis in 1992, which reported that 10,000-20,000 pesticide poisonings among agricultural workers are diagnosed by physicians each year (Environmental Protection Agency, 1992). It has also been estimated that agricultural workers suffer from pesticide-related illnesses at a rate of approximately 40 times higher than all other workforces combined (Calvert et al., 2014).

There is currently one surveillance program that monitors pesticide-related illness among participating states in the US: the Sentinel Event Notification System for Occupational Risks (SENSOR)-Pesticides. In 2011, eleven states participated in the SENSOR-Pesticides program, and among these states, 853 cases of acute occupational pesticide-related illness were reported (National Institute for Occupational Safety and Health (NIOSH), 2019a). These data do not provide insight into the magnitude of pesticide-related illness in non-participatory states, nor the extent to which illnesses go unreported, and for those reasons, the SENSOR report must be considered an extreme underestimate (Calvert et al., 2014).

The problem of underreporting is compounded by the social, cultural, and economic disadvantages inherent in the race and immigration status of many agricultural workers. According to results from the 2015-2016 National Agricultural Workers Survey (NAWS), the average level of completed education among agricultural workers was 8th grade. Compared to most other workforces in the US, agricultural workers also less likely to be US citizens: among NAWS survey participants, 69% were born in Mexico and 49% lacked proper documentation (Hernandez & Gabbard, 2018). In addition, these workers often have limited English proficiency; 77% reported Spanish as their primary language and 30% reported that they could not speak English at all (Hernandez & Gabbard, 2018). Another barrier to reporting is the fact that 53% of agricultural workers do not have health insurance (Hernandez & Gabbard, 2018).

Although the full magnitude of pesticide-related illness among agricultural workers is unknown, it is likely extensive (Calvert et al., 2014). Agricultural workers can

experience substantial occupational pesticide exposure across their lives (Arcury et al., 2014), leaving them at an increased risk for acute and chronic pesticide-related illness.

The Worker Protection Standard

Each pesticide product on the market is accompanied with a legally enforceable label with use instructions for minimizing the potential risks of the product (Environmental Protection Agency, 2017). Any pesticide product registered for agricultural use is also labeled with a reference to the Worker Protection Standard (WPS), a separate set of regulations that aim to reduce pesticide exposure among agricultural workers (Fults, 2017). The WPS is supplemental to the product-specific pesticide label, and is referenced in the Agricultural Use Requirements section of the label with the following statement: Use this product only in accordance with its labeling and with the Worker Protection Standard, 40 CFR Part 170 (Environmental Protection Agency, 2018c).

If an agricultural worker is using a pesticide with a label referencing the WPS, it is the responsibility of the worker's employer to comply with the requirements of the WPS contained in the Code of Federal Regulations, Title 40, Part 70 (Environmental Protection Agency, 2018c). The WPS is a collection of pesticide management practices that are generally applicable to all pesticide use scenarios (Hoffmann, 2018), including the provision of PPE, decontamination supplies, pesticide application communication, and pesticide safety training (Fults, 2017). If an agricultural employer does not comply with the requirements set forth in the WPS, they are in legal violation of the pesticide label and can potentially cause or exacerbate pesticide exposure among those they employ (Environmental Protection Agency, 2018c; Fults, 2017). It should be noted that

the WPS extends beyond the protection of agricultural workers – it aims to protect *any* worker or handler on an agricultural establishment, including family members of the agricultural employer (Environmental Protection Agency, 2018c; Fults, 2017).

The WPS has evolved substantially since the EPA passed the first version in 1974. In the original version, agricultural workers were essentially prohibited from applying pesticides when unprotected workers were in the area being treated, but this initial version of the regulation neglected to address other sources of pesticide exposure (Bohme, 2015; Calvert et al., 2014).

The WPS was revised in 1992, in part motivated by an EPA report that, for the first time, highlighted the full magnitude of pesticide-related illness cases among agricultural workers (10,000-20,000 cases diagnosed annually) (Environmental Protection Agency, 1992; Hoffmann, 2018). Even so, many farmworker advocacy groups lobbied for additional protections (EPA, 2015), and in 2015, the WPS was significantly revised into the version that is federal law today (Environmental Protection Agency, 2015; Fults, 2017).

The 2015 version of the WPS implemented additional protections and strengthened those that previously existed (Fults, 2017). A more detailed historical account of the WPS is described in the following section, but to summarize, the EPA describes the current WPS as a comprehensive set of requirements for "pesticide safety training, notification of pesticide applications, use of PPE, restricted-entry intervals after pesticide application, decontamination supplies, and emergency medical assistance" (Fults, 2017), with the overarching goal to reduce pesticide exposure among workers and handlers.

Labor rights activists and farmworker safety advocates have argued that the WPS was an overdue landmark regulation (Bohme, 2015; Environmental Protection Agency, 2015). Prior to the passage of the original WPS in 1974, most labor laws explicitly excluded agricultural workers from the basic workplace protections afforded to their industrial counterparts, including minimum wage requirements, overtime pay standards and laws restricting child labor, based on a concept known as "agricultural exceptionalism" (Holdier, 2019; Robinson et al., 2011). Advocacy groups, farmworker organizations, and individual workers and handlers have identified the WPS as an improvement, in that it places the responsibility of occupational pesticide safety on the agricultural employer (Environmental Protection Agency, 2015; Flocks, Monaghan, Albrecht, & Bahena, 2007). However, if compliance with the WPS is inadequate on the part of the agricultural employer, workers are either left to rely on supplemental pesticide safety information, or do not receive any information at all (Cabrera & Leckie, 2009).

There is mounting evidence that engaging in protective behaviors required by the WPS can reduce pesticide exposure among agricultural workers (Curwin, Hein, Sanderson, Nishioka, & Buhler, 2003; Salvatore et al., 2008). Protective behaviors are defined as any behavior performed by a person, regardless of his or her perceived or actual health status, to protect, promote, or maintain his or her health (Ping et al., 2018). Pesticide-related protective behaviors include washing hands after working with or near pesticides, wearing PPE, using a respirator if necessary, and applying knowledge gained from trainings about ways in which to minimize risk when using pesticides (Fults, 2017). It is widely established that employing these protective behaviors, especially engaging in

proper pesticide application procedures and using PPE, is effective in reducing pesticide exposure (Keifer, 2000).

For example, farmworkers who engaged in handwashing significantly reduced their exposure to acephate, an organophosphate insecticide used in tobacco production (Curwin et al., 2003). Wearing WPS-required protective clothing has been associated with decreased urinary levels of dimethyl alkylphosphates (DMAPs, indicators of organophosphate insecticide exposure) among farmworkers in strawberry fields (Salvatore et al., 2008). Further, the implementation of safety and hygiene procedures, along with the use of gloves, coveralls, and a scarf to cover the nose and mouth among farmworkers, has been associated with decreased pesticide exposure - as measured by cholinergic inhibition- compared to farmworkers who did not implement those protective measures (Gomes, Lloyd, & Revitt, 1999).

These findings reinforce the notion that employer compliance with the WPS is a critical and necessary step toward correcting the decades of unequal treatment that agricultural workers have received in the workplace. However, research demonstrates that noncompliance with certain WPS requirements may be frequent, and therefore workers are often not afforded the protections required by the standard (Arcury, Quandt, Austin, Preisser, & Cabrera, 1999; Arcury, Quandt, & Russell, 2002; Levesque, Arif, & Shen, 2012a; McCauley, Shapiro, Scherer, & Lasarev, 2004; Salvatore et al., 2008; Shipp, Cooper, Burau, & Bolin, 2005).

The Worker Protection Standard in Idaho

In each state, enforcement of the WPS is either accomplished through inspections conducted by the EPA or a state lead agency (Fults, 2017). The state lead agency in Idaho

is the Idaho Department of Agriculture (ISDA), whose inspection staff perform WPS compliance inspections by visiting agricultural establishments, verifying if the farm, greenhouse, forest, or nursery is meeting specified WPS requirements through direct observation, and indicating whether compliance is observed (Fults, 2017).

WPS compliance inspections are divided into two tiers. Tier 1 inspections are those conducted during the time period that starts with a pesticide application and ends 30 days after the restricted-entry interval (REI) expires, where an REI is the minimum amount of time that must pass between a pesticide application and re-entry into the area without protective clothing or equipment (Environmental Protection Agency, 2018c). In other words, Tier 1 inspections usually occur when a pesticide has been applied at an agricultural establishment within the last 30 days plus the length of the pesticide's REI. For example, for a pesticide with a 14-day REI, a Tier 1 inspection window would start on the day the pesticide was applied, and would end 44 days later. If a noncompliance violation is identified during a Tier 1 inspection, the ISDA may issue an enforcement action depending on the severity of the violation, including a warning letter, regulatory letter, or a notice of violation (Kostka, 2019).

Tier 2 inspections are conducted outside the timeframe of a Tier 1 inspection. These Tier 2 inspections often occur during the agricultural off-season, when pesticides have not been applied within the last thirty days (Environmental Protection Agency, 2018c). During Tier 2 inspections in Idaho, compliance is not required; no enforcement action can occur if a noncompliance is observed. Tier 2 inspections are instead considered "compliance assistance" inspections, meaning the ISDA does not issue penalties, but instead assists the employer in amending the problem in an effort to

mitigate repeated violations (Kostka, 2019). In other words, a noncompliance observation is not considered a punishable violation during Tier 2 inspections. However, for the sake of simplicity throughout the remainder of this thesis, the terms “noncompliance observation” and “violation” are treated synonymously.

Problem

We know that employer compliance with the WPS can have a significant influence on worker pesticide safety, but the extent to which agricultural employers in the US comply with these regulations is largely unknown.

Existing research surrounding WPS compliance is limited and/or largely outdated. The most recent national report regarding WPS compliance comes from data collected in 2016 (Hernandez & Gabbard, 2018), but because the WPS was significantly updated in 2015 and the changes were not fully implemented until 2018, that data is not reflective of the current standard. In addition, several studies have used observational methods and/or relied on farmworker self-reporting to determine the extent of WPS compliance on a single or small set of agricultural establishments (Arcury et al., 1999; Arcury et al., 2002; Levesque et al., 2012a; McCauley et al., 2004; Salvatore et al., 2008; Shipp et al., 2005; Walton et al., 2017). To our knowledge, there are no comprehensive reports of compliance with each requirement of the current WPS, making it difficult to draw firm conclusions about compliance in Idaho or how the WPS could be more effectively enforced.

Purpose & Aims

This thesis aims to report the extent to which farm employers comply with the WPS in Idaho. This was accomplished by analyzing the results of 557 WPS compliance

inspections conducted on farms by the ISDA between January 2001 and August 2019. Although the WPS also extends to nurseries, greenhouses, and forests, we focused our analysis on farm inspections only, which make up approximately three quarters of all WPS inspections conducted by the ISDA.

It should be noted that farm employers who have received a WPS inspection have typically complied with the majority of the requirements, but often, ISDA inspectors identify areas of noncompliance that are not severe enough to warrant an enforcement action. These areas of noncompliance provide opportunities for improved protection of worker health and safety, and this thesis aims to quantify and describe the primary areas in which these opportunities for improvement occur. Specifically, this thesis will address the following **questions:**

1. **How often are farm employers noncompliant with the WPS overall?**
2. **How often are farm employers noncompliant with each major section of the WPS?**
3. **How often are farm employers noncompliant with each of the individual WPS requirements?**

Answering these questions will provide insight about WPS compliance in addition to what we know from observation and farmworker reports. A secondary aim of this thesis is to report findings to ISDA WPS compliance staff. We are providing the ISDA with a quantitative report that describes the frequency of noncompliance violations overall, with each requirement, within each region, and over time. We also identify those requirements for which there may be a need for additional education, training, and enforcement. By identifying areas of the WPS with which farm employers are least

compliant, this report has the potential to influence inspection and training strategies going forward.

The results of this analysis will also be presented to agricultural employers who attend WPS train-the-trainer sessions. In the past at training events, the ISDA has presented data including the number of annual inspections, the number of violations that resulted, and the type of enforcement action taken. While this data is important, it may also be valuable to communicate to agricultural employers the most common violations, and to discuss how they might be prevented.

Limitations and Delimitations

This study has several delimitations that must be defined and several limitations that must be acknowledged. First, this analysis is delimited to include WPS compliance inspections conducted by ISDA staff between 2001-2019. These boundaries limit our ability to apply our findings to situations in other states and during different years. Second, the data analyzed here is limited to WPS inspection criteria, which includes employer compliance but does not include any direct observations of the impact of employer compliance on farmworker health.

This data set is not random; it includes 557 farm inspection results, meaning that thousands of farms were not inspected during the data collection period under investigation in this analysis. Further, the ISDA estimates that a small portion of inspections are requested by farm employers, so these data may over-represent employers who sought out assistance in complying with the WPS, and under-represent those who did not.

The inspections also are not evenly distributed throughout the state, which may be reflective of the regional distribution of the overall population and farms in Idaho. Since 2001, 241 farm inspections were conducted in the southwestern region, 117 in the eastern region, 104 in the central, 79 in the northern, and 16 in the southeastern.

We recognize that these conditions limit our findings in that they may not sufficiently represent WPS compliance across all farms in Idaho. However, the number of inspections conducted in each region will naturally vary due to the varying population sizes within each region, and the availability of ISDA staff and priorities set by the ISDA, which are discussed in the methods section of this thesis. In addition, limited resources make it impossible for ISDA inspections staff to conduct inspections at all 25,000+ farms in Idaho, and we therefore believe these data provide us with a valuable and unique insight into WPS compliance across the farms for which information was available.

Prior to most inspections, the ISDA provided employers with advance notice of a WPS inspection being conducted at their farm, which allows time for employers to prepare and potentially appear to be more compliant than they otherwise would have. Further, this data represents results of WPS compliance *inspections* and does not include results of WPS compliance *investigations* that usually occur following a filed complaint. As a result, it is likely that our findings represent farm employers with relatively high levels of compliance as compared to farm employers who were not given advance notice or were under investigation. Our findings therefore may be overestimates of the magnitude of WPS compliance in Idaho.

Finally, a small portion of data was missing or inapplicable due to data entry errors and/or inconsistencies across inspector data entry methods. In addition, because

inspection criteria changed significantly during our period of interest, we are unable to make direct comparisons between compliance with the previous and updated version of the WPS.

Definitions of Terms

1. **Agricultural employer*:** a) an *owner or operator* of an agricultural establishment directly related to the production of an agricultural plant, and who employs any worker; and/or b) a *labor contractor* who hires or contracts for the services of a worker to do tasks related to the production of agricultural plants on an agricultural establishment
2. **Agricultural establishment***: a farm, forest, nursery, or an enclosed space production facility (e.g. greenhouse, grow house, hoop house, high tunnel)
3. **Agricultural worker*:** a) *workers* who perform hand-labor tasks in pesticide-treated crops, such as harvesting, thinning, and pruning at an agricultural establishment; and b) *handlers* who are in direct contact with pesticides such as mixing, loading, or applying pesticides at an agricultural establishment
4. **Compliance**: adherence to a given component of the WPS by an agricultural employer
5. **Compliance assistance inspection:** an inspection during which an inspector assists the agricultural employer in fixing the noncompliance issue rather than issuing a penalty (an enforcement action)
6. **Enforcement:** the process of monitoring compliance with the WPS by the EPA or state lead agency (the state lead agency in Idaho is the ISDA)
7. **Enforceable inspection:** an inspection during which an inspector has the right to issue the agricultural employer an enforcement action – i.e. an advisory letter, warning letter, or civil penalty – in the event of a severe violation(s)

8. **Pesticide-related illness:** an umbrella term capturing pesticide poisonings and acute and chronic pesticide-related illness or injury
9. **Noncompliance violation:** nonadherence to a given component of the WPS by an agricultural employer
10. **Tier 1 inspections:** enforceable inspections conducted on an agricultural establishment when a pesticide has been applied at an agricultural establishment within the last 30 days plus the length of the pesticide's REI
11. **Tier 2 inspections:** non-enforceable inspections conducted on an agricultural establishment where pesticides have not been applied within the last 30 days plus the length of the pesticide's REI
12. **Violation:** nonadherence to a given component of the WPS by an agricultural employer (referred to synonymously with a "noncompliance observation" for the sake of simplicity throughout this paper)

*Defined by the EPA issued WPS How-To-Comply Manual (Fults, 2017)

Summary

Pesticide exposure can occur through dietary, residential, agricultural, or occupational pathways (Damalas & Eleftherohorinos, 2011; Damalas & Koutroubas, 2016). While everyone is at risk for pesticide exposure to some extent, agricultural workers have a higher risk for occupational exposure to agricultural pesticides than the general public and other workers (Calvert et al., 2014). As a result, they are at an increased risk for pesticide-related illnesses, compounding the many social and cultural vulnerabilities that are inherent among this group (Bohme, 2015; Calvert et al., 2014).

As a means to reduce pesticide exposure among agricultural workers, the US EPA implemented the WPS, a set of protections requiring agricultural employers to provide specific pesticide information and protections to the workers they employ (Fults, 2017). Although the WPS was a historic step toward strengthening regulatory protections among agricultural workers, there are still many uncertainties surrounding enforcement of and compliance with the WPS.

This thesis describes a longitudinal approach to better understanding the extent of employer compliance with the WPS in Idaho. Using inspection records archived by the ISDA, we quantify compliance trends between 2001 and 2019. This analysis provides insight into the extent of compliance with each WPS requirement from an institutional perspective which, to our knowledge, has not been done before. Results will be shared with the ISDA WPS training and inspection staff to potentially influence inspection and education strategies. It will also provide agricultural employers with the most commonly violated requirements to avoid on their own establishments.

CHAPTER TWO: LITERATURE REVIEW

Background

Many labor tasks increase the risk for oral, dermal, and respiratory pesticide exposure among agricultural workers (Damalas & Koutroubas, 2016). Direct contact with pesticides during application, contact with pesticide residues on plants or soil, entry into a recently treated area, or drift from nearby application (Mayer, Flocks, & Monaghan, 2010), are all potential hazards that put agricultural workers at risk for both acute high-dose and chronic low-level exposure to agricultural pesticides (Levesque et al., 2012a). As a frame of reference, lifetime exposure levels of an average consumer may equal only the amount that an agricultural worker receives in half an agricultural season (Goldsmith, 1989).

Chronic Health Effects of Occupational Pesticide Exposure

Repeated or continuous low-dose exposure to pesticides in the workplace can cause serious chronic illness among agricultural workers. The adverse effects of chronic pesticide exposure include carcinogenic, dermatological, gastrointestinal, respiratory, reproductive, and endocrine effects (Curl et al., 2020; Nicolopoulou-Stamati et al., 2016), which often do not develop until years after the initial exposure (US National Library of Medicine, 2019).

A primary source of information on the relationship between chronic pesticide exposure and agricultural worker health is the Agricultural Health Study (AHS), a large prospective cohort study initiated in 1993 among nearly 90,000 private and commercial

pesticide applicators and their spouses from North Carolina and Iowa (Agricultural Health Study, 2019). Extensive analysis of the AHS has linked pesticide exposure to an elevated risk for cancers of the prostate and lip, as well as certain lymphomas, chronic lymphocytic leukemia and acute myeloid leukemia (Lerro et al., 2019; Zhang, Rana, Shaffer, Taioli, & Sheppard, 2019).

In a recent review article, Curl et al. (2020) described the relationship between pesticide exposure and the chronic health of farmworkers. In addition to the cancer risks identified within the AHS, this review article highlights the numerous studies that have documented a variety of neurologic effects of pesticide exposure, including Parkinson's disease, Alzheimer's disease, attention deficit hyperactivity disorder, affective disorders and anxiety and depression, and delayed mental development (Curl et al., 2020). In addition, pesticide exposure among farmworkers can cause or exacerbate respiratory symptoms and pulmonary function impairment, as well as oxidative stress, DNA damage, and metabolic and thyroid effects (Curl et al., 2020; Nicolopoulou-Stamati et al., 2016).

