

PEER-REVIEWED ARTICLE

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Current Trends in Food Safety Practices for Small-scale Growers in the Midwest

ABSTRACT

Fresh produce and nuts are associated with 46% of reported foodborne illnesses. Food safety education through Good Agricultural Practice (GAP) workshops attended by small-scale fruit and vegetable growers may cause positive changes in food safety knowledge, attitude, and behavior. Surveys conducted pre-, post-, and 3–6 month (4 total) after fourteen GAP workshops (n = 134 responses) with produce growers revealed that the majority of participants had farmed for less than 4 years and sold fewer than 3 crops directly to a variety of consumer markets. Prior to the Level 1 workshop, fewer than 10% of participants had written policies on eating, drinking and smoking; worker attire; and documentation of product holding during storage and transportation. Further, over 60% of participants reported that they had clean and accessible handwashing and restrooms stations; tested well water; restricted pets and wildlife from fields; and kept records of harvested

crops. The most frequently cited changes that occurred post workshops were in relation to documentation of on-farm procedures; water quality testing and training of workers; written protocols for sanitizing equipment, bins, and products; and product traceability. Development of policies and documentation development of food safety practices were noted as areas needing the most improvement and should be emphasized by instructors of GAP.

INTRODUCTION

The popularity of local foods and farmers markets, along with government efforts to increase fresh fruit and vegetable consumption, has increased the number of small- and very small-scale fruit and vegetable growers in the United States. The number of foodborne outbreaks and recalls associated with fresh, minimally processed, and processed fruits and vegetables (melon, berries, leafy greens, peppers, tomatoes, seed sprouts, etc.) have increased in recent years, with an estimated 46% of all reported foodborne illnesses attributed to produce and nuts (10). The Food Safety Modernization Act

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(FSMA) proposed Produce Safety Rule under the Food and Drug Administration (FDA) brought attention to the need to develop guidelines for growers, using a holistic approach to ensure safety of the fruit and vegetable food supply. Under this new ruling, small and very small fruit and vegetable growers will be exempt from regulation and educational requirements, although many of these small-scale growers are supplying produce to schools, farmers' markets, grocery stores, restaurants and other institutions without adherence to best food safety practices. Education about proper fresh produce handling from farm to fork has been shown to prevent contamination on the farm, during packing, processing, and distribution, and within retail settings (8).

Beginning in the late 1990s, university extension and outreach programs and other organizations (non-profit and commercial) began educating fruit and vegetable growers about Good Agricultural Practices (GAP) through workshops targeted to fruit and vegetable operations of all sizes. GAP education programs cover best practices in four key areas (water, soil, facilities and people) with the goal of improving growers' food safety behaviors. Educating small-scale produce growers can present challenges to instructors, as these growers have special operating restrictions and growing scenarios (e.g., low employee numbers, high volunteerism, lack of budget for infrastructure, need for equipment upgrades). Food safety educators may have only one opportunity to educate a small-scale fruit and vegetable grower about best practices on the farm and at post-harvest facilities. Thus, the programs must be presented in a way that participants are able to understand so that they can subsequently implement recommended best practices into their day-to-day farm operations.

Although traditional PowerPoint classroom-style GAP workshops (such as those delivered at extension offices, academic campuses and community centers) have been developed for fruit and vegetable growers, little research has been published on the effectiveness of these programs in changing behaviors and attitudes toward food safety. Our research goal was to identify practices of small-scale fruit and vegetable growers in Iowa prior to participation in GAP workshops, and determine the effectiveness of the traditional delivery of information in changing on-farm food safety practices. Four surveys were administered to participants in two sequential GAP workshops.

MATERIALS AND METHODS

Between 2012 and 2014, seven Basic Good Agricultural Practices (Level 1) workshops (n = 70 participants) and seven Advanced Food Safety Plan Preparation (Level 2) workshops (n = 64 participants) were held throughout the state of Iowa. These two courses were part of a state of Iowa-focused sequential, three-level on-farm food safety program (Know, Show, Go) that provided food safety education to growers of fruits and vegetables (13). The Level 1 course focused on

incorporation of Good Agricultural Practices (GAP), Good Manufacturing Practices (GMP), Good Handling Practices (GHP) and food regulations into daily farm operations, using lecture and discussion. Level 2 focused on marketing and economics, GAP auditing readiness, and aiding in the development of an on-farm food safety plan. Level 3 focused on implementation of the GAP plans and preparation for third-party certification through a guided farm tour with the USDA GAP audit form. The focus of this research is on the effectiveness of Level 1 and Level 2 workshops.

