

North Central Region Center for FSMA Training,  
Extension and Technical Assistance

# **Produce Safety Alliance Grower Training Knowledge Assessment Results**

Regional Results, 2022

## Executive Summary

The Food Safety Modernization Act (FSMA) consists of seven Rules, including the Produce Safety Rule, which applies to those who grow, harvest, handle or pack fresh fruits and vegetables. One requirement of the Produce Safety Rule is that fruit and vegetable growers take an approved food safety course. The Produce Safety Alliance (PSA) Grower Training is the first approved course and has been offered by partners in the North Central Region since 2016.

These trainings have been evaluated for five years with a knowledge assessment, a 25-question quiz administered to participants before and after the training to measure knowledge change. New in year 5, some states collected profession and FSMA status from respondents. This report shares the results from 272 trainings held over the course of five years.

- 4,071 complete responses were received.
- In year 5, two-thirds (113 of 173) of respondents were farmers. Of the 99 farmers who shared sufficient information to determine their FSMA coverage status, two-thirds were not covered by FSMA, because they sold an average of less than \$25,000 of produce annually.
- Across the five years, respondents scored an average of 15.9 points out of 25 on the pre-test and 20.3 points on the post-test. These scores are significantly different ( $p < 0.001$ ), so one can conclude that participants gain knowledge during the training. Knowledge gain was highest in year 5, when scores improved by 5.6 points, from 15.3 points on the pre-test to 20.9 points on the post-test.
- Questions 11, 13, 21, 22, 24, and 25 were most often answered incorrectly on the post-test.
  - Although question 22 is among the most frequently missed questions on the post-test, it is also among the questions about which respondents most frequently learned the correct answer.
- The training had the most impact on knowledge related to modules four, five, six, and seven. Participants had relatively low pre-test scores on these modules and the highest level of knowledge gain on these modules.
- Participants in remote delivery trainings learned more and scored higher on the post-test than participants in face-to-face trainings.
- Tribal growers especially benefited from the training. Non-English/limited-English speaker trainings resulted in the lowest knowledge gain, which shows the difficulty of translating food safety concepts and terminology across languages.
  - On average, professionals scored highest on the post-test.
  - Participants in trainings for Tribal growers increased scores the most of any special population training, increasing scores by 6.1 points from 11.8 on the pre-test to 17.9 on the post-test.

- Participants in trainings for non-English or limited English proficiency growers had the lowest average pre-test and post-test scores, on average, and increased their scores by the least (1.6 points).
- Pre-test scores differ dramatically according to a person's profession, but most scored similarly on the post-test.
  - It is difficult to draw broad conclusions based on respondents' profession because of the small number of people in some categories. However, non-agricultural business employees learned the most at the training, increasing their scores on average by 7.5 points from 15.0 on the pre-test to 22.5 on the post-test (but there were only two people in this category).
  - Educators learned the least and scored lowest on the post-test, increasing scores by an average of 3.7 points from 14.2 on the pre-test to 17.9 on the post-test.
- Respondents from farms fully covered by FSMA increased scores by an average of 4.0 points, which is slightly lower than growers of other FSMA coverage statuses. Those from covered farms also had the lowest post-test score, on average.

The following recommendations are shared at the end of the report:

- If allowed, continue to offer PSA Grower Trainings using remote delivery even after the COVID-19 pandemic wanes, to accommodate growers who are unable to travel to face-to-face trainings.
- Continue to offer additional educational resources and events to Plain clothes growers, because they continue to score lower on the knowledge assessment than other populations.

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## North Central Region

Center for FSMA Training, Extension  
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## Introduction

The Food Safety Modernization Act (FSMA) was passed by Congress, and then in January 2011, signed into law by President Obama. The law consists of seven Rules, including the Produce Safety Rule, which applies to those who grow, harvest, handle or pack fresh fruits and vegetables. One requirement of the Produce Safety Rule is that fruit and vegetable growers take an approved food safety course. The Produce Safety Alliance (PSA) Grower Training is the first approved course and is offered in the North Central Region by several partners of the North Central Region Center for FSMA Training, Extension and Technical Assistance (NCR FSMA).

Between July 1, 2021, and June 30, 2022, NCR FSMA partners offered and evaluated 37 PSA Grower Trainings. Of these trainings, 24 were offered using remote delivery, because of the COVID-19 pandemic. In total, 272 trainings have been held and evaluated since Fall 2017. In collaboration with partners, the NCR FSMA evaluated these trainings using a knowledge assessment. This report shares the results from trainings held over the course of five years.