Acute Health Effects of Occupational Pesticide Exposure

More immediate negative health consequences of acute pesticide exposure are easier to detect and may occur immediately or several hours after exposure (Canadian Centre for Occupational Health and Safety, 2019; Lincoln, 2018). A range of symptoms may result from acute pesticide exposure: symptoms of mild poisonings include headache, dizziness, nausea, sweating, or irritation of the nose, throat, eyes or skin. Symptoms of moderate exposure include vomiting, blurring of vision, rapid pulse, excessive salivation or perspiration, or mental confusion. Severe poisonings may result in symptoms including shortness of breath, small or pinpoint pupils, burns on the skin, loss

of reflexes, unconsciousness, or even death (Canadian Centre for Occupational Health and Safety, 2019; Damalas & Koutroubas, 2016; Lincoln, 2018).

It is difficult to capture the full magnitude of chronic and acute pesticide related-illness among individual agricultural workers due to underreporting, a lack of surveillance, and the fact that they are such a vulnerable and difficult-to-reach population (Bohme, 2015). One opportunity to observe the burden of pesticide exposure is by evaluating group symptomologies of pesticide-related illness. Incidents of group hospitalization following a pesticide exposure event are what typically receive attention from the media and the public.

Numerous cases have demonstrated that the health of farmworkers can be severely compromised by pesticide-related events, especially if they are not afforded the protections of the WPS. For example, 29 farmworkers in Idaho in 2005 experienced symptoms of pesticide poisoning after entering a field that was treated with pesticides 4.5 hours prior. Those involved, including the agricultural employer, labor contractor, and the pilot who applied the pesticides, were issued a total fine of $40,000. Investigators determined that the event was the consequence of a breakdown in communication, and the farmworkers also reported they had not received pesticide safety training (Moeller, 2019). Similarly, in California in 2017, 92 farmworkers who were harvesting garlic exhibited symptoms of pesticide exposure after two pesticides were sprayed in the area. A fine was imposed to the pesticide applicator for failing to provide advance notice of the spraying, and for applying it within a quarter mile of a residential area (Philpott, 2017).

The Worker Protection Standard: Past and Present

Although the intent of the WPS has always been to reduce pesticide exposure and related illnesses among agricultural workers, WPS requirements have changed substantially since the standard was first promulgated in 1974. The original WPS was implemented after the EPA began to recognize the need for agricultural worker protections from pesticide exposure during and after application (Calvert et al., 2014; Environmental Protection Agency, 2015), and it contained four basic elements:

1. A prohibition against spraying workers;
2. Specific reentry intervals for 12 pesticides and a general reentry interval for other agricultural pesticides, prohibiting entry until sprays had dried or dusts had settled (a re-entry interval is the amount of time required to wait until re-entering a previously treated filed, as specified on the pesticide product labeling);
3. A requirement for protective clothing for any worker who had to reenter treated areas before the specific reentry interval had expired; and
4. A requirement for "appropriate and timely" warnings (Environmental Protection Agency, 2015).

The elements of the 1974 WPS had multiple limitations. For example, workers in non-agricultural industries were provided greater occupational health protections than those contained in the WPS (i.e. other workers were required to be provided with PPE, hygiene facilities, and worker training programs). In addition, the requirements were not referenced anywhere on any pesticide labeling, and so were not legally enforceable. The regulation also did not assign responsibility for compliance; no one was charged with

communicating the requirements to farmworkers. Lastly, the protections did not extend to pesticide handlers (Environmental Protection Agency, 2015).

Following a review of the WPS in 1983, the original requirements were deemed largely inadequate in scope of coverage, neglecting to account for pesticide handlers and a number of pesticide exposure routes, most notably drift (Bohme, 2015; Calvert et al., 2014; Environmental Protection Agency, 2015). However, an update to the WPS was not negotiated until 1988, not promulgated until 1992, and not fully implemented until 1995 (Environmental Protection Agency, 2015). This updated version aimed to expand the scope of coverage to include not only farms, but also forests, nurseries, and greenhouses, to revise reentry intervals and PPE requirements, and to designate specific responsibilities to agricultural employers. Appendix A includes a comprehensive list of these requirements.

The decision to update the standard was largely influenced by a 1992 EPA report stating that 10,000-20,000 agricultural workers were diagnosed with a pesticide poisoning each year (Calvert et al., 2014; Environmental Protection Agency, 1992), and was also motivated by concerns raised by agricultural groups and members of the public (Environmental Protection Agency, 2015). Despite the progress that was made, stakeholders continued to advocate for another revision to the WPS, concerned that the requirements still did not go far enough to protect agricultural workers (Bohme, 2015; Environmental Protection Agency, 2015).

As a result, several minor amendments were made throughout the 1990s and 2000s, and finally in 2014, the EPA proposed significant updates to the 1992 WPS in response to extensive stakeholder review and to reflect more current research on how to

mitigate occupational pesticide exposure among agricultural workers (Bohme, 2015). The proposed revision was made available for public comment in March 2014 (Environmental Protection Agency, 2015), when a multitude of farmworker advocates actively supported the decision to update the WPS, which had not happened for more than twenty years (Brennan, Economos, & Salerno, 2015).

During a public hearing regarding the proposed update, a farmworker described the illnesses that her family members had long suffered from occupational pesticide exposure, commenting that little had changed in almost 20 years, and that the "consequences of pesticide exposure are things we see every day in our communities" (Brennan et al., 2015). Along with many other advocates, she publicly urged that the proposed requirements not be weakened in any manner but instead be further strengthened (Brennan et al., 2015).

In response to such concerns, the WPS was updated in 2015 to strengthen elements of the existing rule to better protect agricultural workers from pesticide exposure and reduce the number of potentially preventable pesticide related-illnesses (Fults, 2017). The update also required that agricultural workers receive workplace protections comparable to those that were already provided to workers in other industries (Fults, 2017). The major revisions included more frequent and expanded pesticide safety training, application exclusion zones, minimum age requirements, and mandatory record keeping of pesticide applications and training (Fults, 2017). These requirements are described in more detail in Appendix B.

The Importance of WPS Compliance

In an ideal world, there is a chain of events that would link the WPS with its intended outcome. Figure 2.1 illustrates this ideal chain of events, beginning with the WPS as an enforceable federal law, and ending with fewer pesticide-related illnesses among farmworkers. Employer compliance with the WPS (#2) plays a critical role in achieving the ultimate goal of the WPS (Curwin et al., 2003; Salvatore et al., 2008). If an agricultural employer does not fully comply with the WPS, the progression of the remaining chain of events is inhibited. Workers are less likely to (or unable to) improve their pesticide safety knowledge and employ that knowledge to protect themselves (Arcury et al., 2002; Damalas & Koutroubas, 2017; Mayer et al., 2010).

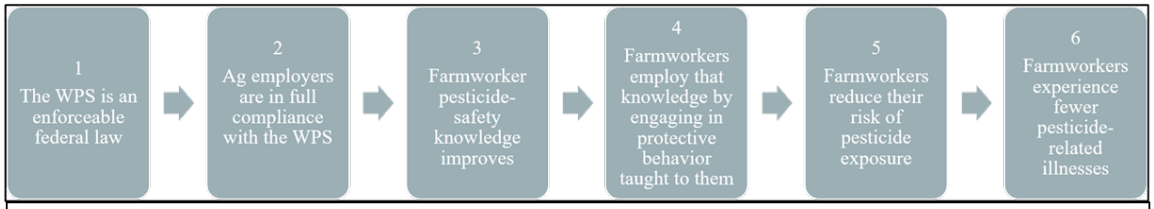


Figure 2.1. The chain of events linking the WPS to its intended outcome.

In this study, we begin with the assumption that compliance with the WPS is a critical determinant of pesticide exposure among agricultural workers, and as such, this thesis primarily focuses on the second event in the chain: employer compliance with the WPS.

In the theory section of this paper, we describe a variety of factors that may explain why agricultural employers may or may not comply with the WPS, and use those factors to inform our study hypotheses. Subsequently, in the literature review section of this thesis, we describe the current state of knowledge regarding the extent of compliance

with the WPS across the US as reported by externally available information (national data sets, farmworker self-report, and field observations).

Theory

Multiple factors may underlie an employer's decision or ability to comply with a federal regulation, not just within the agricultural sector, but within other industries as well. The following interactive elements explain one's willingness and ability to comply with a regulation, and each will be further discussed in the following sections:

1. Economic determinants (i.e. a cost/benefit analysis of compliance)
2. Complexity of the regulation requirements
3. Logistics of complying with the regulation
4. Ignorance of the regulation
5. The relationship and proximity between the target group (e.g. agricultural employer) and regulator
6. Sociological factors (i.e. peer group and normative behavior)

Economic Determinants

The decision to comply with a federal regulation often involves a cost/benefit analysis, wherein the target group weighs the financial constraints of compliance against the financial constraints of noncompliance (Herzfeld & Jongeneel, 2008; Parker, 2000). There is a possibility that complying with the regulation will come with economic costs, including lost production time due to training provided by supervisors to employees, or the costs of purchasing and maintaining materials and supplies. It is also possible that the regulatory authority will detect noncompliance and issue a penalty (Herzfeld & Jongeneel, 2008).

A target group is generally less compliant if they perceive a low likelihood of being caught and if the issuance of noncompliance penalties are rare and/or minor (Herzfeld & Jongeneel, 2008). Weighing the value of compliance against the expected value in the case of noncompliance is a central element to consider when analyzing compliance, as postulated by the standard neoclassical model (Herzfeld & Jongeneel, 2008; Weintraub, 2000).

There are more than 25,000 farms in Idaho (National Agricultural Statistics Service, 2018), thousands of which have never undergone a WPS compliance inspection. Since there is a low likelihood of being inspected, agricultural employers may not perceive any real risk associated with noncompliance. If they do happen to be inspected, ISDA inspection staff first look to provide compliance assistance, only issuing an enforcement action when a severe violation(s) is observed. In this study, we assume the low probability of receiving an inspection or noncompliance penalty does little to incentivize agricultural employers to comply with the WPS in Idaho.

We also believe there is an even smaller incentive to comply with the WPS in the east, southeast, and central regions of Idaho, which are far less populous than the southwest and north regions of the state. Although there may be more agricultural land in these rural regions, more inspections occur in population hot spots where more farmworkers work and reside. The number of inspections conducted in each region is related to the overall population of the region, so it is reasonable to assume that fewer total inspections take place in less populous regions, even though there may be more agricultural establishments. In the east, southeast, and central regions of Idaho, agricultural employers may perceive minimal ISDA presence, and therefore little risk

associated with noncompliance. Given that we expect a lower perceived chance of being inspected to result in less motivation for compliance, we generate the following hypothesis:

1. Our findings will demonstrate frequent noncompliance in all regions, but a higher frequency among agricultural establishments in the east, southeast, and central regions of Idaho.

Complexity of the Regulation Requirements

The complexity of a regulation is also at play in the compliance decision-making process (Herzfeld & Jongeneel, 2008; Parker, 2000). Regulations that are more comprehensive, require more organization, and contain a relatively high number of requirements are going to be more challenging to comply with than simpler, more straightforward regulations. When a regulation is too complex to be easily comprehensible, a target group may be unwilling to put in the time, money, or effort to comply.

Arguably, the one hundred individual WPS requirements are not easily comprehensible. An EPA-issued how-to-comply manual is available for agricultural employers, but taking the time to read and retain all 146 pages is a significant undertaking. As noted by the Organization for Economic Cooperation and Development, the strengthening of existing laws can lead to "a loss of simplicity and therefore the loss of the ability in the target groups to understand what compliance with the resulting regulatory structure involves" (Parker, 2000).

We believe the complexity of the WPS significantly contributes to noncompliance rates among agricultural employers. The updated WPS requirements became more complex, and as such, our hypothesis is as follows:

2. Noncompliance will be more frequent during the post-update period (March 2018-August 2019) compared to the pre-update period (January 2001-February 2018).

Logistics of Complying with the Regulation

A regulation's target group may be less willing to comply when the logistics of the rules are especially daunting. For example, compliance with the WPS requires extensive coordination between employer, workers, and handlers, involving the provision of training, facilities, and supplies. It is our assumption that WPS compliance and coordination becomes increasingly difficult as the number of workers and handlers increases and there are more workers to train, more PPE and decontamination supplies to provide, and more communication about pesticide application to be had.

Each region in Idaho produces different agricultural commodities, each commodity with a different demand for labor quantity and intensity. As such, we expect to see regional compliance variations dependent on differing manual labor demands. Regions in which establishments commonly grow high-labor demand crops will have more employees to accommodate, and consequentially will have a more difficult time complying with the WPS.

Cold-weather crops typically grown in the northern region of Idaho include beans, lentils, rice, and seeds (United States Department of Agriculture, 2019), all of which have a relatively low labor demand (Kostka, 2019). We therefore expect farms in the north to have an easier time maintaining compliance with the WPS as compared to regions in

which high-demand crops are commonly grown, and as such, we make the following hypothesis:

3. Farm employers in the northern region of Idaho will exhibit high compliance levels relative to farm employers in other regions.

Ignorance of the Regulation

Compliance may also be influenced by the target group's regulatory awareness regarding the applicability of the regulation to their operation (Hu, Lee, Shiao, & Guo, 1998). If the target group does not understand that a regulation extends to them, they will see no reason to put forth effort to comply.

Although the WPS applies to any agricultural employer who uses a WPS-labeled pesticide product and employs workers or handlers, there is a common misconception that the WPS applies only to farms and farmworkers, not forest operations, nurseries, or greenhouses (Kostka, 2019). Knowledge of the WPS is likely a significant factor in compliance, and thus we assume that employers of nurseries, greenhouses, and forests are less likely to comply than employers of farms. This assumption is partially supported by the ISDA, whose staff has observed that employers in the forestry sector are least likely to be aware of the WPS (Kostka, 2019).

Contrastingly, we believe there have been local events that may have reduced ignorance of the regulation, particularly among agricultural employers in the farming sector. In 2005, 20 Idahoan farmworkers in 2005 sought care in the emergency room following a pesticide exposure, and those responsible were issued a $40,000 fine for violating requirements pertaining to the notification of pesticide application section of the WPS (Moeller, 2019). The incident was widely publicized, and we believe this event may

have increased employer awareness of the WPS across all establishment types. It also may have reminded employers that insufficient compliance with the WPS can be detrimental, potentially causing them to rethink the previously described costs and benefits associated with noncompliance.

Proximity and Relationship between Target Group & Regulator

The relationship – or lack thereof - between the target group and regulator is another contributing factor in regulatory compliant behavior. As Institutional Theory suggests, the target group's compliance behavior partially depends on the regulating body (Herzfeld & Jongeneel, 2008). If there is mutual respect, an employer is more willing to cooperate, a phenomenon known as reciprocal altruism (Herzfeld & Jongeneel, 2008).

Effective communication between the regulating body and target group contributes to regulatory clarity that will increase the target group's commitment to regulatory compliance and ease compliance concerns (Parker, 2000). The goal of the ISDA's compliance assistance program is to increase this mutual respect – inspectors do not intend to invoke fear or inflict punishment for every violation observed, but instead wish to communicate ways in which the agricultural employer can better comply in the future.

Considering this, we believe compliance levels will directly correlate with the establishment's proximity to ISDA headquarters in Boise, in the Southwest region of the state. Agricultural employers in the Southwest region presumably have more frequent contact and a more positive relationship with the ISDA than establishments further away, who may have no relationship with the ISDA, may be less aware of the compliance

assistance program the ISDA provides, and/or may be less willing to travel far distances to attend WPS trainings. Considering this, we hypothesize the following:

4. Farm employers in the Southwest region of Idaho will exhibit high compliance levels relative to farm employers in other regions.

Sociological Factors

The decision to comply with a federal regulation is never made independent of the social environment (White, 1947), and is often influenced by the established normative behavior of a target group's peer group (Herzfeld & Jongeneel, 2008). If compliance with a particular regulation is the established social norm, it is much more likely for a member of a target group to perceive value in fitting into that social norm (Herzfeld & Jongeneel, 2008).

Again, we believe that compliance levels will reflect an establishment's proximity to an ISDA field office, in large part due to the social environment constructed by the ISDA. Compared to those who are relatively isolated, employers are more likely to communicate about a regulation with neighboring employers, a social network effect that may motivate that neighboring employer to comply (Topa & Zenou, 2015). Although our dataset does not include any information about employer social networks, it is important to acknowledge that social norms could play a significant role in WPS compliance patterns across the state.

In addition to established peer groups between agricultural employers, the relationship between employer and employee may also influence regulatory compliance. If mutual respect exists between the two, an employer may be more willing to comply

with regulations aimed to protect the health and safety of their employees (Herzfeld & Jongeneel, 2008).

The agricultural workforce largely consists of immigrants, about half of which lack legal documentation and about 30% of which cannot speak English (Hernandez & Gabbard, 2018). It is our assumption that the many other social and economic disadvantages experienced by agricultural workers – the fear of jeopardizing employment status, lack of legal documentation, immigrant prejudice and the persistence of agricultural exceptionalism – collectively limit their willingness to report an instance of WPS noncompliance on the part of their employer. This power dynamic between agricultural employer and worker may play a role in the extent to which an employer complies with the WPS.

In addition, while agricultural work has always been done by both men and women, there has been a marked increase in the number of women working in agricultural. This phenomenon, known as the feminization of farm labor (Lastarria-Cornhiel, 2006), is reinforced by the nearly 50% increase in the fraction of the farm workforce comprised by women from 1990-2014 (National Institute for Occupational Safety and Health, 2018). The changing nature of the agricultural workforce has perhaps intensified the power dynamic between predominantly white male employers and the growing number of female minorities comprising the agricultural workforce. The data available in this study cannot substantiate any such relationships, but nonetheless, it is important to acknowledge that employer compliance with the WPS could be influenced by the changing demographics of the agricultural workforce.

Theory Summary

We outlined the multitude of factors that may underlie an employer's decision or ability to comply with the WPS. Considering these possibilities, we hypothesize that violations will be most frequent in the East, Southeast, and Central regions of Idaho, and least frequent in the North and Southwest regions. In addition, we expect violations to be more frequent during the post-update period compared to the pre-update period.

Literature Review

The extent to which agricultural employers comply with the WPS is difficult to measure both temporally and spatially. Insight on this topic is limited to findings from outdated and/or incomplete national data sets, farmworker-self reporting, and field observations. The majority of this data and research is limited to reports and studies conducted before the WPS was significantly revised in 2015, and thus may not reflect the extent of compliance with the updated standard. Likewise, available data may underrepresent the extent of noncompliance that comes with the learning curve of new laws, considering that compliance tends to improve as agricultural employers become more educated about the new requirements (Kostka, 2019). Even with these limitations, available information suggests a lack of compliance with many of the WPS requirements, primarily in the areas of decontamination supplies, pesticide safety training, central location, and notifying farmworkers of pesticide applications (Arcury et al., 1999; Arcury et al., 2002; Environmental Protection Agency, 2018b; Levesque, Arif, & Shen, 2012b; McCauley et al., 2004; Salvatore et al., 2008; Shipp et al., 2005; Walton et al., 2017).

Understanding the historical context of agricultural employer compliance with the WPS is important for several reasons. First, it provides evidence into the historical

successes and challenges of the WPS. It also demonstrates how additional requirements (e.g., WPS revisions) have contributed to compliance and farmworker experiences over time. Lastly, capturing the extent to which agricultural workers have historically complied with the WPS may be predictive of compliance trends now and in the future.

This review summarizes the literature that has been published within the last two decades regarding employer compliance with the WPS. Literature searches were completed through PubMed and the Boise State University Library. Search terms included: Worker Protection Standard; compliance; agricultural pesticide exposure; occupational pesticide exposure; farmworker; agricultural worker; and agricultural establishment.

National & State Reports

The EPA WPS Compliance Monitoring Program describes the total number of WPS inspections that were conducted and reported to the EPA by each state between 2005 and 2016. They also include the number of violations that resulted during these reported inspections (Environmental Protection Agency, 2018b). However, it is important to note that there is no standard for reporting WPS inspections to the EPA, so these numbers do not represent the unreported inspections that may have occurred.

