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Using Multimedia to Help Agricultural Producers Communicate with Consumers about GMOs

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Abstract. Genetically modified organisms (GMOs) and their uses are often misunderstood. Consumers are regularly unsure what GMOs are, or if they are safe for consumption and the environment. Contradictory and sometimes inaccurate information is available from numerous sources, and challenges consumers and others to separate the facts from sensationalized stories. Agricultural producers often communicate with consumers, neighbors, and members of the general public; however, they do not have information to share about GMOs. Multimedia resources can provide agricultural producers with science-based information to share with consumers. Agricultural communicators and Extension educators can create science-based multimedia resources to bridge the communication gap.

Genetically modified organisms (GMOs) are generally poorly understood by the public in the United States (Gibson et al., 2022; Higgins, 2018; Maghari & Ardekani, 2011; PytlikZillig et al., 2018). Agricultural producers and educators need to better communicate with consumers about GMOs (Bhatta & Dasgupta Misra, 2016; Jenkins et al., 2021; Lucht, 2015). Clarifying the science of GMOs with a multimedia approach is one method our University of Connecticut (UConn) Extension team explored to share information with producer and consumer audiences.

Agricultural producers often struggle to communicate with their customers about GMOs and are more accepting of GMOs than consumers are (Wunderlich & Gatto, 2015). Many consumers want GMO products labeled because they distrust science and food manufacturers (DeLong & Grebitus, 2017). Others prefer mandatory labeling because GMOs are complex enough that they prefer someone else make usage decisions (McFadden & Lusk, 2016). Educational outreach is needed to bridge knowledge and acceptance gaps and to help producers communicate with their consumers. Multimedia approaches are one method shown to improve understanding (Jenkins et al., 2021; Mayer, 2019).

The International Food Information Council Foundation (2018) found that 80% of consumers are confused about their food choices. GMOs are a topic that many consumers have chosen not to review or that they have received conflicting information about (Gibson et al., 2022; McFadden & Lusk, 2016). Previous research has also shown an increased belief in the validity of misinformation (Deng & Hu, 2019; Gibson et al., 2022). However, one group of consumers asked to reflect on GMOs reported a lower level of knowledge and a higher level of food-safety belief (McFadden & Lusk, 2016). Most communication campaigns focus on GMO benefits for agricultural producers, not consumers (Higgins, 2018). Consistent and targeted communications could better inform consumers while addressing identified consumer concerns (Jenkins et al., 2021; Ruth & Rumble, 2019).

In 2017, we embarked on a project attempting to inform targeted, segmented audiences about the science of GMOs. We used a multimedia approach to clarify the science of GMOs and help agricultural producers communicate with their customers about GMOs. We hypothesized that the multimedia approach would increase knowledge levels among agricultural producers and consumers. We sought to reduce confusion through consistent messaging in a pro-science format from university sources.

CONCEPTUAL FRAMEWORK

Multimedia, or the use of more than one communication method, improves long-term memory of concepts presented by increasing cognitive function in the learner through active processing (Mayer, 2019). Our team created materials using several methods, but we could not always control how many communication methods our target audiences saw. Our goal was that multiple communication methods would allow them to connect with the information in their preferred medium. Communication from agricultural experts, including

universities, provides consumers with a source for research-based, timely, and unbiased information (Ruth & Rumble, 2019) and builds bridges that connect with stakeholders who are on information overload (Reed, 2018).

Message frames influence public perception (Bhatta & Dasgupta Misra, 2016; Jenkins et al., 2021); therefore, GMO messaging techniques need to shift and focus on shared values between agriculture and consumers (Lucht, 2015). Messages must be tailored to the audience and be within the range of their expectations; otherwise, they will be discredited (Jenkins et al., 2021; Yuan et al., 2019). The bridge-building concept was successfully used by the International Food Information Council to address and support biotechnology communications with various stakeholders (Reed, 2018). We created much of our communication material for the consumer audience and strove for resources to complement and build off one another.