## Methods

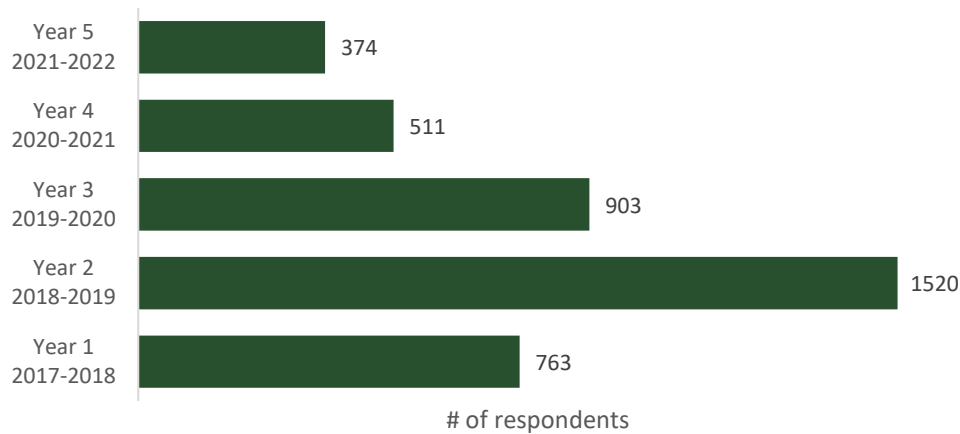
The knowledge assessment was developed by Dr. Catherine Shoulders at the University of Arkansas. The knowledge assessment is a quiz with 25 questions related to the seven modules of the PSA Grower Training. The NCR FSMA has been utilizing the knowledge assessment since 2017.

Training participants were asked to complete the quiz before beginning the training and again after the training. Remote delivery participants completed the assessment online and face-to-face participants completed it on paper. The online survey was conducted using a Qualtrics survey, which the NCR FSMA evaluation team set up. Pre-test and post-test responses were matched using a unique identification number or word, along with the date of the training, and the state.

New in year 5, the knowledge assessment included three questions to better understand demographics of respondents. The first question asked the respondents' profession, and the next two questions were used to identify the FSMA coverage status of respondents who identified as farmers or growers. This newer version of the knowledge assessment was not used by all states. In one case the new questions were used during remote delivery trainings, but not face-to-face trainings, because the paper copies used for face-to-face trainings were printed prior to adding the questions. In total, 170 respondents answered these questions.

Only responses which included both a pre-test and a post-test from the same person were included in the analysis. (In a few cases, a person completed only the pre-test or only the post-test.) In total, 4,071 complete responses have been received from the region since year 1 (2017-18), from 272 trainings. Figure 1 shows the number of responses collected in each year. The number of responses has steadily declined since year 2, reflective of the number of people trained in each year.

**Figure 1: The number of responses has steadily declined since year 2.**



The NCR FSMA evaluation team analyzed the data using SPSS™.

In addition, training organizers completed a cover sheet for each training. The cover sheets provided information including the date of the training, the location, names of trainers, the number of participants, types of supplemental educational activities conducted during the training, and whether the training was targeted towards any special population. Special populations tracked included Plain clothes growers (which includes Amish and Mennonite growers), minority growers, local food growers, military veterans (although no trainings have been offered in the NCR to this population), non-English/limited English language (all have been for Spanish-speaking audiences), students, tribal growers, beginning farmers, professionals, and other.

Years 4 and 5 saw a proliferation of multi-state trainings, when NCR FSMA partners jointly taught remote trainings, as shown in Table 1. A total of 18 trainings have been offered as a collaboration between states using remote delivery, with 193 complete responses.

While the Wisconsin Department of Agriculture, Trade, and Consumer Protection held two trainings in year 4, they did not conduct the knowledge assessment, because of a change in staff responsibilities at DATCP.

**Table 1: Over 4000 people have responded to the knowledge assessment since year one.**

	# of responses						# of trainings					
	Year 1 2017- 18	Year 2 2018- 19	Year 3 2019- 20	Year 4 2020- 21	Year 5 2021- 22	Total	Year 1 2017- 18	Year 2 2018- 19	Year 3 2019- 20	Year 4 2020- 21	Year 5 2021- 22	Total
<b>SINGLE STATE TRAININGS</b>												
Illinois	-	86	179	-	-	266	-	5	7	-	-	12
Indiana	91	161	57	166	60	532	9	14	5	22	9	59
Iowa	184	164	131	13*	43*	535	11	14	9	2*	3*	39
Kansas	57	59	64*	*	4*	184	3	6	4*	*	1*	19
Michigan	-	277	178	185	89	728	-	13	8	16	6	43
Minnesota	131	276	71	43	37	556	5	15	5	4	3	32
Missouri	62	155	109*	*	10*	336	3	10	5*	*	1*	19
Nebraska	54	12	15	*	8*	89	2	2	1	*	1*	6
North Dakota	-	-	-	*	*	0	-	-	-	*	-*	-
Ohio	-	-	-	-	-	0	-	-	-	-	-	-
South Dakota	9	16	-	*	*	25	1	1	-	*	-*	2
Wisconsin	179	326	82	-	41	627	6	13	5	-	4	28
<b>MULTI-STATE TRAININGS*</b>												
Kansas and Missouri	-	-	7	54	55	116	-	-	1	5	6	12
Iowa and Nebraska	-	-	-	43	0	43	-	-	-	2	-	2
Nebraska, North Dakota, and South Dakota	-	-	-	7	0	7	-	-	-	1	-	1
Iowa, Nebraska, North Dakota, and South Dakota	-	-	-	-	27	27	-	-	-	-	3	3
<b>Total</b>	767	1,532	893	511	374	4071	40	93	50	52	37	272

\*See multi-state trainings.