On average, 4,000 annual WPS compliance inspections were reported to the EPA each year between 2005-2016 (Environmental Protection Agency, 2018b). The percentage of inspections that resulted in violations has decreased over time: In 2005, approximately 57% of inspections resulted in violations, while in 2016, only 35% of inspections resulted in a violation (Table 2.1) (Environmental Protection Agency, 2018b).

Table 2.1. The number of inspections and violations reported to the EPA, 2005-2016.												
Fiscal Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Total no. of inspections reported	3497	3857	4899	4777	4864	4227	3739	3552	3663	3618	3557	3309
Total no. of violations during inspections	1987	2335	2650	2263	1802	1698	1521	1218	1292	1044	1199	1142
% of inspections that resulted in a violation	57%	61%	54%	47%	37%	40%	41%	34%	35%	29%	34%	35%

The EPA also reported the types of violations that resulted from WPS compliance inspections between 2005-2013. Violations are grouped within the following requirement categories (Environmental Protection Agency, 2018b; Fults, 2017):

1. The posting of certain information in a **central location**
2. Pesticide safety **training**
3. The provision of **decontamination supplies**
4. The provision of **PPE** as required by the pesticide product labeling
5. **Notice of application** to workers to prevent unprotected pesticide exposure during applications
6. **Information exchange** about treated areas between an agricultural employer and a commercial pesticide handler employer
7. **Entry restrictions** to prevent workers from entering a field following an application
8. Safety instructions to pesticide handlers regarding **mix/loading application equipment** and applications
9. The provision of **emergency assistance** to workers in the event of a pesticide-related illness
10. The prohibition of **retaliation** against a worker who is complying with or attempting to comply with the WPS

As shown in Figure 2.2, agricultural employers have most frequently violated requirements within the central posting and pesticide safety training sections, followed by decontamination supplies, PPE, and notice of pesticide application.

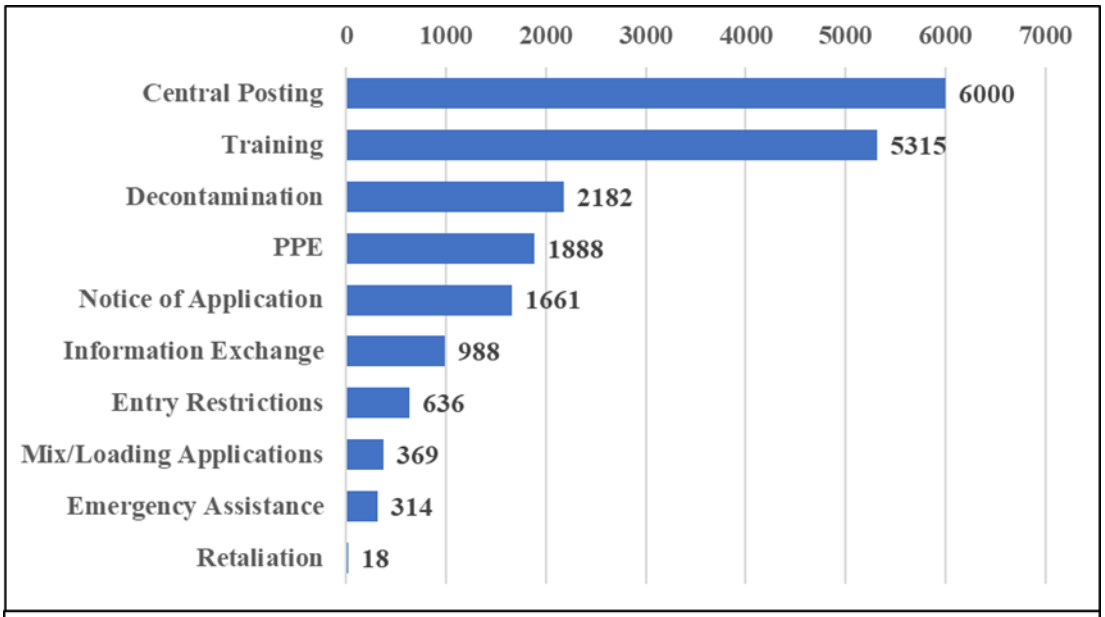


Figure 2.2. The total number of violations reported to the EPA by violation type, 2005-2016.

Data is unavailable for WPS inspections conducted after 2016. Therefore, these data are limited to the WPS requirements enforced during the pre-update period. These reports also do not provide insight into which specific requirement was violated within each major WPS section. For example, we know that central posting requirements were most frequently violated, but we do not know which specific central posting requirements were violated (e.g., we do not know whether emergency medical information was displayed, if pesticide information is displayed for each application, or if an EPA-approved safety poster was displayed). To our knowledge, however, this is the most recent and comprehensive national data regarding WPS compliance inspections and violations.

In addition, the EPA reports state-level WPS inspections and violations, but again these data do not represent those inspections that went unreported to the EPA (Environmental Protection Agency, 2018b). Idaho reported 127 inspections to the EPA in 2016. Of these, nine resulted in a violation – one was a violation pertaining to pesticide safety training, three with decontamination supplies, and five with PPE (Environmental Protection Agency, 2018b).

The EPA or state-lead agency, such as the Idaho State Department of Agriculture, has regulatory authority for compliance monitoring, but to our knowledge, there are no publicly available state-issued WPS inspection reports that describe compliance with each WPS requirement. The ISDA presents limited WPS data to agricultural employers who attend training sessions and other community outreach events in Idaho. In 2018, for example, the ISDA presented general pesticide-compliance data at a pesticide applicator training session in Burley, Idaho, attended by more than one hundred pesticide applicators from across the state. They reported that among the 108 inspections that occurred in 2018, 15 received compliance assistance and 13 resulted in a violation (Pickup, 2018). While this data is available to the public upon request, it does not include details regarding the types of violations, common scenarios that led to the violations, or how they might be prevented.

Farmworker Self-Report and Observation

The majority of available research surrounding WPS compliance is evidenced by farmworker self-report and a few field observation studies. It should again be noted that the most recent of these studies was conducted during the 2014 agricultural season -

before the WPS was significantly revised - and therefore these findings may not represent the extent of employer compliance with the current standard.

Studies based on farmworker self-report provide information on farmworker perceptions of employer compliance with the WPS, but a major limitation is that self-report does not indicate whether an objective assessment would confirm reported compliance (Arcury et al., 1999). However, self-report provides important and detailed insight into the occupational experiences of farmworkers, which is important in developing effective measures to improve agricultural workplace safety (Arcury et al., 1999). Direct field-observations provide information regarding workplace safety practices as observed by researchers, but do not provide insight into farmworker perceptions or experiences. This literature review integrates information from both complementary sources.

Existing literature primarily focuses on compliance with 1) the provision of decontamination facilities and supplies; 2) pesticide safety training; and 3) the notification of pesticide application. The following sections are organized accordingly.

Decontamination

Prior to the 2015 revision, the WPS required workers to adhere to six decontamination requirements (for a complete list, see Appendix A). Existing literature has focused primarily on the following requirement: Worker decontamination sites must be supplied with clean water, soap, and single use towels.

The majority of studies that have evaluated employer compliance with this requirement strongly suggest that compliance is inadequate. During the 1999 agricultural season in North Carolina, for example, 293 farmworkers were asked whether they had

access to water for handwashing while at work, and only 34.5% of farmworkers reported that they did (Arcury et al., 2002). Similarly, Shipp et al. (2005) investigated access to handwashing water, soap, and towels among farm working mothers in Texas compared to other agricultural states. Twenty percent of farmworkers in Texas reported that they had access to those items, while about 70% of farmworkers reported access to those items in other states, suggesting that decontamination practices vary within and between state boundaries (Shipp et al., 2005). Among 187 farmworkers in North Carolina in 2010, 82.3%, 58.8%, and 56.4% reported that their employer provided handwashing water, soap, and towels, respectively (Levesque et al., 2012a).

A number of researchers have reported findings regarding the availability of decontamination supplies according to direct field-observations. Vela-Acosta, Bigelow, and Buchan (2002) observed 1,407 farmworkers during field walk-through surveys at four worksites in Colorado in 1996, and in addition, interviewed 229 farmworkers about field working conditions. The percentage of farmworkers reporting "yes" to the availability of decontamination supplies was higher than what was directly observed at three of the four worksites. Field observations indicated that decontamination supplies - water, soap, and towels - were not available at 3/4 of the worksites observed. A small portion of workers employed at these three worksites, however, reported that decontamination supplies *was* available, even though this was observed not to be true (Vela-Acosta et al., 2002). The discrepancies between farmworker self-report and field observation could be due to farmworkers' fear of jeopardizing employment or different observation periods.

In contrast, Walton et al. (2017) relied exclusively on field observations to evaluate the degree to which decontamination supplies were available to 71 farmworkers at three farms in North Carolina in 2014. Two of the three farms supplied handwashing water and soap 100% of the time during 30 observations, while the third farm only provided those supplies 67% of the time. In other words, in about one-third of observations at a single farm, adequate supplies for handwashing were unavailable (Walton et al., 2017).

Table 2.2 summarizes the characteristics of studies investigating compliance with decontamination requirements. Overall, the average percent of farmworkers who reported having access to water, soap, and towels for handwashing at work was 33%, but these percentages vary greatly across studies. According to the two observational studies, less than half of the agricultural establishments were observed to provide accessible decontamination supplies.

Table 2.2. Studies investigating agricultural employer compliance with decontamination requirements.

Reference	Population	Access to Water for Handwashing	Access to Soap for Handwashing	Access to Towels
Vela-Acosta et al. (2002)	214 farmworkers interviewed and 1,407 farmworkers observed during field safety walk-through surveys in Colorado in 1996	Farmworker Report:	Farmworker Report:	Farmworker Report:
		Worksite #1: **29%**	Worksite #1: **29%**	Worksite #1: **29%**
		Worksite #2: **19%**	Worksite #2: **37%**	Worksite #2: **44%**
		Worksite #3: **7%**	Worksite #3: **0%**	Worksite #3: **0%**
		Worksite #4: **5%**	Worksite #4: **11%**	Worksite #4: **9%**
		Observation:	Observation:	Observation:
		Worksite #2: **100%**	Worksite #2: **34%**	Worksite #2: **100%**
		Worksite #1,3,4: **0%**	Worksite #1,3,4: **0%**	Worksite #1,3,4: **0%**
Shipp et al. (2005)	25 mothers who were farmworkers in Texas and 77 mothers who were farmworkers in other states in 2001	Farmworker Report in Texas: **20%**	Farmworker Report in Texas: **20%**	Farmworkers Report in Texas: **20%**
		Other States: **71%**	Other States: **69%**	Other States: **71%**
Arcury et al. (2002)	293 farmworkers in North Carolina in 1999	Farmworker Report: **35%**	n/a	n/a
Levesque et al. (2012b)	187 farmworkers in North Carolina in 2010	Farmworker Report: **82%**	Farmworker Report: **59%**	Farmworker Report: **56%**
Walton et al. (2017)	71 farmworkers at three farms during in North Carolina in 2014	Farm 1 & 2 (observed 30 times): **100%**	Farm 1 &2: **100%**	n/a
		Farm 3 (observed 30 times): **67%**	Farm 3: **67%**	
	Average According to Farmworker Report	33%	32%	32%
	Average According to Field Observation	52%	43%	25%

Pesticide Safety Training

Many researchers have investigated employer compliance with pesticide safety training requirements, likely because effective farmworker training is a major contributor to pesticide safety knowledge and subsequent protective behavior (Damalas &

Koutroubas, 2017), and because compliance with training requirements is relatively easy to quantify. The following list includes the WPS training requirements discussed in the literature prior to the 2015 revision:

1. Pesticide handlers must receive training before performing pesticide-handling activities;
2. All workers must receive WPS worker training;
3. Training must be repeated every five years;
4. Training must be presented in a language the trainees understand; and
5. Trainer must respond to trainee's questions.

All researchers included in this analysis conducted interviews or administered surveys to determine the number of participants who had ever received pesticide safety training. The majority of studies found that no more than 60% of farmworkers reported ever having received training, although the exact percentage varies widely depending on the study period and population. Study populations and the percentage of farmworkers who reported receiving training are summarized in Table 2.3 and are elaborated upon below.

Table 2.3. Studies investigating agricultural employer compliance with pesticide safety training requirements.

Reference	Population	% of Farmworkers who Reported Having Ever Received Pesticide Safety Training
Anger et al. (2009)	52 farmworkers in Oregon in 2009	32%
Arcury et al. (1999)	270 farmworkers in North Carolina in 1998	35%
Cabrera & Leckie (2009)	50 farmworkers in California in 2009	50%
Arcury et al. (2002)	293 farmworkers in North Carolina in 1999	55%
Shipp et al. (2005)	102 mothers who participated in farmwork in 2001 across 14 agricultural states	56%
Hernandez & Gabbard (2018) (NAWS)	5342 farmworkers between 2015-2016 across the United States	57%
Salvatore et al. (2008)	73 farmworkers in California in 2003	60%
McCauley et al. (2004)	234 farmworkers in Oregon during from 2001-2002	65%
Walton et al. (2016)	71 farmworkers in North Carolina in 2014	97%
Levesque et al. (2012b)	187 farmworkers in North Carolina in 2010	100%
	Average	61%

During the summer of 1998, 270 farmworkers in North Carolina were interviewed regarding the extent to which they received pesticide safety training (Arcury et al., 1999). Only 35% of farmworkers reported ever having received training, and among those, fewer than half reported that they could ask questions during the training or that the WPS was ever mentioned (Arcury et al., 1999). The percentage of farmworkers who reported having ever received training was higher in a 1999 study in North Carolina (55%), but when farmworkers were asked whether their employer encouraged them to dress or work safely, 47% and 31% reported their employer seldom or never told them to, respectively (Arcury et al., 2002).

Among 52 vineyard workers in Oregon in 2009, 68% reported training occurred 'almost never' or 'sometimes' (Anger, Patterson, Fuchs, Will, & Rohlman, 2009). Another study in Oregon during the 2001-2002 agricultural season found that 35% of respondents reported that they did not receive training. Similarly, 50% of farmworkers in California in 2009 reported having never received training, of which a quarter felt the training was not sufficient to generate understanding (Cabrera & Leckie, 2009). These findings demonstrate that pesticide safety training has either been nonexistent or insufficient for farmworkers over time and across agricultural establishments, with as many as three quarters of workers in a single study reporting no training was ever provided to them (Anger et al., 2009).

The insufficiency of pesticide safety training is consistent with findings from the National Agricultural Workers Survey (NAWS), a comprehensive, random-sample survey conducted among farmworkers across the country (Hernandez & Gabbard, 2018). The most recent NAWS report describes the extent of training received among 5,342 farmworkers between 2015-2016; only 57% of farmworkers reported they had received training in the safe use of pesticides (Hernandez & Gabbard, 2018)

Collectively, these data make clear the persistent lack of compliance over the last several decades. However, there is some promising evidence that not all worksites are insufficient in terms of pesticide safety training. In particular, two studies have demonstrated that, according to farmworkers, training requirements have largely been met (Levesque et al., 2012b; Walton et al., 2017). During a 2010 study among 187 farmworkers in North Carolina, 100% reported they had received training (Levesque et al., 2012b), and this is consistent with 97% of farmworkers who reported having received

training in North Carolina in 2014 (Walton et al., 2017). While it is clear that the extent of compliance with WPS pesticide training is highly variable, these two studies demonstrate that it is possible for agricultural employers to provide pesticide safety training to all of their employees.

Notice of Pesticide Applications

There is minimal research describing the extent to which agricultural employers comply with pesticide application requirements, but one study conducted in 2010 provides insight into employer compliance with the following pre-update requirements:

1. Provide both oral and posting warning when required on the pesticide label;
2. Provide oral warning in a language the worker can understand; and
3. If posting, use the appropriate sign for the appropriate time period.

Levesque et al. (2012a) measured workplace conditions according to self-report among 187 farmworkers in North Carolina in 2010. About 17% of farmworkers reported that they were not told when pesticides were being applied or recently applied; 26% reported that information about pesticides was not posted where they could see it; and 35% said there were no signs in treated fields (Levesque et al., 2012a).

Summary

The implementation of the WPS was a historic step in establishing occupational protections for agricultural workers (Bohme, 2015). Since its implementation in 1974, the standard has continued to evolve, and was significantly revised in 2015 to strengthen elements of the pre-existing rule (Fults, 2017). Although the purpose of the WPS has always been to reduce pesticide exposure and related illness among agricultural workers, agricultural employers are frequently noncompliant with the WPS, and several

explanations were proposed as to why that may be. These explanations informed the development of our study hypotheses, which are reflected upon in the Discussion section of this thesis.

Our literature review highlights that the extent of compliance with training, decontamination supplies, and notification of pesticide application requirements largely depend on the agricultural establishment of interest; one set of findings is not necessarily representative of the extent of compliance on a national, state, or even local level. But despite the highly variable findings, available studies overwhelmingly suggest that compliance with the WPS has been insufficient, particularly with decontamination, PPE, central location, and notification of pesticide application requirements.

Nonetheless, there are still many unknowns regarding spatial and temporal compliance with the WPS. Perhaps the best insight into WPS compliance trends lies with state lead agencies, who commonly serve as the regulatory authority for WPS compliance. To date, however, we are not aware that any state lead agency has published a detailed report of compliance with each WPS requirement.

This thesis aims to fill that gap by providing an analysis of WPS compliance inspections that were conducted by the ISDA between 2001-2019. The purpose of this thesis is not to solve any national-level compliance problems, but we anticipate that it does have the potential to influence WPS inspection and training strategies in Idaho, and may also serve as a resource for local agricultural employers.

CHAPTER THREE: METHODS

Study Preparation

This project is funded by a Professional Training Opportunities Program (PTOP) grant awarded by the Northwest Center for Occupational Health and Safety (NWCOHS) at the University of Washington. The NWCOHS offers small grants to support student projects that address health risks associated with work and the workplace (Northwest Center for Occupational Health and Safety, 2019). As part of my thesis work, I developed the idea to investigate WPS compliance in Idaho, and successfully applied and received the PTOP award out of a competitive pool of master and doctoral student applicants.

The PTOP award facilitated my introduction into the world of agricultural-occupational health and safety. In order to gain a better understanding of the ISDA's role in WPS enforcement and compliance prior to beginning this project, I had the opportunity to observe a WPS farm inspection alongside ISDA staff and to complete a WPS Train-the-Trainer session hosted by the ISDA.

First, the inspection staff at the ISDA granted me the unique opportunity to observe a WPS compliance assistance inspection requested by a farm employer in Southwestern Idaho. Because pesticides had been applied on the farm within the last 30 days, it was considered a Tier 1 inspection. However, because the agricultural employer requested the inspection, compliance assistance was provided.

The inspection process took approximately five hours and consisted of an interview with the farm operator, interviews with farmworkers selected by the inspector,

and direct observation of programmatic components including the central location, decontamination supplies and PPE available, and any other observable field practice described within the WPS. Throughout the visit, the inspector indicated compliance or noncompliance with each applicable WPS requirement on the checklist, and upon returning to the office, the inspection results were entered into the ISDA's WPS database. Observing this inspection enabled me to better conceptualize compliance with the WPS in a real-world setting, and it allowed me to witness exactly how inspections are conducted.

This particular employer received compliance assistance to correct the few noncompliance violations that were observed. If this had been a routine Tier 1 inspection that was not requested by the agricultural employer, and there had been a significant issue, the ISDA inspector could have begun the process of an enforcement action, depending on the severity of the violation. However, a significant problem is typically corrected before an enforcement action is necessary.

I also attended a train-the-trainer session hosted by the ISDA: a six-hour pesticide safety training certification offered to agricultural employers. Attendees were taught the information they are required to convey to farmworkers and in what manner, as well as how to comply with other WPS requirements. Attending this training revealed the effort required to comply with the WPS requirements; while it may seem fairly straightforward in writing, the training proved that adherence to the extensive WPS requirements – especially the provision of effective pesticide safety training – is not a simple task.

