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**Going Forward in Education on Agricultural Biotechnology:
Extension's Role Internationally¹**

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Abstract

The development of agricultural biotechnology has proceeded amidst public controversy over the ethics of genetic modification of crops. The role of extension traditionally has been to provide research-based information to clientele on agricultural issues. This paper reviews a case study on the Florida Education Initiative for Agricultural Biotechnology (FEIAB) project. The project was initiated with a needs assessment of domestic and international extension stakeholders in 2001 in the area of agricultural biotechnology. Based on the assessment and related literature, a web site was developed to provide extension and the public with information on issues surrounding agricultural biotechnology.

The results of this study described how the Web could be utilized to provide biotech education materials that can serve the needs of domestic and international extensionists. In addition, assessment revealed that there were significant differences between domestic and international stakeholders with respect to understanding, training and view of extension's role in biotechnology public education.

Keywords: Agricultural Biotechnology, Needs Assessment, Extension's Role

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Introduction

Public concern about agricultural biotechnology is an important issue that extension may find itself continuing to address as it charts its course into the new millennium. The development of agricultural biotechnology, a term used to refer to technologies where specific genes are manipulated using molecular biology techniques (Reiners & Roth, 1989), has proceeded rapidly amidst public controversy over the ethics of genetic modification of food crops and the required level of regulation. As the development of genetically modified (GM) crops has progressed, it has come to the forefront of public debate. In the year 2000, it was estimated that approximately 52.6 million hectares of land were planted with transgenic varieties of over 20 species grown by 5.5 million farmers around the world (James, 2001). It is estimated that 68% of these crops are grown in the U.S., representing a major investment in plant biotechnology by American agriculture. From an international standpoint, trade of these crops has engendered significant controversy, perhaps due to the variety of perspectives and directives that exist in different countries with respect to regulation of genetically modified foods.

While biotechnology may have the potential to enhance global food security, serious concerns remain about its use, regulation and effect on public safety and the environment. A recent poll by the Pew Initiative on Food and Biotechnology revealed that 55% of respondents have heard a "great deal" or "some" about genetically modified foods (Nordquist, 2001). However, 45% responded that they were not "too confident" or "not at all confident" in the government's ability to regulate transgenic crops (Nordquist, 2001). An earlier study in 1986 revealed that although 66% of the American public regard biotechnology as a way of improving life, 52% still believe that genetically modified organisms are at least somewhat likely to present a serious danger to people and the environment (Reiners & Roth, 1989).

Research has shown that the majority of information that the public receives about agricultural biotechnology comes from the media (Hallman & Metcalfe, 1995) or from non-objective sources, such as biotech companies like Monsanto, which promote it, or environmental organizations like Greenpeace, which oppose it. Such information fuels the

debate without providing consumers much in the way of balanced, science-based information. As a result, many consumers have developed questions and concerns about the technology. On the other hand, it has been argued that if consumers understood the science of the process and the benefits, they would accept biotechnology more readily (Rabino, 1998). Further complicating the issue is distrust in government and industry's ability to protect consumers, follow regulations and avoid risks potentially posed by genetic modification of crops (Irani, Sinclair & O'Malley, 2002). This distrust appears to be greater in Europe and many developing nations than in the U.S. For example, in October 2002, Zambia rejected 26,000 tons of U.S. food aid, citing safety concerns about genetically modified corn. Although many farmers and citizens opposed the official policy, Zambian agricultural officials expressed fear that the GM corn would contaminate local corn stocks (King, 2002).

This is but the latest example of the fact that, from a policy and legislation standpoint, the U.S. and countries around the world differ on both the desirability of the perceived benefits and the implications of perceived risk associated with biotechnology. This has led to controversies that have affected international agreements. In 2000, more than 120 countries approved the Cartagena Protocol on Biosafety, which was drafted to "provide protection in the face of the risks to the environment and biodiversity that GMOs [genetically modified organisms] pose" (Tapper, 2000, p. 1). Subsequently ratified by the required 50 nations, went into effect September 11, 2003. In response, the U.S., which opposed the protocol and has not ratified it, filed suit at the World Trade Organization against the European Union, to protest the moratorium on new commercial releases of biotech crops, charging the ban was not based on scientific principles (Pollock, 2003).