## Results

### **Who completed the knowledge assessment in year 5?**

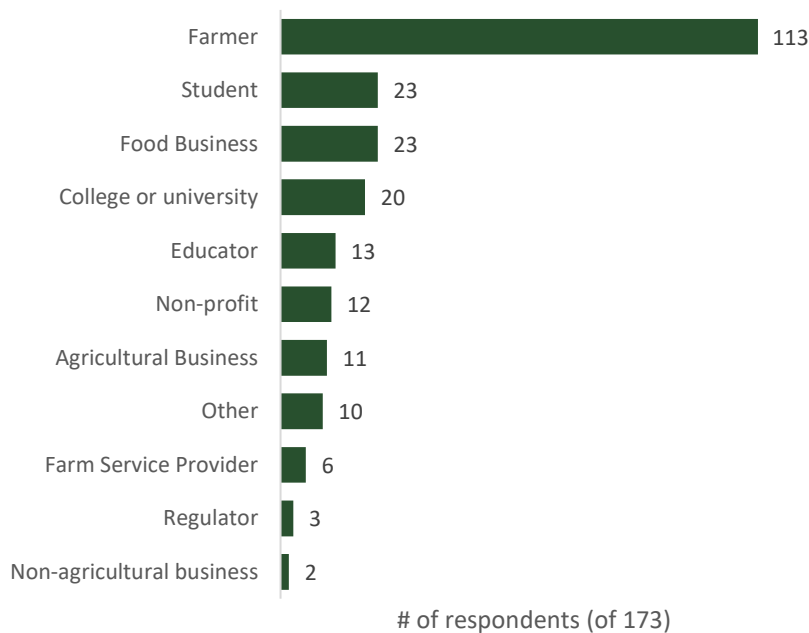
*Two-thirds of year 5 respondents were produce growers. Growers who responded were most commonly not covered by FSMA.*

Starting in year 5, the knowledge assessment included three questions to better understand who was completing the assessment. The first question asked respondents to identify their profession, and the next two questions were used to identify the respondents' FSMA coverage status, if they were growers.

Figure 2 shows that 66 percent of respondents identified as farmers or growers (113 of 170 respondents) followed by students and food business employees (23 respondents each, 13 percent). While the training was developed for produce growers, a surprising number of people who are not produce growers participate in a training.

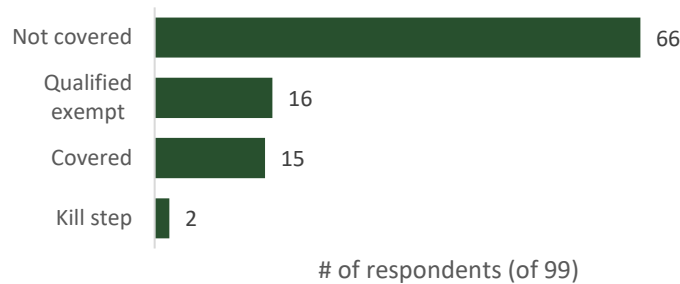
Respondents could select multiple answers. Forty-nine (29 percent) respondents selected more than one answer, showing it is not uncommon for participants to hold multiple roles related to produce.

**Figure 2: Over half of year 5 respondents were growers.**



In total, 99 growers shared sufficient information to determine their FSMA coverage status. Figure 3 shows that 66 percent were not covered by FSMA because they sell less than \$25,000 annually of produce, making it the most common status. Sixteen respondents were qualified exempt and 15 were fully covered. Two respondents are believed to be exempt from FSMA because they sell the majority of their produce to a processor and sell an average between \$25,000 and \$500,000 of produce annually. It is assumed the processor uses a kill step when processing the produce. If this assumption is untrue, these growers may be covered by FSMA.

**Figure 3: Most farmers were not covered by FSMA because they sell less than \$25,000 annually of produce.**



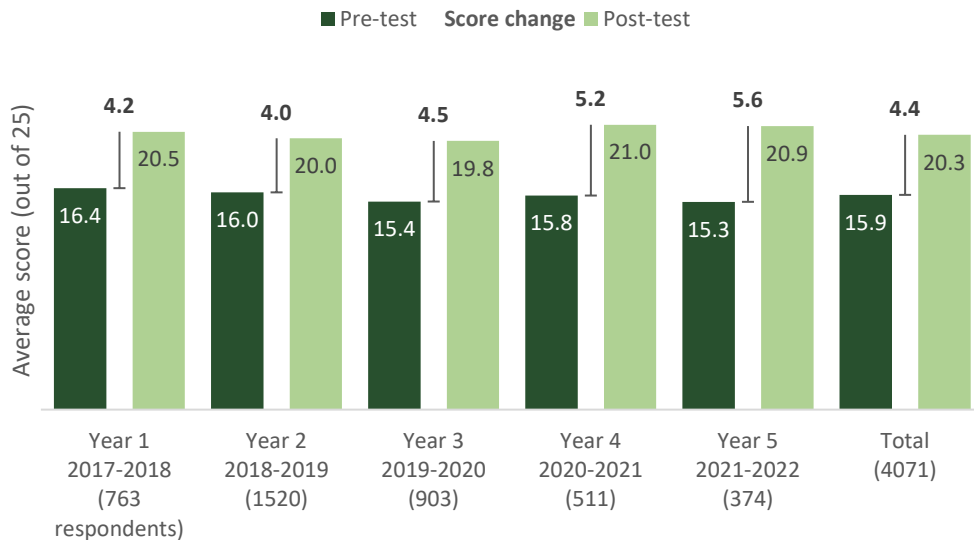
***How much did respondents’ food safety knowledge improve during the training?***

*Participants learned more from trainings held in year 5 than other years.*

Pre-test scores have remained steady over the years, ranging from 15.3 points out of 25 in year 5 to 16.4 points in year 1 (Figure 4).