These experiences resulted in the strengthening of relationships between my research team and ISDA pesticide and WPS compliance staff. Their expertise has been an

invaluable resource that facilitated my preparedness for conducting this research project, a project that would not have been possible without their generous assistance.

In addition to the WPS inspection and the train-the-trainer course, I had the opportunity to travel to a potato production farm to observe an early morning harvest. Pesticides were not being handled, but I did get a better understanding of farmworker responsibilities and the variety of potential ergonomic and structural hazards to which they were exposed. Finally, in preparation for data analysis, I completed an introductory R training course and two, six-week Microsoft Access training courses.

Data Source & Sample

This study analyzes data collected by the ISDA during WPS compliance inspections conducted on farms between January 2001 and August 2019. The ISDA Pesticide Compliance program conducts routine inspections in conjunction with the EPA, which maintains an annual cooperative agreement with the ISDA Division of Agricultural Resources (Idaho State Department of Agriculture, 2019). The state of Idaho commits to conduct a certain number of WPS inspections as part of the cooperative agreement (this number varies annually), granting the ISDA regulatory authority of the WPS in Idaho (Idaho State Department of Agriculture, 2019; Kostka, 2019).

ISDA inspection staff are collectively responsible for monitoring WPS compliance among the thousands of agricultural establishments in Idaho, including farms, forests, nurseries, and enclosed space productions (Fults, 2017; Idaho State Department of Agriculture, 2018). For record-keeping purposes, WPS compliance inspection results have been entered into a Microsoft Access Database. The results of approximately 800 farm, nursery, greenhouse, and forest inspections conducted between 2001-2019 were

contained within the database at the time of this analysis. We chose to analyze the 557 inspections that occurred on farms, because farms are the most common type of agricultural establishment in Idaho, and because an analysis of nurseries, greenhouses, and forests was beyond the scope of this thesis.

During each inspection, ISDA staff utilize a checklist to indicate adherence to or noncompliance with each specific WPS requirement. During the pre-update period, inspectors utilized an older checklist (Appendix A). During the post-update period, inspectors utilized an updated checklist reflecting the updated WPS requirements (Appendix B).

The ISDA's database contains columns that correspond to each checklist item, and each row represents an inspection. For every inspection, the inspector indicates the appropriate response for each requirement: a yes (indicating compliance), a no (indicating noncompliance), NA (indicating the requirement was inapplicable), or CA (indicating noncompliance that was resolved with the provision of compliance assistance). For example, if an inspector observed that the EPA-approved safety poster was displayed in the central location, but emergency medical information was not displayed, the inspector would record a "yes" followed by a "no" under the corresponding columns in the database. As a reminder, inspectors often identify areas of noncompliance that are not severe enough to warrant an enforcement action or penalty. While noncompliance with certain requirements are treated more seriously than others, a multitude of factors are weighed in determining the need to issue an enforcement action.

Study Population

The process for selecting which agricultural establishments to inspect is largely driven by existing relationships between ISDA staff and the agricultural community. Connections are achieved through various community events including pesticide applicator training sessions, train-the-trainer sessions, presentations, and other outreach events for the general public. In 2018 alone, approximately 800 agricultural employers attended meetings and/or presentations hosted by the ISDA, and more than 250 agricultural employers have been trained as pesticide handlers and/or certified train-the-trainers (Urias, 2019). Because there is no way to obtain an exhaustive list of all agricultural employers in Idaho, WPS inspection staff often target employers whom they have already interacted.

Of those agricultural employers with whom the ISDA has already interacted, compliance staff has a targeting strategy and set priorities when determining which establishments should receive a WPS inspection. First, they target employers who request a compliance assistance inspection, or any establishment requiring WPS follow-up for a known issue needing to be resolved. They also target establishments that grow certain types of crops for which there is a high demand for workers and handlers, both in terms of labor intensity and the high concentration of workers on site. Hops, corn, onions, wine grapes, and tree fruit are all crops with a high demand for workers, and are therefore targeted before low labor demand crops such as sugar beets, beans, and alfalfa (Urias, 2019). Lastly, the majority of inspections are conducted in relatively populous regions of Idaho due to the closer proximity to ISDA field offices.

WPS inspections are also triggered by other inspection categories conducted by ISDA staff, including pesticide compliance, chemigation, water quality monitoring, or a follow-up investigation. If a pesticide product that references the WPS is being used on the agricultural establishment during any of these types of inspections, it is common for inspectors to also conduct a WPS inspection, predominantly for the purpose of efficiency and especially if that particular establishment has never before undergone a WPS inspection.

Further, there are restrictions on the number of annual WPS inspections that the ISDA can conduct, for a number of reasons. First, the EPA only provides funding for the ISDA to conduct a certain number of inspections: on average, thirty Tier 1 inspections and twenty Tier 2 inspections (Urias, 2019). Depending on the ISDA's own financial resources and other priorities of the division, the ISDA then sets an additional inspection goal for state inspections (an annual average of thirty).

Inspections that are part of the EPA cooperative agreement are required to meet EPA inspection guidelines. During these "EPA inspections," inspectors are required to utilize the WPS checklist, as well as prepare an inspection report including a written narrative and supportive documentation like photos, interviews and statements (Environmental Protection Agency, 2018c). In contrast, "state inspections" allow for more flexibility on the part of the inspector. They can streamline the process by prioritizing certain sections of the WPS that are most applicable or of highest priority. For example, if an agricultural employer does not employ any handlers, the inspector can forego evaluation of WPS requirements that are specific to handlers and focus on high priority areas like notification of pesticide application (Kostka, 2019).

The number of inspections is also contingent upon the number of inspectors based in each region of the state. The ISDA currently employs 11 investigators across Idaho: one in Coeur d'Alene, one in Lewiston, two in Caldwell, one in Boise, two in Twin Falls, two in Pocatello, and two in Idaho Falls. These inspectors are responsible for conducting all types of inspections in their assigned region: they proctor exams, conduct routine pesticide and WPS inspections, monitor water quality and chemigation, and conduct misuse investigations. WPS inspections across the state are therefore balanced with other components of pesticide safety.

It should also be noted that the majority of agricultural employers are given advance notice of an inspection that is scheduled to take place on their establishment. While advance notice does provide employers time to prepare, correcting compliance issues prior to the inspection is generally not discouraged, as it ultimately improves conditions and minimizes the risk of pesticide exposure among farmworkers. While a small portion of WPS inspections are unannounced, the ISDA works to maintain a positive relationship with agricultural employers, and therefore provides advance notice out of respect for the time of agricultural employers and out of concern for their own limited time and resources.

Although the ISDA has a limited capacity for the number of EPA and state WPS inspections they can conduct, they aim to inspect those agricultural establishments with characteristics of highest priority. The WPS database cannot represent all agricultural establishments across the state of Idaho because ISDA inspection staff does not have the means of locating or traveling to all establishments. However, inspectors do canvas as

many establishments as possible considering the labor force and resources available to them.

Data Characteristics

For analysis purposes, inspection reports are divided into two time periods: 504 inspections conducted from January 2001 through March 2018 (pre-update inspections), and 53 inspections conducted from April 2018 through August 2019 (post-update inspections). This division is due to the fact that inspectors utilized a different checklist listing different requirements during these two periods, as a result of the WPS update that was implemented in Idaho in April 2018. Because inspection criteria differed during pre- and post-update inspections, we are unable to make cross comparisons, and so the remainder of analysis are separated into these two distinct time periods.

Each inspection report (including both pre- and post-update inspections), shows whether farm employers complied with each specific WPS requirement, as indicated by the listed requirements contained in each checklist (see Appendix A and B). Additional variables were recorded for pre- and post-update inspections, including the date of each inspection, whether it was a Tier 1 or Tier 2 inspection, and the type of agricultural establishment that was inspected (farm, forest, nursery, enclosed space production, or any combination of the four).

Several variables were only recorded during pre-update inspections. During the pre-update period, inspectors recorded a unique identification number for the ISDA staff member who conducted the inspection and a unique business number that corresponds with the county and region where the agricultural establishment's company headquarters is located. The location of the company's headquarters is not necessarily consistent with

the location of the agriculture establishment that was inspected; we acknowledge that this may limit our ability to accurately describe the geographic inspection trends of pre-update inspections. However, we estimate that the location of the company headquarters and the agricultural establishment are likely to be in the same region of the state, which include the North, Southwest, Central, Southeast, and Eastern regions – delineated in Figure 3.1.

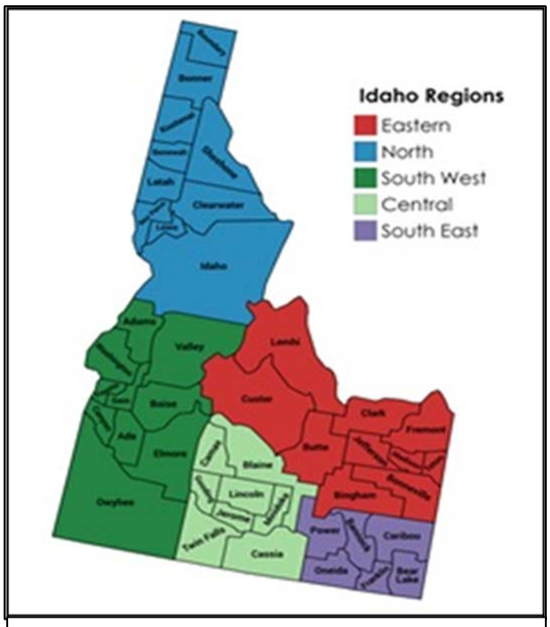


Figure 3.1. The distribution of Idaho counties and regions as described by the ISDA.

We are also able to determine whether each pre-update inspection resulted in an enforcement action and, if an enforcement action was taken, we are able to determine the type of enforcement action that was issued (warning letter, regulation letter, or civil complaint). A warning letter notifies the agricultural employer that a WPS violation occurred that could not be immediately addressed; a regulation letter requires agricultural employers to provide a written response addressing how they will comply in the future; a

civil complaint is a formal citation of a violation(s) that requires the respondent to attend an administrative hearing or an informal settlement hearing where penalty negotiations occur. Penalty negotiations can range from a fine to a license modification, suspension, revocation, or denial (Kostka, 2019).

Other inspection characteristics were recorded exclusively during post-update inspections, including both the county and city where the agricultural establishment was located and whether the employer or supervisor was interviewed during the inspection. Resulting enforcement actions were not recorded for post-update inspections, but ISDA staff has communicated that there were not any enforcement actions cited against agricultural employers during the post-update period.

Data Analysis

Statistical analyses were performed, separately, on 504 pre-update inspections and 53 post-update inspections. Descriptive statistics were used to describe the number of Tier 1 and Tier 2 inspections conducted overall, during each year, and within each region. A chi-square test of equal proportions was used to determine whether the number of inspections varied significantly across time and space.

Our first two research questions are as follow: **1) How often are farm employers noncompliant with the WPS overall? 2) How often are farm employers noncompliant with each WPS section?** To answer these, we analyzed Tier 1 and Tier 2 inspections separately, as these are two very different types of inspections with very different outcomes. For both Tier 1 and Tier 2 inspections, we described the number and percentage of inspections that were observed to be in violation with at least one WPS requirement overall, and within each major WPS section. A t-test was conducted to

determine whether violation proportions were significantly higher during Tier 2 inspections compared to Tier 1.

Next, we described the number of inspections that were observed to be in violation with at least one requirement in each of the major WPS sections (Table 3.1). For a single inspection, if all requirements within a particular section were marked as inapplicable, that inspection was excluded from the corresponding section calculation. In other words, the total number of applicable inspections varied by section.

Table 3.1. Major sections of the WPS, pre- and post-update.

Pre-Update Inspections	Post-Update Inspections
1. Training	1. Training
2. Central location	2. Central location
3. Entry restrictions	3. Entry restrictions
4. Decontamination	4. Decontamination
5. Emergency assistance	5. Emergency assistance
6. Information exchange	6. Information exchange
7. Notice of pesticide applications	7. Notification, entry restriction, posting
8. PPE & application equipment	8. PPE
	9. Minimum age for handlers and early entry workers
	10. Knowledge of labeling
	11. Application and establishment specific information
	12. Pesticide handling equipment
	13. Application, entry restriction, and handler protection

During the pre-update period, for instance, the information exchange section was deemed applicable during 401 inspections, while the notice of pesticide application section was deemed applicable for 486. To determine the percentage of inspections that resulted in at least one violation in each section, we divided those inspections that resulted in at least one violation by the total number of applicable inspections in the corresponding section. For example, if a requirement in the information exchange section was violated during 100 inspections, we divided 100 by the total number of inspections

for which the information exchange section was applicable – in this case, 401 inspections.

We also described the overall violation frequency during Tier 1 and Tier 2 inspections. Again, it is important to note that a different denominator was used in each of these calculations. This means that if an inspector marked that a requirement was inapplicable, it was excluded from analyses, and the number of inapplicable requirements differed across inspections and sections. For example, there are 11 requirements within the training section, and 504 pre-update inspections took place. By multiplying the number of inspections by the number of requirements, there would have been 5,544 total training observations to serve as the denominator. However, 877 (16%) of these observations were either missing or inapplicable, so they were excluded from this analysis, and the denominator for the training section became 4,667. This process was repeated for each section overall for both pre- and post-update inspections, and within each region for pre-update inspections.

It is also important to note that not all WPS requirements were deemed applicable to this analysis. From the pre-update WPS checklist, we excluded the 4th and 7th requirement in the "Notice of Pesticide Application" section, because they were only relevant to greenhouses, not farms (See Appendix A). From the post-update checklist, thirteen requirements were deemed inapplicable because they were either irrelevant to farming operations or were questions the inspector was required to ask the employer but compliance was not required. From the Application, Entry Restriction, and Handler section, we excluded the first requirement. From the Notification, Entry Restriction, and

Posting section, we excluded requirements 2, 6, 6a-6e, 7, and 7a-7c. We also excluded the first requirement in the PPE section, and 7-9 in the Central Location section.

Our final research question asks: **3) How often are farm employers noncompliant with each of the WPS requirements?** To answer this question, we first described the standard deviation and average number of violations observed during Tier 1 and Tier 2 inspections. We next calculated the frequency with which each individual WPS requirement – or checklist item - was violated during Tier 1 and Tier 2 inspections. This was calculated by dividing the total number of violations observed by the total number of possible violations observed, excluding inapplicable observations.

Following these analyses, we ranked each section in terms of violation frequency, and we ranked the top ten most frequently violated requirements, regardless of the section with which they were a part. We anticipate that agricultural employers will be interested to understand which sections and individual requirements were most commonly violated, as a means to avoid those violations on their own establishments.

Summary

We assessed the results of 557 WPS compliance inspections conducted by the ISDA between 2001-2019 in Idaho. For each requirement, inspectors indicated whether agricultural employers were compliant, noncompliant, if the requirement was inapplicable, or if compliance assistance was provided. These inspection reports were analyzed to determine the number of inspections that resulted in at least one violation, as well as the frequency with which each section and individual requirement was violated.

CHAPTER FOUR: RESULTS

Pre-Update Inspections (01/2001-03/2018; n=504)

The WPS was updated in 2015 to implement additional requirements and to strengthen those that previously existed. The ISDA began enforcing the updated standard in April 2018. Before then, inspectors utilized a WPS inspection checklist that included requirements that reflected the previous version of the WPS (Appendix A).

We analyzed 504 WPS inspections that were conducted on farms during the pre-update period and before the updated inspection checklist was in use (January 2001-March 2018). Of these, 284 (56%) were Tier 1 inspections and 220 (44%) were Tier 2 inspections.

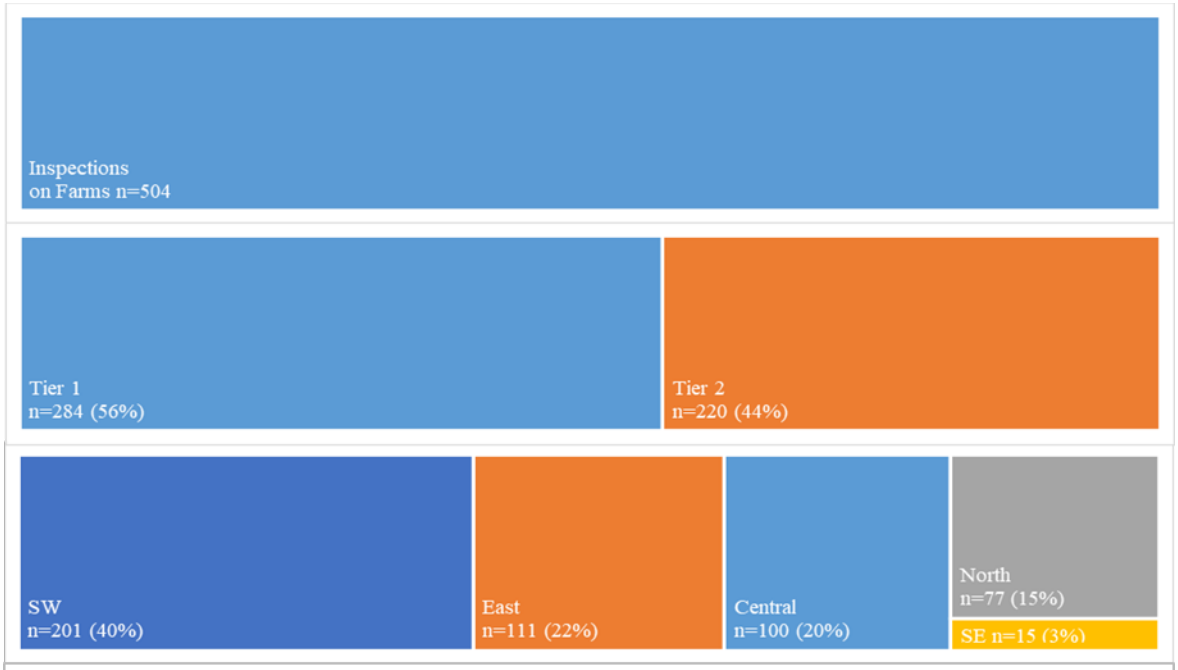


Figure 4.1. The total number of inspections conducted during the pre-update period, separated into Tier 1 and 2 inspections, and further separated by region.

A chi-square test of equal proportions showed that the number of inspections conducted in each region varied significantly, x^2 (4, N=504) =179.29, p < .05. While 40% took place in the Southwest region, only 3% took place in the Southeast. Figure 4.1 includes a further breakdown of these inspections.

The number of inspections conducted each year also varied significantly, x^2 (17, N=504) =129.7, p < .05. These ranged from a low of 15 in 2005 to a high of 65 in 2016 (Figure 4.2).

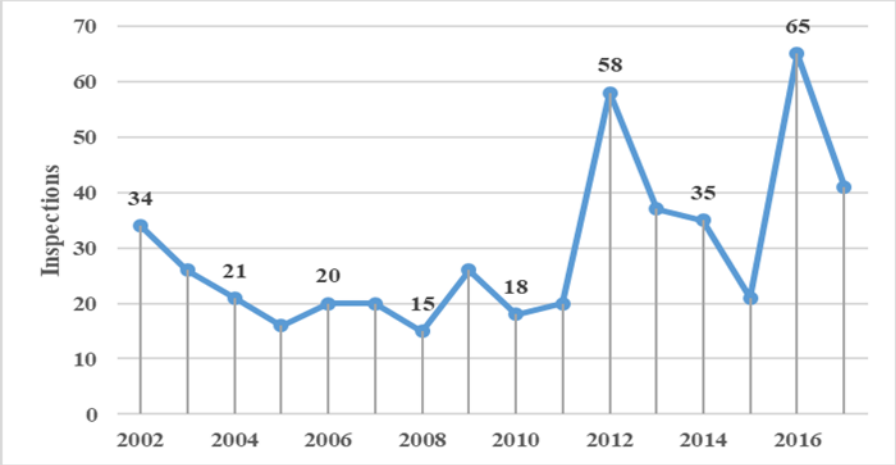


Figure 4.2. The number of inspections conducted on farms in Idaho annually, 2002-2016.

