CONSUMERS AND BENEFITS OF GENETICALLY MODIFIED VEGETABLES

A Thesis
presented to
the Faculty of California Polytechnic State University,
San Luis Obispo

In Partial Fulfillment
of the Requirements for the Degree
Master of Science in Agribusiness

by
Megan Carter Judge
March 2010

© 2010
Megan Carter Judge
ALL RIGHTS RESERVED

COMMITTEE MEMBERSHIP

TITLE: Consumers and Benefits of Genetically
Modified Vegetables

AUTHOR: Megan Carter Judge

DATE SUBMITTED: March, 2010

COMMITTEE CHAIR: James Ahern, Agribusiness Professor

COMMITTEE MEMBER: Wayne Howard, Agribusiness
Department Chair

COMMITTEE MEMBER: Jeffrey Wong, Crop Science Professor

COMMITTEE MEMBER: Allen Van Deynze, Professional
Researcher, UC DAVIS, Seed
Biotechnology Center

ABSTRACT

Consumers and Benefits of Genetically Modified Vegetables

Megan Carter Judge

With the adoption of biotechnology in many agricultural products with first-generation biotechnology traits such as increased pest resistance, greater herbicide resistance, and increased yields the growers have accepted them. The next wave of biotech crops have second-generation traits, such as improved nutrient content, extended shelf life, reduced pesticide and herbicide application (a consumer demanded trait), and better taste. Will these consumer benefits offset any concern that the consumer has regarding biotechnology? What are those benefits and how should the information be communicated to the consumer?

Three focus groups give insight to the proposed questions. The focus groups were done in three California cities, with participants screened to be: 18-65 years of age, the primary shopper for the household, and with an education level up to a bachelor's degree.

We found that the consumer has little knowledge of biotechnology, but that they assume any concern over these products is reduced if the grocery store or point of purchase is a reputable location. The consumer does look for added utility in products, but they are not willing to pay more unless they understand the production of biotechnology developed products. The consumer feels that there should be labeling of these products, but will likely purchase the least expensive option.

ACKNOWLEDGMENTS

Thanks should be given to Seminis/Monsanto for providing the springboard for this thesis. The original presentation was given at a Future Seed Executive (FUSE) educational unit of American Seed Trade Association (ASTA). The 2008 educational unit was sponsored by Seminis at their Woodland research park facility.

Thanks should be given to the Agribusiness Department at California Polytechnic State University, San Luis Obispo, California for sponsoring the costs of the third focus group.

TABLE OF CONTENTS

CHAPTER	Page
LIST OF TABLES	<u>vi</u>
LIST OF FIGURES	vii
I. INTRODUCTION	1
II. LITERATURE REVIEW	8
Biotechnology	8
Consumer Research	12
Focus Groups	30
Market Research	34
III. METHODS	40
Data	40
Assumptions and Limitations	43
IV. RESULTS	44
Vegetable Consumption	44
Biotechnology Knowledge Levels	45
Regulatory Oversight Views	50
Labeling Biotech Foods	53
Labeling Second Generation Attributes	54
Negative Labels	56
V. SUMMARY, CONCLUSIONS, RECOMMENDATIONS	58
Summary	58
Conclusions	60
Recommendations	60
REFERENCES CITED	62
APPENDICES	
A. Discussion Guide	66
B. Opinion Studies Contract	71
C. Consent, Focus Group #3	74
D. Handout with Discussion Guide, Group 1 & 2...	75
E. Handout with Discussion Guide, Group 3.....	79
F. Focus Group Handout - Label Options	85

LIST OF TABLES

Title	Page
1. Estimated Probabilities of Purchase With and Without a Functional Health Property	19

LIST OF FIGURES

Title	Page
1. Focus Group # 1 - Notes on 2 nd Generation Biotechnology Attributes in Vegetables	48
1. Focus Group # 2 - Notes on 2 nd Generation Biotechnology Attributes in Vegetables	49
2. Focus Group # 3 - Notes on 2 nd Generation Biotechnology Attributes in Vegetables	50
3. Summary of Focus Group Findings	51

CHAPTER I

INTRODUCTION

Over the past 14 years (1996-2010) first generation biotechnology in agricultural commodities focused on input traits which primarily benefited growers. These included selected pesticide and herbicide resistance, and insect resistance. Now, second generation biotechnology research has been focused on improved value added output traits, consumer benefits of additional nutrient content, enhanced flavor, increased shelf life, and high quality produce grown with less chemical fertilizers (Fernandez-Cornejo and Caswell 2006).

In the past 14 years mergers and acquisitions among pharmaceutical and chemical firms has demonstrated that agri-biotechnology offers an improved future income stream. In the future second generation traits will offer substantial societal benefits and returns to their investments (Shoemaker, Johnson, and Golan 2003).

Consumer demand for the products of biotechnology is

dependent on many factors: education about biotechnology, perceptions of biotechnology, and marketing of biotechnology developed agriculture products. Research has suggested that the public demand for biotechnology produced vegetables is more acceptable than biotechnology developed animal products (Larue, et al. 2004). However, the research also suggests that there is concern about biotechnology generally. The concern is related to the safety of biotechnology produced products and their consumption by humans over time, and the ethical issues of biotechnology processes of using transgenes. Currently there is a gap in the research regarding consumer demand for biotechnology developed vegetables which have selected improved consumer benefits. The research is not conclusive if selected consumer benefits outweigh the concerns with regards to biotechnology (Larue, et al. 2004).

Biotechnology is being defined by 2008 as:

Newly-developed scientific methods used to create products by altering the genetic makeup of organisms and producing unique individuals or traits that are not easily obtained through conventional breeding techniques. These products are often referred to as transgenic, bioengineered, or genetically modified (GM) because they

contain foreign genetic material.

Do consumer benefits and traits, such as nutrient content, healthfulness, taste, appearance and convenience from biotechnology outweigh consumer concern of the use of biotechnology? If so, which benefits have greater weight to the consumer and what are the existing concerns?

US consumers have been consuming foods derived from biotechnology for the past 14 years. Biotech grains, in the form of cornmeal, oils and sugars are used as ingredients in many foods that Americans consume. These foods are deemed substantially equivalent to their nonbiotech counterparts, but they are not labeled as 'biotech'. Thus consumers are largely unaware they are eating products derived from biotechnology. That could lead to the logical conclusion that if they were harmful, biotech products might not be so widely consumed (Fernandez-Cornejo and Caswell 2006).

Guidance to commercially market food produced through biotechnology is given by the Food and Drug Administration (FDA) underneath the umbrella of the United States Department of Health and Human Services. The procedures call for developers of new products to meet with the FDA to

"discuss relevant safety, nutritional, or other regulatory issues regarding the bioengineered food and then submit to FDA a summary of its scientific and

regulatory assessment of the food".

Once approved by the FDA the Animal and Plant Health Inspection Service (APHIS), a branch of the United States Department of Agriculture (USDA), regulates the trade, interstate movement and release of the product into the environment.

Background on Biotechnology

Seed companies, which, are doing research and developing products through biotechnology need to be able to sell their 'biotech' seed, or justify the expense with forecasts for future sales. Growers also need to ensure that the public will purchase their product before they will plant the seed. Farmers who purchase the improved seed inputs should do so only if the premium charged them is less than the additional revenues they can expect. The domestic and international markets for the final commodity products must be in (both conventional and biotech) equilibrium, and changes in costs and farm productivity must eventually impact market prices (Lence, Hayes, and Dermot 2008).

Justification

Since the introduction of genetically engineered seeds

in 1996 net farm incomes globally have increased \$44.1 billion dollars, half of which is due to yield gains. Sixty-eight percent of the yield gains are a result of insect resistant technology and the balance herbicide tolerant crops. In addition pesticide usage on the biotech crop acreage has been reduced 8.8% contributing to a 17.2% reduction of the overall environmental impact associated with herbicide and insecticide. In 2007, the cuts in carbon dioxide emissions from reduced fuel and additional carbon sequestration associated with biotech crops was estimated to be equal to removing 6.3 million cars from the roads. (Brookes and Barfoot 2009)

Given a specific vegetable commodity, for example a fresh market carrot, that product appears and has been declared by the government (USDA) as homogeneous if the labeling 'produced using biotechnology' is not present. What incentive does a grower have to spend more money on the biotechnology, unless it reduces his costs in some way, as a first generation biotechnology attribute? However, to market or sell a product consumer benefit of 'produced using biotechnology' to reduce pesticide application, increase vitamin content, or improve shelf life, these traits have to be accepted by the consumer with the knowledge of it being produced using biotechnology.

Objectives

- 1.) To Identify primary consumer benefits and desired traits associated with vegetables,
- 2.) To define vision of the level of consumer demand for benefit,
- 3.) To assess consumer concern with biotech vegetable products,
- 4.) To identify consumer's preferences for benefits or traits that outweigh concern with negative aspects of same.

The focus groups will lead to methods by which seed executives can use to market, brand, and sell biotech products.

Importance of the Project

As labor and land becomes more scarce and expensive, producers or growers modify their production operation so as to maximize profits. This creates a need for technology and a special window for biotechnology. Any way to be more productive and increase profits using the same amount of labor/land is a potential for market growth. The current research indicates that US consumers are concerned about

biotechnology (Teisl, et al. 2002). The adoption of second generation biotechnology is dependent on consumer acceptance. This study hopes to provide more research on consumer acceptance of biotechnology.

Market research using multiple focus groups will be conducted and used to research current consumer benefits and traits that could outweigh their concern with biotech vegetables.

