

## Knowledge Gained from Good Agricultural Practices Courses for Iowa Growers

### Abstract

Good Agricultural Practices (GAP) educational courses provide produce growers with the fundamental information for producing and processing safe produce. To determine the effectiveness of the current 7-hour GAP course provided in Iowa, growers were surveyed before and 7-14 days after the course to determine changes in knowledge and opinions. Results show that growers positively changed their knowledge and opinions on key food safety principles and regulations, which provides evidence that Extension programming is an effective method to educate small growers. Food safety educators should focus their training on practical methods for documentation, sanitation, and facilities.

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## Introduction

Centers for Disease Control and Prevention found that 46% of reported foodborne illnesses were linked to fresh produce and nuts (Painter et al., 2013). Interest in local and regional foods has resulted in an increase of small-scale fruit and vegetables producers in the United States. Unlike large-scale produce growers, small and very small growers often don't have the training on best practices to reduce food safety concerns. Thus, effective food safety education for small and very small-scale produce growers is essential to ensure reduction of foodborne illnesses and death.

Food safety educators may have only one opportunity to educate a small-scale produce farmer about best food safety practices on the farm and post-harvest, referred to as Good Agricultural/ Handling/ Manufacturing Practices (GAP/GHP/GMP). Adoption of GAP principles by growers has been shown to be

highly influenced by the market and buyer demand (Eggers, Ackerlund, Thorne, & Butte, 2010). GAP workshops taught through Extension have been seen as a valuable resource for growers and have been shown to be effective at changing knowledge, perceptions, and behavior (Tobin, Thomson, LaBorde, & Radhakrishna, 2013). Extension and outreach programs throughout the country have offered GAP workshops to educate this grower population for many years. Traditional PowerPoint classroom style GAP workshops held at Extension offices or community centers have been the normal format for such education, but very few studies have focused on the effectiveness of these programs on knowledge and attitude changes related to food safety for small-scale growers.

Good Agricultural Practices were first introduced through the Cornell University's National Good Agricultural Practices Program in 1999 (National Good Agricultural Practice Program, Cornell University, 2014). GAP education focuses on four key areas: water, soil, facilities, and people. Topics include: environmental assessments and risk reduction practices; water supply; soil amendments (manure and composting); harvesting equipment and procedures; transfer of human pathogens by field workers, visitors, and other field personal; pest control; post-harvest cooling procedures; packing and storage materials; employee health and hygiene; overall sanitation program; transportation; and record keeping, including a trace back program (FDA, 1998).

The Food Safety Modernization Act's proposed new Produce Safety Rule requires additional food safety practices to be followed and documented, but small and very small growers may not be required to meet these standards. GAP programs targeting small-scale producers may be the only way to transfer this knowledge.

## Objectives

The objectives of the study reported here were to determine current knowledge and opinions of growers in Iowa and if education on GAP and GMP increased knowledge of small-scale growers about food safety topics and if this educational programming changed their opinions on the importance of food safety practices. A quasi-experimental design was used with pre-post assessments administered before and after the first of three sequential workshops. Results provide insights on current knowledge and attitudes of small-scale growers and give guidance to Extension educators on areas of GAP/GMP that need to be emphasized during programming.

## Methods

Iowa State University On-Farm Food Safety Team, through Iowa Department of Agriculture and Land Stewardship funding, developed a three-level sequential on-farm food safety program ("Know," "Show," & "Go") to provide food safety education to fruit and vegetable growers in 2012. Each level focused on a different aspect of GAP/GMP with a goal to increase knowledge and improve attitudes and food safety practices. The focus of this article is to determine the current practices of growers before taking the first course, known as Level 1, and the impact on the growers after the Level 1 training. The Level 1 Basic ("Know") GAP course incorporated education on GAP, GMPs, and general food regulations to educate growers to produce safer crops. The Level 1 course was based upon the Cornell University Good Agricultural Practices curriculum established in 1999 and included PowerPoint lectures on basic food safety recommendations for pre- and post-harvest fruit and vegetable practices. The course lasted 7 hours and was presented by a multi-disciplinary team. The last hour of the workshop had small groups

(2-3 people) work through two case studies to identify what best practices needed to be emphasized on the farms. The case studies were facilitated by Extension personnel and concluded with group discussion. The course was modified from Cornell Universities GAP curriculum to include unique Iowa situations and interactive problem-solving activities.