The Basic Good Agricultural Practices (Level 1; Know) workshop was based upon the Good Agricultural Practices curriculum established as part of the National GAP Initiative at Cornell University. During this workshop, participants received the "Know," or knowledge of best practices. The Level 1 workshop has been offered to growers for over 10 years in Iowa; it included PowerPoint-based lectures and discussions on basic food safety recommendations for pre- and post-harvest fruit and vegetable handling. Participants received a packet of educational materials, resources and tools, including a refrigerator thermometer, sources for portable hand washing stations and water testing, and a copy of the Cornell Growers Self-Assessment workbook. The last hour of the seven-hour workshop divided the participants into small groups (2–3 people) to work through developed case studies (available at www.iastatelocalfoods.org) to identify and prioritize what best practices need to be implemented. The exercise was guided by extension personnel with expertise in food safety and/or horticulture and concluded with group discussion.

During the Advanced Food Safety Plan Preparation (Level 2; Show) workshop, participants learned how to promote their fruits and vegetables to larger markets and begin development of an on-farm food safety plan for their operations, with guidance and technical assistance provided by food safety and value-added agriculture extension specialists. During this workshop, participants learned how to "Show," or document their food safety practices and knowledge. To participate in the Level 2 workshop, the Level 1 workshop had to have been completed within one year prior to the training. This requirement ensured that Level 2 participants had basic GAP knowledge. In the Level 2 workshop, PowerPoint presentations about documenting food safety practices were used for the first two hours, followed by a one-hour presentation of two illustrative examples of a food safety plan (one for a farm with less than 5 acres and the other for a food hub). In the remaining four to five hours, participants worked on food safety plans and standard operating procedures for their farms, using the University of Minnesota's F2P template (12) with technical assistance provided by facilitators.

Data collection occurred via a survey questionnaire administered in both paper/pencil and online formats at four points in time: before Level 1, before Level 2,

immediately after Level 2, and three to six months following the Level 2 workshops. The questionnaires were modified from a validated instrument used in previous projects assessing perceived value of food safety training (5, 14, 15). Modifications to the data collection tool reflected timing of survey administration. Information was obtained about participants' sales venues as well as planned and reported behaviors. At the beginning of each Level 1 workshop, participants were asked to complete the survey that assessed their food safety knowledge, attitudes, and current practices as well as obtaining demographic information. Before the Level 2 workshop began, participants completed a survey with reported food safety practices implemented since Level 1 training. Immediately after the Level 2 workshop, participants completed a survey to report what food safety practices they planned to implement within one year post workshops and those they will not change. A final assessment was sent electronically three to six months after the Level 2 workshops to all participants. This final online survey asked participants what practices had been changed on their farms since the training(s). The data collection instruments and protocol were reviewed by the Iowa State University Office for Responsible Research under the human subject protections regulations and were declared exempt. Data in tables 2, 3, and 4 are presented as percentages. Percentages represent the number of growers that indicated the food safety practices, out of the total number of respondents; answering questions was optional under IRB approval.

RESULTS AND DISCUSSION

In 2014, there were an estimated 168 authorized Iowa farmers' markets, with over 1,200 vendors of fruits and vegetables (6). The majority of locally grown fruits and vegetables in Iowa were produced on small-scale farms and used farmers markets as a major sales venue. Data showed the majority of participants in our GAP programs had been farming for less than 4 years (61.8%) and sold fewer than 3 crops directly to consumers (57.6%), or to foodservices (81.5%), or through farmers' markets (35.3%), auctions (23.5%), community supported agriculture (20.6%), and/or on-farm stands (8.8%) (Table 1). These data support the Iowa State University On-Farm Food Safety Team's observations of newer farmers selling fewer crops directly to consumers and more through farmers market and Community Supported Agriculture (CSA). In a 2005 survey of produce growers in Iowa, our team members found similar results of Iowa farmers' wanting to concentrate on fewer crops (2). This trend illustrates the need for targeted food safety education toward the small-scale grower community.