Theoretical Framework

The debate over the future of agricultural biotechnology comes at a time when extension is re-examining its role. "We are not your grandfather's extension service" looks at extension today and speaks of "a system wanting to engage with people and communities in education on critical issues, moving beyond the conventional outreach function" (Ludwig, 2002,

p. 259). The Kellogg Commission on the Future of State and Land Grant Universities (2001) is working with universities and extension to examine their role once again and to become “engaged” institutions. The debate on biotechnology provides a window of opportunity to analyze critically the fundamental nature of extension’s role with respect to information transmission and technology transfer.

Since the first national extension service was established in France in 1879, the explicit mission of most national systems has been “to keep farmers informed regarding modern discoveries and new inventions which could be applied economically and with advantage” (Ministere de l’Agriculture, 1882, p. 8). For more than a century, extension worldwide primarily followed a transfer of technology approach, presenting “science-based” technologies in the name of progress. In this role, extension “provided the answer” to the client (Seevers, Graham, Gamon, & Conklin, 1997), effectively making the farmers’ decision for them by offering the presumed “best” solution.

However, although most new technologies are not as controversial as agricultural biotechnology, there is always a measure of uncertainty and risk in introducing a new practice to a farmer’s field (Chambers, 1997). According to Chambers, there is an inherent difficulty in being truly “objective” in an advisory function, as there is always a choice of which information to present. The very faith in “science” as a source of unbiased information precludes the question of in whose interest the research was conducted. That agricultural biotechnology could be used to address problems of world hunger seems little in doubt, but whether those technologies will be used to such ends remains a focus of debate. In a similar manner, critics of the Green Revolution have argued that the technologies that were offered were in a one-size fits all variety, which was in reality ill-fitted to the complex constraints of the low-resource farmer (Chambers, 1997).

Partly in response to such concerns, extension has begun to focus more on human resource development, following a “problem-solving” approach (Swanson, Bentz & Sofranko, 1997), in which “the role of extension is to facilitate the process of identifying alternatives” (Seevers et al., 1997, p. 11) such that agricultural biotechnology might be presented as

one possibility, evaluated in all its uncertainty. This role follows naturally from extension’s mandate to be a non-partisan source of information, in the service of the public good. As stated in the Extension Professionals’ Creed of Epsilon Sigma Phi, a professional honorary society for U.S. Extension: “I believe in intellectual freedom to search for and present the truth without bias...” (Seevers et al., 1997).

Research, and the communication of research-based information, remains critical as problems increasingly surpass local boundaries and require the collective insight of the global community. One strength of the U.S. extension service has been its reliance on research as a base for its information and education. As technological advances increase in complexity, extension needs to keep clients informed of alternatives, not “answers,” and trust that “extension clients know what to ask for, they can evaluate the appropriateness of technical information, they are responsible decision makers” (Swanson et al., 1997).

Public education is a major task of extension worldwide, and is one potential strategy to inform diverse audiences about agricultural biotechnology (Irani, Sinclair, & O’Malley, 2001). Researchers such as Hoban (1989) have argued that extension must take a proactive leadership role and formulate innovative strategies to address this issue. Based on the above, it behooves international extension educators and stakeholders to consider how to frame this debate. In light of the issues mentioned above, there appears to be a need for extension internationally to provide objective and research-based information on agricultural biotechnology to assist the public in making informed decisions (Hoban, 1989).

Purpose and Objectives

Based on the above discussion, a case study was conducted which examined extension’s role in public education on agricultural biotechnology. The purpose of the study was to describe the development of the University of Florida’s Florida Education Initiative on Agricultural Biotechnology (FEIAB). In conjunction with this development, a needs assessment was also conducted to assess and compare perceptions of domestic and international extension stakeholders with respect to extension’s role and the most effective ways to communicate information about agricultural

biotechnology to domestic and international clientele groups.