PURPOSE

Our first goal was to understand what information producers needed to communicate with their consumers. The second goal was to create a multimedia campaign to address the communication needs of agricultural producers, including direct communications with consumers by the university. Our Extension team sought to increase consumer knowledge by serving as a resource for consistent communication messages about GMOs. Other agricultural communicators could adopt similar multimedia practices with their audiences.

METHODOLOGY

We sought to identify and comprehend consumer concerns about GMOs and the communication resources that agricultural producers need. Once we ascertained consumer concerns and the communication resources needed, our team developed a communication strategy to help provide science-based information for consumers and agricultural professionals that would connect the audiences to the issue—in this case, GMOs (Reed, 2018). We included multimedia for agricultural producers to share information with their consumers and increase producers' confidence in answering questions about GMOs. Individual producers and consumers should form their own opinions about GMOs by using unbiased research, and we wanted to provide that through the multimedia campaign.

Our project had three phases: we (a) surveyed our audiences, (b) developed messages and multimedia, and (c) evaluated our efforts and adjusted communications as needed. We developed two distinct surveys on GMO knowledge, understanding, and willingness to try agricultural products. One survey was for agricultural producers, and the second targeted consumers. We implemented the surveys before developing GMO communication materials, and the data collected shaped our strategy.

AGRICULTURAL PRODUCER SURVEY

Team members developed a short survey for producers by using Qualtrics. We tested the survey with a smaller sample size, adjusted a few questions, and distributed the survey through email LISTSERVs managed by Extension educators and the State Department of Agriculture.

Questions included multiple-choice, sliding-scale, and text-entry formats. Multiple-choice questions were asked about the county of residence, the type of farm, and whether neighbors and customers asked questions about GMOs. A slider question asked producers how knowledgeable they were about GMOs (1 = extremely knowledgeable, 7 = not knowledgeable at all). Text-entry questions asked about the types of questions producers received and resources they wanted Extension to provide. The survey collected the names and email addresses of producers interested in receiving GMO resources for their farms.

CONSUMER SURVEY

The consumer survey had 10 questions and was distributed through Extension's Facebook page. Multiple-choice questions included gender, age, and residence (urban, suburban, or rural). The survey also asked whether consumers checked to see whether their products contained GMOs, whether they felt safe eating GMOs, and whether they had seen information from Extension about GMOs. The slider question consisted of five parts:

1. How risky would you say GMO foods are in terms of their effects on human health?
2. How willing are you to consume foods produced with GMO ingredients?
3. How willing would you be to consume GMO food if it reduces the amount of pesticide applied to crops?
4. How willing would you be to purchase GMO food if it is more nutritious than similar food that isn't genetically modified?
5. How willing would you be to purchase GMO food if it poses a risk of causing allergic reactions for some people?

The slider scale ranged from 1–7, where 1 was "extremely safe/willing" and 6 was "extremely risky/unwilling." Option 7 was "don't know." A text-entry question asked respondents to name one of the 10 genetically modified crops available at the time of the survey.

Table 1. Producers' Knowledge Level About Genetically Modified Organisms

Question	Minimum	Maximum	*M*	*SD*	Variance
How knowledgeable would you say you are about the facts and issues concerning genetic modification in food production?	1.00—Extremely knowledgeable	7.00—Not knowledgeable at all	3.02	1.62	2.61

FINDINGS

We distributed the surveys concurrently and then analyzed the data. Results demonstrated confusion about GMOs and outlined the resources that producer and consumer respondents were seeking to better understand GMOs.

AGRICULTURAL PRODUCER SURVEY

A total of 83 producers representing all counties completed the survey. The mean for how knowledgeable producers were about GMOs was 3.02; producers generally found themselves moderately knowledgeable about GMOs (see Table 1).

Of the respondents, 49 stated that they had received questions about GMOs from their neighbors and customers, while 26 stated that they had not received questions. Some respondents did not answer this question. Consumer questions that producers had received included:

1. Why are GMOs used?
2. Are GMOs safe to eat?
3. Which crops have GMOs?
4. What is the difference between GMO and organic?
5. Should I, the consumer, pay more for non-GMO food?
6. Do your crops have GMOs in them?
7. What are the health effects of consuming GMO products?
8. Are GMOs safe for the environment?