The average post-test scores were higher in years 4 and 5 (21.0 and 20.9, respectively) than in previous years. Finally, scores improved on the test by 5.2 points, on average, in year 4, and 5.6 points in year 5, higher than previous years.

**Figure 4: Score change was highest in years 4 and 5.**



### **Which questions were still unclear even after the training?**

*Six questions accounted for 50 percent of all incorrect answers on the post-test.*

A few questions on the knowledge assessment were particularly difficult for respondents to answer correctly, even after participating in the course. The questions that were most often answered incorrectly on the post-test were questions 13, 18, 21, 22, 24, and 25 (Figure 5). Most of these questions are at the end of the quiz. It is possible that respondents are fatigued by the time they reach the final page of the assessment, explaining why so many questions are missed. In addition, some of those questions test knowledge multiple modules, which may make them more difficult to answer correctly.

**Figure 5: Questions 13, 18, 21, 22, 24, and 25 were most often answered incorrectly on the post-test.**

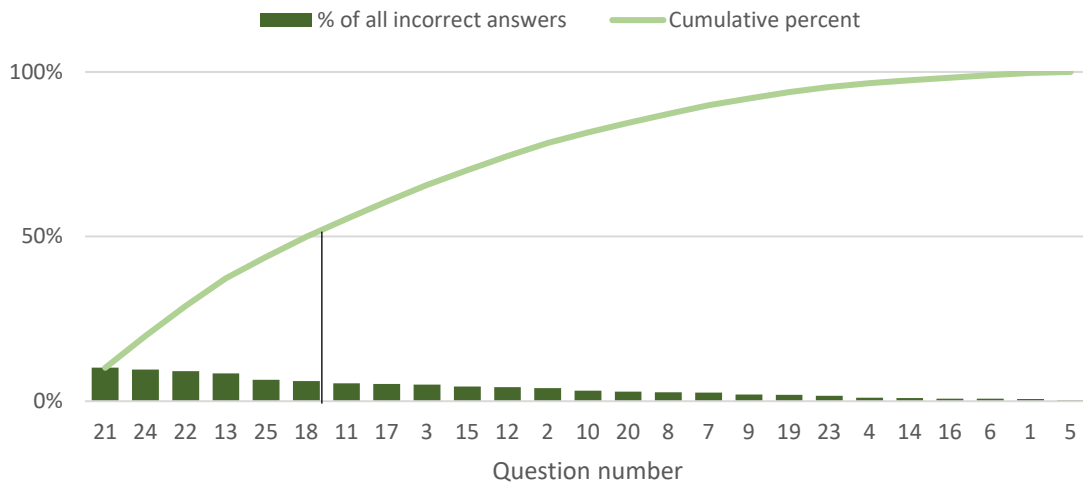
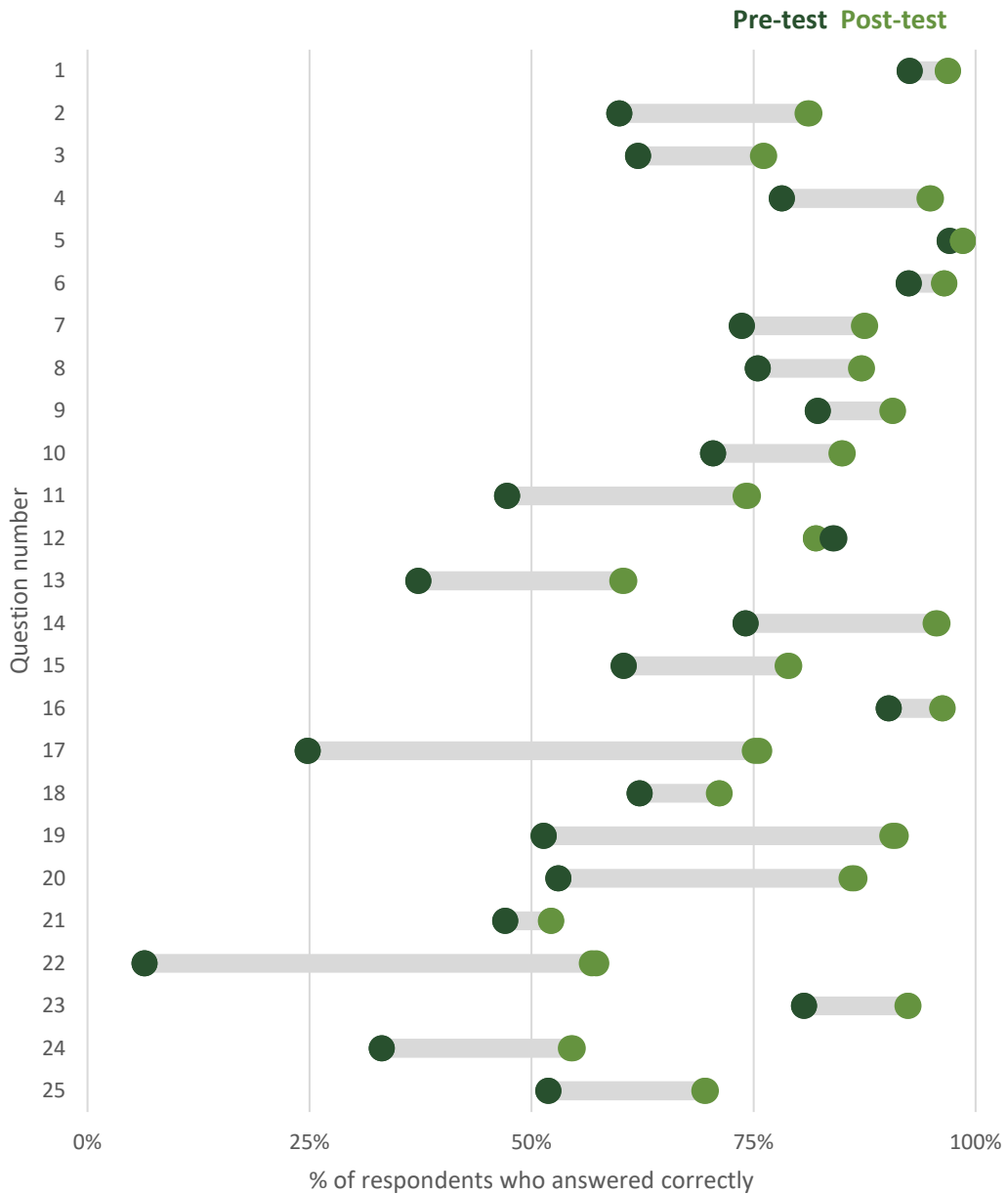


