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To cite this article: Victor A. Soupene, Carri Casteel, Matthew Nonnenmann & Diane S. Rohlman (2022): Safety Measures, Pesticide Concerns and Resources Utilized among Young Adult Workers: A Brief Report, Journal of Agromedicine, DOI: [10.1080/1059924X.2022.2155748](https://doi.org/10.1080/1059924X.2022.2155748)

To link to this article: <https://doi.org/10.1080/1059924X.2022.2155748>



Published online: 07 Dec 2022.



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BRIEF REPORT



## Safety Measures, Pesticide Concerns and Resources Utilized among Young Adult Workers: A Brief Report

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### ABSTRACT

**Introduction:** Resources on pesticide information are widely available; however, little is known about the concerns young agricultural workers have about pesticides, whether they use existing resources to find information about pesticides, and how these resources influence safety behaviors such as personal protective equipment (PPE) use.

**Objectives:** To examine demographic characteristics, safety measures, concerns about pesticide use and resources for pesticide information.

**Methods:** Young agricultural workers were recruited through three collegiate agricultural programs and completed an online questionnaire related to pesticide safety and use.

**Results:** Most participants who applied pesticides reported *always* wearing gloves (60.5%), using a tractor with an enclosed cab (68.4%), and *always* wearing long pants (76.3%). Among all participants, pesticide drift to crops (65.1%) and water contamination (62.3%) were the biggest concerns among young agricultural workers. The internet was the most utilized source to locate information about pesticides (76.4%), with the most common internet resources being online materials from universities or colleges (71.6%), the government (69.1%), or pesticide companies (66.7%). Accessibility (90.6%) and speed (78.3%) were the most common reasons for using the internet for information. Misinformation was the most common barrier (80.2%).

**Conclusions:** Future studies should examine the accuracy and accessibility of pesticide information available on the internet since young adult workers rely on these resources for pesticide information.

### KEYWORDS

Pesticide information; young adult workers; agriculture; pesticides; internet

## Introduction

Pesticides are widely used for agriculture in the United States to limit pest damage, increase crop yield, and to promote food security.<sup>1,2</sup> While pesticides have many benefits to agriculture, adverse health effects including acute poisonings and cancer are associated with pesticide exposure.<sup>2–8</sup>

Young adult workers (i.e., under the age of 25 years) represent approximately 12% of the workforce in the United States but have disproportionately higher rates of occupational injuries, particularly those working in agriculture.<sup>9–14</sup> Young adult workers are seven times more likely to have a fatal injury in agriculture compared to young adult workers in other industries.<sup>11</sup> In Iowa, where pesticides are heavily applied to corn and soybeans, workers between the ages of 20 and 29 accounted for almost a third of all pesticide poisoning cases.<sup>4</sup> Although this is mostly disinfectants, agrochemicals make up the second largest group.<sup>4</sup>

Research also suggests that young agricultural workers in Iowa are concerned about pesticides.<sup>15</sup> However, it is not clear what safety practices young adult workers use to protect themselves, what aspects of pesticides they are concerned about or which resources they use to find information about the risks associated with pesticides. The goal of this study was to examine pesticide safety measures, concerns related to pesticide use and resources utilized among young adult workers to mitigate health risks.

## Methods

Participants were recruited through agricultural programs at two community colleges and one university in Iowa during the Spring 2021 semester. Participants between the ages of 18 and 29 with any farming experience in the midwestern United States were recruited. Faculty at each institution

distributed flyers and/or sent a recruitment email to agricultural science students at their institution that described the purpose of the study and provided a link to an online questionnaire.

The online questionnaire included items addressing demographics, experience in pesticide application, pesticide safety practices used, concerns about pesticide application, and sources of information used to obtain information about pesticides. Participants were given a list of sources and asked to select all that apply (e.g., internet, university or college, pesticide dealer, friend). Those who selected the internet as a resource were asked additional questions about how often they used the internet to search for information about pesticides (always, some of the time, never), what types of online sites or sources they used (e.g., university, government) and any facilitators or barriers to using the internet to obtain information about pesticides. The internet is frequently used by young adults to look up information in general;<sup>16–19</sup> however, little is known about how they use online resources to find information about pesticides. Participants completing the questionnaire were compensated \$10 for their time.

Descriptive statistics were used to summarize demographic characteristics, safety measures, concerns about pesticide use and resources for pesticide information. This study was determined human subjects research and approved by the University of Iowa Institutional Review Board (IRB Number 202008345).

