Journal of Amish and Plain Anabaptist Studies

Volume 9
Issue 2 *Special Issue: Agriculture, the Environment, and Plain People*

Article 6

2021

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Recommended Citation

Laborde, Luke, Jeffrey Stoltzfus, and Kaila Thorn. 2021. "Farm Food Safety Training for Amish Produce Growers Covered under the Food Safety Modernization Act (FSMA)." *Journal of Amish and Plain Anabaptist Studies* 9(2):151-64.

Farm Food Safety Training for Amish Produce Growers Covered under the Food Safety Modernization Act (FSMA)

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Abstract: Commercial production of fruits and vegetables on Amish farms provides significant amounts of fresh produce that are regionally distributed through wholesale markets. In response to several multi-state foodborne disease outbreaks linked to contamination of fresh produce, the U.S. Food and Drug Administration (FDA) mandated farm food safety standards that most commercial produce growers must implement. Although there have been no foodborne disease outbreaks attributed to fresh produce grown on Amish farms, this regulation poses regulatory challenges for those who sell produce at wholesale produce auctions, cooperatives, and distribution warehouses. This article describes recent farm food safety standards issued by the U.S. Food and Drug Administration (FDA) that require most harvesters and handlers of commercially grown fresh produce to attend workshops on the elements of the regulation and best practices to prevent on-farm contamination. We describe the current FDA-approved computer-based Produce Safety Alliance (PSA) national farm food safety curriculum and how Penn State Extension, working with PSA and a regional Amish food safety advisory group, created an alternative printed version of the curriculum that would be acceptable to all Amish growers regardless of restrictions on the use of learning technologies to present materials. We also present data that suggests the two curriculum delivery methods are equivalent in terms of knowledge gained by comparing pre- and post-workshop survey results. [Abstract by authors.]

Keywords: wholesale produce; produce auctions; Pennsylvania State University Extension; federal food safety standards; communications technology; educational outreach

Acknowledgements: This work was supported by the Food Safety Outreach Program [grant no. 2016-70020-25798/project accession no. 1010626] from the USDA National Institute of Food and Agriculture.

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Recommended citation: Laborde, Luke, Jeffrey Stoltzfus, and Kaila Thorn. 2021. "Farm Food Safety Training for Amish Produce Growers Covered under the Food Safety Modernization Act (FSMA)." *Journal of Amish and Plain Anabaptist Studies* 9(2):151-64.
Publication type: Original research article (peer reviewed), open access (may be freely distributed). *JAPAS* is published by the Amish & Plain Anabaptist Studies Association (http://amishstudies.org) and the University of Akron.

INTRODUCTION

Agriculture has historically been the primary economic activity of the Amish (Reschly 2000; Kraybill 2010). Rapid Amish population growth, declining commodity prices, and reductions in affordable farmland have led many to supplement their income with non-agricultural activities such as construction, furniture and cabinet making, and machine shop work (Cross 2018). Yet fruit and vegetable production has remained an essential source of income for many smaller scale Amish farms. The contribution of Amish farms to the total supply of fresh produce is not well documented and is often overlooked when compared to the larger acreage commodity growers in the southern and western United States. Amish preference for marketing their crops at centralized produce auctions provides them with a consistent supply of wholesale buyers who resell to regional restaurants, distributors, and processors (Reid, Simmonds, and Newbold 2018). However, in contrast to direct sales at farm stands or farmers markets, wholesale marketing at produce auctions exposes the Amish to commercial buyers and, more recently, government mandates for evidence that the Amish growers are meeting food safety standards.

EVOLUTION OF FARM FOOD SAFETY STANDARDS

Federal health agencies have estimated that each year contaminated food accounts for 48 million illnesses, 128,000 hospitalizations, and 3,000 deaths (CDC 2018). It has been further estimated that nearly half of the cases of foodborne illness can be traced back to fruits and vegetables, many of which are not cooked or otherwise treated to reduce microbial levels (Painter, et al. 2013).

Throughout the last two decades, agricultural industry groups and government agencies have responded by establishing voluntary guidelines for prevention of on-farm contamination of produce with harmful microbes contained in irrigation water, in soil and soil supplements, and from harvesters and handlers who do not follow adequate hygiene practices (FDA 2021; UFPA 2021). Larger wholesale buyers, including food service and grocery store chains, have adapted these standards to develop commodity specific inspection criteria that they require growers to comply with as a condition of sale. Working as an intermediary between growers and buyers, Extension programs throughout the nation have expanded their food safety trainings to include fruit, vegetable, and mushroom growers.