Figure 6 shows the percentage of respondents who correctly answered each question on the pre-test compared with the post-test. Respondents improved their score the most on questions 17 and 22. Therefore, while question 22 is among the most frequently missed questions on the post-test, it is also among the questions about which respondents most frequently learned the correct answer.

Interestingly, fewer people answered question 12 correct on the post-test (80 percent) than on the pre-test (82 percent), making it the only question on which respondents decreased knowledge. However, the vast majority of respondents knew the correct answer at the beginning of the training.

All pre-test scores are significantly different than the corresponding post-test score with  $p < 0.001$ .

**Figure 6: Scores improved the most on questions 17 and 22. The least on questions 5 and 12.**



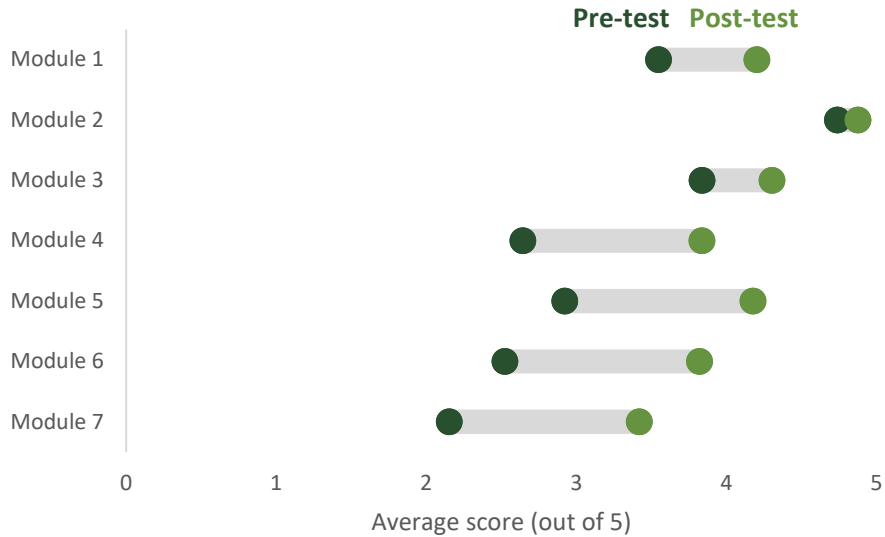
***How did scores and score change compare between training modules?***

*Participants entered the training with a relatively high knowledge of modules 1, 2, and 3, and thus learned less on those modules. Their incoming knowledge of modules 4, 5, 6, and 7 was lower, and they learned more on these modules.*

A paired samples t-test showed that participants gained knowledge on all modules ( $p < 0.001$  on all modules). Knowledge gained varied from 0.1 points on module two to 1.3 points on modules five, six, and seven.

Knowledge gained was closely related to pre-test scores. Figure 7 shows that on the first three modules pre-test scores were relatively high, meaning participants had a relatively high knowledge of these modules before taking the training. Thus, participants learned less about those modules. In contrast, pre-test scores were relatively low on modules four, five, six, and seven. Therefore, participants had room for improvement on these modules, and the assessment showed that they learned more about these modules than the first three.