Methods

With the support of the Florida Cooperative Extension Service, investigators initiated the project by researching agricultural biotechnology materials and resources on the Internet and conducting a needs assessment of extension personnel. Extension stakeholders, represented by purposive samples of Association for International Agricultural and Extension Education (AIAEE) members ($n = 71$) and U.S. Florida extension agents ($n = 109$) were surveyed separately to ascertain their needs in delivering information on agricultural biotechnology to their clientele. Respondents were surveyed via mail, using a one-shot case study research design and a researcher developed questionnaire that was reviewed by a panel of experts for face and content validity. The 32-question questionnaire included Likert-scale type questions on a scale of one to seven, covering respondents' knowledge and perceptions of agricultural biotechnology, perceived attitudes of consumers and clientele, needs, challenges and roles of extensionists and demographic questions. Data were examined using the Statistical Package for Social Science (SPSS) software. Standardized item alpha for the resulting scale was .72.

Based on the results of an evaluation of on-line materials on agricultural biotechnology and the needs assessment, principal investigators then developed a research-based web site for extension educators and consumers. The site was designed to provide unbiased, science-based information to the public and extension educators on domestic and international issues surrounding agricultural biotechnology.

The Internet was selected as the appropriate forum for the educational outreach as a way to cost-effectively reach educators and opinion leaders, who could then download site materials such as fact sheets for their clientele at little or no cost. The intended audience of the site was consumers and educators in Florida; however, because international issues play such an important role in agricultural biotechnology, the researchers decided to include international aspects of the issue as well.

For ease of use and navigation, the web site was broken down into basic informational resources about agricultural biotechnology (including fact sheets, frequently asked questions, a glossary and a quiz), biotechnology in Florida, biotechnology in the United States, and biotechnology in the international arena (see Figure 1). An "About Us" page, links to other sites, and recent issues and news in agricultural biotechnology completed the site.

