Knowledge and Attitudes of Tennessee Agriculture Education Teachers on Biotechnology Issues

A Research Project to Fulfill Requirements for the
Master of Science Degree in
Agriculture and Natural Resources Systems Management
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Abstract

A survey to evaluate Tennessee Agricultural Education teacher's knowledge and attitudes concerning biotechnology issues was developed and deployed in May 2009 (UT Martin IRB: 09-1-01-E05-4005). Participation in the survey was voluntary. Of 300 surveys deployed, 78 were completed, resulting in a 26% response rate.

Tennessee agricultural education teachers were generally knowledgeable of biotechnology issues. Typically respondents were most familiar with biotechnology issues associated with traditional agriculture, such as animal reproduction, hybridization, and herbicide resistant plant species, but had some knowledge in the other areas. They were generally least comfortable with biotechnology-related areas such as electrophoresis and bioremediation.

The Tennessee agricultural education teachers agreed it is their responsibility to: (1) develop teaching plans associated with biotechnology and (2) involve students in Supervised Agricultural Experiences that teach their students about biotechnology There was a variation of opinions on responsibilities associated with: education of farmers, policy makers, and consumers; development and distribution of biotechnology materials; and biotechnology research. They did not favor developing publications on biotechnology.

They were generally supportive of the use of biotechnologies in agriculture and agreed that biotechnology related issues had a place in the classroom. Overall support indicated biotechnology issues are being discussed in the Tennessee agricultural education classrooms.

Table of Contents

CHAPTER I - Introduction and General Information

Introduction

This research project was developed to document the knowledge and attitudes of Tennessee's agricultural education teachers on biotechnology issues. Within the Tennessee educational system there has been a push to introduce new science technologies into the agricultural classroom. Tennessee currently offers an Agriscience course that can be applied as either a *Career and Technical Education* credit or *lab science* credit. This survey will provide insight regarding agricultural education teachers' present knowledge of biotechnology issues and their attitudes towards teaching this subject in the classroom.

Statement of the Problem

This survey will document the present knowledge and attitudes of Tennessee agricultural education teachers on biotechnology issues.

CHAPTER II - Review of the Literature

Biotechnology has become a commonplace topic in the media with the globalization of agricultural markets and the medical industry. With additional media coverage surrounding development of new methods of managing and manipulating living organisms using biotechnology, the potential for debate exists. In some instances, the debate may be centered on basic misconceptions about the science associated with a specific technology. Literature on biotechnology in high schools and agriculture classrooms shows support for biotechnology education in both high school science and agriculture classes (Ahmed, 1996; Harms, 2002; Boone et al., 2006).

A study of West Virginia agricultural education teachers found that most of the teachers lacked applied knowledge in biotechnology, but supported the importance and benefits of biotechnology being integrated into the agricultural curriculum (Boone et al., 2006). An article by Ute Harms from the University of Munich states: "It is the responsibility of science classes to inform the students of scientific and technical aspects of biotechnology and give them the tools to make sound decisions in the future about the risks and benefits of biotechnology" (Harms, 2002). The West Virginia study of agricultural educators indicated that with more training in biotechnology areas, teachers would have been more comfortable introducing and discussing these issues in the classroom.

Agriscience is a curriculum that fuses agriculture and science together by introducing the student to both areas simultaneously. Agriscience includes aquaculture, agricultural engineering, animal science technology, crop science, soil science, biotechnology, integrated pest management, organic foods, water resources, and environmental management (Cooper and Burton, 2002).

Development of the Tennessee Agriscience curriculum started in 1987. Agriscience, as a component of Tennessee agricultural education, was approved in 1989

for either *Career and Technical Education* credit or *lab science* credit (Ricketts and Ricketts, 2002).

Research Questions

1. What are the attitudes of Tennessee agricultural teachers toward biotechnology?
2. What level of knowledge and understanding is demonstrated by Tennessee agricultural teachers regarding biotechnology?
3. Do Tennessee agricultural education teachers with advanced degrees have more knowledge about biotechnology issues?