Between 2012 and 2014, seven Basic Good Agricultural Practices (GAP) (Level 1) short courses 7 hours in length were held for produce growers (n=82 participants) throughout the state of Iowa. A survey to assess changes in knowledge and attitudes was administered before each Level 1 training and 7-14 days after the Level 1 trainings. Modifications to the data collection tool reflected timing of survey administration. These surveys were modified from a validated instrument used in previous projects assessing perceived value of food safety training (Strohbehn & Gregoire, 2003; Gregoire, Arendt, & Strohbehn, 2005; Strohbehn, Smith, Domoto, & Wilson, 2012). Growers were asked if 10 fundamental food safety statements related to GAP, GMPs, and food regulations were true, false, or they didn't know (Knowledge) and if they agreed or disagreed (using a Likert 5 point scale) with 10 listed food safety practices (Attitudes). Participants also identified educational needs to be addressed in future programming.

Recruitment for participants was performed through use of Extension listservs, direct emails, brochures, and word-of-mouth. Project assessments and protocol were granted an exemption by the Iowa State University Office for Responsible Research under the human subject protections regulations. In accordance with this exemption, participants could complete as much or little of the surveys as they desired. Additionally, not all questions applied to all growers; therefore, no response was provided. For these reasons the number of responses was not the same for all questions on the survey.

## Results

### Knowledge

The average workshop consisted of 10-15 growers from farms with less than 5 acres of land (99.9% of participants). Knowledge levels about GAP, GMPs, and food regulations in Iowa before and after the Level 1 workshop are shown in Table 1. The surveys provide evidence that participants gained knowledge about Iowa regulations related to produce sales (such as need for licenses, certifications, and allowable procedures); food safety concerns with produce (outbreaks, recalls); and key elements of food safety practices (water, packaging, documentation). An increase in the percent of participants responding correctly to food safety statements after the workshop also provides evidence that growers became more confident in their answers (i.e., there were zero "Don't know" responses post-workshop).

**Table 1.**  
 What Do You Know? Number and Percent of Participants Who Completed Knowledge Questions Before and After Level 1 Basic Good Agricultural Practices Workshop

	Percent Participants with Correct Answer	Don't Know

Question	Before	After	Before	After
State of Iowa regulations allow local produce growers to sell directly to school and hospital foodservices. (N before=39; N after=69)	51.3%	88.4%	38.5%	0.0%
Producers can add value to fresh produce items before selling to retail foodservices, such as washing and chopping lettuce, without any special type of license. (N before=30; N after=74)	80.0%	98.6%	13.3%	0.0%
Iowa does not require any farm inspections or producer certification about food safety. (N before=40; N after=71)	42.5%	100.0%	27.5%	0.0%
Fresh produce is not a food item that has been implicated in outbreaks of food borne illness. (N before=49; N after=70)	98.0%	100.0%	2.0%	0.0%
It is required producers document the use of good agricultural practices. (N before=43; N after=74)	41.9%	100.0%	18.6%	0.0%
The pathogen of greatest concern on fresh produce is parasites. (N before=40; N after=80)	65.0%	97.5%	25.0%	0.0%
Water is considered the "stealth" ingredient. (N before=41; N after=70)	46.3%	100.0%	43.9%	0.0%
Specific materials are required to be used when packaging fresh produce for sale to consumers and retail foodservices. (N before=44; N after=70)	38.6%	92.9%	38.6%	0.0%
A written food safety plan will include standard operating procedures for worker practices and facility use. (N before=30; N after=72)	93.3%	100.0%	6.7%	0.0%
A food processing license is not needed if only preparing a small amount of product, such as amounts sold at farmer's market. (N before=40; N after=79)	25.0%	93.7%	32.5%	0.0%

### Attitudes

To determine what specific food safety practices growers were deemed important, a Likert scale agree/disagree scale was presented to growers, as shown in Table 2. Responses showed that growers changed their attitudes about the importance of on-farm food safety practices (as indicated by higher

mean scores) for all but two items (related to land history and type of packaging materials). The items showing the greatest change in attitudes were washing of hands, need for closed packing shed, wild animal control, and wearing of clean attire during packing.