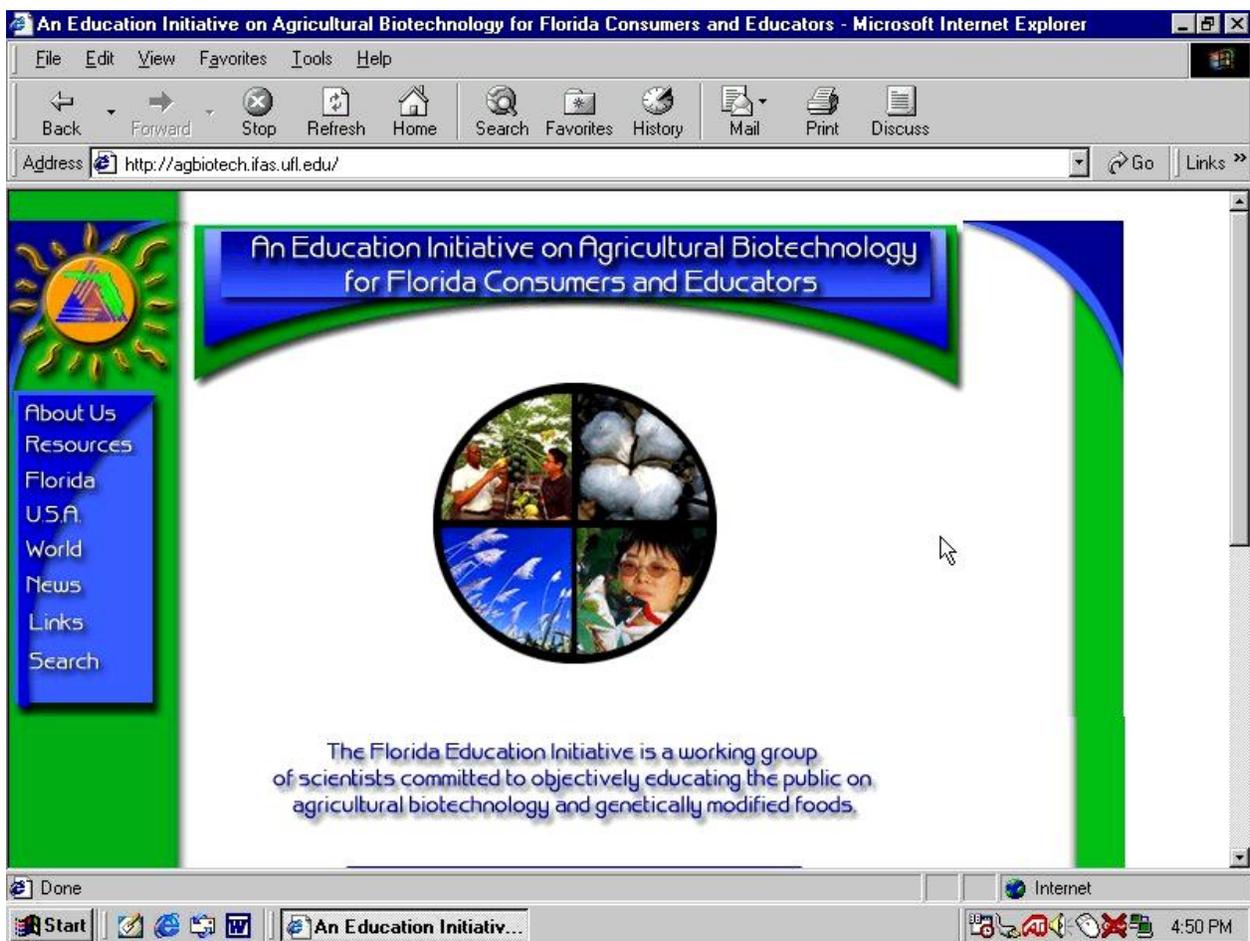


Figure 1. Florida Education Initiative Web Site.

In reviewing web resources on agricultural biotechnology, it became evident that while there was much detailed specialized information, there was a lack of clear summary information on international issues that would be of value to the average consumer. The international portion of the site therefore included pages explaining issues related to

biodiversity, developing world concerns, food safety, intellectual property rights and trade (see, for example, Figure 2). Recognizing the complex and evolving nature of these issues, the authors compiled only brief summaries of each topic area, relying primarily on links to recent research to provide a wider perspective.