Despite these efforts, foodborne outbreaks linked to produce such as leafy greens, melons, tomatoes, and sprouted seeds continued to occur. This prompted the FDA in 2015 to write mandatory farm food safety standards in "Standards for the Growing, Harvesting, Packing, and Holding of Produce for Human Consumption" (FR 2015) under the 2011 U.S. Food Safety Modernization Act (FSMA) (P.L. 111-353). The Produce Safety Rule, as it is commonly known, established for the first-time nationwide farm food safety standards for safe production of fresh produce. Key components of the regulation focus around practices to prevent contamination from crop-contact agricultural water, raw and composted animal manure, domestic and wild animals, workers who handle produce, as well as lapses in pre- and post-harvest sanitation protocols (LaBorde 2018).

The Produce Safety Rule further requires all farm personnel who harvest or handle fresh produce to receive training on the importance of maintaining health and personal hygiene practices in addition to any other standards within the regulation that apply to their job responsibilities. At least one supervisor or responsible person must have completed food safety training that is at least equivalent to that received under a standardized curriculum recognized by the FDA. The regulation further states that on-farm training must be conducted upon hiring and at least annually thereafter and must be presented in a manner that is easily understood by all workers.

Not all produce growers are affected by the regulation, which only applies to commercial production of fruits and vegetables likely to be eaten raw. Only crops grown on farms with annual produce sales greater than $25,000 (in 2011 dollars) are covered, meaning they are required under federal law to comply with the regulation. However, covered farms with annual food sales between $25,000 and $500,000 are subject to less stringent requirements. In a survey of Amish and Mennonite produce growers in Ohio, Bergefurd (2011; 2021) reported that among the 141 respondents, 16% reported gross farms sales of $1,000

to $9,999, 56% of $10,000 to $49,999, and 21% from $50,000 to $99,000. Only 5% claimed sales greater than $100,000. Despite the smaller sales numbers for Amish farms, wholesale produce buyers and distributors are cautious of the impact that a food recall or outbreak could have on their businesses and are increasingly requiring evidence from all of their produce suppliers, regardless of total sales or acreage, that they meet new federal food safety standards as a condition of purchase (Tobin, et al. 2011).

Potential Farm Food Safety Impacts on Amish Produce Growers

There are significant costs involved in complying with farm food safety standards, not only from investments for new equipment and facilities, but also dedication of time for training, plan development, and record keeping (Ribera, et al. 2012). A concern among Amish growers was that their smaller sized farms would disproportionally be affected by the regulation and thus excluded from wholesale market channels (Hatanaka, et al. 2005; Eggers, et al. 2010). They also have been aware of concerns among some buyers that Amish field practices such as the common use of work animals in fields, application of raw manure to soil, and in some instances, the use of sharp pins instead of buttons to fasten clothes could be in conflict with farm food safety standards.

The Amish were actively involved in monitoring and providing input to the FDA as the Produce Safety Rule was being written. Their interests were represented by the Amish Food Safety Education Team (FSET), a group of nine "plain" produce industry leaders in Ohio, Kentucky, Indiana, Missouri, Wisconsin, and Pennsylvania, as well as one non-Amish representative, Jeff Stoltzfus, a Penn State Extension farm food safety educator in Lancaster County, PA, and co-investigator on this project. The FSET has provided valuable information to their constituents on how to comply with farm food safety standards. They have written articles for Amish newsletters such as *Truck Patch News* and created booklets and worksheets including *Farm Food Safety Plan* and *Farmer's Friend Record Book*. During listening sessions with the FDA, the FSET expressed a desire for a farm food safety curriculum for and about plain growers that is relevant to their farming methods thus helping them to maintain produce sales as an important source of income in their communities (Yoder 2011). Since the roll out of the regulations, the group has continued to serve as a conduit between the FDA and Amish growers to answer their questions on the final rule and to seek clarity from the FDA on issues that affect Amish growers.

Approaches for Successfully Training Amish Growers

Food safety training is most effective when cultural, economic, and social factors of the audience are considered (Nieto-Montenegro, et al. 2004). Traditional Extension teaching approaches for achieving program success may therefore need to be modified so that important differences in current knowledge, scale of operation, preferred learning methods, and cultural factors that limit access to training are considered (Parker, et al. 2012a; 2012b). Educators need to become aware and respect the values and norms of Amish produce growers such as the mannerisms and appearance of instructors. Yost, et al. (2005) reported the importance of knowing preferred manners of communication and familiarity with other issues such as wearing appropriate dress during training. Including members of the community who can share practical experience in implementing farm food safety practices adds greatly to educator facilitated discussions (Parker, et al. 2016).