**Figure 7: Scores significantly improved from pre-test to post-test on all modules.**



### ***Did knowledge change at remote delivery trainings differ from face-to-face trainings?***

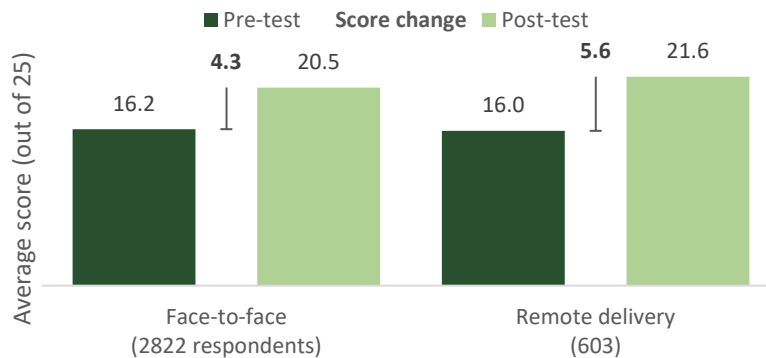
*Participants in remote delivery trainings learned more and scored higher on the post-test than participants in face-to-face trainings.*

To determine if learning at remote delivery trainings was any different than face-to-face trainings, the NCR evaluation team compared knowledge change scores between the two types of trainings using data from all years. Trainings for Plain clothes growers and growers who do not speak English were removed from the analysis, because they did not participate in remote delivery trainings. Removing these two populations allows the analysis to compare similar populations, thus removing any confounding effects these special populations could have on the results.

Figure 8 shows that on average remote delivery participants had similar knowledge assessment scores on the pre-test (16.0) as participants in face-to-face trainings (16.2 points). The difference between pre-test scores is not statistically significant ( $p=0.303$ ). Therefore, remote delivery participants came to the training with the same level of baseline knowledge as face-to-face participants.

The average post-test score was higher for remote delivery participants (21.6) than face-to-face participants (20.5), and the difference is statistically significant ( $p < 0.001$ ). Finally, on average scores increased by 5.6 points at remote trainings, significantly higher than at face-to-face trainings (4.3,  $p < 0.001$ ). Hence, one can conclude that participants in remote delivery trainings learned more on average than participants in face-to-face trainings, and they ended the training with a higher knowledge of on-farm produce safety and FSMA.

**Figure 8: Remote delivery participants learned more, on average, than face-to-face participants.**



When taking the knowledge assessment on paper, some respondents chose multiple answers to a question, as opposed to one answer, and therefore received zero points for that question. In contrast, participants in remote delivery trainings took the assessment electronically and could only choose one answer. Had participants in face-to-face trainings been forced to select one answer they may have gotten the question right. To test whether forcing participants in face-to-face trainings to choose one answer would have increased their average scores and

account for the differences between face-to-face and remote delivery trainings, the evaluators created several scenarios:

1. In scenario 1, respondents were awarded 0.25 points on questions for which they had selected multiple answers, which is the probability they would select the correct answer if they randomly chose one of the four answer choices.
2. In scenario 2, respondents were awarded 0.33 points on questions for which they had selected multiple answers, which is the probability they would select the correct answer assuming they could eliminate one answer choice as incorrect and then randomly select an answer from the three remaining choices.
3. In scenario 3, respondents were awarded one point on questions for which they had selected multiple answers, which is an extreme case assuming all respondents would select the correct answer if forced to choose one.

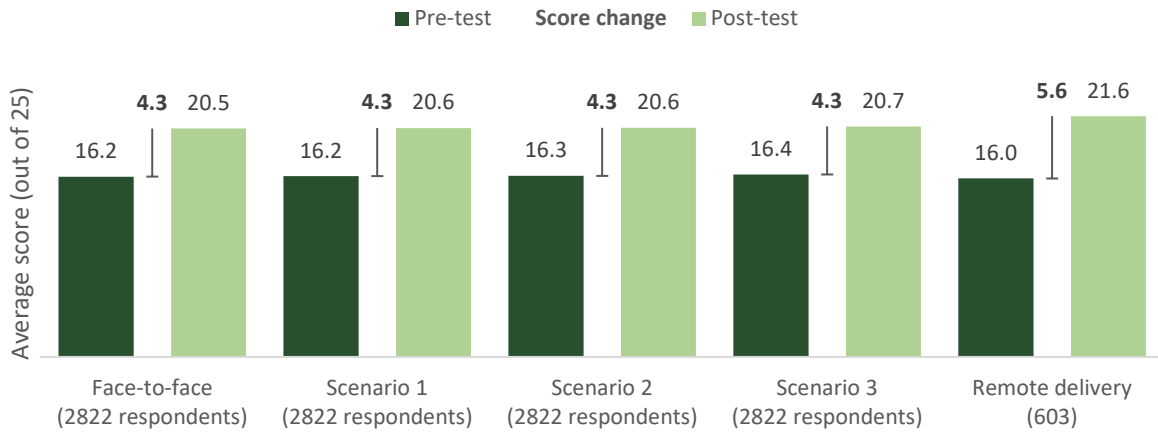
In each of these scenarios, the average pre-test and post-test score for face-to-face trainings were slightly higher than in the original analysis (Figure 9). In each scenario the average pre-test score of face-to-face participants was higher than the average pre-test score of remote delivery participants, and the difference was statistically significant only between scenario three and remote delivery ( $p=0.045$ ). While scenario three is the least realistic of the scenarios, if scenario three represents reality, one can conclude that face-to-face participants came to the training with a higher knowledge of FSMA and food safety than remote delivery participants, which actually strengthens the case that remote delivery participants learned more.