Producers asked for GMO communication resources to share with their customers. Resources requested included:

- A website with GMO information
- A list of GMO crops
- GMO talking points, including the latest trends
- Posters and educational lessons
- Articles
- Social media posts
- Handouts
- Educational sessions and seminars
- Continued research
- Science-based information
- Information about the difference between modification for human health, to increase yield, and for herbicide use
- Facts about GMO use and land stewardship
- Information about the benefits of GMOs
- Cost of production in GMO crops versus non-GMO crops
- How crops are modified, specifically on the cellular level
- The difference between GMO and genetic engineering
- Benefits versus risks
- An overview that shows the positive and negative sides of GMOs

One producer respondent requested as many resources as possible and to increase the amount of research on GMOs. The producer cited having their own fears about GMOs and stated that information provided could be useful for the producer as well as for consumers and neighbors.

CONSUMER SURVEY

A total of 56 consumers completed the survey, and 89% of the respondents were female. They included urban, suburban, and rural residents, and their ages varied from 18 to 55 and over. Respondents stated that they were "moderately willing" to consume GMOs. They were generally neutral on whether GMO crops were risky and their willingness to consume them (see Table 2).

Naming one GMO crop was an open-ended question; only two respondents could not provide a correct answer. Corn was the most frequently listed crop, and many respondents listed multiple crops. A few answers included incorrect crops, such as oranges, watermelons, and bananas (see Figure 1).

Checking whether products contained GMOs was not a priority; 25% of the respondents sometimes checked whether their products contained GMOs, and 45% stated that they never checked. Only 14% always checked to see whether a

Table 2. Consumer Willingness and Risk Associated With Genetically Modified Organism Foods

Question	Minimum	Maximum	*M*	*SD*	Variance
How risky would you say GMO foods are in terms of their effects on human health?	1 –extremely safe/willing	6—extremely unsafe/unwilling	3.55	2.05	4.22
How willing are you to consume foods produced with GMO ingredients?	1	6	4.01	2.09	4.40
How willing would you be to consume GMO food if it reduces the amount of pesticide applied to crops?	1	6	3.58	2.14	4.59
How willing would you be to purchase GMO food if it is more nutritious than similar food that is not genetically modified?	1	6	3.70	2.14	4.57
How willing would you be to purchase GMO food if it poses a risk of causing allergic reactions for some people?	1	6	4.32	1.84	4.06

Figure 1. Consumer listing of genetically modified organism crops.

Figure 2. Advertisement for genetically modified organism information.

product contained GMOs, 10% checked most of the time, and 6% checked about half of the time. On the question "I feel safe eating GMOs," 27% of the respondents strongly agreed, 34% agreed or somewhat agreed, 6% neither agreed nor disagreed, 19% somewhat disagreed or disagreed, and 14% strongly disagreed.

EXTENSION'S RESPONSE: MULTIMEDIA RESOURCES

Our team built a suite of resources for producers and consumers in response to the survey results, with the intent of better connecting with identified audiences by building content bridges (Reed, 2018). First, we built a website, the Science of GMOs (gmo.uconn.edu). Pages on the site address topics identified in the survey that align with team member expertise. We created GMO fact cards and distributed them to agricultural producers statewide. The fact cards, *Know Your Terms,* show the definitions of GMO, common terms, and the difference between GMOs and organic. This material was again based on survey results and sought to clarify GMO communication messages shared with consumers and point them toward additional resources on the website. An internal peer-review process evaluated the website, fact cards, animated videos, and social marketing messages prior to release.

Communication tools included producing animated videos about GMO uses. These included a video about what GMOs are, a second on the use of GMOs to preserve the American chestnut tree, and a third on GMO insulin production. We advertised in the student dining halls on campus and in the "Morning Ag Clips" email newsletter (see Figure 2). Our team also completed a social marketing campaign on the Extension Facebook page.