This research in collaboration with current and past literature should lead to an analytical marketing discussion and framework for increasing consumer acceptance of biotech vegetables.

CHAPTER II

LITERATURE REVIEW

Biotechnology

If growers are going to grow genetically modified (GM) crops they will do so if they can sell it, and are actually more strict than the consumer because they are also expected to grow a minimum quality, to meet USDA grades. A problem arises when it is too difficult to distinguish non-GM from a GM counterpart. This makes the commodities difficult to track and for non-GM it places the burden of Identity Preservation in their hands. The activity of separation is costly. Separation has to be done because standards are heterogeneous across countries. There exists a welfare-maximizing standard for products that claim non-GM status, and this welfare standard has intuitive properties. The lack of standards leads to a pooling equilibrium. Lapan and Moschini speculate that too strict standards may lead to the collapse of the market for non-GM product. Research suggests that producers should accept both mandatory and voluntary labeling policy because the

labeling may lead to higher prices received for non-GM and GM products (Lapan and Moschini 2006).

Alternatively some view GM labeling as a trade barrier, and therefore welfare reducing, in that the consumer is paying a greater cost to protect in country domestic producers or to have the choice of non-GM product. These choices when studied in the Swedish marketplace show that there is not a difference between what consumers are willing-to-pay (expressed versus revealed preference) for a ban of GM content and a labeling policy (Carlsson, Lagerkvist, and Johan 2007).

In the past, the choice to plant non-GM versus GM rested with growers, but that is changing. Thrity-five percent of growers surveyed had concerns with respect to planting GM varieties; however, of those seventy percent said it was do to marketability (Saak and Hennessy 2002). Options for the grower were two-fold. First, if the demand for GM was greater than for non-GM, and there is more non-GM supply than GM, then prices are equal. If the opposite situation happens, demand for non-GM was greater than GM, and the supply of GM is greater than non-GM, then the non-GM would have a price premium. So does a grower want to hedge against the counsumer wanting non-GM or GM? The grower may be better off planting non-GM because it gets

the same price as GM when demand is greater for GM, but gets a premium when demand is for greater non-GM (Saak and Hennessy 2002).

McCann-Hiltz, et al. (2004) policy implication study looked at the tradeoffs between regulatory policy and the higher level of food costs that are associated with higher levels of food quality. Their three policy options were: (1) follow a more restrictive regulatory policy that limits production, processing or marketing of food containing products from biotechnology, (2) increase food inspection, and (3) provide information on food labels that give more information about biotechnology. The background for their antecedent research showed that respondents were 'very concerned' with chemical pesticides (63%), antibiotic use (45%), and biotechnology (37%).

Also McCann-Hiltz, et al. (2004) found those opposing agriculture biotechnology argue that the long-term human health effects and long-term environmental effects of such products cannot be known with certainty. Using discrete choice data (1,203 Canadian respondents) they sought the policy more Canadian consumers are willing to pay for, either increased food inspection and regulatory restrictions on production versus labeling. Respondents

were willing-to-pay more for labeling, and for food inspections, but were willing-to-pay the least, in terms of higher food costs, for policy restricting agricultural biotechnology (McCann-Hiltz, et al. 2004).

The most difficult question to answer is whether the findings from the lab are likely to provide reliable and pertinent information outside of the laboratory. Economists and researchers use contingent valuation and experimental methods to assess consumers willingness-to-pay and willingness-to-accept for the non-GM attribute and the GM attribute. Researcher's have also look at purchases from all different countries both with GM labeling required and without. It is presumed that consumer demand may be adversely affected by first-generation GM products, but that may not be the case at all. The major constraints are that existing GM regulations are non-existent in the US. The USDA has declared the GM products equivalent to the conventional counterpart, and no additional labeling required (Moschini 2008).

The key to future GM offerings new products singled out for more regulation could reduce the incentives for further research and development, disrupting the flow of

innovation and have negative effects on welfare in the long run (Moschini 2008).

The key to labeling is whether it should be voluntary or mandatory. A voluntary labeling assumes positive attribute and mandatory a presumed negative attribute. This alone could lead to the failure of a new product (Moschini 2008).

Consumer Research

Just's (2001) view of the future for agribusiness firms will be a result of consumers demanding higher quality 'end-use' products. 'End-use' products defined by any of the following attributes, or a combination of greater convenience, added nutritional benefit, produced in environmental friendly systems, free of chemicals residues, harmful pathogens, and better taste. The agribusiness system and structure is adjusting to a demand-pull from consumers as opposed to a supply-push from growers, as in the past. This demand-pull for more 'end-use' products is linked to media influence on consumer perceptions and preferences (Just 2001).

An 'average consumer' or single consumer profile should no longer be characterized or defined (Hu, et al.

2004). Agribusiness firms have increased difficulty in marketing products and forecasting production with the new demand-pull paradigm shift because 'average consumers' are less obvious. Marketing goods and forecasting production for newly developed technology and products is difficult because agribusiness firms have not verified their technology is socially acceptable (Kalaitzandonakes 2000). The discussion of a paradigm shift to a consumer demand pull looks at recent agriculture technologies, media coverage on those technologies, and the consumer response to labels and perceptions.¹

The agricultural sector has changed dramatically over the past twenty years with both organic products and genetically modified organisms. Organic agriculture is defined by a "process standard" production as opposed to a product standard production (Deaton and Hoehn 2005). Process standards define organic products by the method and means of production, whereas product standards define the physical quality of the end product. Organic certification is achieved through production process review and approval by the United States' Department of Agriculture's (USDA) National Organic Program (NOP), which defines organic food as (AMS-USDA 2003):

¹ Yet with GM the government (USDA) asserts consumers should not care.

Organic food is produced by farmers who emphasize the use of renewable resources and the conservation of soil and water to enhance environmental quality for future generations....Organic food is produced without using most conventional pesticides; fertilizers made with synthetic ingredients or sewage sludge; bioengineering; or ionizing radiations. Before a product can be labeled "organic," a Government approved certifier inspects the farm where the food is grown to make sure the farmer is following all the rules necessary to meet USDA organic standards....

The increasing acceptance of organic foods by consumers is due to social changes in consumer perception of risk and the unknown. The organic sales market grew 200% from 2004-2007, and although it still only represents 3% of the current food sales it commands a higher dollar value (Economic Research Service 2008). Consumers are willing-to-pay a higher dollar for organic produce because they perceive it safer and better for the environment.

The rapid increases in planted acres of genetically modified corn, soybean, cotton, and canola from 1996 to 1999 was historical in regards to adoption rates of new agriculture technology (Shoemaker, Johnson, and Golan 2003). In retrospect the adoption rates of hybrid seeds to similar acreage took almost 20 years (Griliches 1957). What is notable is that both the transition to hybrid corn and GM seed were for grower benefits and were marketed as input traits to help maximize producer profit (agribusiness

firms). The current trend with organics and functional foods is consumer demand driven (Veeman 2000).

Media coverage on biotechnology in the agribusiness sector over the last two decades has been primarily negative and inaccurate. The media creates inaccurate parallels between biotechnology and other known food hazards (e.g., mad cow disease, or chemical contamination) usually because the reporters are unclear of what exactly biotechnology is and are uneducated on the subject matter themselves. Media will also play up the idea of the "unknown" which may never come to actualization (Kalaitzandonakes, Marks, and Vickner 2004).

Two types of studies were done, one where consumer response to sustained media "health risks over the long run" and the other "acute risks for relatively brief time" found that media was more likely to evoke acute avoidance behavior rather than continuing decline over a long period. The key issues for consumers with regard to new agriculture technologies have been environmental impacts, the right to know and choose, and ethics (Kalaitzandonakes 2004).

Two other empirical case studies looked further into media coverage and influence. The first study looked at Dutch consumers and their degree of response to media coverage of biotech foods. Frequency of coverage in a

national press agency was a measurement for media coverage and national-level, syndicated point-of-purchase grocery store scanner data was assessed for consumer demand. The result was the absence of scientific evidence confirming risk, which failed to reinforce risks in the minds of the Dutch consumers, and overall major brands eased perception of risk. In a second empirical study in the US examined media coverage linked to the word "Starlink", a GM corn for animal consumption only. Starlink was found to be in human food products, such as taco shells, and was recalled in 2001. This study reflected changes in consumer demand affected primarily branded products identified by the media suggesting a direct impact of media coverage on consumer behavior. The overall change in consumer demand was temporary and small because the brand, Kraft, was seen positively by consumers and protected media negativity as opposed to the media negatively compromising brand equity (Kalaitzandonakes 2004).

Traditional demand theory looks at the concept of utility maximization and its constraint by income. This approach does well with general products, but when introducing functional foods, organics and genetically modified organisms a different view arises. A new focus, based on discrete consumer choices of particular products

from specified choice sets will allow for utility maximization, but as a function of relevant product characteristics (Veeman 2000). The utility associated with these choices can also relate to consumer: income, education, gender, and religion.

Canadian researchers seeking a bridge between psychology and economics to discover why consumers choose certain attributes in food. A reference point refers to a base line of a person's wealth, underlined by a implicit value function. A change in wealth may introduce dramatically different impacts on the value function depending on whether the changes involve gain or loss (Hu, Adamowicz, and Veeman 2006).

Consumers are becoming increasingly concerned about the environment and social issues and growers have developed generic schemes for highlighting best practices in integrated pest management and disease control. Consumer demand for a greater range of products; differentiated by intuitive component (e.g. functional foods) non components (e.g. GMO), processing methods, and methods of production (e.g. organic or hydroponics) give rise to niche retail markets.