In the case of the post-test and score change measures, in all scenarios, remote delivery trainings continue to have higher scores than face-to-face trainings, and the differences between remote delivery and face-to-face trainings remained statistically significant on the post-test and change scores ( $p < 0.001$  for all scenarios compared with remote delivery for post-test and change scores).

*In conclusion, participants in remote delivery trainings scored higher on the post-test and increased their scores by more points on average than participants in face-to-face trainings. One question that cannot be answered using the knowledge assessment data is whether the better performance of remote delivery trainings was due to the delivery mode, to differences between populations who might choose or have access to remote delivery trainings and populations who might not, or other factors.*



**Figure 9: All scenarios confirm that remote delivery participants scored higher on the post-test and learned more than face-to-face participants.**



### How did trainings for special populations perform?

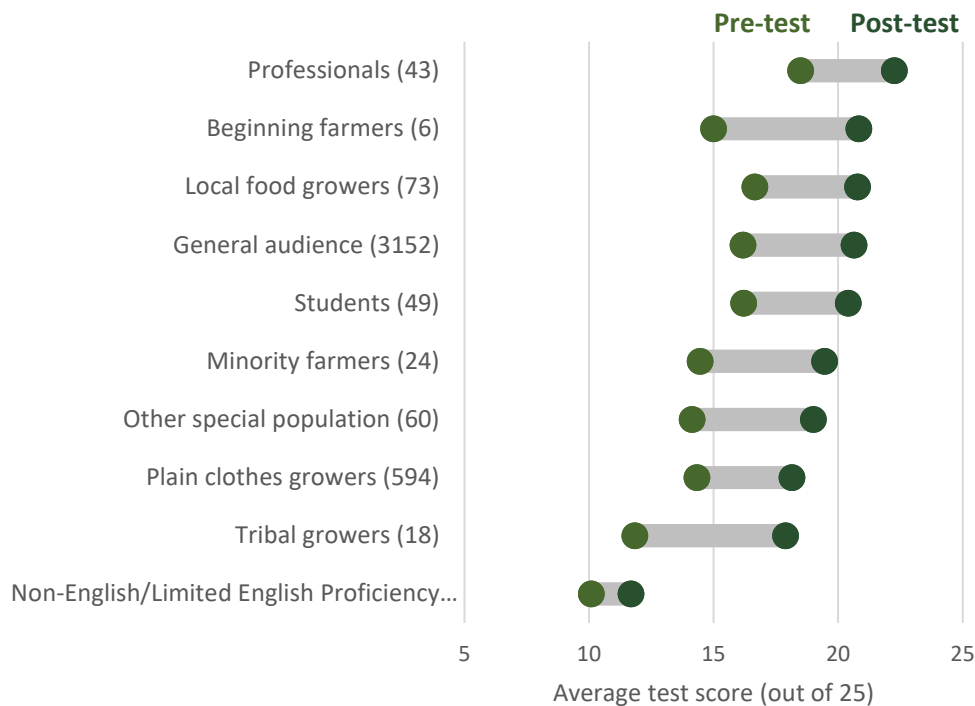
*Tribal growers especially benefited from the training. Non-English/limited-English speaker trainings resulted in the lowest knowledge gain, which shows the difficulty of translating food safety concepts and terminology across languages.*

Figure 10 shows the average pre-test and post-test scores from trainings for special populations as well as trainings for general populations. On average, professionals, such as regulators or employees of state departments of agriculture, scored highest on both the pre-test and post-test. While tribal growers had one of the lowest average pre-test scores, they improved their scores by more than any other audience (an average of 6.1 points). This is followed by beginning farmers, whose scores increased on average by 5.8 points.

Participants in trainings for non-English or limited English proficiency growers had the lowest average pre-test and post-test scores, on average, and increased their scores by the least (1.6 points). While these trainings were offered in the growers' first language, Spanish, this shows the difficulty of translating food safety concepts and terminology across languages.

Finally, Plain clothes growers continued to have relatively low pre-test and post-test scores, as in past years. This supports the need for continued outreach to this population.

**Figure 10: Average scores varied widely by audience.**



**What differences in scores were found between types of respondents?**

*Pre-test scores differ dramatically according to a person’s profession. People from non-agricultural businesses learned the most and scored highest on the post-test and educators learned the least and scored lowest on the post-test, on average.*

*Respondents from farms fully covered by FSMA increased scores by an average of 4.0 points, which is slightly lower than growers of other FSMA coverage statuses. Those from covered farms also had the lowest post-test score, on average.*

Figure 11 shows knowledge assessment scores of people with different professions from year 5, the only year when this information was collected from respondents. It is difficult to draw broad conclusions based on the information in Figure 10 because of the small number of people in some categories. However, non-agricultural business employees appeared to learn the most at the training, increasing their scores on average by 7.5 points from 15.0 on the pre-test to 22.5 on the post-test (but there were only two people in this category).