Overall Compliance Frequency

Inspectors indicated the number of individual requirements that were violated at each inspection, which ranged from 0-50. Inspectors observed a significantly higher frequency of violations during Tier 2 inspections compared to Tier 1 (t-test, p<.05). Farms that received a Tier 1 inspections were observed to be fully compliant during 189 (67%) of the 284 Tier 1 inspections (Table 4.1). Records from another 43 (15%) of these indicated that between 1 and 5 of the requirements were violated.

Compared to 67% Tier 1 inspections, only 36% (n=80) of Tier 2 inspections were observed to be fully compliant with the WPS requirements. It may be worth noting that 20+ requirements were observed to be violated during 20 (9%) of Tier 2 inspections. This is perhaps unsurprising considering the fact that, during Tier 2 inspections, "compliance assistance" is provided and noncompliance does not result in a penalty.

Table 4.1. The number of violations observed per inspection.

Tier 1 inspections			Tier 2 inspections		
Noncompliance Violations	# of Inspections	% of Inspections	Noncompliance Violations	# of Inspections	% of Inspections
None	189	66.55%	None	80	36.36%
1-5	43	15.14%	1-5	55	25.00%
6-10	19	6.69%	6-10	18	8.18%
11-15	9	3.17%	11-15	26	11.82%
16-20	9	3.17%	16-20	21	9.55%
21-25	7	2.46%	21-25	9	4.09%
25+	8	2.82%	25+	11	5.00%
Total	284	100%	Total	220	100%

The 55 WPS requirements included in this analysis are divided into eight major sections (previously listed in Table 3.1 of the methods). According to inspection records, farms most commonly violated requirements within the central location, training, and decontamination sections of the WPS. Conversely, violations with requirements within the notice of pesticide application, early-entry, and emergency assistance sections were rarely observed (Table 4.2). Table 4.2 allows a vertical comparison of violations with each WPS section, as well a horizontal comparison of violations observed during Tier 1 and 2 inspections.

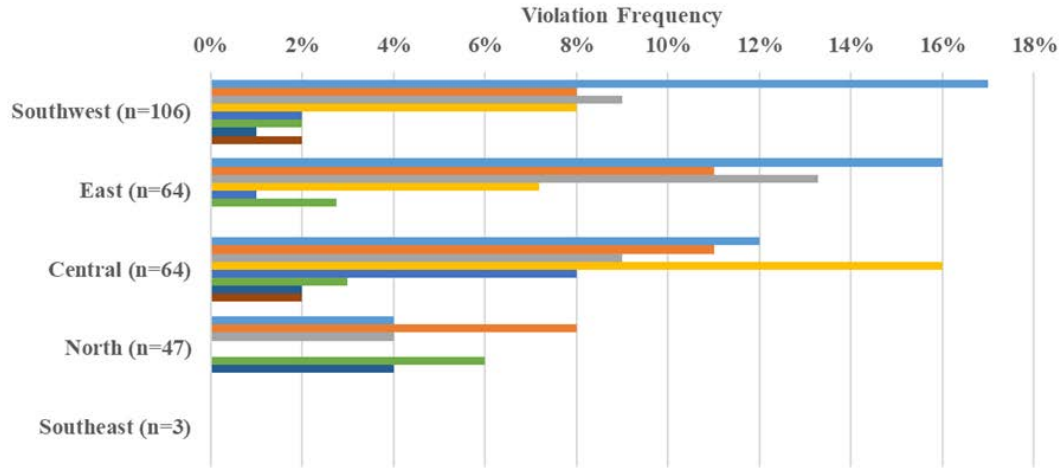
Table 4.2. Number and percentage of inspections with ≥1 noncompliance violation within each WPS section.

*If all requirements within a section were marked inapplicable for an inspection, that inspection was exlcuded from the corresponding calculation. Therefore, the number of inspections included in each section calculation varies from 401 in the information exchange section, to 486 in the notice of pesticide application section.

	# and % of **Tier 1** inspections with ≥ 1 noncompliance violation	# and % of **Tier 2** inspections with ≥ 1 noncompliance violation
Central Location	61 (25%)	100 (52%)
Training	48 (18%)	81 (39%)
Decontamination	42 (17%)	83 (42%)
PPE	20 (7%)	38 (19%)
Information Exchange	25 (11%)	27 (15%)
Notice of Pesticide Application	12 (4%)	26 (12%)
Early-Entry	14 (5%)	11 (5%)
Emergency Assistance	5 (2%)	3 (2%)

Noncompliance with WPS Sections

Inspection reports indicated that violations were most common within the central location, training, decontamination, information exchange, and PPE sections. This held true for both Tier 1 and Tier 2 inspections (Figure 4.4), and across all regions (Figure 4.3). Figure 4.3 displays the regional distribution of violations in each section during Tier 1 inspections. According to inspectors, the most frequently violated section was the central location in the Southwest region, of which 17% of the requirements were violated. Only three Tier 1 inspections were conducted in the Southeast region, during which no violations were observed.



	Southeast (n=3)	North (n=47)	Central (n=64)	East (n=64)	Southwest (n=106)
Central Location	0%	4%	12%	16%	17%
Decontamination	0%	8%	11%	11%	8%
Training	0%	4%	9%	13%	9%
Info Exchange	0%	0%	16%	7%	8%
Entry Restrictions	0%	0%	8%	1%	2%
PPE	0%	6%	3%	3%	2%
Notice of Pesticide Application	0%	4%	2%	0%	1%
Emergency Assistance	0%	0%	2%	0%	2%

Figure 4.3. The percentage of requirements in each section that were violated during Tier 1 inspections in each region. *Denominators differ across each section because requirements that were marked as "inapplicable" were excluded from the corresponding section calculation.

The frequency of violations with the central location, decontamination, training, PPE, decontamination, and notice of application sections was significantly higher during Tier 2 inspections compared to Tier 1 (t-test, $p < .05$). For example, during Tier 2 inspections, 34%, 23% and 20% of the central location, decontamination and training requirements were violated, respectively. In contrast, during Tier 1 inspections, only 14%, 9%, and 9% of requirements were violated in the same sections (Figure 4.4).

When analyzing inspections collectively across the state, inspection results indicated that <5% of the requirements were violated in each of the following sections: Entry Restrictions, Notice of Pesticide Application, and Emergency Assistance. Because violations in these sections were rarely observed, these sections are not further analyzed.

Instead, we focus the remainder of our analyses on the top five most frequently violated sections: central location, decontamination, training, information exchange, and PPE.

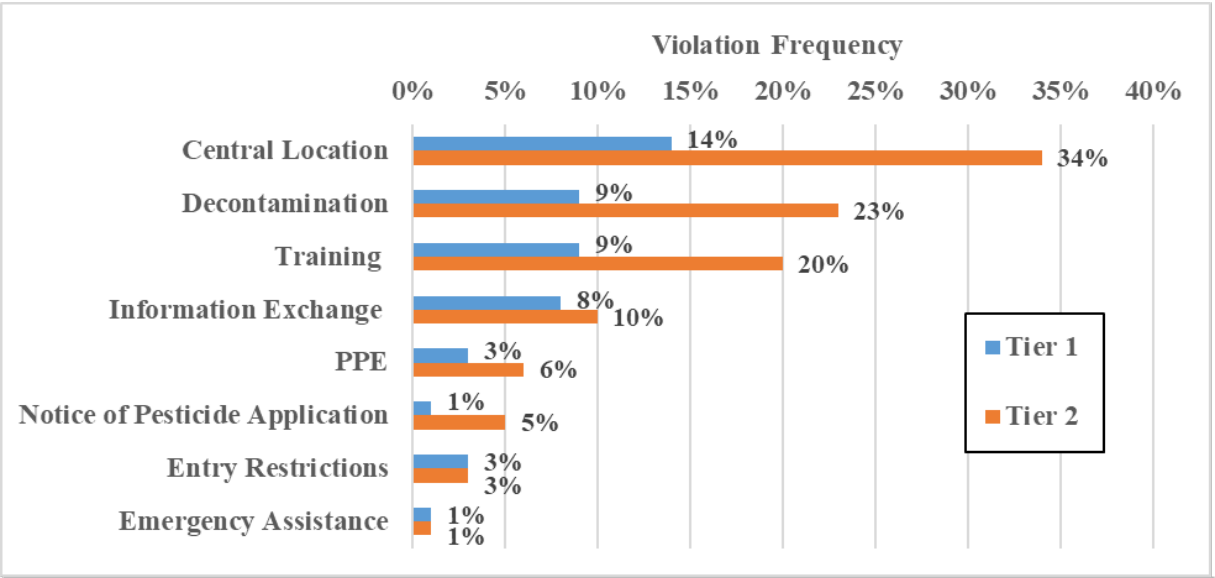


Figure 4.4. The percentage of requirements in each section that were violated. *Denominators differ across each section because requirements that were marked as "inapplicable" were exlcuded from the corresponding section calculation.

Noncompliance with WPS Requirements

According to inspection reports, an average of 3 of 55 (5.4%) requirements were violated during Tier 1 inspections (SD=7.22), and an average of 7 of 55 (12.7%) requirements were violated during Tier 2 inspections (SD =9.08). More specifically, Table 4.3 describes the frequency with which each individual requirement was violated, as observed by ISDA inspectors. When considering the central location section, for example, the requirement most frequently violated was “posting the time and date of a pesticide application,” which was violated 21% of the time during Tier 1 inspections. During Tier 2 inspections, the requirement to “post the active ingredient of the pesticide being applied” was most frequently violated (43% of the time).

The ten requirements most frequently violated are ranked in Table 4.4, regardless of the section with which they were a part. Eight of the top ten were part of the central location section (written in red), and the remaining two were part of the training section (written in blue).

Table 4.4. The top ten most frequently violated requirements, as indicated by inspection reports.

Rank	Violation Frequency		Requirement
	Tier 1	Tier 2	
1	21%	42%	Central location: Is the time and date of the pesticide application displayed?
2	18%	43%	Central location: Is the active ingredient - common or chemical name - dispalyed?
3	17%	41%	Central location: Is pesticide information displayed for each application?
4	17%	39%	Training: Are all workers Certified Pesticide Applicators or have received WPS worker training?
5	16%	40%	Central location: Does the pesticide information remain for 30 days after the application or after the REI expires?
6	16%	41%	Central location: Is the EPA registration number displayed?
7	16%	41%	Central location: Is the REI displayed?
8	16%	36%	Training: Do workers receive training before the 6th day of entry into treated areas?
9	14%	39%	Central location: Is the location of the are treated displayed?
10	14%	35%	Central location: Is the product name displayed?

Table 4.3. The frequency with which each requirement was violated, as observed by inspectors.

Section	Requirement	Tier 1	Tier 2
Central Location	Is the time and date of the pesticide application displayed?	21%	42%
	Is the active ingredient: Common or chemical name displayed?	18%	43%
	Is pesticide information displayed for each application?	17%	41%
	Does the pesticide information remain for 30 days after the application or after the REI expires?	16%	40%
	Is the EPA registration number displayed?	16%	41%
	Is the REI (restricted entry interval) displayed?	16%	41%
	Is the location of the area treated displayed?	14%	39%
	Is the product name displayed?	14%	35%
	Is central location displayed when handlers or workers are on the agricultural establishment during an application or when an REI has been in effect in the last 30 days?	12%	29%
	Is emergency medical information displayed?	9%	31%
	Is an EPA-approved safety poster displayed?	9%	30%
	Is the site easily accessible to workers/handlers?	2%	6%
Decon-tamination	Are worker decontamination sites supplied with clean water, soap, and disposable towels?	13%	32%
	Are decontamination sites provided for workers until 30 days following the expiration of the REI?	14%	29%
	Is 1 pint of eyeflush water immediately available to handlers and early-entry workers if label requires protective eyewear?	8%	25%
	Are handler decontamination sites supplied with clean water, soap, disposable towels, and clean coveralls?	8%	21%
	Is the decontamination site provided within 1/4 mile for the duration of the handling activities?	7%	16%
	Does handler mixing or loading pesticides have a decontamination site at the mix/load area?	5%	15%
Training	Are all workers Certified Pesticide Applicators or have received WPS worker training?	17%	39%
	Do workers receive training before the 6th day of entry into treated areas?	16%	36%
	Do trainers have proper qualifications to conduct training?	12%	30%
	Do early-entry workers receive required additional training?	10%	31%
	Is training repeated every 5 years?	8%	21%
	Are handlers Certified Pesticide Applicators or have received WPS handler Training?	10%	18%
	Do handlers receive training before performing pesticide-handling activities?	9%	16%
	Is training presented in a language the trainees understand?	6%	17%
	Does trainer respond to trainee's questions?	6%	14%
	Are handlers informed of labeling and have access to labels?	2%	5%
	Do trainers have proper qualifications to conduct training?	3%	3%
Information Exchange	Have you provided information to the professional applicator about REI's in effect on your property?	8%	11%
	Has your professional applicator provided you with required information for your central location prior to application?	9%	9%
PPE	Have those cleaning PPE received special instructions on laundering procedures?	5%	12%
	Are cleaning/maintenance requirements of PPE met?	4%	10%
	Is PPE inspected before each day's use?	4%	9%
	Is required PPE provided to handlers and early-entry workers?	5%	7%
	Are handlers and early-entry workers instructed in the proper use of PPE?	3%	8%
	Is a clean place provided for PPE storage?	3%	7%
	Are appropriate measures taken to avoid heat-related illness?	1%	2%
	Is equipment used for mixing, loading, and applying pesticides inspected and repaired before each day of use?	1%	1%
	Have handlers been instructed in proper use of application equipment?	0%	1%

Post-Update Inspections (04/2018 – 06/2019; n=53)

We analyzed 53 WPS inspections that were conducted on farms after the update was implemented and after the updated inspection checklist was in use (04/2018 through 06/2019). Of these, 40 (75%) were Tier 1 inspections, and 13 (25%) were Tier 2 inspections.

Consistent with the previous section that described pre-update inspections, a chi-square test of equal proportions showed that the number of inspections conducted in each region varied significantly, x^2 (4, N=53) =103.32, $p < .05$. Three quarters of inspections were conducted in the Southwest region (n=40; 75%), with the remaining quarter divided amongst the Eastern region (n=6; 11%), central region (n=4; 7%), northern region (n=2; 4%), and southeastern region (n=1; 2%). Figure 4.5 includes a breakdown of these inspections. Because of the small sample sizes with each region, geographic trends during the post-update period will not be further described.

Figure 4.5. The total number of inspections conducted during the post-update period, separated into Tier 1 and Tier 2 inspections, and further separated by region.

Overall Compliance Frequency

Inspectors indicated the number of individual requirements that were violated during each inspection, which ranged from 0-50. Inspectors observed a significantly higher frequently of violations during Tier 2 inspections compared to Tier 1 (t-test, $p<.05$). Farms that received a Tier 1 inspection were observed to be fully compliant during 16 (40%) of the 40 inspections (Table 4.5). Records from another 14 of the inspections indicated that between 1 and 5 of the requirements were violated.

Compared to 16 Tier 1 inspections, only a single Tier 2 inspection was observed to be fully compliant with the WPS requirements (Table 4.5). However, results for Tier 2 inspections should be interpreted with caution due to the small sample size of only 13 inspections. As a result, the remainder of this analysis will focus on Tier 1 inspections only.

Table 4.5. The number of violations observed per inspection.

Tier 1 Inspections			Tier 2 Inspections		
Noncompliance Violations	# of Inspections	% of Inspections	Noncompliance Violations	# of Inspections	% of Inspections
None	16	40.00%	None	1	7.69%
1-5	14	35.00%	1-5	1	7.69%
6-10	5	12.50%	6-10	2	15.38%
11-15	3	7.50%	11-15	2	15.38%
16-20	2	5.00%	16-20	2	15.38%
20+	0	0.00%	20+	5	38.46%
Total	40	100.00%	Total	13	100.00%

The 100 requirements applicable to this analysis are divided into 13 major sections (previously defined in Table 3.1 of the methods). According to inspection reports, farms most commonly violated requirements within the central location, training, and PPE sections of the WPS (Table 4.6). Conversely, there were no observed violations

with the notice of pesticide application, minimum age, pesticide handling equipment, and emergency assistance sections.

Table 4.6. Number and percentage of inspections with ≥1 noncompliance violation within each WPS section.

Section	# (%) of Tier 1 inspections with ≥ 1 violation
Central Location	14 (35%)
Training	12 (30%)
PPE	8 (21%)
Early-Entry	3 (6%)
Decontamination	2 (5%)
Information Exchange	1 (4%)
Knowledge	1 (3%)
Application	1 (3%)
Notification of Pesticide Application	0
Minimum Age	0
Pesticide Handling Equipment	0
Emergency Assistance	0

Noncompliance with WPS Sections

Inspection reports indicated that the rates of violations were highest within the central location, training, and PPE sections (Figure 4.6). Again, it is important to note that a different denominator was used to calculate the noncompliance frequency within each section. If an inspector marked that a requirement was inapplicable, it was excluded from analyses, and the number of inapplicable requirements differed across inspections and sections. The percentage of inapplicable observations ranged from 0% in the emergency assistance, pesticide handling equipment, and notice of pesticide applications sections, to 60% in the early-entry section.

Figure 4.6 includes only the sections of the WPS that were violated at least once. It excludes the following sections that were never observed to be violated: Emergency

Assistance, Minimum Age Requirements, and Pesticide Handling Equipment. In addition, fewer than 5% of the requirements were observed to be violated in the following sections: Early-Entry Restrictions; Decontamination; Notification, Entry Restrictions & Posting; Information Exchange; Knowledge of Labeling, Application & Establishment-Specific Information; and Application, Entry Restrictions & Handler Protection. We do not further analyze the sections that were rarely or never violated, and we instead focus our analysis on the three sections most frequently violated: Central location, training, and PPE.

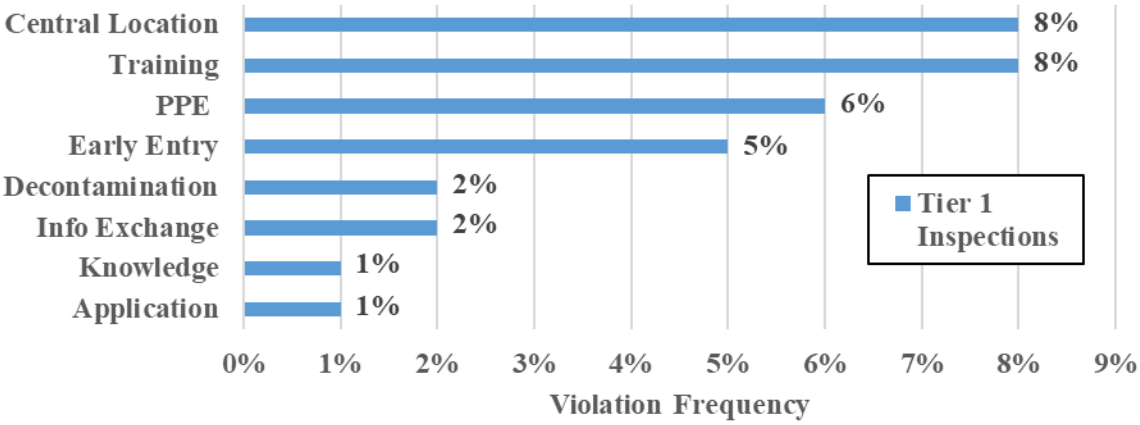


Figure 4.6. The percentage of requirements in each section that were violated. *Denominators differ across each section because requirements that were marked "inapplicable" were excluded from the corresponding section calculation.

Noncompliance with Each of the WPS Requirements

According to inspection reports, an average of 3 of 85 (3.5%) requirements were violated during Tier 1 inspections (SD=5.18). More specifically, Table 4.7 describes the frequency with which each individual requirement was violated during Tier 1 inspections, as observed by ISDA inspectors. The top ten requirements most frequently violated

during Tier 1 inspections are ranked in Table 4.8, regardless of the section with which they were a part.