To identify current food safety behaviors, growers were asked what GAP principles they were following before and after the workshops. Table 2 shows percentages of the possible 70 participants (response to all questions was not mandatory) who reported they were currently practicing

identified food safety practices before taking the Level 1 GAP workshop. Survey data illustrated that 47% of growers already had hygiene training and hand washing sinks within the appropriate distance (less than ¼ mile) from the work site prior to attending the Level 1 workshop. The food safety practices reported as being performed by less than 10% of participants were those pertaining to written protocols for eating, drinking, and smoking; worker attire; and product holding during storage and transportation. Lack of documentation and written policies was a common theme in Level 1 and 2 workshops. "If you didn't write it down, sign and date it, then it never happened" is a common phrase used to illustrate the need for proper documentation. The basis of this phrase is the need for proof or evidence of an act occurring and supports the reasonable care legal doctrine that requires that steps be taken to mitigate risks (16). Findings from the survey data in this study were consistent with reported observations of relatively little use of written policies and procedures to guide practices among small-scale Iowa food producers (2). Improvement in documentation was a needs area identified by the mostly small-scale growers in this study and verbalized during the workshops.

At the beginning of the Level 2 workshop, the 64 grower participants were asked what food safety practices had been implemented since the Level 1 workshop (before Level 2 survey) and what practices would be implemented in the next year (after Level 2 survey) (Table 3). Although not all participants responded to every question, findings showed participants had introduced new practices into their operations, with over half of participants indicating well water testing documentation prior to the growing season had occurred (65.6%); accessible restrooms and hand washing sinks were in place (76.3%); and measures to restrict wild animals, domestic animals, and pets from food crops had been taken (70%, 57.7%, and 60.7% respectively); written procedures were in place for cleaning harvest containers (51.5%); and records were maintained for harvesting crops (63.9%). These results provide evidence that the presentation of basic GAP principles resulted in behavioral changes to improve on-farm infrastructure of written policies and document management.

Over half of the respondents indicated after the Level 2 training (n = 64) that written procedures would be developed for the following items within the next year: hand washing (50%); worker health (62.1%); eating, drinking, and smoking (60%); worker attire (55.6%); handling of bird or mammalian droppings (67.9%); preparation, use, and testing of sanitizing solutions (56.9%); and product holding during transportation (53.5%). Further, half the respondents planned to maintain records for cleaning and sanitizing of harvest containers (57.1%), cleaning of products (50.0%), product storage and holding temperatures (53.6%), product holding during transportation (69.6%), and cleaning and sanitizing of packing facilities (50.0%) within the next year.

Table 1. Buying and selling patterns of participants in the Level 1 Good Agricultural Practices workshops (n = 70). Values (n) are the number of growers that indicated that characteristic; answering questions was optional under IRB approval

Characteristic	Number of Respondents
Description of Participant (n = 70)	
Farm Owner	34
Farm Worker	17
Produce Vendor	12
Educator	7
Number of Years Selling Produce (n = 34)	
<1 yr	8
1–4 yr	13
5–9 yr	6
10–15yr	5
15+ yr	1
Buyers of growers' produce interest in food safety over the last years (n = 34); did the buyers ask about the growers' food safety practices?	
A lot	10
Some	12
A little	3
None to no	9
Number of products sold directly to consumers (n = 33)	
Do not sell directly to consumers	7
1–3 crops	12
4–6 crops	2
7+ crops	12
Number of products sold directly to foodservice (n = 27)	
Do not sell directly to foodservice	17
1–3 crops	5
4–6 crops	3
7+ crops	3
Other venues growers sold produce to (3 sold to more than 1 venue) (n = 34)	
Community supported agriculture (CSA)	7
Farmers' Market	12
Road Stands	3
On-farm Stands	7
U-Pick	2
Auction	8

Table 2. Food safety practices identified as in place prior to Level 1 Good Agricultural Practices workshop (n = 70 partially or completely filled out surveys). Percentage represents the number of growers currently following the food safety practice; answering questions was optional under IRB approval

Farm Practice	Number of respondents (n)	Respondents performing the practice (%)
Provides hand washing sinks with clean running water and soap within quarter mile walk for workers	41	61
Train workers about food safety fundamentals	40	48
Test well water annually (answer yes if use city water)	41	27
Control wild animal contact with crops through fencing or other method	41	24
Written procedures in place for hand washing	33	21
Written procedures in place for cleaning of surfaces	33	18
Written procedures in place for worker health	33	15
Written procedures in place for cleaning of products	33	15
Written procedures in place for eating, drinking, and smoking	33	9
Written procedures in place for product holding during storage	33	9
Written procedures in place for product holding during transportation	33	9
Written procedures in place for worker attire	33	3