According to Stoltzfus (2019), building relationships with Amish communities can be achieved by regularly meeting with growers at their markets or farms. Once trusted relationships are established, Amish growers become more receptive to training and are eager to learn practical solutions to issues most important to them. Bergefurd (2011; 2021) further stated that the educational background of Amish growers should be considered when developing training materials. In that study, growers were predominately white males aged 30-49 years with farming as their primary occupation. The majority (94%) had less than a twelfth grade education, with 84% indicating that they do not belong to any farm organizations. Beaudreault, et al. (2009) reported that it is essential for educators to understand Amish communication norms such as the common practice for one individual to act as a spokesperson. Focus group discussions have been more effective than

written evaluations for drawing out individual opinions; patience and sensitivity to cultural traditions were important to the success of the training projects.

Bergefurd (2011; 2021) also recommended Extension training strategies that emphasize interpersonal teaching methods that enable producers to get their specific questions answered. He noted that plain sect farms are typically family run organizations with the wife and children accomplishing most of the growing chores while the men tend to focus on livestock and poultry, care and milking of cows, and machine shop work. Yet, it is often the case that only men attend training. The authors proposed that efforts to encourage attendance by women must therefore be considered.

Kline, et al. (2012) reported the results of Ohio farm food safety training directed to plain sect audiences. They learned from their efforts that care was needed to make messages clear so that materials would not be misinterpreted. They reiterated the necessity of working through plain sect leaders to access individual growers. Low technology methods for presenting concepts may be necessary when cultural norms restrict the use of computer presentations that utilize electricity. Many of these authors' outreach strategies were also named in Brock, Ulrich-Schad, and Prokopy's (2018) interviews with agricultural agents in Indiana.

FSMA Produce Safety Training Requirements

The only currently approved FSMA Produce Safety curriculum approved by the FDA was developed by the Cornell University Produce Safety Alliance (PSA) (https://producesafetyalliance.cornell.edu/). Since 2010, the FDA-funded PSA has led nationwide efforts to present train-the-trainer certification workshops to inform Extension educators on how to effectively teach the computer-based (PowerPoint) curriculum. Over 60,000 growers have been trained at 3,000 training events held in the United States and beyond.

The curriculum consists of a set of 267 computer-based PowerPoint slides within seven modules, in addition to a Produce Safety Grower Manual. Trainers are instructed to lead growers through the slides as they underline key points in the accompanying manual and not to make any significant modifications to the course material without approval from the FDA. At the end of each PSA workshop, participants are asked to complete a formative course evaluation to gather data on participant demographics, overall quality of the course and instructors, and perceived increases in knowledge and confidence in implementing risk control methods. Upon completion the forms are sent back to the PSA where the data are compiled.

The PSA evaluation currently in use does not include summative pre- and post-workshop questions to quantify actual knowledge gains. To date, the only independent summative assessment of the standard PSA curriculum was reported in a study by Perry, et al. (2021) where a 25-question pre- and post-test knowledge survey was given out to 2,606 produce growers in 10 North Central U.S. states. The authors reported significant ($p<0.001$) knowledge gains among all English-speaking growers after attending the 8-hour course with average 2-year total pre- and post-test scores ($n = 2,286$) of 16.1 (64%) and 20.0 (80%), respectively. However, plain growers included in the study had lower overall scores, averaging only 14.3 (57%) and 17.9 (72%) on pre- and post-test scores, respectively.