## Results

### Demographic characteristics

Of the 115 participants who started the questionnaire, 106 completed the entire questionnaire and were included in the analysis (92.2% completion rate). Ages ranged from 18–25 with an average age of 19.5 years (range = 18–22 years) among those who apply pesticides and 19.0 (range = 18–25 years) among non-applicators. More than half of the participants were male (59.5%). Farming experience averaged 7.2 years and ranged from 0.1 to 20 years. Most participants were recruited through community colleges (86.8%).

### Pesticide application

Among the 106 participants, 38 (35.8%) had experience applying pesticides and had applied them for an average of 2.9 years (range = 1–10 years) (Table 1). Participants who had applied pesticides were mostly male (84.2%) (data not shown), applied to corn (86.8%) and/or soybean (84.2%) crops, and had applied pesticides two or more times in the past year (65.8%). When asked about safety behaviors related to pesticide use (Table 2), many applicators reported *always* wearing gloves (60.5%), using an enclosed cab on the tractor (68.4%), and wearing long pants (76.3%). On the other hand, 45% reported *never* wearing a respirator, and 53% reported *never* wearing a protective suit. When asked about other protective equipment, responses included

**Table 1.** Pesticide application practices among pesticide applicators (n = 38).

Which crops have you applied pesticides to? (n*, %)	(n, %)
Corn	33 (86.8%)
Soybeans	32 (84.2%)
Fruit	2 (5.2%)
Vegetables	3 (7.9%)
Other	7 (18.4%)
During the past year, how often did you apply pesticides? (n, %)	
Three times or more	13 (34.2%)
Twice	12 (31.6%)
Once	9 (23.7%)
Never	4 (10.5%)
Have you ever received training on pesticide safety? (n, %)	
Yes	29 (76.3%)
No	9 (23.7%)
How many years have you been applying pesticides in an agricultural setting? (mean, range)	2.9 (1–10)

\*Distribution does not add to 100% because participants were permitted to check more than one option.

**Table 2.** Number (and percentage) of applicators who use personal protective equipment (PPE) and other methods to control exposure to pesticides (n = 38).

Safety Measures	(n, %)		
	Always	Some of the Time	Never
Long Pants	29 (76.3%)	8 (21.1%)	1 (2.6%)
Enclosed Cab on Tractor	26 (68.4%)	8 (21.8%)	4 (10.5%)
Glove Use	23 (60.5%)	12 (31.6%)	3 (7.9%)
Long Sleeves	15 (39.5%)	16 (42.1%)	7 (18.4%)
Goggle Use	14 (36.8%)	17 (44.7%)	7 (18.4%)
Protective Suit	8 (21.1%)	10 (26.3%)	20 (52.6%)
Respirator Use	7 (18.4%)	14 (36.8%)	17 (44.7%)
Other Protective Equipment	8 (21.1%)	6 (15.8%)	24 (63.2%)
Read the Pesticide Label? <sup>1</sup>	17 (44.7%)	20 (52.6%)	1 (2.6%)

<sup>1</sup>Only one participant claimed they never read the pesticide label.

wearing hats, close-toed shoes, or safety glasses, and washing themselves after applying. One participant reported not wearing any protection. Less than half (44.7%) of applicators *always* read the pesticide label which includes health risks and safety measures.

## Concerns about pesticides

All participants were asked about their pesticide-related concerns (Table 3). The top two concerns were pesticide drift to crops (65.1%) and water contamination (62.3%). A larger percentage of study participants were more concerned about long-term health outcomes (e.g., cancer) (43.4%) compared to short-term health outcomes (e.g., acute pesticide poisonings) (29.2%). Only three participants indicated they were not concerned about pesticide-related issues. A larger percentage of non-applicators (i.e., 66.2%) were concerned about water contamination and pesticide exposure to young children, while a larger percentage of applicators were concerned about pesticide drift to crops (63.2%) and pesticide resistance (55.3%).

## Information resources about pesticides

Most participants reported using the internet to find information about pesticides (76.4%, n = 81) with only four participants reporting that they do not look for information on pesticides (Table 3). Less than 15% of all participants used social media, non-governmental organizations (NGOs), or news

**Table 3.** Number and percentage of pesticide-related concerns identified, and resources used to find information on pesticides by all participants, applicators, and non-applicators.