Table 4.8. The top ten most frequently violated requirements during Tier 1 inspections, as indicated by inspection reports.

Rank	Noncompliance Frequency	Requirement
1	27%	PPE - Are respirator safety records kept on the establishment for 2 years?
2	23%	Central Location - Are Safety Data Sheets (SDSs) for each pesticide available?
3	19%	PPE - If the label requires respirator us did handlers receive medical clearance, fit testing, and training?
4	18%	Early-Entry Restrictions - Are the appropriate decontamination supplies provided? (3 gallons of water for each early-entry worker, soap and single use towel)
5	18%	Training - Is the name of the worker/handler employer retained on establishment for 2 years?
6	18%	Training -Are training record retained on establishment for 2 years?
7	15%	Training -Is the date of training retained on establishment for 2 years?
8	15%	Training - Is the trainer's name and qualification (Certified applicator or RUP's or Train-the-Trainer) retained on establishment for 2 years?
9	15%	Training - Is the EPA-approved training material retained on establishment for 2 years?
10	15%	Central Location - Are the location and description of treated area(s) displayed?

Table 4.7. The frequency with which each requirement was violated, according to inspections reports.

Section	Requirement	Tier 1 Inspections
Central Location	Are Safety Data Sheets (SDSs) for each pesticide available?	23%
	Are the location and description of treated area(s) displayed?	15%
	Is the pesticide safety information (safety poster) displayed?	13%
	Are the name, address and phone number of the state/tribal pesticide agency displayed?	13%
	Is the active ingredient(s): Common or chemical name displayed?	10%
	Does the pesticide information remain for 30 days after the application or after the REI expires?	10%
	Is pesticide safety information displayed at any permanent decontamination site?	8%
	Are the name, address and phone number of an emergency medical facility displayed?	8%
	Is the REI (restricted-entry interval) displayed?	8%
	Are pesticide application and hazard information records retained on establishment for 2 years?	8%
	Is pesticide information displayed for each application?	5%
	Is the EPA registration number displayed?	5%
	Is the crop or site treated displayed?	5%
	Is pesticide safety information displayed at a location where decontamination supplies are required in quantities for 11 or more workers?	5%
	Are pesticide application records and SDSs available, upon request, to workers/handlers, personal representative, and medical personnel?	3%
	Is the central location information displayed when handlers or workers are on the agricultural establishment during an application or when an REI has been in effect in the last 3 days?	0%
	Is the name of the pesticide applied displayed?	0%
	Is the site easily accessible to workers and handlers?	0%
PPE	Are respirator safety records kept on the establishment for 2 years?	27%
	If the label requires respirator us did handlers receive medical clearance, fit testing, and training?	19%
	If using particulate-filtering face piece respirators, are they replaced appropriately?	10%
	If using vapor-removing canister/cartridge respirators, are they replaced appropriately?	10%
	Have those cleaning PPE received special instructions on laundering procedures?	5%
	Is a clean place provided for PPE storage and separately from personal clothing and contaminated areas?	3%
	Is label-required PPE provided to pesticide handlers clean and operational?	0%
	Does the employer ensure that pesticide handlers wear and use PPE correctly, and before each day of use PPE is inspected, repaired, or discarded as appropriate?	0%
	Are cleaning/maintenance requirements of PPE met?	0%
	Are appropriate measures taken to avoid heat-related illness?	0%
Training	Is the name of the worker/handler employer retained on establishment for 2 years?	18%
	Are training record retained on establishment for 2 years?	18%
	Is the date of training retained on establishment for 2 years?	15%
	Is the trainer's name and qualification (Certified applicator or RUP's or Train-the-Trainer) retained on establishment for 2 years?	15%
	Is the EPA-approved training material retained on establishment for 2 years?	15%
	Have current handlers been trained in the last 12 months prior to performing pesticide-handling activities?	14%
	Is the worker/handler printed name and signature retained on establishment for 2 years?	13%
	last 30 days?	11%
	Do Early-Entry Workers receive required additional training?	8%
	Is establishment-specific information provided?	3%
	Is establishment-specific information provided on decontamination supplies?	3%
	Are handlers informed of labeling requirements and have access to labels?	0%
	Is training presented orally or audio visually and using a translator, if necessary?	0%
	Was the trainer present at all times during training to respond to trainee’s questions?	0%
	Is establishment-specific information provided on pesticide safety information?	0%
	Is establishment-specific information provided on pesticide application and hazard information?	0%

Comparing Pre- and Post- Update Inspections

According to both pre- and post-update inspection reports, the central location and training sections were most frequently violated. Pre-update reports indicated that specific requirements within the decontamination and information exchange sections were also frequently violated, but there were relatively few violations observed with requirements within the PPE and Early-Entry sections. Post-update reports indicated the opposite; violations were observed to be more common with requirements within the PPE and early-entry section, compared to requirements within decontamination and information exchange section (Figure 4.7).

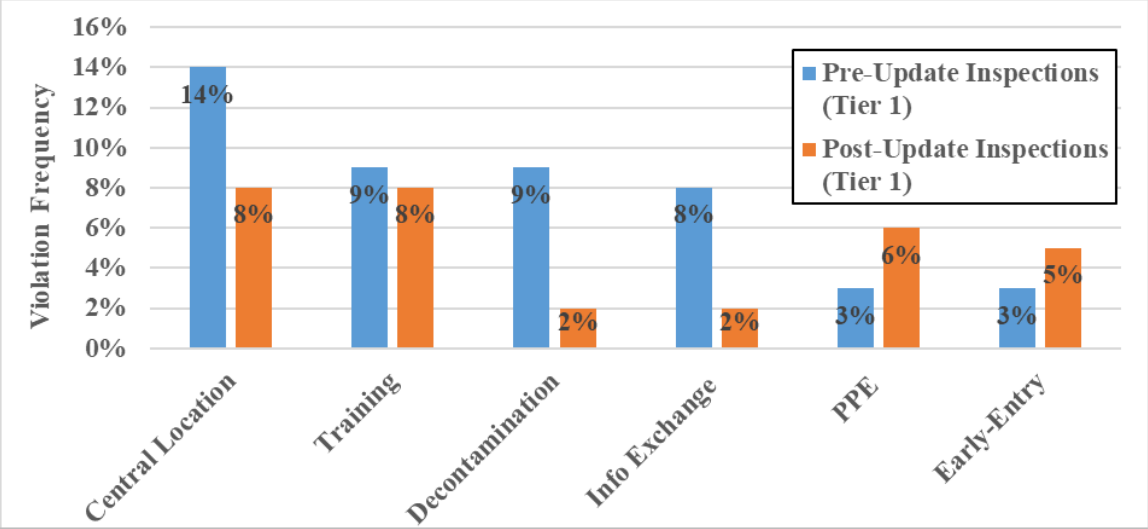


Figure 4.7. The percentage of requirements within each section that were violated. *Denominators differ across each section because requirements that were marked "inapplicable" were excluded from the corresponding section calculation.

CHAPTER FIVE: DISCUSSION

We found that at least one WPS violation was observed during 36% (119/324) of Tier 1 inspections and 65% (152/233) of Tier 2 inspections. Both pre- and post-update, inspectors most frequently observed violations with central location and training requirements. Together, these results are consistent with previous research suggesting that the WPS is frequently violated, and that certain sections are violated more frequently than others.

Our first research question asked how often farm employers were noncompliant with the WPS overall. This question can best be answered by considering our findings for Tier 1 inspections, since these are enforceable inspections during which noncompliance could be penalized. We found that 33% of Tier 1 *pre*-update inspections resulted in at least one violation, and this was consistent with the EPA's National WPS Monitoring Program, which reported that 34% and 35% of inspections resulted in a violation in 2015 and 2016, respectively (Environmental Protection Agency, 2018b).

Compared to 33% of Tier 1 *pre*-update inspections, our analysis showed that 60% of Tier 1 *post*-update inspections resulted in a violation. This finding confirmed our hypothesis that noncompliance would be more frequent during the post-update period, and we believe that this could be explained by a combination of unfamiliarity with, and the logistical challenges of, the new requirements. If this analysis were to continue, we might expect violation rates to decrease annually as the WPS becomes more commonplace. A similar trend was identified by the EPA WPS Monitoring Program,

which reported that 57% of inspections resulted in a violation in 2005, but by 2016, this decreased to 35% of inspections (Environmental Protection Agency, 2018b). Despite contextual differences between the previous decade and now, historical compliance trends nationwide may be predictive of compliance trends in Idaho in the future.

We also hypothesized that violations would occur most frequently in the Eastern, Central, and Southeastern regions of the state. This hypothesis was partially confirmed after our analysis showed that violations occurred more frequently during Tier 1 inspections in the Eastern and Central regions of the state. This could be explained by the fact that these are relatively less populous regions of the state, and therefore these farm owners perceive a low likelihood of being inspected and little risk associated with noncompliance. Perhaps owing to a minimal or nonexistent relationship with the ISDA, it is also possible that these farm owners were unfamiliar with the WPS and the compliance assistance program the ISDA provides, or unwilling to travel to attend WPS training sessions hosted by the ISDA.

Similarly, we hypothesized that violations would be least frequent in the Southwestern region, based on our assumption that these farm owners have more frequent contact and thus more established relationships with the ISDA than employers operating establishments further away. The ISDA often inspects employers with whom they have already interacted (i.e. training events or previous inspections), and we theorized pre-existing relationship would have a positive impact on WPS compliance levels. While this association should be further explored, our analysis suggested that this may not be the case; violations were actually most frequent in the Southwest region,

suggesting that the target group's proximity to and relationship with the regulating body may not be directly associated with compliance performance.

Another of our study hypotheses was that the frequency of violations in the Northern region would be relatively low, which our analysis found to be true. We hypothesized that this finding would be related to the types of cold weather crops typically grown in the North: beans, lentils, rice, and seeds. These crops require a relatively low labor demand which may make compliance less difficult for growers of these crops than for those who grow crops that require a high labor demand. However, the regional distribution of violations described in this thesis should be interpreted with caution due to the wide range in number of inspections conducted in each region. This ranges from 205 Tier 1 pre-update inspections in the Southwest compared to only three in the Southeast.

Further research is needed to explain whether there is a systematic reason for the regional trends identified in this analysis, or if they are due to chance. To this end, there are other geographic and temporal trends that could be explored using WPS inspection data. Although these were outside the scope of this thesis, better understanding annual compliance characteristics in different regions could inform more targeted inspection and training strategies going forward. For example, inspection records could be used to describe the evolution of violation rates among farms that were inspected in each region over time, as well as which WPS sections and requirements appear to be most problematic.

The potential utility of analyzing WPS inspection records would be increased if data were available on the total number of farms to which the WPS is applicable in each

region of Idaho. There are thousands of farms in Idaho, but there is no central source of information on precisely where each of these farms is located or how many farms there are in a given region. Capturing such insight would allow the ISDA to understand whether farms in a certain region are disproportionately inspected, and/or disproportionately in violation of the WPS. Future researchers investigating WPS compliance in Idaho should first consider quantifying and locating Idaho farms, which would contextualize the WPS inspection reports that have already been conducted.

Our second research question asked how often farm employers violated each *section* of the WPS. We found that the central location, training, and decontamination sections were most frequently violated. Approximately 25% of Tier 1 pre-update inspections resulted in a violation with at least one central location requirement, while 18% and 17% resulted in a violation with at least one training and decontamination requirement, respectively. These trends were consistent with findings of the EPA WPS Monitoring Program, which reported that over the last two decades, these three sections were most frequently violated nationwide (Environmental Protection Agency, 2018b).

We speculate that these three sections are the most difficult to comply with, logistically speaking. Training workers and handlers is time consuming, and an agricultural employer must first obtain proper certification to conduct training. Central location requirements are perhaps the most detailed of any section – agricultural employers are required to post a variety of characteristics of each pesticide application in a timely manner. Decontamination supplies may be difficult for agricultural employers to regularly maintain compared to other sections – water, soap, and towels often need replacing, and there may be multiple decontamination sites on a single establishment.

It is also possible that there were more reported violations with these sections because they were relatively easy for inspectors to observe. In other words, central location, training, and decontamination violations could have been observed with greater certainty – such as a missing safety poster - while violations in other sections could have been present but were not recognized – such as not cleaning pesticide safety equipment each day before use. When assessing compliance with requirements that cannot be easily observed, inspectors rely on the word of the agricultural employer, and it is certainly possible that their answers where not altogether truthful.

This could be considered a major obstacle in truly understanding WPS compliance levels. The nature of the WPS does not allow inspectors to monitor each requirement with equal certainty, and as a result, inspection reports may not accurately reflect compliance performance with those requirements that are more difficult – or impossible – to observe. Nonetheless, we believe that our analysis does provide valuable insight pertaining to the central location, training, and decontamination sections, as the majority of these requirements *can* be accurately monitored.

Several studies have investigated compliance specifically with training and decontamination requirements (previously synthesized in Tables 2.2 and 2.3). Findings across these studies were mixed, but the majority suggested that violations were more frequent than what was found in this study. Of the five studies included in Table 2.2, an average of 67% of farmworkers reported not having access to water for handwashing. In our study, this requirement was observed to be violated only 10% of the time during pre-update Tier 1 inspections. Similarly, of the ten studies included in Table 2.3, an average of 39% of farmworkers reported never having received pesticide safety training, while

our study found that this requirement was violated only 16% of the time during pre-update Tier 1 inspections.

The inconsistencies between our findings and existing literature demonstrate that compliance levels vary substantially depending on the agricultural establishment under investigation. Agricultural employers can fall to both extreme ends of the compliance spectrum, operating as both good and bad actors. For example, Shipp et al. (2005) surveyed 25 farmworkers in Texas, only 20% of which reported having access to water for handwashing. Contrastingly, Levesque et al. (2012b) found that 100% of farmworkers in North Carolina reported having received pesticide safety training. Our analysis and existing literature provide evidence that additional WPS research, education, and outreach is needed, not just for the purpose of improving reported compliance rates, but in fact to better protect farmworkers from pesticide exposure and related illness.

Our third research question asked how often farm employers were noncompliant with each individual WPS *requirement*. To our knowledge, this is the first study to describe WPS compliance to this level of detail; all previous studies have focused on only one or a few relevant requirements, and the EPA WPS Monitoring Program described compliance with each general WPS section.

A few noteworthy differences are apparent between the requirements found to be most frequently violated during the pre- and post-update periods. During the pre-update period, the top ten most frequently violated requirements all fell into the central location and training sections, but post-update, two PPE requirements were the first and third most commonly violated. These two PPE requirements were related to respirator use: the first requires pesticide handlers to receive training, fit testing, and medical clearance to use a

respirator if it is required by the pesticide label, and the second requires respirator safety records to be retained on the establishment for two years. Respirator use was not included in the pre-update WPS, so this finding most likely indicates that many agricultural employers may not yet be aware of respirator requirements, and that additional outreach is needed to increase these compliance levels and better protect farmworkers from associated pesticide exposure.

A novel contribution of this analysis was our ability to compare outcomes of Tier 1 versus Tier 2 inspections. During both the pre- and post-update period, we found that a substantially larger portion of requirements were violated during Tier 2 inspections compared to Tier 1. Because employers can be noncompliant without the fear of a penalty during Tier 2 inspections, it is unsurprising that violations would be more frequently observed during this type of inspection. This could also be attributed to the fact that Tier 2 inspections rarely occur during the outdoor growing season, a time when the WPS may not be a high priority for agricultural employers. In addition, some agricultural employers request a Tier 2 "compliance assistance" inspection when they know they may be in violation of the standard and want to become compliant.

In contrast, the higher compliance frequency observed during Tier 1 inspections could be due to the following reasons: 1) Tier 1 inspections typically occur during the agricultural spray season, a time when WPS compliance may be perceived to be especially important; 2) Agricultural employers may be aware that they can be penalized for noncompliance during Tier 1 inspections, and so they may put forth extra effort to comply when they know they could be receiving a Tier 1 inspection; and 3) Tier 1 inspections occur more frequently – in this analysis, 58% of inspections were Tier 1 – so,

agricultural employers may perceive a higher likelihood of receiving this type of inspections and therefore take measures to comply.

The finding that violations were observed more frequently during Tier 2 inspections compared to Tier 1 was consistent with expectations communicated by the ISDA in advance of this work (Kostka, 2019; Urias, 2019). It reinforces the value of agricultural employers receiving a low-risk WPS inspection, during which the ISDA can provide compliance assistance and help them become prepared in the event they receive an enforceable Tier 1 inspection. Based on our work, we believe that the ISDA's compliance assistance program is a positive component of the WPS in Idaho; rather than being overtly invasive and inflicting punishment for every violation observed, the ISDA works to strengthen relationships with the agricultural community as a means of improving both compliance and farmworker health.

Despite the benefits of the compliance assistance program in Idaho, this analysis suggests several limitations in the ISDA's monitoring capacity, as well as in the WPS as a whole. As previously noted, the ISDA – and any other regulating body, for that matter – lacks the ability to monitor each WPS section with equal accuracy. This makes enforcement difficult and the extent of farmworker protection uncertain. We acknowledge that this limitation could cause our results to be misleading or misinterpreted. They should therefore be interpreted with caution and with the understanding that WPS inspections do not capture the full picture of compliance levels in Idaho. Nonetheless, this analysis does add some coherence to that picture.

WPS enforcement in Idaho is also limited by the fact that the WPS is an extension of pesticide product labeling. Idaho Code §22-3420(1) states that "No person shall: Use a

pesticide in a manner inconsistent with its labeling except as provided for by rule," and the WPS is inherently included in the labeling of pesticide products that are registered for agricultural use (Fults, 2017). Thus, if an agricultural employer violates the WPS, they are in legal violation of the pesticide label.

The challenge here lies with the fact that the WPS has not been adopted into state rule apart from the pesticide label, which makes it impossible to issue legal penalties over WPS violations that are independent of a physical pesticide product. For example, an employer could be noncompliant with PPE requirements, but if there is no record of a pesticide product being used in a manner inconsistent with its label, the PPE violations alone would not be sufficient evidence to warrant a legal penalty. If the WPS was adopted into state rule separately from pesticide labeling, however, the ISDA could cite individual violations with specific WPS requirements, which would likely strengthen the ISDA's enforcement capabilities.

Another challenge related to WPS enforcement is the limited annual EPA funding that the ISDA uses to conduct WPS inspections. The ISDA has the capacity to conduct <100 WPS farm inspections per year, which encompasses <1% of the 25,000+ farms in Idaho (National Agricultural Statistics Service, 2018). It is clear that this reach should be expanded, especially because inspection records that are available tell us that compliance is largely lacking. To address this insufficiency, the results of this thesis support efforts to advocate for additional EPA funds be allocated to the ISDA's WPS program, not only to increase inspection numbers, but also education and outreach to the agricultural communities across Idaho.

The structure of WPS inspections also contributes to the ISDA's limited inspection capacity. Currently, WPS inspections in Idaho are required to meet EPA inspection guidelines: inspectors are required to utilize the WPS checklist, as well as prepare an inspection report that includes a written narrative and supportive documentation such as photos, interviews and statements (Environmental Protection Agency, 2018c). Altogether, a single inspection often lasts for more than four hours (Urias, 2019).

There is clear value in undergoing such a thorough inspection process, but the ISDA's inspection capacity could be increased by allowing inspectors to streamline a portion of the WPS inspections that they conduct. This could be accomplished by monitoring compliance with a subset of WPS sections exclusively (i.e. training and central location), thus enabling inspectors to conduct additional inspections during their saved time. Although these streamlined inspection reports would not capture compliance with all ten WPS sections, it is arguably more important to conduct inspections - in any capacity - on as many agricultural establishments as resources allow.

There are also opportunities to enhance the ISDA's strategy when selecting which farms to inspect. Currently, inspection staff often target agricultural employers with whom they have already interacted at various training sessions and/or community events hosted by the ISDA (Urias, 2019). Of those agricultural employers with whom the ISDA has already interacted, they will next target establishments that grow certain crop types for which there is a higher demand for workers and handlers, both in terms of labor intensity and the high concentration of workers on site (Urias, 2019).