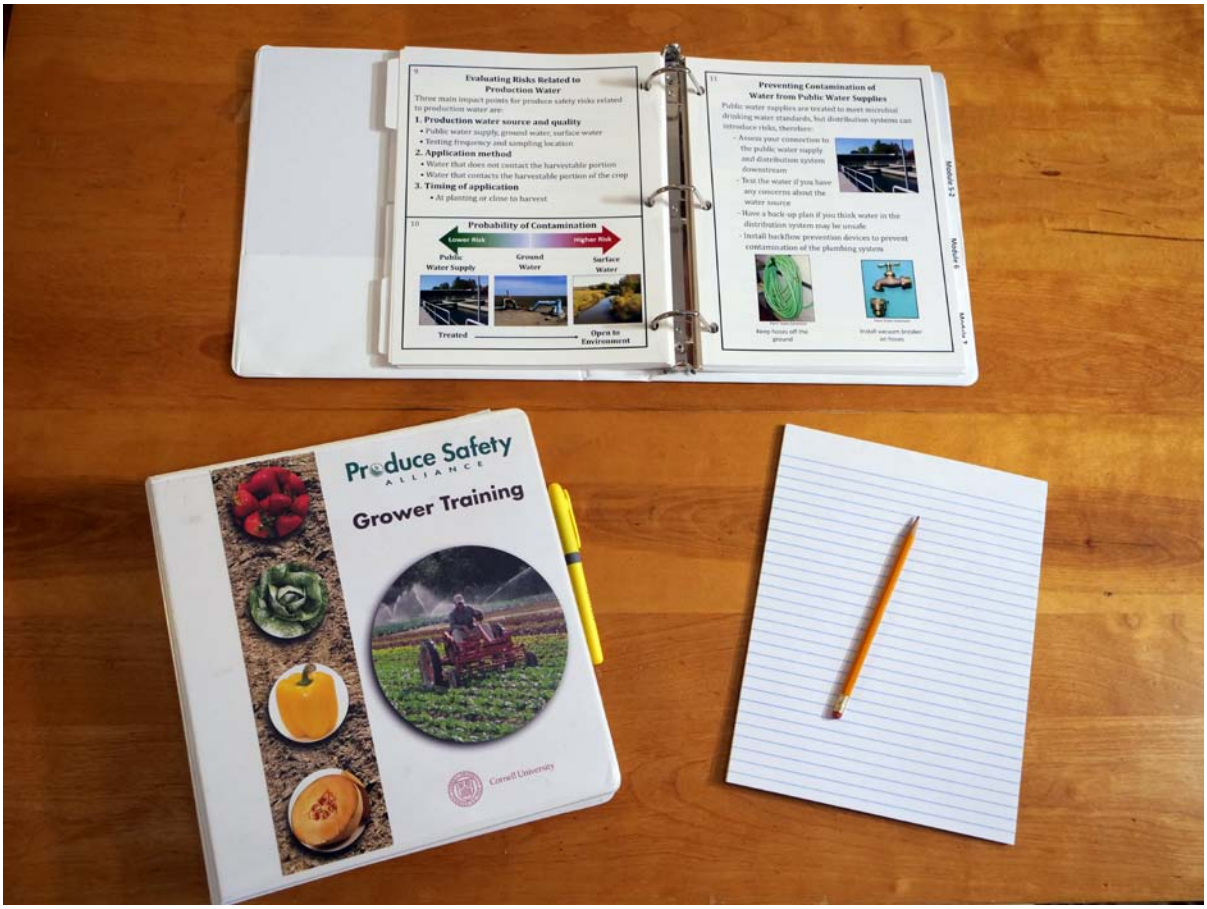
Because the Produce Safety Rule requires that training be made available to all growers, Amish growers in settlements where cultural norms limit the use of technology may be at risk for unintentional exclusion from Extension farm food safety programing. Therefore our objectives were to 1) modify the current FDA approved computer-based curriculum to a print format that is compatible with Amish learning preferences, cultural norms, and technological limitations yet is equivalent to the standardized PSA curriculum and; 2) compare the efficacy of the print format curriculum with that of the standard PSA computer-based curriculum in terms of knowledge gains acquired during the workshops.

METHODOLOGY

Amish Curriculum Development

Lacking explicit guidance in the Produce Safety Rule on criteria for meeting the regulatory requirement for curriculum equivalence, we decided, in consultation with the PSA and individual FDA inspectors, to retain the text in the PSA slides while only modifying images. To

Figure 1: Slide Book and PSA Produce Safety Manual Arranged on a Table in Front of Workshop Participants