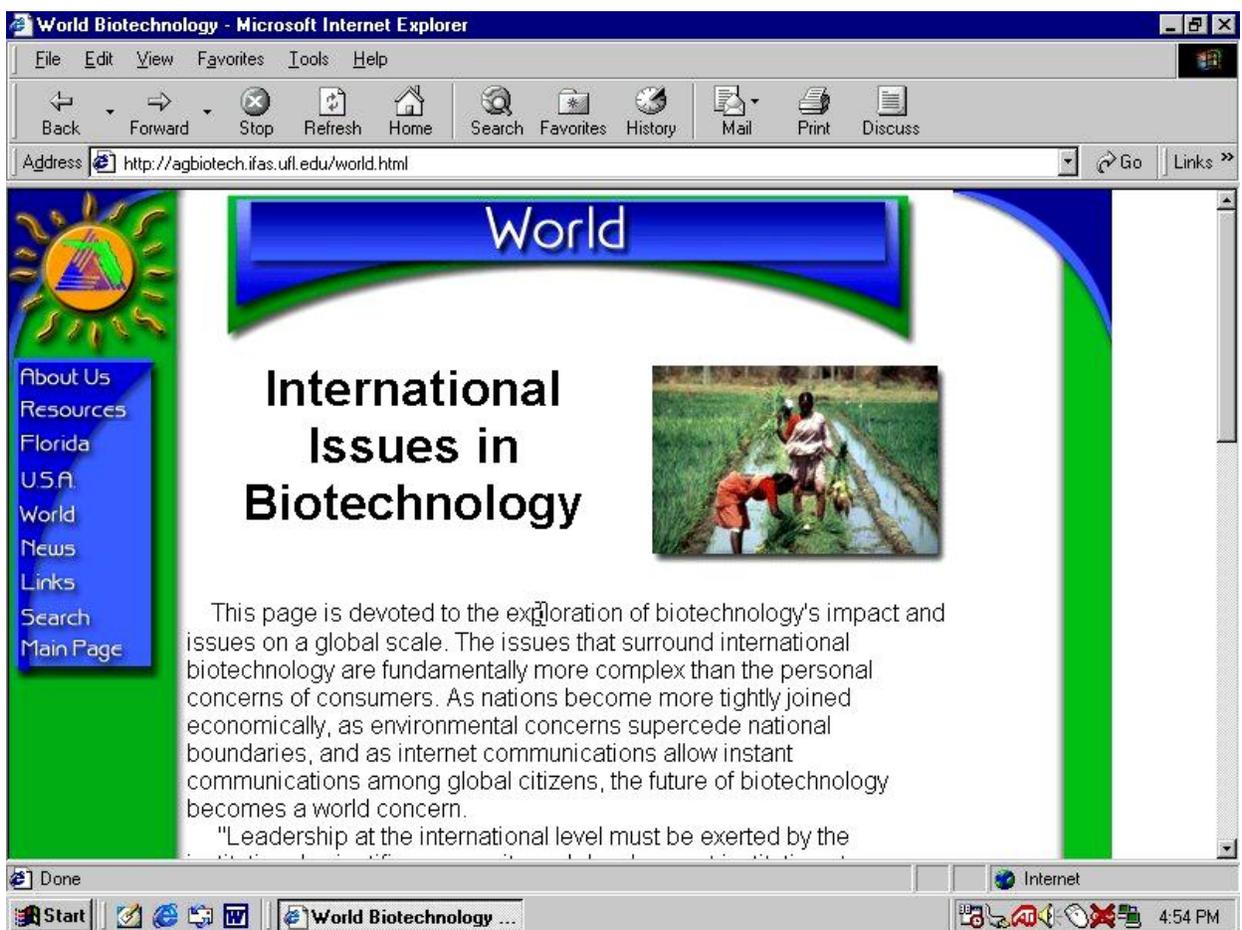


Figure 2. International Portion of FEIAB Web Site.

Investigators are in the process of collecting web site evaluation data. Preliminary evaluations were collected at the University of Florida and at the 18th Annual Conference of AIAEE, the Association for International Agricultural and Extension Education in Durban, South Africa.

Results

The needs assessment questioned respondents as to their attitudes, knowledge, understanding and training needs regarding agricultural biotechnology. Further questions related to their perception of their clientele's attitude toward agricultural biotechnology. Respondents' views of extension's role in agricultural biotechnology were also assessed. See Table 1 for a comparison of responses from the two groups of extension stakeholders.

Table 1

Statistical Results of Understanding and Attitudes toward Agricultural Biotechnology of Domestic and International Stakeholders in Extension

Response	Domestic			International			t-value
	n	M	SD	n	M	SD	
Understanding of biotechnology	108	3.25	1.39	71	4.58	1.27	-6.47**
Only moderate regulations necessary	109	3.65	1.75	70	3.69	1.53	-0.13
Biotechnology will make quality of life better	109	3.48	1.67	70	5.27	1.31	-7.61**
Research on biotech should be increased	109	3.32	1.57	69	5.64	1.19	-10.50**
Consumers in my country approve of biotech	108	3.82	1.39	70	3.91	1.26	-0.44
Extension should take a stand on biotech	107	4.07	1.77	68	3.81	1.82	0.92
Extension should provide balanced, objective information	108	3.56	2.56	67	6.06	1.46	-7.28**

Note. Likert-scale items ranged from 7=high or strongly agree to 1=low or strongly disagree.

** $p < .01$

It can be seen from Table 1 that there are significant differences between the two groups of stakeholders on certain issues. For instance, with regards to extension's perception of agricultural biotechnology, the international extensionists perceived themselves as having a greater understanding of agricultural biotechnology than the domestic (Florida) extension did ($t = -6.47$; $p < .01$).