As previously mentioned in the methods section of this thesis, these selection strategies are utilized largely because the ISDA does not have an exhaustive list of all farms in Idaho, nor do they have explicit guidance on how to best structure their sampling strategy. In order to increase the representativeness of employers who receive a WPS inspection, it may be helpful for the ISDA to understand the location of every farm in the state, as well as basic farm characteristics such as the commodity grown or the number of workers employed. The ISDA would then have the capacity to randomly select farms to be inspected, or to target employers based on a variety of relevant characteristics (i.e. size of workforce, crop type, region), which could be an even better strategy than random selection. Utilizing existing resources on the number of agricultural workers in each county (University of Idaho Extension, 2020), in addition to collecting complimentary information on the number of agricultural establishments, is an important next step in capturing a more representative picture of WPS compliance in Idaho.

Further, WPS compliance and pesticide exposure among farmworkers remain extremely understudied areas. It is important to acknowledge that stronger surveillance is needed to gain a better grasp of the incidence of pesticide-related illness among farmworkers. Our analysis partially fills the knowledge gap surrounding national WPS compliance levels, but there are opportunities to further fill the gap through additional analyses of WPS inspection reports in other states, and through observational studies and studies based on farmworkers self-report. It may also be justified to conduct a prospective, exposure-based cohort study to investigate the relationship between WPS compliance and farmworker health outcomes.

Overall, this analysis provides novel evidence of WPS compliance trends across hundreds of farms in Idaho. We identify the WPS sections and individual requirements that are most commonly violated among farm employers, which may allow WPS inspection staff to target their training and inspection strategies going forward. Although the WPS remains an understudied topic, this analysis demonstrates the feasibility of learning from WPS inspection records to increase awareness, improve compliance, and most importantly, improve the health and safety of farmworkers.

REFERENCES

Agricultural Health Study. (2019). About the Study. Retrieved from https://aghealth.nih.gov/about/

Aktar, M. W., Sengupta, D., & Chowdhury, A. (2009). Impact of pesticides use in agriculture: their benefits and hazards. *Interdisciplinary toxicology, 2*(1), 1-12. doi:10.2478/v10102-009-0001-7

Andreotti, G., Hoppin, J. A., Hou, L., Koutros, S., Gadalla, S. M., Savage, S. A., . . . Beane Freeman, L. E. (2015). Pesticide Use and Relative Leukocyte Telomere Length in the Agricultural Health Study. *PLOS ONE, 10*(7), e0133382. doi:10.1371/journal.pone.0133382

Anger, W. K., Patterson, L., Fuchs, M., Will, L. L., & Rohlman, D. S. (2009). Learning and recall of Worker Protection Standard (WPS) training in vineyard workers. *Journal of agromedicine, 14*(3), 336-344. doi:10.1080/10599240903042057

Arcury, T. A., Nguyen, H. T., Summers, P., Talton, J. W., Holbrook, L. C., Walker, F. O., . . . Quandt, S. A. (2014). Lifetime and current pesticide exposure among Latino farmworkers in comparison to other Latino immigrants. *American journal of industrial medicine, 57*(7), 776-787. doi:10.1002/ajim.22324

Arcury, T. A., Quandt, S. A., Austin, C. K., Preisser, J., & Cabrera, L. F. (1999). Implementation of EPA's Worker Protection Standard training for agricultural laborers: an evaluation using North Carolina data. *Public health reports (Washington, D.C. : 1974), 114*(5), 459-468. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/10590768

Arcury, T. A., Quandt, S. A., & Russell, G. B. (2002). Pesticide Safety among Farmworkers: Perceived Risk and Perceived Control as Factors Reflecting Environmental Justice. *Environmental Health Perspectives, 110*, 233-240.

Atwood, D., & Paisley-Jones, C. (2017). Pesticide Industry Sales and Usage. Retrieved from https://www.epa.gov/sites/production/files/2017-01/documents/pesticides-industry-sales-usage-2016_0.pdf

Barr, D., Bravo, R., Weerasekera, G., Caltabiano, L., Whitehead, R., Olsson, A., . . . Needham, L. (2004). Concentrations of dialkyl phosphate metabolites of organophosphorus pesticides in the U.S. population. *Environmental Health Perspectives, 112*(2), 186-200. doi:10.1289/ehp.6503

Bohme, S. R. (2015). EPA's proposed Worker Protection Standard and the burdens of the past. *International journal of occupational and environmental health, 21*(2), 161-165. doi:10.1179/2049396714Y.0000000099

Bradman, A., Castorina, R., Barr, D. B., Chevrier, J., Harnly, M. E., Eisen, E. A., . . . Eskenazi, B. (2011). Determinants of organophosphorus pesticide urinary metabolite levels in young children living in an agricultural community. *International Journal of Environmental Research and Public Health, 8*(4), 1061-1083. doi:10.3390/ijerph8041061

Brennan, K., Economos, J., & Salerno, M. M. (2015). Farmworkers Make Their Voices Heard in the Call for Stronger Protections from Pesticides. *NEW SOLUTIONS: A Journal of Environmental and Occupational Health Policy, 25*(3), 362-376. doi:10.1177/1048291115604428

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. doi:10.1177/0739986309331877

Calvert, G. M., Beckman, J., Prado, J. B., Bojes, H., Mulay, P., Lackovic, M., . . . Higgins, S. (2014). Acute Occupational Pesticide-Related Illness and Injury -- United States, 2007-2010. *MMWR: Morbidity & Mortality Weekly Report, 62*(54).

Canadian Centre for Occupational Health and Safety. (2019). Pesticides - Health Effects. Retrieved from https://www.ccohs.ca/oshanswers/chemicals/pesticides/health_effects.html

Cooper, J., & Dobson, H. (2007). The benefits of pesticides to mankind and the environment. *Crop Protection, 26*(9), 1337-1348. doi:https://doi.org/10.1016/j.cropro.2007.03.022

Curl, C. L., Fenske, R. A., Kissel, J. C., Shirai, J. H., Moate, T. F., Griffith, W., . . . Thompson, B. (2002). Evaluation of take-home organophosphorus pesticide exposure among agricultural workers and their children. *Environmental health perspectives, 110*(12), A787-A792. doi:10.1289/ehp.021100787

Curl, C. L., Spivak, M., Phinney, R., & Montrose, L. (2020). Synthetic Pesticides and Health in Vulnerable Populations: Agricultural Workers. *Current Environmental Health Reports, 7*(1), 13-29. doi:10.1007/s40572-020-00266-5

Curwin, B. D., Hein, M. J., Sanderson, W. T., Nishioka, M., & Buhler, W. (2003). Acephate exposure and decontamination on tobacco harvesters' hands. *Journal of Exposure Analysis and Environmental Epidemiology, 13*(3), 203-210.

Damalas, C. A., & Eleftherohorinos, I. G. (2011). Pesticide exposure, safety issues, and risk assessment indicators. *International Journal of Environmental Research and Public Health, 8*(5), 1402-1419. doi:10.3390/ijerph8051402

Damalas, C. A., & Koutroubas, S. D. (2016). Farmers' Exposure to Pesticides: Toxicity Types and Ways of Prevention. *Toxics, 4*(1), 1. doi:10.3390/toxics4010001

Damalas, C. A., & Koutroubas, S. D. (2017). Farmers' Training on Pesticide Use Is Associated with Elevated Safety Behavior. *Toxics, 5*(3), 19. doi:10.3390/toxics5030019

Deziel, N. C., Freeman, L. E. B., Graubard, B. I., Jones, R. R., Hoppin, J. A., Thomas, K., . . . Friesen, M. C. (2017). Relative Contributions of Agricultural Drift, Para-Occupational, and Residential Use Exposure Pathways to House Dust Pesticide Concentrations: Meta-Regression of Published Data. *Environmental health perspectives, 125*(3), 296-305. doi:10.1289/EHP426

Environmental Protection Agency. (1992). Regulatory Impact Analysis of Worker Protection Standard for Agricultural Pesticides. Retrieved from https://nepis.epa.gov/Exe/ZyPDF.cgi/P100LYPD.PDF?Dockey=P100LYPD.PDF

Environmental Protection Agency. (2015). Pesticides; Agricultural Worker Protection Standard Revision. Retrieved from https://www.federalregister.gov/documents/2015/11/02/2015-25970/pesticides-agricultural-worker-protection-standard-revisions

Environmental Protection Agency. (2016). Inert Ingredients Regulation. Retrieved from https://www.epa.gov/pesticide-registration/inert-ingredients-regulation

Environmental Protection Agency. (2017). Introduction to Pesticide Labels. Retrieved from https://www.epa.gov/pesticide-labels/introduction-pesticide-labels

Environmental Protection Agency. (2018a). What is a Pesticide? Retrieved from https://www.epa.gov/minimum-risk-pesticides/what-pesticide

Environmental Protection Agency. (2018b). Worker Protection Standard Compliance Monitoring Program. Retrieved from https://www.epa.gov/compliance/worker-protection-standard-compliance-monitoring-program

Environmental Protection Agency. (2018c). Worker Prtoection Standard Inspection Manual. Retrieved from https://www.epa.gov/sites/production/files/2013-09/documents/wpsinspectionsguide.pdf

Environmental Protection Agency. (2019). Pyrethrins and Pyrethroids. Retrieved from https://www.epa.gov/ingredients-used-pesticide-products/pyrethrins-and-pyrethroids

Fernandez-Cornejo, J., Osteen, C., Nehring, R., & Wechsler, S. (2014). Pesticide Use Peaked in 1981, Then Trended Downward, Driven by Technological Innovations and Other Factors. Retrieved from https://www.ers.usda.gov/amber-waves/2014/june/pesticide-use-peaked-in-1981-then-trended-downward-driven-by-technological-innovations-and-other-factors/

Flocks, J., Monaghan, P., Albrecht, S., & Bahena, A. (2007). Florida Farmworkers' Perceptions and Lay Knowledge of Occupational Pesticides. *Journal of Community Health, 32*(3), 181-194. doi:10.1007/s10900-006-9040-6

Fults, J. (2017). How to Comply with the 2015 Revised Worker Protection Standard for Agricultural Pesticides: What Owners and Employers Need to Know. Retrieved from http://www.pesticideresources.org/wps/htc/htcmanual.pdf

Goldsmith, M. F. (1989). As Farmworkers Help Keep America Healthy, Illness May Be Their Harvest. *JAMA*, *261*(22), 3207-3213. doi:10.1001/jama.1989.03420220013002

Gomes, J., Lloyd, O. L., & Revitt, D. M. (1999). The influence of personal protection, environmental hygiene and exposure to pesticides on the health of immigrant farm workers in a desert country. *International Archives of Occupational and Environmental Health*, *72*(1), 40-45. doi:10.1007/s004200050332

Hernandez, T., & Gabbard, S. (2018). Findings from the National Agricultural Workers Survey (NAWS) 2015-2016: A Demographic and Employment Profile of United States Farmworkers. Retrieved from https://www.doleta.gov/naws/research/docs/NAWS_Research_Report_13.pdf

Herzfeld, T., & Jongeneel, R. (2008). Economics of compliance: a review of theories and an application to agriculture. *A Paper Presented at the IAMO Forum conference Germany 25-27, January, 2008.*

Hoffmann, T. (2018). The Federal Worker Protection Standard: A Primer on Its History and Implication of the 2015 Revisions. Retrieved from https://extension.wsu.edu/wam/the-federal-worker-protection-standard-a-primer-on-its-history-and-implication-of-the-2015-revisions/

Holdier, A. G. (2019). Farmworker Abuse and Agricultural Exceptionalism. Retrieved from https://www.prindlepost.org/2019/07/farmworker-abuse-and-agricultural-exceptionalism/

Hu, S. C., Lee, C. C., Shiao, J. S. C., & Guo, Y. L. (1998). Employers' awareness and compliance with occupational health and safety regulations in Taiwan. *Occupational Medicine*, *48*(1), 17-22. doi:10.1093/occmed/48.1.17

Idaho State Department of Agriculture. (2018). 2018 Idaho Agriculture Facts. Retrieved from https://agri.idaho.gov/main/wp-content/uploads/2018/02/IdahoAgStatsWEB.pdf

Idaho State Department of Agriculture. (2019). Pesticide Compliance Inspections. Retrieved from https://agri.idaho.gov/main/56-2/pesticides/enforcement/inspections-2/

Keifer, M. C. (2000). Effectiveness of interventions in reducing pesticide overexposure and poisonings. *American Journal of Preventive Medicine, 18*(4, Supplement 1), 80-89. doi:https://doi.org/10.1016/S0749-3797(00)00144-6

Kim, K.-H., Kabir, E., & Jahan, S. A. (2017). Exposure to pesticides and the associated human health effects. *Science of The Total Environment, 575*, 525-535. doi:https://doi.org/10.1016/j.scitotenv.2016.09.009

Kostka, K. (2019) *Former Pesticide Compliance Program Manager [Personal Communication]*. Idaho State Department of Agriculture.

Koutros, S., Alavanja, M. C. R., Lubin, J. H., Sandler, D. P., Hoppin, J. A., Lynch, C. F., . . . Freeman, L. E. B. (2010). An update of cancer incidence in the Agricultural Health Study. *Journal of occupational and environmental medicine, 52*(11), 1098-1105. doi:10.1097/JOM.0b013e3181f72b7c

Lastarria-Cornhiel, S. (2006, 01/01). Feminization of Agriculture: Trends and Driving Forces. Retrieved from https://www.researchgate.net/publication/237337003_Feminization_of_Agriculture_Trends_and_Driving_Forces

Lerro, C. C., Koutros, S., Andreotti, G., Sandler, D. P., Lynch, C. F., Louis, L. M., . . . Beane Freeman, L. E. (2019). Cancer incidence in the Agricultural Health Study after 20 years of follow-up. *Cancer Causes & Control, 30*(4), 311-322. doi:10.1007/s10552-019-01140-y

Levesque, D. L., Arif, A. A., & Shen, J. (2012a). Association between Workplace and Housing Conditions and Use of Pesticide Safety Practices and Personal Protective

Equipment among North Carolina Farmworkers in 2010. *The International Journal of Occupational and Environmental Medicine, 3*(2), 53-67.

Levesque, D. L., Arif, A. A., & Shen, J. (2012b). Effectiveness of Pesticide Safety Training and Knowledge About Pesticide Exposure Among Hispanic Farmworkers. *Journal of Occupational and Environmental Medicine, 54*(12), 1550-1556. doi:10.1097/JOM.0b013e3182677d96

Lincoln, E. (2018). Accountability for Pesticide Poisoning of Undocumented Farmworkers. *Hastings Enviornmental Law Journal, 24*(2).

Lorenz, E. (2017). Potential Health Effects of Pesticides. Retrieved from https://extension.psu.edu/potential-health-effects-of-pesticides

Marquez, E. (2018). In the US and the world, pesticide use is up. Retrieved from http://www.panna.org/blog/us-and-world-pesticide-use

Mayer, B., Flocks, J., & Monaghan, P. (2010). The role of employers and supervisors in promoting pesticide safety behavior among florida farmworkers. *American Journal of Industrial Medicine, 53*(8), 814-824. doi:10.1002/ajim.20826

McCauley, A. L., Shapiro, E. S., Scherer, A. J., & Lasarev, R. M. (2004). Assessing Pesticide Safety Knowledge Among Hispanic Migrant Farmworkers in Oregon. *Journal of Agricultural Safety and Health, 10*(3), 177-186. doi:https://doi.org/10.13031/2013.16474

Moeller, K. (2019). At least 20 Idahoans land in ER after toxic exposure. Did pesticides cause illness? *The Idaho Statesman*. Retrieved from https://www.idahostatesman.com/news/local/article230965033.html

National Agricultural Statistics Service. (2018). 2018 State Agriculture Overview: Idaho. Retrieved from https://www.nass.usda.gov/Quick_Stats/Ag_Overview/stateOverview.php?state=IDAHO

National Institute for Occupational Safety and Health. (2018). *National Agricutlural Workers Survey (NAWS) public-use data 1999,2002-2004-2008-2010 and 2014-2015*. Retrieved from https://www.doleta.gov/naws/research/data-tables/

National Institute for Occupational Safety and Health (NIOSH). (2019a). Acute Pesticide-Related Illnesses Charts. Retrieved from https://wwwn.cdc.gov/Niosh-whc/chart/sensor-pe?T=ZY&V=C&S=++&D=ALL&Y

National Institute for Occupational Safety and Health (NIOSH). (2019b). Agricultural Safety. Retrieved from https://www.cdc.gov/niosh/topics/aginjury/default.html

Nicolopoulou-Stamati, P., Maipas, S., Kotampasi, C., Stamatis, P., & Hens, L. (2016). Chemical Pesticides and Human Health: The Urgent Need for a New Concept in Agriculture. *Frontiers in Public Health, 4*. doi:10.3389/fpubh.2016.00148

Northwest Center for Occupational Health and Safety. (2019). Pilot Project Funding. Retrieved from https://deohs.washington.edu/nwcohs/research/pilot-funding

Parker, C. (2000). Reducing the Risk of Policy Failure: Challenges for Regulatory Compliance. Retrieved from http://www.oecd.org/regreform/regulatory-policy/1910833.pdf

Pesticide Educational Resources Collaborative. (2019). Definition: Labor Contractor. Retrieved from http://pesticideresources.org/wps/definitions/laborcontractor.html

Philpott, T. (2017). Drifting Pesticides Keep Making California Farm Workers Sick. *Mother Jones*. Retrieved from https://www.motherjones.com/food/2017/12/drifting-pesticides-keep-making-california-farm-workers-sick/

Pickup, W. (2018) *Chemigation Program Specialist [Personal Communication]*. Idaho State Department of Agriculture.

Ping, W., Cao, W., Tan, H., Guo, C., Dou, Z., & Yang, J. (2018). Health protective behavior scale: Development and psychometric evaluation. *PloS one, 13*(1), e0190390-e0190390. doi:10.1371/journal.pone.0190390

Robinson, E., Nguyen, H. T., Isom, S., Quandt, S. A., Grzywacz, J. G., Chen, H., & Arcury, T. A. (2011). Wages, wage violations, and pesticide safety experienced by migrant farmworkers in North Carolina. *New solutions : a journal of environmental and occupational health policy : NS, 21*(2), 251-268. doi:10.2190/NS.21.2.h

Salvatore, A. L., Bradman, A., Castorina, R., Camacho, J., López, J., Barr, D. B., . . . Eskenazi, B. (2008). Occupational behaviors and farmworkers' pesticide exposure: findings from a study in Monterey County, California. *American journal of industrial medicine, 51*(10), 782-794. doi:10.1002/ajim.20622

Sarwar, M. (2015). The dangers of pesticides associated with public health and preventing of the risks. *International Journal of Bioinformatics and Biomedical Engineering, 1*(2), 130-136.

Shipp, E. M., Cooper, S. P., Burau, K. D., & Bolin, J. N. (2005). Pesticide safety training and access to field sanitation among migrant farmworker mothers from Starr County, Texas. *Journal of agricultural safety and health, 11*(1), 51-60.

Strong, L. L., Thompson, B., Koepsell, T. D., Meischke, H., & Coronado, G. D. (2009). Reducing the take-home pathway of pesticide exposure: behavioral outcomes from the Para Niños Saludables study. *Journal of occupational and environmental medicine, 51*(8), 922-933. doi:10.1097/JOM.0b013e3181ad4995

Thundiyil, J. G., Stober, J., Besbelli, N., & Pronczuk, J. (2008). Acute pesticide poisoning: a proposed classification tool. *Bulletin of the World Health Organization, 86*(3), 205-209. doi:10.2471/blt.08.041814

Topa, G., & Zenou, Y. (2015). Neighborhood and Network Effects. *Handbook of Regional and Urban Economics, 5,* 561-624. doi:10.1016/B978-0-444-59517-1.00009-X

United States Department of Agriculture. (2019). Agriculture & Irrigation. Retrieved from https://digitalatlas.cose.isu.edu/geog/agirrig/agirtext/agigmain.htm

University of Idaho Extension. (2020). Indicators Idaho: Agricultural Workers. Retrieved from: http://indicatorsidaho.org/DrawRegion.aspx?RegionID=16000&IndicatorID=100050

Urias, L. (2019) *Worker Protection Program Specialist [Personal Communication]*. Idaho State Department of Agriculture.