Consumer concern is growing with recent health risks

and safety of food borne illnesses. Specifically consumers are more concerned with the process and production of crops, and the handling/exposure of food crops. Consumers have skepticism about GM foods related to uncertain long-term health consequences, long-term environmental effects, the perception of unnatural creation, and gains from development accruing to large multinational corporations, not to consumers. Currently there are GM foods in trial that offer functional health benefits to consumers, but health properties can be enhanced in conventional and organic foods as well as through traditional plant breeding or nutrient fortification.

Attempting to differentiate consumer values for functional foods in conventional, organic and GM foods was the goal for Larue, et al. (2001). Labeling is a big issue with respect to commercialization of functional foods and so the researchers used the terms "heart-healthy" and "anti-cancer". Price was treated as fixed variable and random parameters logit models analyzed the choices made by 1,008 Canadian respondents for the three food products. Holding all variables constant, respondents tended to choose the least expensive product and that GM and organic production processes were less favored relative to conventional foods. The presence of a health property was

positive across all three food products. Probabilities of purchase computed at mean prices for conventional, organic, and GM foods are reported below in Table 1. The results show Canadians are more likely to buy conventional chicken breasts than organic or GM. The introduction of health properties in GM foods, but not in other foods, increased the probability of purchase (Larue, et al. 2004).

TABLE 1. Estimated Probabilities of Purchase With and Without a Functional Health Property by Type of Production for Selected Food Products.

Type - Property	Chicken breasts	Tomato sauce	Potato chips
Conventional			
None has health	.833	.835	.835
GM has health	.843	.819	.811
All have health	.873	.894	.883
Organic			
None has health	.002	.031	.031
GM has health	.002	.031	.030
All have health	.005	.016	.029
Genetically Modified			
None has health	.164	.133	.133
GM has health	.154	.149	.158
All have health	.120	.088	.086

Source: Larue, et al. (2004)

Past studies (Carlsson and Lagerkvist 2007; Hu, Veeman, and Adamowicz 2005; Baumgarnder 2004; Hu, et al. 2004; or Teisl, et al. 2002) have looked at how consumers behave under different labeling policies, and to what extent do they value the information revealed in different labeling contexts. Hu, Veeman, and Adamowicz (2005) used a mixed-logic model to determine consumers utility with regards to labels and used existing welfare economics

literature to calculate the 'value of information'. They found more reaction with mandatory labelling than voluntary labeling. There was greater consumer utility with mandatory rather than voluntary labelling. Consumers were willing to tolerate higher prices with associated mandatory labeling than with voluntary labeling. Consumers take the voluntary labeling as a marketing scheme or ploy and discount the value associated with it. The presence of GM ingredients significantly decreased the value of the product, while information on bread without GM ingredients increased the value of the product. Expected increased costs are associated with mandatory labeling as are increase benefits to the consumer with respect to voluntary labelling (Hu, Veeman, and Adamowicz 2005).

An ERS-USDA (Tangene, et al. 2003) found consumers reacted to the information on the labels, but also to the source of the information (e.g. government, producer, 3rd party firm). Consumers, when bidding on items with positive information, negative information, or both, overall placed a greater weight on negative information than on positive information. The scientific based pro-biotech information strongly offset anti-biotech information, but even with positive information and/or

positive with negative information, and 3rd party information people would still bid slightly below plain-labeled foods. Respondents were willing to pay 17-21 cents per unit more to purchase plain-labeled food than GM-labeled food. Third party information has the most effect on those consumers who received negative information, prompting them to view biotech foods more favorably (Tagene, et al. 2003).

Additional studies also found that biotechnology is more acceptable depending on the food product. Observing the choice-modeling framework, results show that GM is viewed negatively; however, respondents viewed hybrid breeding and plant based GM less negatively than bacterium and animal based GM. In the case of bananas, which are non-processed, positive associated GM attributes were less pesticide use, and longer shelf life. Respondents were willing to pay about three percent to obtain benefits via own gene transfer (natural hybrid breeding), however if GM (plant, animal or bacterium) respondents require compensation to accept (Onyango, Govindasamy, and Nayga Jr. 2004).

Direct health, environmental and production related benefit have a positive effect on choice and the

respondents willingness-to-pay for benefits embedded in the products suggest a potential market for GM foods.

Consumers main concerns came from controversy over externality costs from unanticipated health, and environmental impacts, along with the moral and ethical acceptability of biotechnology in the food system (Onyango, Govindasamy, and Nayga Jr. 2004).

Baumgardner (2004) evaluated consumer awareness and education is still the essential issue with regards to biotechnology. Simulated test marketing methodology was utilized with respect to labeled and non-labeled product. Only 30% recognized the label when prices were the same as an existing product. At a 20% premium price for the GM product, 55% recognized the GM labeling, but were confused with its meaning and their desire to purchase non-GMO product did not match their stated purchase intent. Baumgardner (2004) results highlighted that GM attributes were low in importance to consumers relative to those concerning taste for their purchase decision of a product (Baumgardner 2004).

The International Food Information Council (IFIC) in 2006 conducted a quantitative assessment of the US adult consumer and attitudes towards food biotechnology. Their

2006 findings show that nearly three-fourths (72%) of consumers say they are confident in the safety of the US food supply. When prompted to indicate food safety concerns they mentioned microbial food-borne illness (36%) or improper handling (35%), while only three percent of consumers cited food biotechnology. When communicating specific speculative GM benefits it appears to enhance the perception and likelihood to buy. The study reports that 77% are likely to buy for increased omega-3 fatty acid content, 75% for reduced saturated fat content, 75% for insect protection/pesticide reduction and 63% for improved taste or freshness.² When asked if any foods produced through biotechnology were in the supermarket now, 68% responded they don't know. Thirty three percent believed that biotechnology will provide benefits in the next five years, and of those nutrition and health benefits were the most expected with 41% followed by improved quality and taste with 35%. Respondents were asked 'all things being equal' how likely respondents would be to buy a variety of GM produce to provide: greater pest resistance and reduce pesticide application; reduce the saturated fat content; and provide more healthful fats, like Omega-3. Seventy

² Flavr Savr Tomato claimed this [attribute](#), but was a market failure.

seven (77%) percent were very likely and somewhat likely to make those purchases (IFIC 2006).

Gao, Veeman, and Adamowicz (2005) found that the majority of consumers are not educated about biotechnology; however, it is not surprising that most don't take the time to educate themselves because they don't have the time. Gao, Veeman, and Adamowicz (2005) experimented with what information a consumer will search for. They concluded that consumers will seek information as long as the incremental benefits outweigh the incremental costs of search. The consumers' opportunity costs of time and their search efficiencies are weighted against the benefits perceived. The consumer also needs to trust the information source if the search is to be effective in communicating benefits and risks. When analyzing the information seeking behaviour of the survey respondents. Thirty-one percent of the sample population accessed health attributes, 36% accessed environmental attribute information, and 25% accessed the GM attribute information. Women were more likely to seek information and respondents with no children. General knowledge of GM was not held by most of the survey population, only 33% answered six questions regarding GM correctly. The research indicated

that many respondents were not highly motivated to search for information. Study suggested that there is a preference for information to be available, even if it is not accessed. Overall conclusions are that a reduction in the costs of finding and accessing information should encourage information access (Gao, Veeman, and Adamowicz 2005).

Scholderer and Frewer (2003) concluded that in research GM foods are seen as less acceptable because they are linked to first generation traits, ones with little or no direct consumer benefit. As their research continued a new strategy for communication to consumers was beginning. This strategy became two-stage, first offer a product with a consumer benefit, and second convince them the benefits outweigh the risk. However, researchers are still not clear on what the benefits were that would convince consumers on GM foods (Scholderer and Frewer 2003).

Previous research had shown that sustainability and health benefits were perceived as the greatest way to improve consumer acceptance; however, they are credence characteristics or quality based and can't be experienced by consumers (Chen 2008).

The general attitudes consumers have for GM products are linked to their attitudes toward technological progress, environment and nature, and trust in the institutions that regulate emerging technologies. To meet the need for a new strategy consideration must be given to these attitudes. Could pro-active information counter the pre-existing attitude when substantial benefits are offered, or would the information stabilize consumer attitudes because pre-existing, general attitude structures are so strong they override the information given (Scholderer and Frewer 2003).

Scholderer and Frewer (2003) found promotion of GM foods actually led to marketing failure. The additional information triggered attitudes into action, so negative attitudes turned into negative actions of a decrease in the probability that consumers will actually choose a GM product. The new hypothesis is that exploratory research needs to be expanded to sensory experiments where consumers can smell and taste the actual product (Scholderer and Frewer 2003).

Consumer attitudes in northern Europe have historically been negative and US consumer attitudes more neutral; however, more recent opinion polls have shown a

changing attitude (European Commission 2006).

Recent polls in Europe found that 56% of consumers would "definitely" or "probably" buy GM foods if these foods were healthier and 51% would "definitely" or "probably" buy GM foods if these foods contained less pesticide residues (European Commission 2006).

Chen (2008) tried to put together a framework incorporating an attitude model. The first part of the attitude model was that experience influenced perceived benefits and risks, which we have looked at previously. The general attitude towards technology, nature, and consumer alienation from the marketplace. The second part of Chen's attitude model were the perceived benefits and perceived risks of GM foods. The consumers have a natural progression of attitudes, opinions and feelings with this new technology (Chen 2008).