	(n, %)*		
	Total (n = 106)	Applicators (n = 38)	Non-Applicators (n = 68)
<b>Areas of Concern</b>			
Pesticide Drift to Crops	69 (65.1%)	24 (63.2%)	45 (66.2%)
Water Contamination	66 (62.3%)	18 (47.4%)	48 (70.6%)
Long-term Health Outcomes	46 (43.4%)	15 (39.5%)	31 (45.6%)
Pesticide Resistance	46 (43.4%)	21 (55.3%)	25 (36.8%)
Environmental Concerns	43 (40.6%)	15 (39.5%)	28 (41.2%)
Exposure to Young Children	38 (35.8%)	9 (23.7%)	29 (42.6%)
Pesticide Drift to Homes	36 (34%)	10 (26.3%)	26 (38.2%)
Effectiveness in Eliminating Pests	35 (33%)	15 (39.5%)	20 (29.4%)
Short-term Health Outcomes	31 (29.2%)	12 (31.6%)	19 (27.9%)
Food Contamination	31 (29.2%)	8 (21.1%)	23 (33.8%)
Exposure to Pregnant Women	24 (22.6%)	9 (23.7%)	15 (22.1%)
I am not concerned about Pesticide-related Issues	3 (2.8%)	2 (5.3%)	1 (1.5%)
<b>Resources</b>			
Internet	81 (76.4%)	28 (73.7%)	53 (77.9%)
University/College	62 (58.5%)	16 (42.1%)	46 (67.6%)
Pesticide Dealer/Elevator	56 (52.8%)	28 (73.7%)	28 (41.2%)
Friend or Family Member	47 (44.3%)	14 (36.8%)	33 (48.5%)
4-H/FFA	29 (27.4%)	6 (15.8%)	23 (33.8%)
Agricultural Extension Office	28 (26.4%)	13 (34.2%)	15 (22.1%)
Pesticide Label	3 (2.8%)	3 (7.9%)	0
I have not looked for information on pesticides.	4 (3.8%)	1 (2.6%)	3 (4.4%)

\*Distribution does not add to 100% because participants were permitted to check more than one option.

media outlets. In addition to using online resources, participants also sought information about pesticides from non-online sources including universities or colleges (58.5%), pesticide dealers (52.8%), and/or a friend or family member (44.3%). Around a quarter of the participants used 4-H or Future Farmers of America (FFA) and/or the agricultural extension office.

Among internet users, over half used the internet to find general pesticide information *some of the time* (60.5%) (data not shown). The online sites they primarily reported using included university or college websites, government websites such as the Environmental Protection Agency (EPA), and/or pesticide dealer's websites (Table 4). A larger percentage of applicators referred to pesticide companies (85.7%) rather than universities/colleges (53.6%) or government (60.7%) sites. Among all participants, the top three reasons for using the internet to obtain information about pesticides included accessibility (90.6%), speed (78.3%), and technological possibilities (e.g., photos, videos; 46.2%). Misinformation was reported as the largest barrier for not using the internet (80.2%), followed by preference for traditional media (36.8%).

## Discussion

Safety practices frequently utilized by young adult workers who apply pesticides included glove use, wearing long sleeves, wearing long pants, reading the pesticide label, and using a tractor with an enclosed cab. In contrast, study participants were less likely to wear respirators and protective suits for applying pesticides. However, this finding does not necessarily suggest that young agricultural workers are being "less safe" and may be that the pesticides being applied, and the methods used to apply them, may not recommend the use of these PPE items.<sup>20</sup>

Pesticide drift to crops was the most reported concern among all participants. This finding could be due to the significant increase in pesticide drift cases in Iowa during recent years. According to a 2020 Iowa Department of Agriculture and Land Stewardship (IDALS) report on pesticide drift cases in Iowa, agriculture-related pesticide misuse cases (i.e., drift cases) increased from 89 to 295 between 2012 and 2020.<sup>21</sup> This finding may also suggest that young agricultural workers have concerns about the impact of pesticides on their health, farming operation or the environment.

**Table 4.** Type of online sources utilized for information on pesticides and reasons and barriers for using online sources by all participants, applicators, and non-applicators.