Educators, with 13 respondents, increased scores by the least (3.7 points) and scored lowest on the post-test, on average. This could be that these respondents had a lower baseline knowledge of farming, making it difficult to assimilate the information. In contrast, regulators also had low knowledge gain (4.0 points), but this may be because they had relatively high pre-test scores when compared with other professions and, therefore, had less room for improvement.

**Figure 11: Employees of non-agricultural businesses learned the most from the training and had the highest average pre-test score.**

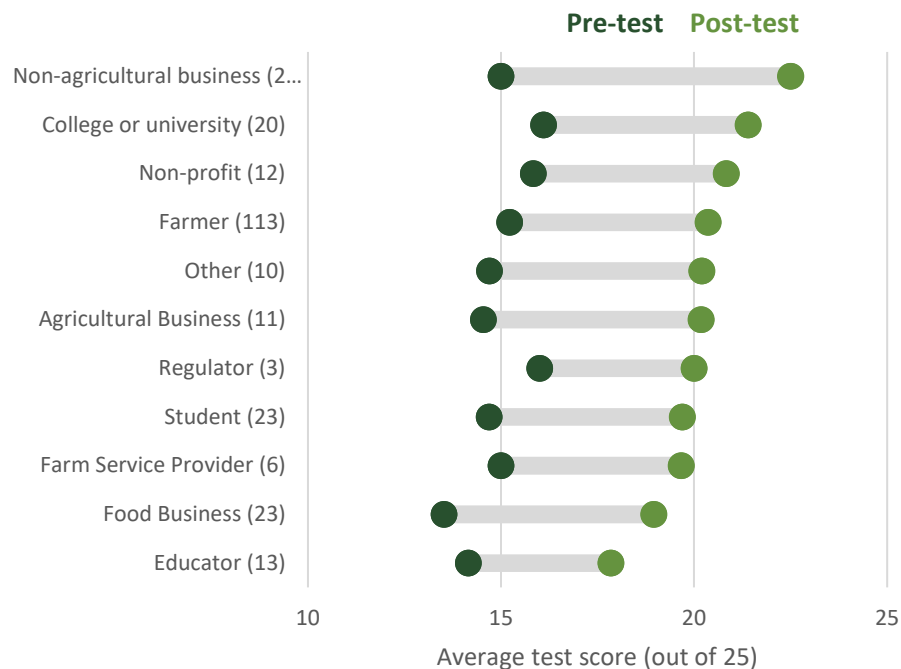
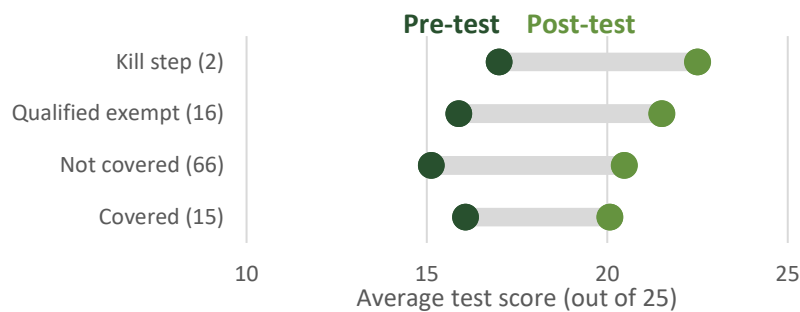


Figure 12 shows pre-test and post-test scores according to the FSMA coverage status of farmers. It shows that the growers who sell their produce to processors (who presumably use a kill step) scored highest on the pre-test and post-test. Those whose product goes through a kill step, those who are qualified exempt, and those not covered by FSMA had very similar knowledge gain, ranging from 5.4 points among those not covered by FSMA to 5.6 points for those whose farms are qualified exempt.

Respondents from farms fully covered by FSMA increased scores by an average of 4.0 points, which is slightly lower than growers of other FSMA coverage statuses. Those from covered farms also had the lowest post-test score, on average. If these results are generalizable, one could conclude this training was less useful to them than farms of other coverage statuses. This is somewhat ironic, because people from fully covered farms are the only ones who are required to take the training. However, the low number of respondents makes it difficult to draw firm conclusions from the data.

**Figure 12: People from farms fully covered by FSMA learned the least from the training.**



## Conclusion and recommendations

The knowledge assessment has consistently shown that participants in the Produce Safety Alliance Grower Training increase knowledge related to FSMA and food safety. Participants have increased knowledge on all modules and all special populations increased knowledge from pre-test to post-test.

Regionally, remote delivery trainings performed better than face-to-face trainings, with post-test scores and score change significantly higher than face-to-face trainings.

Therefore, these recommendations result from the knowledge assessments:

- If allowed, continue to offer PSA Grower Trainings using remote delivery even after the COVID-19 pandemic wanes, to accommodate growers who are unable to travel to face-to-face trainings.
- Continue to offer additional educational resources and events to Plain clothes growers, because they continue to score lower on the knowledge assessment than other populations.