WEBSITE AND SOCIAL MEDIA

The Science of GMOs website (see Figure 3) had 86,836 visitors and 141,863 page views from September 2018 through December 2022. Of these, 10,292 visitors were unique, and 84% came to the site through organic searches. The average

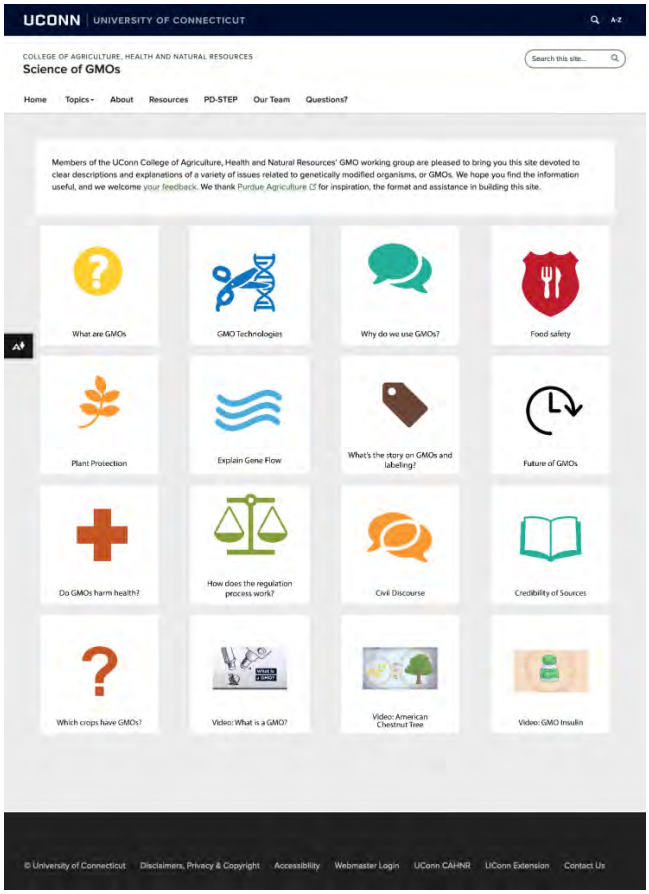

Figure 3. Science of genetically modified organism website.

duration of a visit was 1 minute and 10 seconds, and the future of GMO crops was the most popular page, with 32,197 views. Google was the top referral source for all visitors, with 62,373 users in total. The website is the fourth-most-visited page across all Extension websites and programs, including the overall Extension page.

We created social media posts with the website content, but these had limited engagement. Facebook posts reached between 238 and 1,376 people per post. Twitter impressions ranged from 212 to 430 per tweet. Social media engagement on the posts was lower than on other content-specific posts on the Extension platforms.

ANIMATED VIDEOS

We produced three animated videos. The university communications office created the first video, *What Are GMOs? A Primer for FDA and USDA Labeling*. The university published it on its YouTube channel on May 31, 2018, and it had 3,983 views as of December 2022. A digital media graduate student at the university created two animated videos for our team. *The American Chestnut Tree: A GMO Story* (see Figure 4) was the second video, published on February 11, 2019, on the Extension YouTube channel. It is 2 minutes and

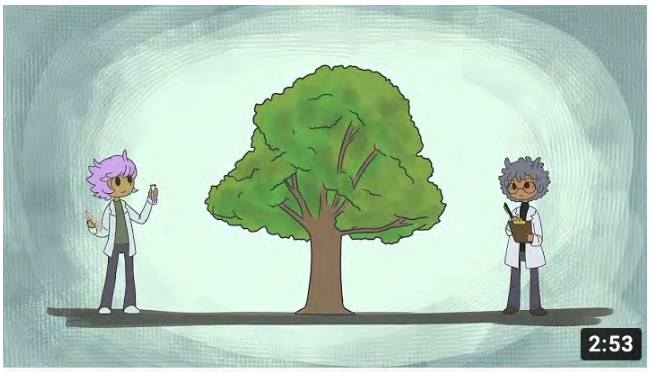

Figure 4. American chestnut tree: a genetically modified organism story animation.