Source: https://extension.psu.edu/amish-farm-food-safety-curriculum-materials

assure cultural appropriateness and relevance to Amish crop production, the Association of Food Scientists & Technologists (AFST) and the PSA were asked to review and provide feedback on format approaches. Factors under consideration were re-usability of the materials, ability to easily update the content in the not unlikely event that the PSA was to make significant edits to the Grower Manual and PowerPoint slide set, and reductions of the PSA PowerPoint image quality when transferred to print format. For instance, large color posters were found to be useful for farm food safety workshop presentations (Kline, et al. 2012). However, this approach was rejected because of the large amount of material contained in the PSA curriculum and the potential for it to change as the FDA revises and updates their guidance. We therefore chose to present the slides in a 3-ring binder that would allow for easier curriculum content changes. Printing the PSA slides using the PowerPoint "Print slide" function was not an acceptable option because the quality of the over 208 images and graphics in the 267 slides was greatly degraded when viewed on paper. Many of the images were therefore either edited or substituted with higher resolution photographs. Preferences among the more conservative Amish for disallowing images of individuals' faces were resolved by cropping or replacing some photographs. The printed slides were numbered in the same order as in the PowerPoint slide deck and the PSA Grower Manual (Version 1.1.) text so that participants could follow both at the same time as intended by the PSA (Figure 1). Early in the development process, the AFST reviewed the slide book and reported no issues with the content, the use of pictures, and the reading level of the material. The final 168-page slide book was reviewed by the PSA for equivalency with the standardized curriculum and any necessary edits were made

Table 1. Training Workshop Locations, Dates, Delivery Methods, and Number of Participants

Location	Workshop Date	Curriculum Delivery Method	Number of Participants
Belleville, PA	November 2, 2018	Slide book	25
Rebersburg, PA	December 14, 2018	PowerPoint	15
Bart, PA	January 22, 2019	Slide book	18
Leola, PA	January 21, 2019	PowerPoint	20

prior to double-sided printing on high quality durable 8-mil synthetic paper (Mohawk Fine Papers Inc., Cohoes, NY).

To minimize workshop costs, trainers are instructed to pass binders out to participants at the beginning of the workshop, and then collect them at the end for re-use at later workshops. More details on the display format, teaching tips, and a preview of the some of the slides are available at https://extension.psu.edu/amish-farm-food-safety-curriculum-materials.

Workshop Recruitment and Delivery

Four workshop locations (Table 1) were selected for their known proximity to Amish produce farms and with whom Penn State Extension educators have a history of providing Amish training. Educators previously certified by the PSA to teach the curriculum, including an Amish member of the AFST assisted in participant recruitment by personal contact with Amish leaders and produce auction managers as well teaching the course. Computer-based PSA trainings were randomly selected for use at two locations (Figure 1) while the alternate slide books were used at the other two sites.

Workshop Evaluation

To supplement the formative survey developed by the PSA, we developed a summative 20-question multiple choice survey, framed around the following main topic areas presented in the PSA curriculum: 1) key metrics and definitions covered in the Produce Safety Rule (types of crops covered, microbial standards for agricultural water quality, restrictions on applications of raw (uncomposted) animal manure to soils, record keeping and record storage, and training requirements); 2) awareness of animals and soils (composting manure and field monitoring for intrusion of animals to reduce food safety risks; 3) sanitation (definition of food contact surfaces, correct procedures and frequency for post-harvest cleaning and sanitizing, wash water disinfection; and 4) personal hygiene (correct hand washing procedures, use of hand sanitizers, restrictions on not handling food when ill). PSA experts were consulted to verify accuracy of the survey answers and for suggestions on improving clarity and accuracy. Issues of instrument validity and rigor were tested at a pilot workshop and final changes to the questions were then made.

The final version of the survey was administered to participants before and after each of the four workshops listed in Table 1. Pre- and post-workshop surveys at each location were color-coded and participants were assigned a unique identifying number; participants did not write their names on the surveys. Before teaching began, each participant was provided a copy of the pre-workshop survey and given instructions for completing it, including handing it back to the instructor before the presentation began. At the end of the workshop, a separate post-workshop survey, containing the same questions and choice of answers, was handed out for participants to complete before going home. Data obtained from each workshop location were then transcribed to an Excel spreadsheet for statistical analysis. For each delivery method, knowledge scores for the completed and returned pre- and post-tests were determined by counting the number of correct answers in the 20-question tests. Changes in knowl-

edge scores were determined by calculating the difference between the pre- and post-test scores. Differences between the means for each delivery method were compared for statistical significance using a dependent t-test. To compare the effect of delivery method on knowledge change, the results from the two slide book workshops and the two computer-based workshops were each combined and an independent t-test was used to determine the significance of knowledge gains between the two delivery methods.

RESULTS

Attendance at each of the four workshops where the slide book or computer-based PowerPoint delivery methods were used ranged from 18 to 25 for a total of 78 Amish produce growers (Table 1). The four workshops were taught by 3-4 PSA-approved trainers, including an Amish member of the AFST. Workshops were completed within the 7-8-hour time interval typical of PSA courses in other states. The results from the demographic profile of workshop participants in this study (Table 2) are similar to those reported in a study of Ohio produce auction farmers by Bergefurd (2011; 2021). Workshop participants in the current study were almost entirely male (98.7%). The majority were aged 26-40 years (57.3%) followed by 28.9% over age 40, and 14% under age 26. Nearly half (44.0%) had 6-10 years of farming experience; over half (50.0%) had been farming for 11-30 years; and only 4% over 30 years farming. The maximum education level achieved was almost entirely (97.7%) at the eighth grade level.