The GM diffusion process and rate of adoption is influenced by five characteristics: relative advantage, compatibility, complexity, divisibility, and communicability. The relative advantage plays a role in the consumers' attitude to GM foods. If the perceived benefits are greater than the perceived risks than the positive attitudes will be greater than the negative attitude and GM foods will be accepted (Chen 2008).

Grunert, et al (2004) incorporated sensory experiences in the their experiments with cheese consumption. The input to processing cheese, starter culture, was labeled as either GM or conventional. Researchers used an initial blind taste test first to find the preferred cheese. Researchers then had a second blind taste test where they introduced the GM product as the best tasting cheese from the preliminary taste test. The sensory experience showed that the taste is important and can help reduce the negativity already associated with top-down formation of attitudes by created a bottom-up formation of actual experience. The sensory experience of taste, smell and appearance can lend to a greater positive experience and the attitude towards GM foods, thus less negative and that the type of starter culture used had less impact on their buying intentions or in other words the GM/conventional was not as important as fat content, taste and price (Grunert, et al. 2004).

Economists and overall agribusiness marketing firms need to incorporate policy information, media coverage and consumer perceptions in mainstream economic models of consumer behavior for analysis and public policy application (Just 2001). Policy makers should be aware of

the heterogeneity, and associated marginal utility that exists over large market segments and groupings. When looking to market organic, conventional, or GM functional foods consumers are going to demand more information, better information, and the ability to stretch their dollar in more segmented ways.

Overall, primary shoppers place a high degree of importance (75%) on the taste and flavor of their produce purchased, and there is willingness-to-pay at least a little extra for produce that does taste better. However when taken into context with health, health considerations edge out taste by 10% (Produce Marketing Association 2007).

Research and development is shifting from input traits and grower benefits to output traits which benefit the consumer. The key is to identify the product attributes that consumers value and will pay a premium for. But agriculture has not always been good at looking at the final consumer, and in the future it is even more important because in the future larger and fewer businesses will control access to the higher income consumers. Consumers are seeking other things other than low prices, such as the healthiest, best tasting, traditional variety, food with a "story" attached to it, convenience, appearance and

organic. Consumers want a blend of four principle elements when choosing food products: great taste and flavour for sensory pleasure, convenience, contribution to good health and well-being and esoteric elements or credence factors such as environmentally friendly and sustainable (Hughes 2007).

Focus Groups

In 2000 the US Food and Drug Administration (Levy and Derby 2000) conducted a series of consumer focus groups to better understand domestic consumer awareness of foods produced through biotechnology, their familiarity and understanding of possible terms for describing these foods and their reactions to options for identifying whether foods were products of bioengineering. Twelve focus groups were conducted in four cities. Knowledge of biotechnology was uneven. They had heard a fair amount about the uses of biotechnology pertaining to medical and drug research, and were not surprised that it was used in food production; however, they could not give details. Few participants had direct product experience and some mentioned that countries in Europe did not want to import those types of food (Levy and Derby 2000).

Participants, regardless of their understanding had well developed opinions of food biotechnology. Some of the positive opinions were feeding the worlds hungry, improving agricultural production, and making new varieties of food with improved taste, appearance or nutritional characteristics. The con was unknown long-term health consequences that might be associated with the technology but which cannot be anticipated based on current science (Levy and Derby 2000).

The analogy of biotechnology to current technology unknowns lead to association with pesticides, growth hormones and antibiotics to promote animal growth. Cloning was mentioned in several groups. Participants saw a technological innovation introduced for the benefit of producers and distributors, with little benefit to the consumer (Levy and Derby 2000).

The participants' recognized possible benefits and that the risks relevant to those benefits were slim. The participants displayed a degree of technological fatalism, the belief that ordinary people can't have much influence over the spread of new technologies, associated with the acceptance of food biotechnology (Levy and Derby 2000).

In past studies done about product labeling consumers want information about product characteristics that are

relevant to their health and safety concerns. In the case of biotechnology people want the label to provide how the food product was produced, rather than the compositional effect of the process on the food product. The unknown long-term effects seem to underlie the reasoning for labeling the product as produced using biotechnology. The unknown is the product characteristic (Levy and Derby 2000).

During the focus group labeling options were discussed. Participants were in agreement on the value of a "mere disclosure" labeling. However, they thought that anything additional would need to be concise and not requiring a college degree. Groups also discussed different ways to label foods that were not products of biotechnology. Participants saw these as product promotion claims, and not held to very high standards. Participants had a hard time discussing how food products that are not organic, but which are also not products of food biotechnology should be described (Levy and Derby 2000).

The moderator then presented information about factual grain crops grown in the US being produced from bioengineered seed, and the extent of processed food with bioengineered ingredients. Participants were not concerned with the health and safety effects of unknowingly eating

bioengineered foods but expressed outrage that they were not given the information about the change in food supply. Some participants felt this was evidence of how biotechnology was 'snuck-in' to the food supply and why distrust existed, that there must be something to hide, or it should have been disclosed (Levy and Derby 2000).

Teisl, et al (2002) used focus group research to develop an understanding of the characteristics that may impact the effectiveness of a genetically modified food labeling policy. Six focus groups were conducted in three cities. Two cities were delineated by education; however, one city was broken up by the respondents' negative opinions of GM foods. Researchers used frozen products - corn, chicken tenders, and pasta with vegetables. Statements were placed on packaging - negative, neutral, positive. Results showed that consumers purchased based on actual food product rather than the method of production. In other words they don't think about a chicken being killed to make nuggets, but they know that chicken is a healthy source of protein. Consumers confused genetically modified with the use of hormones and growth stimulants, and with traditional hybridization and crossbreeding techniques. The majority of respondents did not realize how prevalent genetically modified products were in

available foods, some were angry, while others saw it as comforting, genetically modified foods in existence without anyone becoming sick.

Participants were un-aware of GMO-free labeling and viewed it as a marketing tool. Participants favored a label on genetically modified products however did not think that they should have to pay higher prices for that labeling.

Groups were not unanimous on where the authority for labeling should come from, but rather than a government entity it should be independent (Teisl, et al. 2002).

Market Research

Our focus now shifts from already-available secondary to the collection of primary data. When there is not enough information available to move directly from secondary data into a structured study with quantifiable results, qualitative data collection is done. There are a variety of qualitative methods that can be used for exploratory purposes. The focus group allows for exploratory research and qualitative data. Feelings, thoughts, intentions and behavior are examples of data that can be obtained through qualitative data collection

methods. Exploratory research is used for defining problems in more detail, suggesting hypothesis' to be tested in subsequent research, generating new product or service concepts, problem solutions, getting preliminary reactions to new product concepts, and pre-testing structured questionnaires (Aaker, Kumar, and Day 2001-).

Exploratory focus groups are used as a type of qualitative research. This setting allows an outlining of the intended direction of the group; however, participants are encouraged to interact and discussion often leads to greater insight, new ideas and meaningful comments. Another advantage is that participants feel the security of being in a crowd and are more encouraged to speak out (Templeton 1987).

Three focus group sessions are sufficient, in the first group the analyst learns a great deal, the second group yields more, but less is new. The third and fourth session much has already been heard before (Aaker, Kumar, and Day 2001-).

In many ways a multiple focus groups are similar to multiple case study design. Extensive resources and time are required. The replication predicts similar results, predicts contrasting results but for predictable reasons. A case study is an empirical inquiry that investigates a

contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident. The case study inquiry copes with the technically distinctive situation in which there will be many more variables of interest than data points and as one result relies on multiple sources of evidence with data needing to converge in a triangulating fashion, and as another result benefits from the prior development of theoretical propositions to guide data collection and analysis. Case study research can be applied to explain, describe, illustrate, explore, and meta-evaluation (Yin 2003).

The focus group planning begins by creating a discussion guide or agenda. The research purpose is set into questions to reach the research objectives. The discussion guide is for guidance and it is not desirable to read formal questions to the group. The moderator proceeds from general questions to specific issues (Aaker, Kumar, and Day [2001](#)).

When recruiting participants it is desirable to provide for both similarity and contrast within a group. The focus group participants may all be the primary household shopper for example, but you may want to diversify by age, or by levels of education. Scheduling the focus group to

increase attendance is also important. Offering incentives (e.g. money for gas, childcare, coupons, or a meal), conducting the focus group in a comfortable setting (e.g. hotel board room, restaurant banquet room, etc.), are also recommended (Templeton 1987).

Critical to the focus group is ensuring the participants are comfortable. The moderator should give an introduction about the purpose of a focus group, the general premise of the topic, and what can be expected during the next 60-120 minutes. The moderator should ensure that the discussions will be kept private within the organization, and the video is meant to record words and won't be zoomed to any one person. The moderator will also let the participants know that honesty and respect is expected at all times (Templeton 1987).

The moderator encourages all focus group respondents to discuss their feelings, anxieties, and frustrations as well as their attitudes and perceptions of issues related to the topic without bias or pressure. The moderator should listen carefully, take a genuine interest in each participant's view, dress similar to participants and avoid sophisticated terminology or jargon. The moderator should be flexible and conduct the focus group agenda in a way that makes the group comfortable. The moderator should

sense when a topic has been exhausted or is becoming uncomfortable, and know which new topic to introduce to keep a smooth flow. The moderator must be able to control the outside influences in the group and avoid having a dominant individual that will suppress others from contributing (Aaker, Kumar, and Day 2001).

Templeton (1987) gives us other guidelines for a successful focus group: early planning, correctly managing the recruitment process, no pre-judgements based on physical appearance, the moderators should bring objectivity and expertise in the process of a project, achieving the research objectives does not guarantee a successful focus group project, the moderator and client need to coordinate efforts at all stages, conduct more focus groups than are necessary, execute fast report turnaround, summarize objective conclusions based on interpretation of the research, without regard for what the client wants to hear (Templeton 1987).