Online Sources	(n, %)*		
	Total (n = 81)	Applicators (n = 28)	Non-Applicators (n = 53)
University/College	58 (71.6%)	15 (53.6%)	43 (81.1%)
Government (e.g., EPA)	56 (69.1%)	17 (60.7%)	39 (73.6%)
Pesticide Company (e.g., Bayer CropScience)	54 (66.7%)	24 (85.7%)	30 (56.6%)
Social Media (e.g., Facebook)	11 (13.6%)	3 (10.7%)	8 (15.1%)
Non-Governmental Organization (e.g., Practical Farmers of Iowa)	7 (8.6%)	3 (10.7%)	4 (7.5%)
News Media Outlets (e.g., CNN)	7 (8.6%)	3 (10.7%)	4 (7.5%)
Motives	(n, %)*		
	Total (n = 106)	Applicators (n = 38)	Non-Applicators (n = 68)
Accessibility	96 (90.6%)	34 (89.5%)	62 (91.2%)
Speed	83 (78.3%)	29 (76.3%)	54 (79.4%)
Technological possibilities (e.g., photos, videos)	49 (46.2%)	15 (39.5%)	34 (50%)
Social interaction	14 (13.2%)	5 (13.2%)	9 (13.2%)
I do not use the internet	2 (1.9%)	2 (5.3%)	0
Barriers	(n, %)*		
	Total (n = 106)	Applicators (n = 38)	Non-Applicators (n = 68)
Misinformation	85 (80.2%)	28 (73.7%)	57 (83.8%)
Competition of traditional media	39 (36.8%)	14 (36.8%)	25 (36.8%)
Time-consuming	24 (22.6%)	12 (31.6%)	12 (17.6%)
Accessibility	17 (16%)	9 (23.7%)	8 (11.8%)
Speed	9 (8.5%)	4 (10.5%)	5 (7.4%)
Other	2 (1.9%)	1 (2.6%)	1 (1.5%)
I do not use the internet	1 (0.9%)	1 (2.6%)	0

\*Distribution does not add to 100% because participants were permitted to check more than one option.

Young adult workers primarily used the internet to get information about pesticides. This finding differed slightly from a previous survey which had the internet as the third most used resource for health and safety hazards, followed by community college and 4-H/Future Farmers of America (FFA),<sup>15</sup> but consistent with general trends of young people using the internet to find information.<sup>17</sup> We found that those who apply pesticides also utilized pesticide dealers and non-applicators used universities/colleges to find pesticide information, suggesting that the accuracy and validity of pesticide information needs to be consistent across multiple sources.

Motives and barriers for using the internet or internet-based applications such as social media for pesticide information were similar to findings from previous studies.<sup>18,19</sup> Speed and accessibility were the primary benefits identified in our study for using the internet for information. While this is the first study to examine misinformation of pesticides in the public health literature that we are aware of, other studies of the general population have described misinformation on the internet as a rising problem, including misinformation and quality of information related to COVID-19.<sup>22</sup> Ensuring that online resources include citations from reliable sources is one way to ensure that agricultural workers have access to accurate information.<sup>23</sup>

### Limitations

There were limitations in this study. Survey recruitment targeted individuals who attended agricultural science programs at college institutions in Iowa as a convenience sample. Therefore, these results may not be generalizable to all young agricultural workers in the midwestern United States. The survey instrument did not capture the types of pesticides applied and therefore could not link concerns and safety practices with specific pesticides used.

### Conclusions

The goal of this study was to understand safety measures, pesticide-related concerns, and resources young agricultural workers use to find

information about pesticides. Developing trustworthy and credible online resources may be a way to promote pesticide safety behaviors among young agricultural workers. Future studies should focus on identifying the most appropriate practices for distributing safety and health information that increase adoption of pesticide safety behaviors among young adult workers.

### Acknowledgments

We would like to thank Marsha Cheyney for her assistance in developing the survey questions and Dr. Jonathan Davis who helped with developing the methods for analyzing the survey data. We would also like to thank the collegiate institutions involved for helping recruit participants for this study.

### Disclosure statement

No potential conflict of interest was reported by the author(s).

### Funding

Fellowship support was provided by the Heartland Center for Occupational Health and Safety at the University of Iowa through Training Grant No. T42OH008491, Centers for Disease Control and Prevention/National Institute for Occupational Health and Safety. Funding was also provided by the University of Iowa College of Public Health through the Advancing Graduate Student Success Award to assist in compensating study participants. Study team members were also supported through funds from the University of Iowa Injury Prevention Research Center (Grant No. CE003095) and the Great Plains Center for Agricultural Health (Grant No. U54OH007548).

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