Knowledge levels before and after each of the workshops, determined by the 20-question survey, were highly variable (Table 3). The number of correct answers and corresponding percent scores before attending the course, among all locations and delivery methods, ranged from 3 (15%) to 17 (85%). After completing the course, the number of correct answers and corresponding percent scores ranged from 7 (35%) to 19 (95%). Standard deviation values compared to the means were high, suggesting a wide disparity between those who did well at the training and those that did not.

Because learning differences before and after the workshop for the slide book and computer-based trainings were not significantly ($p<0.05$) affected by workshop location, the knowledge data for each delivery method were combined and compared (Table 4). For the slide book delivery method, mean number and percent correct scores for the post-test (M=13.7, 69%) were significantly higher than those for pre-test scores (M=10.0, 50%) ($t=-9.01$, $p<.001$). Similarly, PowerPoint delivery method number and percent correct scores for the post-test scores (M=14.2, 71%) were also higher than those for pre-test scores (M=10.9, 55%) ($t=-7.07$, $p<.001$) (Table 4). Although the mean change in knowledge scores for the slide book method (M=3.7) was slightly (1.3x) higher than the mean for the PowerPoint method (M=3.3), the difference was not significant ($p=0.525$). These results therefore indicate that both delivery methods increase participant overall knowledge and therefore can be considered equally effective.

In Table 5, pre- and post-workshop knowledge scores and score changes are shown for each of the topics in the set of 20 survey questions. The

Table 2: Demographic Profile of Workshop Participants (n=78)

Gender	**n**	**%**
Male	76	98.7%
Female	1	1.3
Age		
15-25 years	11	14.2
26-40 years	44	57.1
41-55+ years	22	28.6
Total	77	100
Number of years farming		
6-10 years	33	44.0
11-20 years	28	37.3
21-30 years	11	14.7
31-50 years	3	4.0
Total	75	100
Education		
Eighth Grade Education	73	94.8
High School Diploma/GED	1	1.3
Associates	1	1.3
Bachelors	2	2.6
Total	77	100

If not total 78, due to missing data

Table 3: Pre- and Post-Test Score Data for Each Training Location in Pennsylvania and Delivery Method

			Pre-test			Post-test		
Location	**Method**	**n[1]**	**Min[2]**	**Max[2]**	**M (SD)[2]**	**Min**	**Max**	**M (SD)[2]**
Belleville	Slide book	25	6	17	10.7 (2.7)	9	18	14.3 (3.2)
Rebersburg	PowerPoint	15	9	14	11.3 (1.3)	12	18	14.4 (1.7)
Bart	Slide book	18	3	13	8.9 (2.5)	8	17	13.6 (2.5)
Leola	PowerPoint	20	5	14	10.6 (2.5)	7	19	14.1 (3.3)

n[1] = number of survey respondents; Min and Max = lowest and highest scores on the pre- and post-test survey; M (SD)[2] = mean of number of correct answers and standard deviation

data presented under question topics within key topic areas are ranked from lowest to highest pre-workshop knowledge score. Pre-workshop scores can be considered as an indicator for the level of learning that participants had before attending the workshop. They were generally lowest—and range of differences between pre- and post-tests were highest—for specific quantitative metrics written in the Produce Safety Rule, such as water sampling and testing frequencies required for crop-contact irrigation water, minimum time intervals between amendment of soils with raw manure and harvesting, required records retention times, and the Produce Safety Rule definition of agricultural water (water that is intended or likely to contact the edible part of the plant). In contrast, pre-test scores were higher and pre- and post-test score differences were lower for questions on microbial limits on crop-contact irrigation water and personal hygiene standards, possibly because of earlier teaching efforts by the Amish FSET and Extension educators as well as standards imposed on them by auctions and other wholesale buyers. Similarly, pre-workshop scores for awareness of risks related to the presence of animals and the use of animal manures as soil amendments were relatively high. This could also be attributed to earlier outreach educational efforts to alert them to wholesale buyer and the FDA's concerns about their reliance on draft animals and use of animal manure in fields. Pre-test scores for pre- and post-harvest sanitation practices were mostly high, probably again due to prior training in these areas.