When writing the report the analyst would give the background and the purpose of the focus group. The analyst would make the data accessible and relative. This means not only handing over the videos but also putting responses into categorical charts and then this would become the worksheets for writing the report. The moderator must

include the responses but also the mood and tone as well
(Templeton 1987).

Templeton (1987) suggests that within the body of the
report there are, instead of numbers, quite explicit
translations:

- "A couple" = one or two in each panel
- "A handful" or "several" or "a small minority" = at
least three in each panel, but less than one-third
of panel.
- "Some" - at least one-fourth but not much more than
one-third of the panel.
- "Evenly divided" = one-half of the panel.
- "Many" = more than one-half, but less than two-
thirds of the panel.
- "A preponderance" = more than two-thirds but less
than three-fourths of the panel.
- "Most" - at least three-fourths but less than 90
percent of the panel.
- "Almost" or "virtually" all = at least 90 percent,
but less than 100 percent of the panel.

Formatted: List Paragraph, Bulleted + Level:
1 + Aligned at: 36 pt + Indent at: 54 pt

Formatted: Font: (Default) Courier New, 12 pt

CHAPTER III

METHODS

Data

Three focus groups were conducted in three cities - one group each in San Luis Obispo, Pismo Beach, and Santa Monica, California. All participants were recruited by phone; a screener survey was used to determine eligibility requirements. In order to organize the Santa Monica focus group a third party market research firm was hired. Six calls to market research firms in San Luis Obispo, Santa Barbara, Ventura, Los Angeles, San Francisco and Fresno counties were made. Two of the firms returned the phone calls and submitted bids (see Appendix B). The firm, Opinion Studies (San Luis Obispo), was hired to recruit for the Santa Monica focus group. Participants were only told that the study was about fresh produce purchasing in the grocery store. This was done to avoid revealing the research purpose by participant preparation research or

background on biotechnology prior to the focus group.

The final moderator's guide is included as Appendix A. Slight refinements were made to the guide over the course of groups. Ice breaker questions were used to lead into the main topic of biotechnology. Introductory and exploratory questions about primary vegetables eaten at home and in restaurants along with primary reasons for eating vegetables were discussed. The groups were then questioned about their knowledge of biotechnology, their definitions for hybrid gene selection and genetically modified organisms. The moderator then asked the groups about concern or worries with these terms. The moderator then asked about safety and regulation of these products. A handout was provided to the groups after the introduction and exploratory section. The handout listed all the recent genetic modifications of crops for animal and human consumption, which were currently grown for market in the US (see Appendix [GD](#) and [HE](#)). The moderator then redirected the group back to the topics of consumer demanded traits and benefits from vegetables (fresh, ripe, appearance, vitamins and nutrients and shelf-life) and their specific concerns with respect to biotechnology (processing, breeding, and contents).

Three labeling options were also provided to the group

(see Appendix ~~IF~~). They were each on a separate page so the group could discuss them individually without looking ahead or looking at the previous label. The labels were delineated into three categories: neutral, positive, and negative. Option 1 read "Produced using biotechnology", Option 2 were positive statements: "Produced using biotechnology to increase Vitamin A content", "using biotechnology to reduce pesticide and herbicide use", and "fresher and longer shelf life from biotechnology". Option 3 was "Caution: Produced using biotechnology. Long term effects have not been determined".

Participants were asked to comment on whether the statements should be placed somewhere on the display next to the products, what added value there was to the consumer, how they felt consumers would react and if it would make them more or less likely to buy the product.

Finally, to wrap up the moderator asked several open-ended questions regarding a consumer education campaign and anything not discussed thus far. This gave groups the opportunities to ask questions and bring up anything that they had been thinking about during the discussion which had not been brought up.

The three groups were analyzed for content, specific insights, and consistency. The three groups are referred

to as the Santa Monica group, the SLO group and the Pismo Beach group.

Assumptions and Limitations

Focus group participants can be influenced by how questions are worded. Care was taken to make all questions neutral in context, no positive or negative bias; however, asking the questions at all add to a perceived 'why do you want to know'. Answers may be biased if they know I am looking for positive or negative answers. Suppositional wording is a way of asking a question that implies particular assumptions. Information provided to the focus group participants and its content and wording can influence responses, if it is their first exposure to biotechnology what they are told can have a pronounced effect on how they answer the questions. Lack of awareness about agricultural biotechnology is a reason to interpret focus group discussion cautiously. Respondents can express great concern, but yet have never heard about the subject before the session began (James 2004).

CHAPTER IV

RESULTS

Vegetable Consumption

When asked what proportion of vegetables were prepared and eaten at home as opposed to out of the home (or at restaurants), ~~the majority~~ most of participants consumed 80 to 100 percent of vegetables at home. A handful of ~~very few~~ participants consumed less than 50 percent at home. The primary vegetables that respondents consumed and purchased most often were broccoli, head lettuce, bagged salad mix, tomato, spinach, carrots, and peppers. The primary motivators for purchasing and eating vegetables were health, balanced nutrition, taste, cost-effective, as an ingredient and ease of cooking.

When asked about a particular nutrient, vitamin, or benefit that they associated with a specific vegetable there was a common theme. Respondents mentioned dark, leafy greens with greater antioxidants, iron, and fiber.

Respondents mentioned beta carotene associated with carrots, and iron associated with broccoli and asparagus. Respondents mentioned "zero" [meaning lower] calories with respect to many vegetables as well as vitamins that are naturally available as opposed to taking vitamin supplements. When asking for a ranking of which benefit they prefer when purchasing a vegetable the top three were taste, health and vitamins.

Biotechnology Knowledge Levels

The next set of questions asked about biotechnology. When asking what respondents had heard about biotechnology, very few of the participants had a response. A ~~few-small~~ minority mentioned crops are better, pest resistant and cleaner. The Santa Monica group mentioned that it makes crops grow faster and go quicker to market, that it was unnatural and one person mentioned pro-biotics that were placed in yogurts. Overall, the Santa Monica group had not heard about biotechnology in contrast to Pismo Beach and San Luis Obispo, which, had heard the term before.

The groups were asked if they were familiar with terms like "produced using biotechnology", "hybrid gene

selection", "genetically modified organisms" and "genetically engineered organisms". Respondents mentioned cloning when they hear biotechnology, and overall said that they don't think genetic modification and genetic engineering were good things. A common theme appeared to be that people didn't know precise definitions, but ~~some-a~~ couple knew that there were differences between the terms. One respondent in San Luis Obispo gave a fairly correct example of genetic engineering with regards to its application for reducing pesticide application and plant pesticide resistance. One respondent in the Pismo Beach group was very knowledgeable about hybrid gene selection in plant breeding and informed the group that it had been used for decades. The Santa Monica group mentioned how there are different types of fruit, such as 'pluots', a mix of a plum and apricot, but thought that a biotechnology product.

Respondents were then asked if anything about these types of vegetables might concern consumers. The San Luis Obispo group mentioned the science behind it was not widely known or understood by the public and that it is beyond the common consumers' education level. The science makes people nervous and the consumer question the content of such products (see Figure 1). One respondent in San Luis

Obispo mentioned biotechnology was used in wine grape production.

Figure 1. Focus Group #1 - Notes on 2nd Generation Biotechnology Attributes in Vegetables

Location: Embassy Suites, San Luis Obispo, CA 93405

Date: August 7th, 2008 6pm

Demographics: 8 women, 1 male

Age 18-24: 2

Age 25-35: 2

Age 36-55: 5

Age 56-65: 0

Major Points:

- The ability to get fresh and local produce on the Central Coast of California year round is the primary demanded traits, along with healthfulness.
- Cloning is associated with biotechnology.
- Concern over the change in contents of GM products - Is there still the full health benefit or has it been altered somehow?
- If GM is marketed as more for your spending dollar, then the consumer will buy it. The example was given for orange juice fortified with more vitamin C.
- The group was concerned with the additional costs of education and labeling and who would pay those costs.
- The group expressed that it is important for shoppers to purchase and consume vegetables, and that some sort of warning label or labels with biotechnology may reduce consumption of produce.

the long-term effects are not known because there has not been the time to study and measure any effects. The Pismo group mentioned genetic mutation that could possibly affect

other species and allergens that could become impossible to control (see Figure 2).

Figure 2. Focus Group #2 - Notes on 2nd Generation
Biotechnology Attributes in Vegetables

Location: Marie Callendars Restaurant, Pismo Beach, CA

Date: August 21st, 2008 6pm

Demographics: 8 women, 1 male

Age 18-24: 0

Age 25-35: 5

Age 36-55: 3

Age 56-65: 1

Major Points:

- Large corporations control the industry, and they will dictate what is sold, if we had a choice then [GMO] wouldn't already be in the market.
- Consumers look for dark, leafy greens, and colorful produce for greater iron, and anti-oxidants.
- Respondents were concerned about the producers of the biotechnology products. Who were they, and were farmers in favor of the technology or was it pushed onto them?
- Participants felt that the FDA and USDA were more reactionary than pro-active, and that if there was a problem we [consumers] would likely find out much later than sooner.
- Respondents were very outspoken/insistent about a national educational campaign. A choice should be given to the consumers.
- Participants agreed that if products had attributes such as cancer prevention, higher nutrients and other disease prevention qualities they would likely go up in price. That increase in price would also lead to more pill-popping, since people see that as an easy alternative to a more well-balanced diet.
- Participants suggested that an education campaign needs to come from a trusted source, which is not likely to be the producers
- Video monitors in grocery stores would be a good first-step location to educate the shoppers.