International extensionists had significantly more favorable attitudes towards the contribution of agricultural biotechnology to the public good versus the Florida extension faculty ($t = -7.61$; $p < .01$). This was further evidenced by their greater support for further research ($t = -10.50$; $p < .01$).

Interestingly, despite extensionists' differing personal attitudes toward agricultural biotechnology, both domestic and international extension respondents felt that the public was ambivalent or uncertain about agricultural biotechnology, with no significant difference in their perception of consumers' attitudes ($t = -0.44$; $p < .66$).

U.S. and international stakeholders had significantly different opinions about the role of extension in agricultural biotechnology. While

both groups were neutral about whether extension should take a stand on the issue ($t = 0.92$; $p < .36$), the internationalists were much more convinced that extension must provide a balanced view on the topic rather than taking a stand. Results of a T-test indicated a significant difference between the two groups ($t = -7.28$; $p < .01$).

To explore the perceptions of international stakeholders further, questions regarding the perceived needs of respondents for training were included. Respondents were asked what kind of preparation and skills training they needed to take a role in facilitating public discussion on agricultural biotechnology. This included training in conflict management skills, media training or learning to deal with the media, enhancing ability to understand the science/evaluate the research, moderator/facilitator training to handle a public meeting or forum and communication skills/learning how to deal and be effective with diverse audiences. While domestic agents chose media training, international stakeholders felt that communication skills were the most important need (see Figure 3).

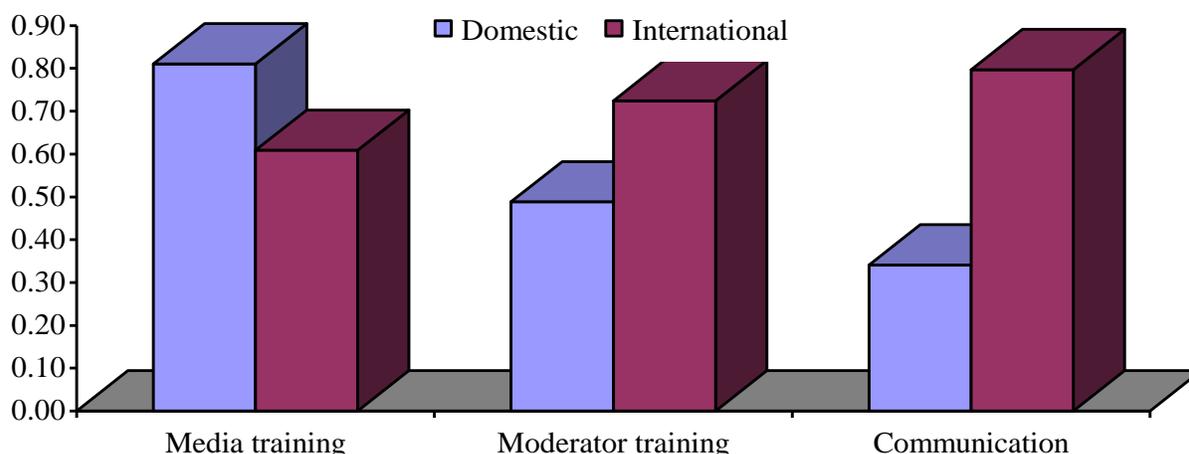


Figure 3. Frequency of Preparation/Skills Training Needed for Extension to Take a Role in Facilitation of Public Discussion on Agricultural Biotechnology.

Types of programs for biotechnology public education efforts and dissemination of materials were also issues addressed in the survey. International stakeholders felt that the most effective programs for public education were fact sheets for consumers and facilitation of public forum or debate. Top choices for dissemination of materials on agricultural biotechnology were printed materials and web pages.

The results showed that international extension stakeholders' primary needs were in helping consumers to both evaluate the issues surrounding agricultural biotechnology and understand the science and technology (Table 2). The international respondents also expressed the view that they felt consumers most needed to be educated as to the benefits of agricultural biotechnology as well as provided with a balanced viewpoint (Table 3).