Comparison of our results with those from the study by Perry, et al. (2021) is difficult because the two survey tools were organized around different topic titles, consisted of different questions, and were aimed at general grower populations. In the Perry, et al. (2021) study, lowest pre- and post-test scores were for course sections titled Wildlife, Domesticated Animals, and Land Use; Agricultural Water; Postharvest Handling and Sanitation; and How to Develop a Farm Food Safety Plan. On the other hand, the highest pre- and post-test scores were for sections titled Introduction to Produce Safety; Worker Health, Hygiene, and Training; and Soil Amendments. It is noteworthy that knowledge scores reported in both studies were generally highest for personal hygiene, animal risks, and soil amendment risks topics yet were not in agreement for post-harvest sanitation topics. A standardized set of pre- and post-test questions for use nationally at all PSA curriculum workshops would lead to better comparisons of differences in learning achieved for all participant backgrounds.

Interestingly, there was an unexpected decrease in knowledge scores for the pre- and post-harvest sanitation question on post-harvest water and food contact surfaces. This was the only ques-

Table 4: [t-test] Results for Pre- and Post-Workshop Test Scores and Score Changes for Slide Book and PowerPoint Delivery Methods

	Slide Book Test Scores			
	n[1]	**M (SD) [2]**	**t-value**	**p-value**
Pre-test	43	10.0 (2.7)	-9.01	<.001
Post-test	43	13.7 (2.9)		
	PowerPoint test scores			
	n	**M (SD)[2]**	**t-value**	**p-value**
Pre-test	35	10.9 (2.1)	-7.07	<.001
Post-test	35	14.2 (2.7)		
	Slide book vs. PowerPoint differences in percent correct scores			
	n	**M (SD) [2]**	**t-value**	**p-value**
Slide book	43	+3.7 (2.7)	0.64	0.525
PowerPoint	35	+3.3 (2.8)		

n[1] = number of respondents using each delivery method; M[2] = mean number of accurate answers; M[3] = mean change in percent score for each workshop delivery method; SD = standard deviation. Possible range for mean scores is 1 to 20 and –20 to +20 for mean changes in percent scores.

tion where two correct answers ("Sanitizers must be added to post-harvest produce wash water as often as necessary" and "Surfaces that contact food must be sanitized when appropriate as often as necessary") were followed by a "Both statements are true" answer. Although we intended for the last answer to be best choice, it is possible that, after taking the course, many participants perceived (correctly) that all three choices could technically be true. This confusion may have been the cause for some to score lower on this question.

Instructors did not report any problems with the ability of participants to simultaneously follow the material in the printed slide set while making notes or underlining important lines in the PSA Grower Training Manual, to ask questions, and to volunteer relevant anecdotes based on their own farming experiences. Some instructors felt that the slide book delivery method was more conducive to an interactive classroom experience because they did not have to look away from the audience and toward the projected slides behind them to keep track of where they were during the presentations.

DISCUSSION

The printed slide set version of the FDA standardized computer-based produce safety curriculum described in this study will increase accessibility of farm food safety training opportunities to Amish growers in settlements that have restrictions on the use of technological learning meth-

Table 5: Pre- and Post-Workshop Mean Knowledge Scores for Each Test Question

Key Area	Question Topic	Pre	Post	Change
Metrics and definitions in the Produce Safety Rule	Water sampling frequency	3.8	57.3	53.5
	Interval between manure application and harvest	13.4	49.8	36.4
	Records storage	14.2	52.6	38.5
	Agricultural water definition	18.7	65.0	46.4
	Required records	29.8	35.8	6.0
	Allowable bacteria levels in agricultural water	44.8	76.8	32.0
	Produce types covered	54.4	80.1	25.7
	Training requirements	59.9	68.3	8.4
Awareness of animal and manure risks	Risks due to animal intrusion in fields	67.8	83.4	15.6
	Risk comparison for raw vs. composted manure	77.8	88.8	11.0
	Risk for raw manure contact on produce	81.2	95.9	14.7
Pre- and post-harvest sanitization	Post-harvest water and food contact surfaces	35.5	9.3	-26.2
	Quality of produce wash water	70.7	76.2	5.6
	Food contact equipment types	70.7	79.3	8.6
	Equipment cleaning and sanitizing procedures	73.4	93.3	19.9
	Bacterial infiltration in wash water	75.6	97.0	21.4
Produce handler hygiene	Visitor policies	40.1	50.0	10.0
	Hand washing and use of hand sanitizers	47.4	80.2	32.8
	Harvesters as potential sources of contamination	87.4	88.0	0.7
	Recognition of reportable signs of illness	92.2	97.4	5.2

Question topics are ranked by pre-test score within each key topic area.

ods. A strength of this study is the open communication channels developed between Extension educators and Amish produce growers through the multi-state AFSET.