**Table 2.**

What Do You Think? Number and Percent of Participants' Mean Rating of Agreement with Statements Before and After Level 1 Basic Good Agricultural Practices Short Course

Questions	Mean Value of Agreement <sup>a</sup>	
	Before	After
It is important to test the safety of well water each year and keep documentation. (N before=42; N after=69)	4.19	4.58
A history of the use of the land where I grow my food crops is important. (N before=33; N after=74)	4.39	3.96
Marketing the safe food handling practices I use on the farm to prospective foodservice buyers will help promote my products. (N before=32; N after=71)	4.53	4.65
Everyone involved with harvesting or packing of products on my farm understands the importance of washing hands and knows when and how to do so properly. (N before=33; N after=70)	3.73	4.76
Controlling access to food crops by wild animals or pets is important. (N before=39; N after=74)	3.92	4.53
A closed packing shed is not needed. (N before=40; N after=80)	2.78	4.66
The type of package materials used is important to my clients. (N before=33; N after=70)	4.27	2.69
Selling to retail foodservices and/or at the wholesale level means I will need to make some investments in my business. (N before=43; N after=70)	4.14	4.21
A daily cleaning and sanitizing program on my farm includes all food contact surfaces (including harvest containers) and product cleaning. (N before=40; N after=72)	4.28	4.38
Everyone who packs products on my farm knows to put on clean gloves and aprons after harvesting. (N before=39; N after=79)	3.36	4.27
a Scale is as follows: 5 Strongly Agree, 4 Agree, 3 Neutral, 2 Disagree, and 1 Strongly Disagree		

## Future Education Needs

Additional information on how to properly train employees, family members, children, and volunteers was an area identified for more educational programming through the survey and in the workshop discussion session. Table 3 highlights these topics along with some references. Examples include Appropriate facilities, packaging materials, product cleaning procedures and chemicals, and work surfaces were also identified as areas in which further programming would be useful. Further, many of the grower participants did not have hand washing facilities and restrooms outside of their homes or didn't have designated packing sheds. Discussions of appropriate food contact surfaces and packaging materials also ensued. These comments suggest inclusion of usable, alternative approaches to meet food safety best practices for smaller farms in the program.

**Table 3.**

Key GAP/GMP Educational Areas Identified in Level 1 Basic Good Agricultural Practices Workshop and Recommendations and References for GAP Educators

Educational Areas	Resources	Example of an Educational Strategy
1. Cleanable Product and Surfaces	<ul style="list-style-type: none"> <li>• PM 1974C On-farm Food Safety: Cleaning and Sanitizing Guide (Strohbehn et al., 2014)</li> <li>• PM 1974D Guide to Liquid Sanitizer Washes with Fruit and Vegetables (Shaw et al., 2014)</li> <li>• On-Farm GAPs Education Program (University of Minnesota, 2014)</li> <li>• Sanitary Design and construction of Food Equipment (Schmidt &amp; Erickson, 2005)</li> </ul>	<p>Demonstration on how to clean different food contact surfaces (i.e. plastic bin versus stainless steel table)</p> <p>Develop worksheet with questions on mixing and using surface sanitizers</p>
2. Appropriate Packaging Materials	<ul style="list-style-type: none"> <li>• PM 1974A On-farm Food Safety: Guide to Good Agricultural Practices (GAPs) (Strohbehn et al., 2014)</li> <li>• Packaging Materials and Equipment Suppliers (Penn</li> </ul>	<p>Demonstration with a variety of packaging types for produce (i.e. clam shells, netting bags, plastic vented bins)</p>

	<p>State Extension, 2015)</p> <ul style="list-style-type: none"> <li>• Packaging (Utah State University, 2014)</li> </ul>	
<p>3. Appropriate "Packing Shed" Design</p>	<ul style="list-style-type: none"> <li>• Packing Shed Layout (University of Wisconsin-Madison, 2014)</li> <li>• Plan the Perfect Packing Shed (Byczynski, L., 2002)</li> </ul>	<p>Within small groups, design a packing shed with emphasis on food flow and high risk versus low risk areas</p> <p>Tour an existing facility on a small-scale farm</p>
<p>4. Written Sanitation Procedures</p>	<ul style="list-style-type: none"> <li>• PM 1974C On-farm Food Safety: Cleaning and Sanitizing Guide (Strohbehn et al., 2014)</li> <li>• On-Farm GAPs Education Program (University of Minnesota, 2014)</li> <li>• Iowa State University data base modifiable standard operating procedures at <a href="http://www.iowahaccp.iastate.edu">www.iowahaccp.iastate.edu</a></li> </ul>	<p>Identify priority SOP needs in case scenario</p> <p>Provide templates for development of sanitation standard operating procedures and have them complete one for their farm</p>
<p>5. Written Policy on Worker Health and Hygiene</p>	<ul style="list-style-type: none"> <li>• PM 1974B On-farm Food Safety: Food Handling Guide (Strohbehn, Wilson, Domoto &amp; Smith, 2014)</li> <li>• Food Safety Field Training Kit for Fresh Produce Handlers (Penn State Extension, 2014)</li> <li>• On-Farm GAPs Education Program (University of Minnesota, 2014)</li> </ul>	<p>Develop worksheet that asks when should or shouldn't an employee handle produce (i.e. sore throat with fever or diarrhea as should not items)</p> <p>Use of simulated germ lotion to illustrate hand washing effectiveness</p>