Present Study

A review of West Virginia Agriculture educators found that agricultural educators lacked fundamental applied biotechnology knowledge, but agreed that it was important for agricultural education curriculums (Boone et al., 2006). Therefore, this survey was developed to document the attitudes and knowledge of Tennessee agricultural education teachers at the high school level.

CHAPTER III - Materials and Methods

Participants

This study was sent to 300 agricultural education teachers in the state of Tennessee. Educational demographics of the population were determined during the survey.

Instrument(s)

The participants completed the survey through an email link that directs them to an Internet-based survey site (www.surveymonkey.com). The survey was approved by the University of Tennessee at Martin's Institutional Review Board (IRB approval number: 9-1 01-E05-4005). The survey consisted of 50 questions/statements (Appendix A). The results for the survey were compiled and presented to the author in a spreadsheet format.

Experimental Design

A descriptive survey will be used to collect data from high school agricultural education teachers in Tennessee via an electronic survey (www.SurveyMonkey.com). The goal of this research is to document the present Tennessee agricultural education teachers' knowledge on biotechnology issues. The survey was designed (style, nomenclature, etc.) for the selected population of Tennessee agricultural education teachers.

Procedures

The participants were emailed a direct link to the web-based survey. The survey software compiles the information and sends results to the survey author via email.

Demographics of Sample

Three hundred surveys were sent to Tennessee agricultural education teachers throughout the state and 78 completed the survey for a 26% response rate. Of those that responded, the highest degree earned included 36 with a B.S. degree (48.6%), 26 with a M.S. degree (35.1%), one with a M.S. degree plus 30 hours (1.4%), six with a M.S. degree plus 45 hours (8.17%), four with a E.D.S. degree (5.4%), and one with a Ph.D. (1.4%).

Level of Biotechnology Issue Knowledge

The survey included 20 Likert questions designed to explore the agricultural education teachers' knowledge on biotechnology issues. The response values were averaged for each question. A 4-point Likert scale was used for this portion of the survey: (1: No Knowledge; 2: Heard about, but very little knowledge; 3: Read about, possess some knowledge; 4: Applied, Knowledgeable; Table 1). The Mode frequency value for each knowledge area is demarcated in **bold** in Table 1.

When the majority of the responses were "No Knowledge" and "Little Knowledge," the frequency distribution is shifted or *skewed to the left* (L; Table 1). This type of distribution indicates a "negative" response to the question or statement. A *skew to the right* (R) indicates a frequency distribution where the majority of the responses were: "Some Knowledge" and "Knowledgeable." This distribution indicates a "positive" response to the question or statement. When the histogram has a somewhat *normal* (N) distribution, it indicated that the responses were generally "centered," i.e., not *skewed right* (R) or *left* (L).

Biotechnology Issues and Responsibilities of Agricultural Education Teachers

The Tennessee agricultural teachers were asked about the relationship between their job responsibilities and biotechnology issues. This section included 10 statements about job responsibility. The respondents were asked to rank their agreement to each

statement using a 5-point Likert scale (1: Strongly Disagree; 2: Disagree; 3: Neutral; 4: Agree; 5: Strongly Agree). The Mode frequency value for each job responsibility area is demarcated in **bold** in Table 2.

When the distribution of responses was *skewed to left* (L), it indicates the majority of the responses were "Strongly Disagree" and "Disagree." A distribution that is *skewed to the left* (L) indicates a "negative" response to the question or statement and is denoted "L" (*skewed to the left*). When the majority of the responses were "Agree" and "Strongly Agree," the frequency distribution is *skewed to the right* (R). This distribution indicates a "positive" response to the question or statement and is denoted as "R" (*skewed to the right*). When the frequency distribution has a somewhat *normal* distribution (N), it indicated that the responses were generally "centered," i.e., not *skewed right* or *left* and is denoted with "N." This nomenclature is applicable for Tables 2 and 3.