Figure 3. Focus Group #3 - Notes on 2nd Generation
Biotechnology Attributes in Vegetables

Location: Double Tree Suites, Santa Monica, CA

Date: February 20th, 2010 9:30am

Demographics: 10 women, 2 males

Age 18-24: 0

Age 25-35: 2

Age 36-55: 6

Age 56-65: 4

Major Points:

- No person had heard anything about biotechnology except in regards to efficiency of production, longer shelf-life, and pro-biotics.
- One participant expressed that she was open minded, if the product was better, she would try it.
- Participants talked about 'pluots' a product at their local farmers market, which they suggested as a sample of biotechnology. [It was a combination of a plum and an apricot - natural plant breeding].
- Several participants were concerned with health consequences in the long-run. They were fearful of cancer prevalence increasing, and the idea that these products had altered contents that might make them less beneficial.
- One participant mentioned that a reduction of pesticides and herbicides would actually be a sustainable benefit and make produce currently available more healthy and safe.
- Participants all depended on their grocery stores (i.e. - Trader Joes, Fresh and Easy, Vons, etc.) to provide safe food products.
- One participant had an interesting comment about how vegetables are low on the food chain and she assumed a 'pure' product. The idea of biotechnology made a new concern about even the simplest of food decisions.
- Many participants would probably not even read the labels in the grocery store if they were provided [When the moderator used country of origin labeling as an example most of the group did not know that country of origin labeling was mandatory for the past 2 years].

|

When asked if anything about these vegetables worried them personally the groups mentioned the ethical and moral issues of "messaging with nature" as well as general lack of knowledge about biotechnology and genetically modified organisms. The Santa Monica group was concerned about the long-term health effects as well as the nutrient existence in the modified varieties (see Figure 3). An interesting comment also was made that vegetables were considered the bottom of the food chain, and basically assuming unadulterated or pure products, now consumers have to worry about "what's in my vegetable?"

Regulatory Oversight Views

The moderator next asked how concerns were being addressed, if at all and by whom? The groups all mentioned FDA and USDA. The San Luis Obispo group mentioned watchdog groups, and the Santa Monica group said that their local farmers' market, grocery retailers, and the corporations who do this technology should be informing the consumer. They said that the limited resources within the FDA would make it too difficult for them to do a good job.

The San Luis Obispo group felt that it was the job of the entire supply chain to ensure the safety of the vegetables from the grower to the packer to the shipper to the retailers. The Pismo Beach group felt it was the grower's job, but also a responsibility of the consumer to be educated and demand that the food be safe when it gets to the retail level. The Santa Monica group felt that they could rely on the food being safe because it was in the stores. They felt that retailers such as "Trader Joes" and "Fresh and Easy" were the main parties responsible for ensuring the food was safe. The Santa Monica group also assumed that they could avoid biotechnology by shopping at farmers' markets. When the moderator asked what vegetables were in the supermarket that were produced using biotechnology the Santa Monica group only responded with their earlier example of 'pluots'. The San Luis Obispo group mentioned corn, tomato, and broccoli. The Pismo Beach group had no knowledge of any GM items.

At this point in the focus group the moderator passed out an info sheet with a listing of all ~~commercially~~ approved GM crops ~~trials produced through~~ for biotechnology (see Appendix DG and HE). The most prevalent ~~varieties~~

species were corn and soybeans. The list also mentioned squash, papayas and potatoes.

Figure 4. Summary of Focus Group Findings

General Impressions:

- Most participants were more concerned with pesticides and herbicides than biotechnology.
- Most participants were confident in farmers, and retail stores to provide safe food.
- At the point-of-purchase consumers look for appearances: fresh, ripe, taste; and are not likely to read labels.
- Consumers have little knowledge of biotechnology and GM products.
- Consumers will purchase functional foods for the value.
- Consumers would like information about biotechnology on the vegetable product; however, they do not feel they should have to pay extra for that labeling.
- Consumers will purchase organic produce if they demand that their vegetables are grown without GM and harmful pesticides and herbicides.
- All groups mentioned that the long-term health and environmental effects are still not known at this time.

The moderator then went back to the consumer demanded traits and benefits that people use to purchase vegetables. Using fresh, ripe, appearance, vitamins and nutrient, and shelf-life the respondents were asked to rank their attribute or trait preferences. The majority of respondents ranked them 1st - fresh, 2nd - ripe, 3rd - appearance, which, all describe how the vegetable looks and what they expect it to taste like. Respondents were then

asked what order their concerns for biotechnology ranked. Respondents in San Luis Obispo ranked contents first, breeding second, and processing third. The Pismo Beach and Santa Monica groups ranked breeding first, contents second, and processing third. The Santa Monica group again placed emphasis on how they really didn't know what concerned them the most because they knew so little and admitted that this focus group was their first exposure to the topic ([see Figure 4](#)).

Labeling Biotech Foods

The next part of the focus group sought feedback on alternative labels for biotech vegetables. The moderator asked for feedback on the aforementioned generic label first, "Produced Using Biotechnology." The majority of respondents felt that consumers would not buy it. The respondents also expressed that more information needed to be disclosed. The Pismo Beach and Santa Monica groups both thought a marketing campaign similar to 'certified organic' needed to happen first. One respondent from Pismo Beach thought that an internet site (e.g. www.producedusingbiotechnology.com) might be a way to educate consumers. One San Luis Obispo group member thought that this would

send a negative connotation with science dealing with nature and may hinder consumer interest in vegetables. The group member also expressed it is approved by FDA meant it was not harmful and there is no need for a warning label [USDA determined equivalent, accepted by FDA]. Another respondent from San Luis Obispo felt that more important things that should be on the label, such as chemicals used in producing should be disclosed.

Labeling Second Generation Attributes

The moderator then asked for feedback on several labels with positive information about biotechnology. The first label was "produced using biotechnology to increase Vitamin A content." The majority of respondents felt that this would likely lead to a purchase or at least an interest in purchase, depending on the price. A participant in San Luis Obispo group mentioned that they would not pay more for it without comparing the actual vegetable with the conventional version, without the statement. The groups in Pismo Beach and Santa Monica both mentioned that it sounded like a marketing campaign and would likely sell to the majority of shoppers.

The statement "using biotechnology to reduce pesticide and herbicide use" was generally accepted as a good label idea. However, there was at least one person in each group that felt the statement caused more concern because the mention of pesticides and herbicides brought with them a negative connotation and the label says "reduced" rather than "remove." The statement "fresher and longer shelf life from biotechnology" also produced concerns. Even with positive benefits the panel consumers thought that further information was needed with this statement. Focus group participants indicated that the statement could mislead people into thinking that preservatives and chemicals were used to improve freshness and shelf life. The San Luis Obispo group felt that in their case they were surrounded by agriculture and when purchasing vegetables they are not concerned with the shelf life and freshness because they assume that everything is fresh and local. Several participants in all three groups mentioned that they depend on their local farmers' markets for safe, healthy and fresh produce. Many of the 'local' farmers at the Santa Monica Farmers' Market were from Sacramento and Monterey.

Participants were asked about consumer demands for health qualities and traits related to vegetables. The

specific traits were: cancer prevention, higher quantity of vitamins and nutrient, and other disease prevention. Most expressed that these were already prevalent reasons for eating fruits and vegetables and that more of these would be desirable as a way to get "more bang for your buck." The majority of respondents felt that any attempt to promote these traits along with biotechnology would be associated with a questionable marketing scheme.

Negative Labels

The final labeling option was a negative statement, "Caution: Produced using biotechnology. Long term effects have not been determined." The groups all seem to laugh when this statement was read. The moderator asked them why it was comical and many thought that it would be obvious that no one would purchase anything with this type of label. However, a small portion also mentioned that these warning labels are on over-the-counter products, such as ibuprofen prescriptions, alcohol, cigarettes and those are still purchased and consumed by many people. A few focus group participants commented that they were interested and would do further research. This viewpoint then led other participants to then argue that only if required by the FDA

to put such a label would someone do so, and that because there is currently no requirement the products must be deemed safe. A participant in San Luis Obispo felt that it was getting so difficult for people to eat vegetable and healthy items that this type of a label would reduce consumption even further. An overwhelming majority of respondents said they would not buy the product with such a label.

Lastly, participants were asked if an information program that explains biotechnology should be available to the general public. All the groups agreed that this should be done, but questioned who the author of the information would be. If it is presented from a corporation that makes money off the technology the information will still be viewed with skepticism. Participants in the San Luis Obispo group were concerned with the additional costs associated with mandatory labels, voluntary labeling and information costs. The Pismo Beach group suggested using video monitors within the produce department to give shoppers information. Participants also expressed that the source of the biotechnology information should be associated with entities capable of inspiring consumer trust.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

Similar to the literature review and past studies we observe a very low level of awareness and knowledge surrounding biotechnology. In addition we find that much of what is written and advertised about biotechnology, with regards to genetic engineering, is negative. The persons most skeptical of biotechnology are the most likely to purchase organic and "GMO-free" products.

Regarding consumer demanded benefits we observed that the consumers' primary motivator for purchasing vegetables is for health reasons, but what they actually purchase is based on appearance, in other words, what is fresh looking, ripe and what they expect will taste good. This leads the researcher to believe that if a product is produced using biotechnology and is placed in the store and it looks

fresh, ripe, and good tasting the consumer will likely purchase the product and many would not even look at a sign or label.