However, we recognize there are limitations to our experimental approach for determining curriculum equivalence. Amish growers have a common cultural framework for how they conduct their lives and their willingness to engage with people outside their settlement. We believe that the Amish growers recruited from the four geographical locations in Pennsylvania are a reasonable representation of Amish attitudes in the state. It is our experience from other training programs that most Amish prefer low technology options when they are available. However, the Amish settlements in central Pennsylvania (Rebersburg and Belleville sites) tend to be more conservative and therefore less accepting of technological learning delivery methods compared to those in the Lancaster County region (Bart and Leola sites). It is possible that settlements outside of Pennsylvania may not have the same learning style preferences and it would be useful to recruit trainers in other states with significant populations of Amish produce growers to compare results. The formal statistical inference in this study assumes that the participants are a random sample from a common population of growers and that the natural variation among sampled growers' pre- and post-test scores is the same whether or not they were in the same or a different workshop. However, there also may have been some unavoidable self-sorting of individuals in the participant recruitment process. Before assigning treatment groups, we asked growers which learning style they preferred. At

three locations, no objections to computer-based training were stated. At one location, all of the recruits insisted on the printed slide set version and a new training location had to be found where less conservative views made it possible for some to enroll in the computer-based PowerPoint session.

Very low post-tests scores (less than 50% correct) among some participants, for both delivery methods, are concerning since they indicate that a sizable number did not gain a complete understanding of the Produce Safety Rule and best practices for preventing on-farm contamination. Lower educational attainment levels and comfort with formal learning environments are possible reasons for why some did not perform as well as others. It may also be the case that some are not yet fully convinced that all the information in the national curriculum applied to them. Others might be less motivated to maintain their focus on the material knowing that informal learning through family and friends, produce auctions managers, and the AFSET is readily available when they need it through widely distributed Amish newspapers, conference calls, and grower meetings.

A better understanding of how Amish group dynamics influence learning success both inside and outside of workshops on food safety and other topics would be useful for developing teaching practices that engage all participants. It is striking that women who contribute significantly to produce growing activities were not well represented among the workshop participants in this study. Future study is needed to clarify gender differences in the distribution of labor on Amish produce farms and to develop strategies to expand farm food safety training opportunities for women.

From the results of this study, it is clear that a single, one-day training is not sufficient to ensure that all growers are knowledgeable about all aspects of farm food safety. The national PSA farm food safety curriculum should be considered a foundational course that covers a broad range of topics that may be difficult for participants to absorb and retain. As Amish contributions to the local and regional supply of fresh produce continue to increase, Extension must support them by creating culturally appropriate supplementary materials, such as fact sheets and posters for display at produce auctions and field demonstrations, training tools for on-farm presentations to harvesters and handlers, and additional workshops that reinforce and dig deeper into farm food safety issues that are particularly relevant to them. To the extent possible, educators should gather impact data to document any changes to food safety and sanitation practices on Amish produce farms that can be traced to outreach activities.

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APPENDIX: PENNSYLVANIA STATE UNIVERSITY RESOURCES FOR AMISH PRODUCE GROWERS.

The Pennsylvania State University Extension website has additional information on Amish produce safety materials and information on critical edits and required supplementary slides when using the Version 1.1 curriculum materials. Visit https://extension.psu.edu/amish-farm-food-safety-curriculum-materials

The FSMA Produce Grower Training Slide Set

PSA-approved educators with interest in offering FSMA certified workshops to Amish produce growers may obtain up to 20 copies of the reusable Amish slide book at no cost except for shipping, while supplies last. Email lfl5@psu.edu for further information and to obtain a discount code before placing your order.

Flip Charts for On-Farm Food Safety Training of Harvesters and Handlers of Fresh Produce

Penn State has developed a durable, 44-page re-usable flip chart designed to help growers meet the FDA training standards for harvesters and handlers in the FSMA Produce Safety Rule or those required in third-party audits. The material in the flip chart was created with small scale plain sect growers in mind and includes over 35 professionally drawn images that reflect Amish growing activities in a culturally appropriate manner. Visit the PSU Extension website for a preview of the flip chart and ordering information: https://extension.psu.edu/amish-farm-food-safety-curriculum-materials