Table 3. Characteristics of growers' food safety practices completed before Level 1 workshops, implemented between Level 1 and 2 workshops, and planned or not planned to be implemented in the next year. Percentage represents the number of growers who indicated the food safety practices, based on the number of respondents; answering questions was optional under IRB approval

Food Safety Practices					
	Number of respondents (n)	Did before workshop (%)	Implemented since workshop (%)	Plan to implement next year (%)	Not in plans for near future (%)
On-farm food safety practice:					
If municipal or rural water is used in your operation, documents are maintained for testing.	20	45	15	35	5
If well water is used in your operation, it is tested more than once during the season and documents are maintained.	32	66	3	28	3
If surface water is used in your operation, it is tested more than once during the season and documents are maintained.	9	11	0	11	78
Restrooms and hand washing sinks with clean water and soap are within quarter mile of workers.	38	76	0	18	5
Worker food safety practices training is conducted.	34	44	9	41	6

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Table 3. Characteristics of growers' food safety practices completed before Level 1 workshops, implemented between Level 1 and 2 workshops, and planned or not planned to be implemented in the next year. Percentage represents the number of growers who indicated the food safety practices, based on the number of respondents; answering questions was optional under IRB approval (cont.)

Food Safety Practices					
	Number of respondents (n)	Did before workshop (%)	Implemented since workshop (%)	Plan to implement next year (%)	Not in plans for near future (%)
Measures are taken in the field to curtail crop contact by:					
Wild Animals	29	70	10	14	7
Domestic animals	26	58	8	23	12
Pets	28	61	7	25	7
Birds	22	41	9	27	23
Use either raw or composted manure to fertilize my crops				Yes = 19	No = 7
<i>If yes, maintain record of manure applications</i>		37	11	42	11
<i>If making your own compost, maintain a record of composting procedures</i>		5	11	47	21
Written procedures are in place for:					
Hand washing	36	47	3	50	0
Worker health	29	34	3	62	0
Eating, drinking, and smoking	30	33	7	60	0
Worker attire	27	37	7	56	7
Bird droppings are found on product or when mammalian fecal matter is found in field	28	25	4	68	4
Cleaning harvest containers	33	52	9	36	3
Cleaning of products	34	44	9	44	3
Cleaning of food contact surfaces	34	44	9	47	0
Preparation, usage and testing of sanitizing solutions	32	34	13	57	6
Maintain records for:					
Cleaning and sanitizing harvest containers	28	39	4	57	4
Harvesting the crops	36	64	3	31	3
Cleaning of products	32	38	3	50	9
Product storage and holding temperature	28	29	11	54	7
Product holding during transportation	23	13	9	70	9
Cleaning and sanitizing packing facility	32	34	3	50	13
Cleaning and sanitizing restroom facilities	34	41	6	47	6

Table 4. Three to six month follow-up responses on food safety practices implemented since Level 2 Good Agricultural Practices workshop (n = 15). Percentage represent the number of growers who have implemented the given food safety practice; answering questions was optional under IRB approval

Food Safety Practices Changed	
Practices	n (%)
On-farm Practices	
Have clean packing room	15 (100)
Implement SOPs with food safety plan	14 (93)
Keep handling produce safer and cleaner	14 (93)
New personnel clothing policy	13 (87)
Clean produce equipment regularly	12 (80)
Conducted a Risk Assessment	12 (80)
Get toilets and wash sinks in place	11 (73)
Keep buckets for picking cleaner	10 (67)
Tested well and pond water	10 (67)
Wash hands regularly	10 (67)
Avoid cross-contamination from livestock-fowl to produce patch	8 (53)
Not go from chores to produce	8 (53)
Walk field for animal fecal matter	8 (53)
Hand washing stations	6 (40)
Restrict domestic animals from fields	5 (33)
Set up a place to set boxes on other than on floor	5 (33)
Different display practices at farmer's market	2 (13)
Written Procedures	
Develop plans for GAP and SOP	15 (100)
Train workers (workers also include children)	15 (100)
Traceability plan for all produce items	15 (100)
Sanitation SOPs	15 (100)
Visitors document their visit	11 (73)
Worker hygiene	11 (73)
Well testing documentation	8 (53)
Temperature of cooler	3 (20)
Training	
Train workers (workers also include children)	15 (100)
How to sanitize	15 (100)
Food safety plan	15 (100)
Hand washing	11 (73)
How to harvest	5 (33)

Results also revealed that growers identified new food safety practices to implement, suggesting that workshops had resulted in attitudinal changes as well as awareness of on-farm steps to mitigate risks of food borne illnesses.