Consumers are driven by price as well. The respondents were all willing to pay more for organic because they understood that it is more expensive to produce; however, they were not willing to pay more for biotechnology. They felt that biotechnology allowed for cheaper and faster produced food, and that they were not willing to pay more. The respondents were clear that they did not want to make big companies any richer.

Respondents also felt that these products were for the most part safe. They trusted in the FDA and USDA to protect their food supply. If these products were tested and were not safe then they would not be in the grocery stores. Many respondents felt that the existence in large grocery stores made them feel safe as well.

Most respondents felt that they would purchase products with more 'bang for their buck'. A claim of greater vitamins or nutrients would be something they would purchase. The idea being that if you only eat 2-3 servings of fruits and vegetables a day, you would like to be able to get 5 servings in 3 servings. The responses to extended

shelf-life and reduced pesticide and herbicide use only raised more questions and concerns.

Conclusions

Since many respondents and likely most shoppers are not aware of biotechnology, many are not sure whether they have concern or not. They do however like fresh, ripe and appearances and are looking for more utility out of each dollar they spend. A product that offers greater nutrients and benefits to a consumer would likely lead to a purchase even if the product was produced using biotechnology, where currently there is little consumer knowledge and little associated concern.

Recommendations

These finding emphasize that the majority of the US population is greatly disconnected from the food on their plate to the farm gate. Because so many consumers are not aware of how their food is grown they are even less aware of how their food is produced. The current policy allows products that are produced with biotechnology to be sold without labeling if it is not significantly different.

This would lead to the conclusion that no policy changes are needed. Persons who wish to avoid GM products can do so by purchasing certified organic products, which are not allowed to have any GM products in the contents.

Research on the long-term effects of GM products on animals and on humans who consume these products should be ongoing. The research could lead to negative information, but also the possibility of positive information. Additional research about the use of these products to reduce carbon dioxide and information related to their use in drought areas to feed people in less-developed countries. Additional research about nutrient enhanced GM products should be done as a way to encourage more consumption of vegetables in the US as a way to combat obesity and heart disease.

Overall, the future use and production of GM products can be beneficial and safe as long as there is proper oversight and management of these products.

References Cited

- Aaker, David A., V. Kumar, and George S. Day. (2001) *Marketing Research*. 7th Edition. New York: John Wiley & Sons, Inc., 2001.
- Baumgardner, Darl K. (2004) "Consumer Response to a Branded Non-GMO Food Product: Awareness of Label, and Impact of Price on purchase interest." Unpublished Master's Thesis, Agribusiness, California Polytechnic State University, San Luis Obispo, 2004.
- Brookes, Graham, and Peter Barfoot. (2009) *GM Crops: Global Socio-Economic and Environmental Impacts 1996-2007*. Dorchester: PG Economics Ltd, 2009. pp 7-15.
- Carlsson, Fredrik F., Peter Lagerkvist, and Carl Johan. (2007) "Consumer Benefits of Labels and Bans on GM Foods - Choice Experiments with Swedish Consumers." *American Journal of Agriculture Economics* (89: 1) February: 152.
- Chen, Mei-Fang. (2008) "An Integrated Research Framework to Understand Consumer Attitudes and Purchase Intentions toward Genetically Modified Foods." *British Food Journal* (110:6): 559-579.
- Deaton, J. and J.P. Hoehn. (2005) "The Social Construction of Production Externalities in Contemporary Agriculture: Process versus Product Standards as the Basis for Defining 'Organic'." *Agricultural Human Values* (22:1) March: 31-38.
- Economic Research Service, United States Department of Agriculture (2008) *Organic production*. Economic Research Service, United States Department of Agriculture, Washington, DC. 2008. <http://www.ers.usda.gov/data/organic>
- European Commission. (2006) "Europeans and Biotechnology in 2005: Patterns and Trends." *Eurobarometer* (64:3) May: 1-23.
- Fernandez-Cornejo, Jorge and Margriet Caswell. (2006) "The First Decade of Genetically Engineered Crops in the United States." Economic Research Service, United States Department of Agriculture. Economic Information Bulletin Number 11. April: 1-30.
- Gao, Ge, Michele Veeman, and Wiktor Adamowicz. (2005) "Consumers' Search Behaviour for GM Food Information." *Journal of Public Affairs* (5) August-November: 217-225.

- Griliches, Zvi. (1957) "Hybrid Corn: An Exploration of the Economics of Technological Change." *Technology, Education and Productivity: Early Papers with Notes to Subsequent Literature* (1957): 27-52. New York: Basil Blackwell, 1988 [1957].
- Grunert, Klaus G., Tino Bech-Larsen, Liisa Lahteenmaki, Oydis Ueland, and Annika Astrom. (2004) "Attitudes Towards the Use of GMOs in Food Production and Their Impact on Buying Intention: The Role of Positive Sensory Experience." *Agribusiness* (20:1) Winter: 95.
- Hu, Wuyang, Michele M. Veeman, and Wiktor L. Adamowicz. (2005) "Labelling Genetically Modified Food: Heterogeneous Consumer Preferences and the Value of Information." *Canadian Journal of Agriculture Economics* (53): 83-102.
- Hu, Wuyang, Wiktor L. Adamowicz, and Michele M. Veeman. (2006) "Labeling Context and Reference Point Effects in Models of Food Attribute Demand." *American Journal of Agricultural Economics* (88:4) November: 1034-1049.
- Hu, W., A. Hunnemeyer, M. Veeman, W. Adamowicz, and L. Srivastava. (2004) "Trading off health, environmental and genetic modification attributes in food." *European Review of Agriculture Economics* (31:3) September: 389-408.
- Hughes, David. (2006) "Supply Chain Management and Global Trade in Horticultural Products." *International Symposium on Horticulture Plants in Urban and Peri-Urban Life*. XXVII International Horticulture Congress, International Society for Horticulture Science. Seoul, Korea.
- International Food Information Council. (2006) "Food Biotechnology: A Study of US Consumer Attitudinal Trends." 2006 Food Biotechnology Consumer Research September: 1-10.
- James, Jennifer S. (2004) "Consumer Knowledge and Acceptance of Agricultural Biotechnology Vary." *California Agriculture*, April-June 2004, 99-105.
- Just, Richard E. (2001) "Addressing the Changing Nature of Uncertainty in Agriculture." *American Journal of Agriculture Economics* (83:5) December: 1131-1153.
- Kalaitzandonades, N. (2000) "Agrobiotechnology and Competitiveness." *American Journal of Agriculture Economics* (82:5) November: 1224-1233.
- Kalaitzandonades, N., L.A. Marks, and S.S. Vickner. (2004) "Media Coverage of Biotech Foods and Influence on Consumer Choice." *American Journal of Agriculture Economics* (86:5) December: 1238-1246.

- Lapan, Harvey, and GianCarlo Moschini. (2006) "Grading, Minimum Quality Standards, and the Labeling of Genetically Modified Products." *American Journal of Agricultural Economics* (89:3) October: 769-783.
- Larue, B., G.E. West, D. Gendron, and R. Lambert. (2004) "Consumer Response to Functional Foods Produced by Conventional, Organic, or Genetic Manipulation." *Agribusiness* (20:2) February: 155-166.
- Lence, Sergio, H. Hayes, and J. Dermot. (2008) "Welfare Impacts of Cross-Country Spillovers in Agriculture Research." *American Journal of Agriculture Economics* (90:1) February: 197.
- Levy, Alan S., and Brenda M. Derby. (2000) "Report on Consumer Focus Groups on Biotechnology." United States Food and Drug Administration Center for Food Safety and Applied Nutrition. October.
- McCann-Hiltz, Diane, Michele Veeman, Wiktor Adamowicz, and Wuyang Hu. (2004) "Agriculture Biotechnology: A Comparison of Consumers' Preferences for Selected Policy Options." *Canadian Journal of Agriculture Economics* (52): 333-350.
- Moschini, GianCarlo. (2008) "Biotechnology and the Development of Food Markets: Retrospect and Prospects." *European Review of Agriculture Economics* (35:3) April: 331-355.
- Onyango, Benjamin, Ramu Govindasamy, and Rodolfo M. Nayga Jr. (2004) "Measuring US Consumer Preferences for Genetically Modified Foods Using Choice Modeling Experiments: The Role of Price, Product Benefits and Technology." *American Agriculture Economics Association Annual Meeting*. August 1-4, Denver: Rutgers University, Food Policy Working Paper No. WP1104-017. 1-13.
- Produce Marketing Association. (2007) "Consumer Perceptions on Flavor and Taste." Produce Marketing Association, Newark, Delaware April: 1-45.
- Saak, Alexander E., and David A. Hennessy. (2002) "Planting Decisions and Uncertain Consumer Acceptance of Genetically Modified Crop Varieties." *American Journal of Agriculture Economics* (84:2) May: 308-319.
- Scholderer, Joachim, and Lynn J. Frewer. (2003) "The Biotechnology Communication Paradox: Experimental Evidence and the Need for a New Strategy." *Journal of Consumer Policy* (26) 125-157.
- Shoemaker, Robbin, D. Demcey Johnson, and Elise Golan. (2003) "Consumers and the Future of Biotech Foods in the United States." *Amber Waves*, November. United

- States Department of Agriculture Economic Research Service. <http://www.ers.usda.gov/AmberWaves>
- Tagene, Ababayehu, Wallace E. Huffman, Matthew Rousu, and Jason F. Shogren. (2003) "*The Effects of Information on Consumer Demand for Biotech Foods.*" Economic Research Service, United States Department of Agriculture, Technical Bulletin Number 1903. March 2003.
- Teisl, Mario F., Lynn Halverson, Kelly O'Brien, Brian Roe, Nancy Ross, and Mike Vayda. (2002) "Focus Group Reactions to Genetically Modified Food Labels." *AgBioForum* (5:1) 6-9.
- Templeton, J. F. (1987) *Focus Groups*. Chicago: Probus Publishing Company, 1987.
- United States Department of Agriculture, Agriculture Marketing Service. (2003) "*Organic food standards and labels: the facts.*" Agricultural Marketing Service, National Organic Program, US Department of Agriculture, Washington, DC. <http://www.ams.usda.gov/oldnop/Consumer-brochure.htm>
- Veeman, Michele. (2000) "Changing consumer demand for food regulations." *Canadian Journal of Agriculture Economics* (47): 401-409.
- Yin, Robert K. (2003) *Case Study Research: Design and Methods*. 3rd Edition. London: Sage Publications, 2003.