Agricultural Education Teacher's Attitudes toward Biotechnology

The teachers were asked to indicate their attitude toward 13 biotechnology topics using a 5-point Likert scale (1: Strongly Disagree; 2: Disagree; 3: Neutral; 4: Agree; 5: Strongly Agree). The response values were summed and averaged for to the thirteen questions. See Table 3 for the descriptive data for the questions. The Mode frequency value for each *attitude statement* is demarcated in **bold** in Table 3.

CHAPTER IV - Results and Discussion

Level of Biotechnology Issue Knowledge

Animal reproduction was the only issue that the majority (87.2%) of the Tennessee agricultural education teachers identified as having "applied knowledge." Less than 50 percent of the responses signified having "applied knowledge" on hybridization (46.8%), resistant plant species (43.6%), growth hormones (34.2%), cloning (31.6%), bio-fuel processing (30.8%), genetically modified foods (28.2%),

genetic engineering (26.0%), plant tissue culture (25.8%), bio-fuel technology (25.0%), and gene splicing (21.8%). Less than 20 percent of the respondents had "applied knowledge" of food biotechnology (19.2%), recombinant DNA (19.2%), environmental biotechnology (16.7%), biotechnology ethics (14.3%), human genomics (14.1%), and transgenetic splicing (11.8%). Less than 10 percent of the teachers indicated "applied knowledge" about microbial biotechnology (9.0%), electrophoresis (5.1%), and bioremediation (2.6%).

Based on distributions *skewed to the right* (R), Tennessee agricultural education teachers indicated they were knowledgeable about: (a) Animal Reproduction, (b) Hybridization, and (c) Resistant Plant Species. They were somewhat knowledgeable (N) about" (a) Growth Hormones (bST/pST), (b) Biofuel Processing, (c) Cloning, (d) Genetically Modified Food, (e) Genetic Engineering, (f) Plant Tissue Culture, (g) Biofuel Technology, (h) Gene Splicing, (i) Food Biotechnology, (j) Microbial Biotechnology, (k) Environmental Biotechnology, (l) Biotechnology Ethics, (m) Human Genomics, (n) Recombinant DNA, and (o) Transgenic Species. Electrophoresis and Bioremediation responses were *skewed to the left* (L) indicating limited knowledge of these areas.

Two-sample t-tests were conducted on the mean response for populations with (1) Bachelors, (2) Masters, and (3) Master's plus (+) degrees. There was no significant difference in the mean responses for these populations ($\alpha = 0.05$; Appendix B).

Biotechnology Issues and Responsibilities of Agricultural Education Teachers

The survey indicated that over 75% of the teachers agreed (Agree or Strongly Agree) with two of the job responsibilities: (1) involve students in biotechnology-related Supervised Agricultural Experience (93.5%) and (2) teach high school students about biotechnology (84.6%). The majority (51.3%) of educators Agreed on "develop biotechnology instructional materials." On the remaining seven questions the majority of the teachers "Disagreed." The questions including their respected response percentages

are: (1) educate policy makers about biotechnology (46.1%), (2) educate farmers/agriculturists about biotechnology (38.5%), (3) educate consumers about biotechnology (29.9%), (4) conduct biotechnology research (20.8%), (5) distribute publications about biotechnology (19.7%), (6) to sponsor meetings related to biotechnology (10.8%), and (7) develop publications about biotechnology (6.5%).

Based on *Distribution Skew* for each question or statement in Column 2 (Table 2), Tennessee agricultural education teachers place a high priority on the following responsibilities: (a) Teach high school students about biotechnology and (b) Involve students in biotechnology-related SAE's. Their responses were mixed (N) on: (a) Educate farmers/agriculturists about biotechnology; (b) Educate public policy makers about biotechnology; (c) Develop biotechnology instructional materials; (d) Distribute publications about biotechnology; (e) Educate consumers about biotechnology; (f) To sponsor meetings related to biotechnology; and (g) Conduct biotechnology research. The respondents generally disagreed (L) with the statement: "It is the job of the agricultural education teacher to develop publications about biotechnology.

Two-sample t-tests were conducted on the mean response for populations with (1) Bachelors, (2) Masters, and (3) Master's plus (+) degrees. There was no significant difference in the mean responses for these populations ($\alpha = 0.05$; Appendix B).