53 seconds long and targets a younger audience. It has 7,699 views, a watch time of 246.3 hours, and 57,032 impressions. Audience retention is 67%, or 1 minute and 55 seconds, and 129 people "liked" the video. YouTube searches brought in 49% of all viewers. An Extension forester served as the content reviewer and narrator.

We released *Insulin: A GMO Story* on June 20, 2019. This video has no audio and is text overlaid on the animation. It is 2 minutes and 56 seconds long and designed for use on social media. On YouTube, it has received 10,166 views, 192.4 hours watched, and 40,303 impressions. The average view time is 1 minute and 8 seconds, or 59% retention. External searches accounted for 42% of the views. On Facebook, the video had 512 views. An animal science biotechnology professor was the content expert. Both animated videos are among the top-six most-watched videos across the entire Extension YouTube platform of more than 600 total videos.

FACT CARDS

We used the results of the producer survey to create GMO fact cards. Our team developed and reviewed the content prior to design, printing, and distribution. The team printed 1,750 fact cards and included the PDF version on the resources page of our website. We shared the fact cards statewide through the county Extension centers, with producers, and at events, using a complementary display.

CONCLUSION AND RECOMMENDATIONS

Agricultural producers and consumers have concerns and confusion about GMOs (Deng & Hu, 2019; Gibson et al., 2022; International Food Information Council Foundation, 2018; McFadden & Lusk, 2016; Ruth & Rumble, 2019). Agricultural communicators and educators have an opportunity to bridge knowledge gaps about GMOs by using multimedia to provide understandable, pro-science information. A large segment of the population is curious and willing to

accept and review new information; therefore, communicators should focus on these producer and consumer groups (Lucht, 2015).

The data we collected shaped the development of our multimedia communications. These results helped us target the information provided on our website, on fact cards, and in animated videos and social marketing messages. Communication resources should focus on building trust and enhancing producer and consumer knowledge in these areas (Reed, 2018). We focused on agricultural producers and sought to bridge the knowledge gap for producers so they could, in turn, communicate with consumers.

Evaluation of the communication resources was ongoing throughout the process and built into the various components. We collected feedback directly from agricultural producers while distributing the fact cards, and content edits were made in the section on GMOs and health and genetic engineering, based on their input and recommendations from the target audience, and shared in a subsequent version of the fact card. User testing and analytics were used to refine the website and create new content based on that feedback, including a section on labeling, civil discourse, and the credibility of resources. Social media analytics determined which content was further shared through the platforms. Finally, a survey was developed to test the effectiveness of the animations and found that with a college-student audience, the chestnut tree video decreased audience trust in GMOs (Rao & Stearns, 2023). This finding about animations was consistent with research on consumer knowledge in China (Wen et al., 2016). Therefore, our team focused our communication efforts on other areas, including developing curriculum and courses rather than continuing to create videos and animations.

This study had limitations, including a limited response rate on both surveys and the underrepresentation of males. Prior studies in Europe have demonstrated a disconnect between what consumers say and the actions they take; consumers may state in a survey that they will not purchase GMO foods when shopping, yet they often purchase the products (Lucht, 2015).

Technology presents limitations in that not all audiences can be reached. We had reduced social media engagement because education and information seeking are not common social media uses among our audiences (Yuan et al., 2019). Personal relationships are often the foundation of trust, and using technology as a communication tool can hinder relationship building.

Future studies could determine whether the communication strategies used herein could close the gap in GMO knowledge or increase confidence among agricultural producers when communicating with their customers and neighbors. Pre- and posttest studies could analyze consumer knowledge gained through the communication strategies of Extension and which multimedia methods yielded the greatest knowledge change. Our animated videos and social media campaign were not as successful as other initiatives; therefore, we focused our continuing efforts on other multimedia.

Educators and communicators at land-grant institutions have a responsibility to provide unbiased information that can help producers and consumers form their own opinions about GMOs. Our purpose in sharing the results of our initiatives is to help other communicators develop effective strategies based on the successful multimedia in our study. We further developed our multimedia messaging to include an online certificate program about developing consistent GMO communication messages, professional development training and curriculum for secondary and high school teachers, and an online interactive activity on food labels, including the non-GMO label.

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