## Discussion and Implications

In a 2011 study with Pennsylvania supermarket managers, Tobin, Thomson, LaBorde, and Bagdonis.

found that grocers preferred growers to have GAP training and educational practices. Within Iowa, the grocery association along with many other buyers (e.g., wholesale markets, restaurants, hospitals, and other institutional foodservices) are recommending that growers supplying produce have proof of training and documentation of GAP. Many grocery stores in Iowa are requiring growers fill out the ISU developed checklist that lists GAP (see [www.iastatelocalfoods.org](http://www.iastatelocalfoods.org)), supply the results of water tests, and/or show a copy of the Certificate of Completion from a GAP or food safety course.

Our study provides evidence that growers participating in the Level 1 GAP course increased knowledge about regulations related to produce (licenses, certifications, allowable procedures), food safety concerns with produce (outbreaks, recalls), and the key elements of food safety practices (water, packaging, documentation) and also improved growers' awareness of the importance of key GAP practices pre- and post-harvest (water, soil, wildlife, building, harvesting, and packaging). Knowledge and a willing attitude are needed for changes in behavior to occur. The growers may require guidance from Extension educators about the proper knowledge needed as a basis for the behavior to change. For example, one topic discussed in the GAP training is previous use of the land and importance of soil testing. In Iowa, there have been instances of community gardens and farms placed in locations using reclaimed land such as landfills or chemical dumps, without the recognition toxins in the soil may still be present. Growers need to be able to identify scenarios of risk and take action to reduce food safety risks and extension educators need to be familiar with local soil testing locations and procedures to support GAP adoption by growers.

Our study further highlighted a need for practical education on what is considered a cleanable surface, appropriate packaging materials, and appropriate places to process fresh produce. With most small-scale growers using wood benches and plastic harvesting bins and the lack of stainless steel presences on farms, education is required about options for cleaning and sanitizing products. Further, the importance of training personnel on how to clean and sanitize food contact surfaces, harvesting equipment, and storage bins needs to be emphasized to ensure food integrity and protect physical health of workers. The structure of the processing area or building ("packing shed") can also affect safety of product as rodents, birds, and other animals are commonly found within farm settings. Processing under open air can present an opportunity for fecal matter to be incorporated onto the fresh produce. Growers frequently had questions about examples of food safety appropriate design and if structures could be used for processing. Practical solutions were sought.

Packaging materials was another identified area of education. Packaging is required to protect the integrity of the food items; re-use of boxes and bins without proper sanitization can cause a cross contamination scenario through the transfer of biological or chemical hazards or present physical damage to the fresh produce. The use of non-food grade materials as packaging or containers can increase the food safety risk to the products. Garbage bags have been used as a product container because they are readily available and inexpensive, without recognizing that garbage bags are not made of a food-grade material and contain harmful chemicals to reduce odors and pest infestation. Extension educators need to know what is and what is not an appropriate packing material, and provide guidance on alternative packaging choices.

Another area of need is on worker training and guidance on how to address health concerns and hygiene practices. Many of the participants worked alone or with fewer than five individuals, and they recognized the need to provide clear expectations of proper practices to these workers.

## Summary

With the increased interest in local foods and greater numbers of farmers' markets along with more small-scale growers and food entrepreneurs in the U.S., education about GAP and GMPs along with food regulations is essential to reduce risks associated with fresh produce and contribute to healthy lives for citizens. The study reported here provides evidence that an Extension and Outreach program that combines traditional PowerPoint delivery with discussion infusing practical implementation strategies can improve knowledge and attitudes toward food safety on the farm, with the potential for improved practices resulting in fewer outbreaks of food borne illness. With changes in food regulations and market driven food safety requirements, extension educators need to be prepared to meet the needs of growers for useful and relevant information.

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