Some studies have shown that enhancement in knowledge can change the behaviors and practices of participants (4, 7), while others have found that knowledge alone may not always result in behavioral changes (1, 9). *Table 4* provides a summation of changed policies and food safety practices reported by 15 participants three to six months after the two workshops. The 3–6 month follow up survey showed that the items of change most frequently identified were related to personnel clothing policy, risk assessments, testing of water, visitor policies, traceability plans and employee training. These participants also reported the addition of hand washing stations, development of sanitation procedures for equipment and facilities, implementation of written standard operating procedures (SOPs) as part of a food safety plan, and use of different display practices at farmers markets. Participants also indicated some restructuring of chore flow and increased emphasis on hand washing and cleaning of work surfaces. One limitation of our study was the low response rate for surveys administered later in data collection; this may be a function of survey fatigue. However, the tracking of reported behavior changes within a known cohort of producers provides insights into impacts of sequential workshops and supports educators' role as experts and facilitators.

Food safety educators should be encouraged by these results, which showed participants in sequential GAP workshops were able to transform principles into actions. We suspect the formation of relationships between producers and educators was also a contributing factor to reported changes in on-farm food safety practices. An earlier, observational case study of produce and egg farmers in Iowa selling direct to small foodservice outlets, or farmers' markets or through Community Supported Agriculture by team members (2) included one opportunity to interact with producers. Findings from the 2005 study revealed there was relatively little annual testing of water (6 of 11 farms did so); no availability of hand washing stations in the field; multiple uses of harvest containers (observed at 7 of the 11 farms), with cleaning and sanitizing of these occurring only annually at all 11; and inappropriate use of food packing materials at 3 of the 11 sites. These same themes have been shown by others conducting GAP assessments of small-scale growers.

Insight about GAP educational needs from GAP programming based outside of the country can provide guidance for U.S. GAP educators. Rodrigues and others (11) found, in a self-assessment survey of lettuce growers in southern Brazil, that manure composting was not adequately controlled and appropriate waiting times before application as an organic fertilizer to crop were not respected. Also, the selection of the water source ("stealth ingredient" due

to its widespread use) and the sanitary quality of the water used for irrigation were not under control (11). Ganpat and others (3) found similar results in a study of 196 Trinidad farmers having a low compliance rate with Good Agricultural Practices guidance as reported in a survey. They noted that better education through extension services and governmental intervention was needed (3). These reported findings of practices outside the U.S. are important, as a majority of crops are imported and there is thus a need for GAP education across borders.

We have learned through experience, teaching GAP across the state, that providing examples and tools to implement GAP principles within the farm setting empowers growers. Our results supported the assumption that small growers within Iowa benefitted from GAP education and the personalized attention to application of the knowledge in development of their farms' food safety plans. Prior to the workshops, participants reported, they did not consistently follow GAP practices; post workshop assessments indicated GAP education was effective in bringing about policy and behavior changes at the farm level. Growers working fewer acres of land or serving smaller market venues have different needs from those of larger growers serving wholesale markets. Tools and strategies that make food safety "user friendly" were perceived as useful.

Improvements in specific GAP, such as well water testing, record keeping, and availability of restroom and hand washing facilities, were reported. In addition, growers are taking steps to eliminate product contamination from wild animals, domestic animals, and pets, procedures for cleaning harvest hazards are in place, and records related to crop harvest traceability are being kept. In the Level 1 workshop, participants became knowledgeable about GAP. Level 2 offered the opportunity to develop a written food safety plan with technical assistance provided by food safety and marketing experts.

CONCLUSIONS

Our results show that growers understand the importance of putting GAP principles into action on their farms and highlight the need for continued training to raise awareness of produce safety risks and knowledge about mitigating risks. Food safety educators have the knowledge to communicate the information needed and assist in facilitating change. In these workshops, educators served as change agents by guiding participants through the steps of knowledge and applications of on-farm food safety practices, along with practical recommendations.

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