US National Library of Medicine. (2019). Acute vs. Chronic Conditions. Retrieved from https://medlineplus.gov/ency/imagepages/18126.htm

Vela-Acosta, M. S., Bigelow, P., & Buchan, R. (2002). Assessment of occupational health and safety risks of farmworkers in Colorado. *American Journal of Industrial Medicine, 42*(S2), 19-27. doi:10.1002/ajim.10064

Walton, A. L., LePrevost, C. E., Linnan, L., Sanchez-Birkhead, A., & Mooney, K. (2017). Benefits, Facilitators, Barriers, and Strategies to Improve Pesticide Protective Behaviors: Insights from Farmworkers in North Carolina Tobacco Fields. *International Journal of Environmental Research and Public Health, 14*(7), 677. doi:10.3390/ijerph14070677

Wang, S. L., Nehring, R., & Mosheim, R. (2018). Agricultural Productivity Growth in the United States: 1948-2015. Retrieved from https://www.ers.usda.gov/amber-waves/2018/march/agricultural-productivity-growth-in-the-united-states-1948-2015/

Weintraub, R. (2000). Neoclassical Economics. In *The Concise Encyclopedia of Economics*. Retrieved from https://www.econlib.org/library/Enc1/NeoclassicalEconomics.html

Whiford, F., Pike, D., Hanger, G., Burroughs, F., Johnson, B., & Blessing, A. (2009). The Benefits of Pesticides, A Story Worth Telling. *Purdue Extensions.* Retrieved from https://www.extension.purdue.edu/extmedia/ppp/ppp-70.pdf

White, L. A. (1947). Culturological vs. Psychological Interpretations of Human Behavior. *American Sociological Review, 12*(6), 686-698. doi:10.2307/2086954

Zhang, L., Rana, I., Shaffer, R. M., Taioli, E., & Sheppard, L. (2019). Exposure to glyphosate-based herbicides and risk for non-Hodgkin lymphoma: A meta-analysis and supporting evidence. *Mutation Research/Reviews in Mutation Research, 781*, 186-206. doi:https://doi.org/10.1016/j.mrrev.2019.02.001

APPENDIX A

WPS ID # _____

ENTRY RESTRICTIONS (HTC 36-37, 41-44, 47-52)

YES	NO	N/A		
☐	☐	☐	1.	Are workers prohibited from an area under REI? (unless early-entry with no contact)
☐	☐	☐	2.	Do early-entry workers with contact but no hand labor activity remain in the treated area no more than 8 hours in a 24-hour period? (Irrigation tasks only)
☐	☐	☐	3.	If the pesticide requires DOUBLE NOTIFICATION, is there only 1 hour of work in a 24 hour period allowed in treated areas? (Irrigation tasks only)
☐	☐	☐	4.	Do early-entry workers with limited contact with treated surface remain in the treated area no more than 8 hours in a 24 hour period?

DECONTAMINATION SUPPLIES (HTC 24-25, 54-55)

☐	☐	☐	1.	Are handlers supplied with clean water, soap, single use towels, and clean coveralls?
☐	☐	☐	2.	Does the handler conducting pesticide mixing or loading activities have decontamination supplies immediately available at the mix/load area?
☐	☐	☐	3.	Are decontamination supplies provided within ¼ mile of the area to be treated for the duration of the handling activities?
☐	☐	☐	4.	Is at least 1 pint of eyeflush water immediately available to handlers and early-entry workers if label requires protective eyewear?
☐	☐	☐	5.	Are workers supplied with clean water, soap, and single use towels within ¼ of mile of area treated?
☐	☐	☐	6.	Are decontamination supplies provided for workers until 30 days following the expiration of the REI? **EXCEPTION:** Pesticides with a 4-hour REI require decontamination supplies for only 7 days.

EMERGENCY ASSISTANCE (HTC 27)

☐	☐	☐	1.	Is transportation made available to any employee who becomes sick or injured by pesticides?
☐	☐	☐	2.	Is pesticide information provided to the worker or handler, or medical personnel upon request?

PPE AND APPLICATION EQUIPMENT (HTC 56, 61, 62-65)

☐	☐	☐	1.	Is required PPE provided to handlers and early-entry workers?
☐	☐	☐	2.	Are handlers and early-entry workers instructed in the proper use of PPE?
☐	☐	☐	3.	Is PPE inspected before each day's use?
☐	☐	☐	4.	Are cleaning/maintenance requirements of PPE met?
☐	☐	☐	5.	Is a clean place provided for PPE storage?
☐	☐	☐	6.	Are appropriate measures taken to avoid heat-related illness?
☐	☐	☐	7.	Have those cleaning PPE received special instructions on laundering procedures?
☐	☐	☐	8.	Is equipment used for mixing, loading, and applying pesticides inspected and repaired before each day of use?
☐	☐	☐	9.	Have handlers been instructed in proper use of application equipment? **EXCEPTION:** Some of the label-required handler PPE may be omitted if using a closed system, enclosed Cab, or cockpit. **(HTC 66-67)**

INFORMATION EXCHANGE (HTC 26)

☐	☐	☐	1.	Has your professional applicator provided you with required information for your central location prior to application?
☐	☐	☐	2.	Have you provided information to the professional applicator about REI's in effect on your property?

NOTICE OF PESTICIDE APPLICATIONS (HTC 33-35, 59)

☐	☐	☐	1.	When required on the label, are both oral and posting warnings given?
☐	☐	☐	2.	Are oral warnings given clearly and in a language the worker understands?
☐	☐	☐	3.	If posting:
☐	☐	☐		a. Is the appropriate sign being used?
☐	☐	☐		b. Is the sign put up no more than 24 hours prior to application?
☐	☐	☐		c. Does the sign come down within 3 days after the end of the REI?
☐	☐	☐		d. Is the sign posted at normal worker points of entry to the treated area?

WPS ID # _____

YES	NO	N/A		
☐	☐	☐	4.	Are all greenhouse applications posted?
☐	☐	☐	5.	Are pesticides applied so that no one is contacted except appropriately trained and equipped handlers?
☐	☐	☐	6.	Is sight or voice contact made with handlers at least every 2 hours when using a pesticide with a skull and crossbones on its label?
☐	☐	☐	7.	Is constant visual or voice contact maintained when using a fumigant in a greenhouse?

EXCEPTIONS: Posting is not required under certain conditions. **(HTC 33)**

COMPLIANCE ASSISTANCE

YES	NO		
☐	☐	1.	Compliance assistance provided? If yes, describe what type of compliance assistance was provided.

COMMENTS: _____

For more information concerning this audit / inspection contact the Idaho State Department of Agriculture, Pesticide Safety Program: (208) 465-8478.

Grower/Employer Signature Date Inspector Signature Date

Copies: Original: Boise Canary: Inspector Pink: Grower/Employer

APPENDIX B

IDAHO STATE DEPARTMENT OF AGRICULTURE
WORKER PROTECTION PROGRAM

TIER I ☐ TIER II ☐

☐ Farm ☐ Nursery ☐ Forest ☐ Enclosed Space Production

Business	Time	Date	WPS ID #	County
Address		City	State ID	Zip
Person Interviewed	Lic. Number	Exp. Date	Telephone	Related Case #

☐ GROWER / EMPLOYER ☐ ESTABLISHMENT SUPERVISOR

TRAINING §170.401(d), 170.403(a)-(c), §170.501(d), §170.503(a)	YES	NO	N/A	C/A
1. Have current workers been trained in the last 12 months prior to performing hand labor activities in treated areas in the last 30 days	☐	☐	☐	☐
2. Have current handlers been trained in the last 12 months prior to performing pesticide handling activities	☐	☐	☐	☐
3. Are training records retained on establishment for 2 years?	☐	☐	☐	☐
a. Worker/handler printed name and signature	☐	☐	☐	☐
b. Date of training	☐	☐	☐	☐
c. Trainer's name and qualifications (Certified applicator of RUP's or Train-The-Trainer)	☐	☐	☐	☐
d. Name of the worker/handler employer	☐	☐	☐	☐
e. EPA-approved training materials	☐	☐	☐	☐
4. Are handlers informed of labeling requirements and have access to labels?	☐	☐	☐	☐
5. Do early-entry workers received required additional training?	☐	☐	☐	☐
6. Is training presented orally or audio visually and using a translator, if necessary?	☐	☐	☐	☐
7. Was the trainer present at all times during training to respond trainee's questions	☐	☐	☐	☐
8. Establishment-specific information provided	☐	☐	☐	☐
a. Pesticide safety information	☐	☐	☐	☐
b. Pesticide application and hazard information	☐	☐	☐	☐
c. Decontamination supplies	☐	☐	☐	☐

Comments:

CENTRAL LOCATION § 170.311(a)(3)(i)-(x)(5), 170.311(b)(1)-(5), §170.311(6)				
1. Is the central location information displayed when handlers or workers are on the agricultural establishment during an application or when an REI has been in effect in the last 30 days?	☐	☐	☐	☐
2. Does the pesticide information remain for 30 days after the application or after the REI expires?	☐	☐	☐	☐
3. Is the site easily accessible to workers and handlers?	☐	☐	☐	☐
4. Is the pesticide safety information (safety poster) displayed?	☐	☐	☐	☐
5. Are the name, address and phone number of the state/tribal pesticide agency displayed?	☐	☐	☐	☐
6. Are the name, address and phone number of an emergency medical facility displayed?	☐	☐	☐	☐
7. Date of last application:_____				
8. Pesticides applied:_____				
9. Were pesticide labels collected from this establishment?	☐	☐	☐	☐
10. Is pesticide information displayed for each application?	☐	☐	☐	☐
a. Name of pesticide applied	☐	☐	☐	☐
b. Active ingredient(s): Common or chemical name	☐	☐	☐	☐

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	YES	NO	N/A	C/A
c. EPA registration number	☐	☐	☐	☐
c. REI (restricted-entry interval)	☐	☐	☐	☐
d. Crop or site treated	☐	☐	☐	☐
e. Location and description of treated area(s)	☐	☐	☐	☐
f. Date(s) and times application started and ended	☐	☐	☐	☐
11. Are Safety Data Sheets (SDSs) for each pesticide available?	☐	☐	☐	☐
12. Are pesticide application and hazard information records retained on establishment for 2 years?	☐	☐	☐	☐
13. Are pesticide application records and SDSs available, upon request, to workers / handlers, personal representative, and medical personnel?	☐	☐	☐	☐
14. Is pesticide safety information displayed at any permanent decontamination site?	☐	☐	☐	☐
15. Is pesticide safety information displayed at a location where decontamination supplies are required in quantities for 11 or more workers?	☐	☐	☐	☐

Comments:

INFORMATION EXCHANGE §170.309(k), 170.313(i)(1)-(6) & (j)

1. Do you provide information to the professional applicator about location and description of areas treated or REIs and restrictions in effect on your property	☐	☐	☐	☐
2. Does your professional applicator provide you with the required information for your central location prior to application: location of areas treated, date & time of application, product name, EPA Reg. #, active ingredient, REI, oral and posting requirements and any other restrictions?	☐	☐	☐	☐

* If information changes, the agricultural employer must be provided with updated information **PRIOR** to the application when there are any changes to location to be treated, REI, method of application, labeling requirements to protect workers/other persons, or if the start time will be earlier than estimated.

Comments:

MINIMUM AGE FOR HANDLERS AND EARLY ENTRY WORKERS §170.309

1. Are Early-Entry Workers and pesticide handlers at least 18 years old?	☐	☐	☐	☐

EARLY - ENTRY RESTRICTIONS §170.605 (b)(c)(d)

1. Are any workers considered Early-Entry Workers?	☐	☐	☐	☐
2. Prior to early-entry, did the employer provide information on:				
a. Location of early-entry area where work is to be performed?	☐	☐	☐	☐
b. Pesticide applied?	☐	☐	☐	☐
c. Dates and times the REI begins and ends?	☐	☐	☐	☐
d. Amount of time workers are allowed in the treated area?	☐	☐	☐	☐
e. PPE required by the label for early-entry?	☐	☐	☐	☐
f. Location of pesticide safety information and decontamination supplies?	☐	☐	☐	☐
3. Prior to early-entry, did the employer ensure each early entry worker is provided with the required PPE?	☐	☐	☐	☐

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	YES	NO	N/A	C/A
4. Prior to early-entry, are measures taken to prevent heat-related illness and workers are instructed in prevention, recognition, and first aid treatment of heat-related illness?	☐	☐	☐	☐
5. Are decontamination supplies located outside any treated area or area under REI?	☐	☐	☐	☐
6. Are decontamination supplies located where workers removes PPE?	☐	☐	☐	☐
7. Are the appropriate decontamination supplies provided? (3 gallons of water for each early-entry worker, soap and single use towel)	☐	☐	☐	☐
8. Does each Early-Entry Worker have at least one pint of water immediately available for eye flushing in a portable container when pesticide label requires eye protection?	☐	☐	☐	☐

Comments:

DECONTAMINATION SUPPLIES §170.411(d)(b)(c) & §170.509(b)(c)(1)(d)(1)(2)

1. Are decontamination supplies for agricultural workers located within ¼ mile of the work site or nearest site of vehicular access and outside a pesticide treated area under an REI?	☐	☐	☐	☐
2. Are the appropriate decontamination supplies provided including 1 gallon of water for each worker at the beginning of the day, soap, and single-use towels? **If REI is = or < 4 hours = 7 days / If REI is > 4 hours = 30 days**	☐	☐	☐	☐
3. Are decontamination supplies for pesticide handlers located at the mixing/loading site?	☐	☐	☐	☐
4. For all other handler tasks, are decontamination supplies located within ¼ mile from handler or nearest place of vehicular access?	☐	☐	☐	☐
5. Are the appropriate decontamination supplies provided, including 3 gallons of water for each handler at the beginning of the day, soap, single use towels, and a change of clothes?	☐	☐	☐	☐
6. At each mixing/loading site for products requiring eye protection or using a closed system under pressure is there an appropriate eyewash system immediately available to the handler?	☐	☐	☐	☐
7. Does each applicator have at least 1 pint of water immediately available in a portable container when pesticide label requires eye protection?	☐	☐	☐	☐

Comments:

EMERGENCY ASSISTANCE §170.309(f)(1)-(2)(i)-(iii)

1. Is transportation made available to worker/handler from the agricultural establishment (including any worker/handler housing area on the establishment) to a medical care facility?	☐	☐	☐	☐
2. Is pesticide information provided to the worker, handler, or medical personnel upon request?	☐	☐	☐	☐

Comments:

PERSONAL PROTECTIVE EQUIPMENT §170.507(a), §170.507(b), §170.507(c), §170.507(d), 170.507(b)(10)

1. Is label-required PPE provided to pesticide handlers clean and operational?	☐	☐	☐	☐
2. Does the employer ensure that pesticide handlers wear and use PPE correctly, and before each day of use PPE is inspected, repaired, or discarded as appropriate?	☐	☐	☐	☐
3. Are cleaning/maintenance requirements of PPE met?	☐	☐	☐	☐
4. Is a clean place provided for PPE storage and separately from personal clothing and contaminated areas?	☐	☐	☐	☐

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5. Are appropriate measures taken to avoid heat-related illness?	☐	☐	☐	☐
6. Have those cleaning PPE received special instructions on laundering procedures?	☐	☐	☐	☐
7. If the label requires respirator use, did handlers receive medical clearance, fit testing, and training?	☐	☐	☐	☐
8. If using particulate-filtering face piece respirators, are they replaced appropriately?	☐	☐	☐	☐
9. If using vapor-removing canister/cartridge respirators, are they replaced appropriately?	☐	☐	☐	☐
10. Are respirator safety records kept on the establishment for 2 years?	☐	☐	☐	☐

EXCEPTION: Some of the label-required handler PPE may be omitted if using a closed system, enclosed cab, or cockpit.

Comments:

KNOWLEDGE OF LABELING, APPLICATION & ESTABLISHMENT-SPECIFIC INFORMATION

1. Before a handler performs any handler activity, does the handler's employer ensure the handler read applicable label information on the safe use of pesticides or was informed in a manner the handler can understands?	☐	☐	☐	☐
2. Do handlers have access to the labeling at all times, and made aware of any entry restrictions, AEZ, and REIs?	☐	☐	☐	☐

Comments:

PESTICIDE HANDLING EQUIPMENT §170.309(i)(j)

1. Is equipment used for mixing, loading, and applying pesticides inspected and repaired before each day of use?	☐	☐	☐	☐
2. Have handlers been instructed in the proper use of application equipment?	☐	☐	☐	☐
3. Has any person employed by the agricultural establishment, who cleans, repairs, or adjust the pesticide equipment been trained as a pesticide handler?	☐	☐	☐	☐

Comments:

APPLICATION, ENTRY RESTRICTIONS & HANDLER PROTECTION §170.405 & 170.505

1. Does the handler suspend an application if someone is in the AEZ?	☐	☐	☐	☐
2. Are pesticides applied in a manner as to prevent anyone other than appropriately trained and equipped handlers from coming into contact either directly or through drift?	☐	☐	☐	☐
3. Is sight or voice contact made with handlers at least every 2 hours when using a pesticide with a Skull and Crossbones on its label?	☐	☐	☐	☐
4. Is constant visual or voice contact maintained with another handler equipped with PPE to be used in case a rescue is required in an enclosed space when using a fumigant?	☐	☐	☐	☐

Comments:

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	YES	NO	N/A	C/A
NOTIFICATION, ENTRY RESTRICTIONS & POSTING §170.407, §170.409				
1. After the application of any pesticide to an outdoor production area, does the employer not allow any worker to enter or remain in the treated area before the REI has expired and all warning signs have been removed or covered? (except for permitted early-entry activities)	☐	☐	☐	☐
2. After the application of any pesticide to an area of enclosed space production, does the employer not allow any worker to enter or remain in the area before the REI has expired and all warning signs have been removed or covered? (except for permitted early-entry activities)	☐	☐	☐	☐
3. When required on the label, are both oral and posting warnings given? (Highly Toxic)	☐	☐	☐	☐
4. For any outdoor production area applications with an REI of 48 hours or less, are either oral notification or posted warning signs used?	☐	☐	☐	☐
5. For any outdoor production area applications with REI greater than 48 hours are posted warning signs used?	☐	☐	☐	☐
a. Do signs meet the size and content requirements?	☐	☐	☐	☐
b. Are signs posted in adequate locations?	☐	☐	☐	☐
c. Are signs posted before the application, but no sooner than 24 hours before?	☐	☐	☐	☐
d. Do signs remain posted until the REI expires?	☐	☐	☐	☐
e. Are signs removed within 3 days of expiration of REI?	☐	☐	☐	☐
6. For any enclosed space production area applications with an REI greater than 4 hours are posted warning signs used?	☐	☐	☐	☐
a. Do signs meet the size and content requirements?	☐	☐	☐	☐
b. Are signs posted in adequate locations?	☐	☐	☐	☐
c. Are signs posted before the application, but no sooner than 24 hours before?	☐	☐	☐	☐
d. Do signs remain posted until the REI expires?	☐	☐	☐	☐
e. Are signs removed within 3 days of expiration of the REI?	☐	☐	☐	☐
7. For any enclosed space production area applications with REI of 4 hours or less, are either oral notification or posted signs used? If oral notification:	☐	☐	☐	☐
a. Does the notification include location, dates and times of the restriction?	☐	☐	☐	☐
b. Does the notification include instructions about the restriction in a manner that is understandable to the workers?	☐	☐	☐	☐
c. Is the notification provided before the application or at the time a worker begins their work period?	☐	☐	☐	☐

Comments:

Latitude: Longitude:

For more information concerning this audit / inspection contact the Idaho State Department of Agriculture, Worker Protection Program: (208) 332-8605.

Grower Signature Date Inspector Signature Date

Form WPP5 – 3/19