Table 2

Ranking of Challenges that Exist to International Stakeholders with Respect to Conveying Information to Clientele (1=most important; 10=least important)

Response	n	M	SD
Helping consumers evaluate what they hear	65	2.92	2.09
Making sure media presents balanced information	64	3.09	2.61
Understanding the science and terminology	65	3.20	3.02
Identifying the issues	65	3.34	2.39
Credibility of national extension service	65	3.46	3.77
Getting science across to the public	65	3.85	2.65
Recognizing the role of divergent consumer values and viewpoints	65	4.17	3.43
Lack of research on perceived risks	65	4.35	3.02
Lack of consumer trust in science	65	4.71	2.96
Lack of consumer trust in government regulation of safety	65	4.74	2.99

Table 3

Ranking of Important Points to be Conveyed About Agricultural Biotechnology to Consumers (1=most important; 7=least important)

Response	n	M	SD
The science	67	3.99	1.89
The benefits	67	2.75	1.56
A balanced viewpoint	67	2.72	1.83
The regulatory process and how it works	67	4.36	1.48
Potential risks	67	3.42	1.50
How likely it is that potential risks will occur	67	4.00	1.75

Discussion and Conclusions

This study utilized a case study approach to describe development of the FEIAB web site as well as compare U.S. and AIAEE members in terms of their perceptions of extension roles and ways to effectively communicate about agricultural biotechnology. Although the study did provide some support for the argument that U.S. based and international extension stakeholders may differ in their perceptions, the results are limited in terms of generalizability to Florida extension and AIAEE members.

The study did, however, reveal an important potential difference between domestically focused and international respondents regarding extension's role in disseminating information about agricultural biotechnology. International respondents were significantly stronger advocates for the provision of a balanced viewpoint. This may indicate different perceptions of issues, needs and views of extension's role at the national and international levels. Some respondents appeared to be more comfortable in promoting the technology, while others may have perceived their role as avoiding taking a stand and attempting to provide balanced, objective information on the issues. This apparent division in approach may indicate a need for extension organizations to clarify, on institutional, national and international levels, what their appropriate role is in the education and promotion of new technologies in general, and agricultural biotechnology in particular.

International extensionists' choice of fact sheets for consumers as the number one preferred method of disseminating materials lends credence to the FIEAB initiative in providing web-based information. Printed materials and web pages were the top two

choices for dissemination of materials on agricultural biotechnology. Therefore, a key implication of this finding is that the use of the web site with downloadable fact sheets may meet an important need for extension educators.

The web site was designed to make a specific contribution to the educational materials on agricultural biotechnology through its development of a section on international issues in agricultural biotechnology. Although agricultural biotechnology has implications for consumers on an individual level (such as labeling or allergies), the results of this study seem to suggest that it is also important for extensionists to understand that perceptions may differ among even extensionists themselves, and that, specifically with respect to international issues, different needs for training, communication skills development and education information and materials may exist.

In addition to educating about biotechnology through web-based information and fact sheets, extension educators may be able to access other communications channels. Results of this study showed that extension respondents saw a need to facilitate public forums and debates to provide objective information as to the possible risks and benefits of agricultural biotechnology. Within this context, extension may be able to play a critical role with respect to providing the link between subject matter specialists and their clientele, and facilitating feedback and information flow.

It can be argued that perceptions of technology are seldom value-neutral. The results of this study suggest that even extensionists themselves are somewhat divided on aspects of their role and perspective with respect to agricultural biotechnology. As the debate on agricultural biotechnology continues, it is therefore imperative that the international

scientific and educational communities step forward to provide extension educators and the public with clear, objective information on the domestic and international issues surrounding agricultural biotechnology. Groups such as the Florida Education Initiative for Agricultural Biotechnology must continue to be proactive in determining needs of agents and providing means for relevant education to be disseminated to extension's clientele. Further, the debate on agricultural biotechnology may be especially important, as it provides the impetus to re-examine fundamental questions related to the role of extension with respect to 21st century technology and to consider what, why and how we provide extension education.

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