Appendix A: Discussion Guide

| Why doesn't the text for this start here?

Moderators Guide

- Usual introduction and background on focus groups. Ice breaker question.
 - Focus-group discussion is the process of obtaining possible ideas or solutions to a marketing problem from a group of respondents by discussing it.
 - In a normal week what ratio of vegetables do you prepare and eat at home with respect to out of home/restaurant meals?
- Priors:
 - What are the primary vegetables you eat and purchase when going to the grocery store or out to dinner?
 - What are the primary motivators for purchasing and eating vegetables?
 - Is there any vegetable you purchase most often?
 - In particular is there a nutrient, vitamin, benefit that you are associating with a specific vegetable?
 - Identify the ranking of your benefit for purchasing a vegetable?
 - What have you heard about biotechnology?
 - When you hear terms like “produced using biotechnology”, “hybrid gene selection”, “genetically modified organisms”, and “genetically engineered organisms”, what comes to mind?
 - Are there any important differences between these terms? What are they?
 - Is there anything about these types of vegetables that might

concern consumers?

- Is there anything about these vegetables that worries you personally?
- How are these concerns being addressed, if at all? By whom?
- Who do you think is responsible for ensuring the safety of these vegetables?
- Are there any vegetables in your supermarket produced using biotechnology? What are they?

○ Background:

- Widespread nature of biotechnology in food supply.
- New vegetable products on the market produced using biotechnology:
 - Squash
 - Tomato
- Consumer demanded traits and benefits from vegetables.
 - Fresh
 - Ripe
 - Appearance
 - Vitamins and nutrients
 - Shelf-life
- Consumer concerns with biotechnology:
 - Processing
 - Breeding

- Contents

- Possible labeling for vegetables that are produced using biotechnology
 - Option 1 – Do you think, for example, vegetables should have a simple statement such as “Produced using biotechnology” somewhere on the display? How do you think consumers will respond to such disclosures? Will it make them more or less likely to buy the product?
 - Option 2 – Do you think a more product specific kind of disclosure statement might be better, such as “Produced using biotechnology to increase Vitamin A content” or “Using biotechnology to reduce pesticide and herbicide use” or “Fresher and longer shelf life from biotechnology”. Why do you think these kinds of statements might be better or worse than Option 1? What is the added value to you as a consumer from this kind of labeling?
 - Option 3 – Do you think that a statement such as “Caution: Produced using biotechnology. Long term effects have not been determined” might be appropriate for vegetables? What is the added value to you as a consumer from this kind of labeling? How do you think consumers will respond to such a statement? Will it make them more or less likely to buy the product?
- Questions about consumer demanded health qualities and traits related to vegetables.
 - Cancer prevention

- Higher quantity of vitamins/nutrients
- Other disease prevention
- Wrap Up
 - We've looked at several different types of vegetables and the different ways information about the production of these vegetables can be given. Do you think there should be an information program that explains the benefits of biotechnology to the general public?
 - Is there any other information we haven't discussed that you think needs to be on the label or in stores, that tells consumers about vegetables produced using biotechnology?

Appendix B: Opinion Studies Contract

OPINION STUDIES

784 Greystone Place ♦ San Luis Obispo, CA 93401 ♦ 805-549-0367 ♦ Fax: 805-549-9046

January 28, 2010

TO: Cal Poly Corporation (CPC)
FROM: Robyn Letters
RE: Letter of Agreement

Thank you for entrusting your focus group recruit project to Opinion Studies. The purpose of this memo is to confirm plans and our agreed terms. I understand that you are contracting on behalf of Cal Poly's Agribusiness Department with Opinion Studies to pre-screen and recruit respondents for a focus group project. Dr. Wayne Howard and Dr. James Ahern of Agribusiness Department agree that Megan Judge, graduate student in Agribusiness, will conduct the focus group. Per instructions, Opinion Studies will recruit 12 respondents for one session and expect 8 to 12 to show per session. Specific recruiting requirements and our agreed terms are outlined below:

Recruiting requirements:

- All respondents will be between 18 and 65; approximately ½ will be 18-45 and ½ 46-65;
- All will be the 'primary grocery shopper' in the household.
- None will have educational attainment levels of more than a Bachelor's degrees, i.e., all with masters or other post grad degrees will be terminated.
- Recruiting will be done without consideration to any other demographic category or composition of household (although this information will be collected as part of the screen interview).

Project logistics:

- One focus group will be conducted at the [place to be determined] [date to be determined].
- The session will each be 1.5 hours in length.
- Each participating respondent will be paid \$50 in cash at the conclusion of the session. Megan Judge will handle the distribution of these funds.

Agreed terms:

- Cal Poly Agribusiness agrees to pay Opinion Studies \$85 per recruited respondent or \$1020 total.
- Opinion Studies will develop all recruiting and screen materials, complete all screen interviews, send all confirmation letters and complete all confirmation phone calls. Opinion Studies will also provide Megan Judge with a list of all expected attendees. This list will have basic profile information about each attendee (age, education, city of residence, ethnicity, size/composition of household).
- An invoice for all recruit fees accompanies this letter of agreement. Invoice is due and payable upon receipt.

Please review these points. If they reflect your understanding, please sign below to indicate your agreement. We will commence recruiting as soon as we have received this signed agreement and check.

The terms and conditions outlined above are consistent with my understanding of contracted services. CPC is the non profit auxiliary that supports Cal Poly State University.

We concur:

Date: _____ James Ahern, Thesis Committee Chair

Date: _____ Wayne H. Howard, Agribusiness Department Chair

Date: _____ Cal Poly Corporation

Date: _____ Robyn Letters, for Opinion Studies

784 Greystone Place ♦ San Luis Obispo, CA 93401 ♦ 805-549-0367 ♦ Fax: 805-549-9046

INVOICE

Job #:	Date:	Terms:
09-982	January 28, 2010	Due upon receipt

TO: Agribusiness Department
Cal Poly University
San Luis Obispo, CA

VIA E-MAIL ONLY

RE: Invoice for Recruiting Services to Support One Focus Group, Santa Monica, CA

Description of Services	Amount
Development of screen materials and recruitment of 12 respondents @ \$85	\$1,020.00
TOTAL DUE Opinion Studies	\$1,020.00

Payment is due upon receipt.

Thank you!

Please remit payment to:

Opinion Studies

784 Greystone Place * San Luis Obispo, CA 93401
FED ID 77-0305907

Appendix C: Consent

Date of Focus Group Study: _____

From: Megan Judge, Masters Candidate Cal Poly, SLO

I agreed to participate in a marketing research process-focus group investigating consumer preferences and feelings about biotech/genetically engineered foods. By my signature below, I am confirming that I have received a participant premium of \$50 for my completion of my participation in this focus group study.

_____	_____	_____
Signature	printed name	date/time

Appendix D: Handout with Discussion Guide, Group 1 and 2

Crop Name	Events	Phenotypic Trait
<u>Alfalfa</u>	1	Glyphosate herbicide tolerance.
<u>Argentine Canola</u>	1	Oxynil herbicide tolerance, including bromoxynil and ioxynil.
<u>Argentine Canola</u>	1	Modified seed fatty acid content, specifically high laurate levels and myristic acid production.
<u>Argentine Canola</u>	2	Glyphosate herbicide tolerance.
<u>Argentine Canola</u>	3	Phosphinothricin (PPT) herbicide tolerance, specifically glufosinate ammonium.
<u>Argentine Canola</u>	1	Imidazolinone herbicide tolerance, specifically imazethapyr.
<u>Argentine Canola</u>	5	Glufosinate ammonium herbicide tolerance and fertility restored.
<u>Argentine Canola</u>	2	Modified seed fatty acid content, specifically high oleic acid, low linolenic acid content.
<u>Carnation</u>	1	Increased shelf-life due to reduced ethylene accumulation through introduction of truncated aminocyclopropane cyclase (ACC) synthase gene; Sulfonylurea herbicide tolerance, specifically triasulfuron and metsulfuron-methyl.
<u>Carnation</u>	2	Modified flower colour; Sulfonylurea herbicide tolerance, specifically triasulfuron and metsulfuron-methyl.
<u>Chicory</u>	1	Glufosinate ammonium herbicide tolerance and fertility restored.
<u>Cotton</u>	2	Resistance to lepidopteran pests including, but not limited to, cotton bollworm, pink bollworm, tobacco budworm.
<u>Cotton</u>	1	Oxynil herbicide tolerance, including bromoxynil and ioxynil.
<u>Cotton</u>	1	Resistance to lepidopteran insects; oxynil herbicide tolerance, including bromoxynil.
<u>Cotton</u>	1	Sulfonylurea herbicide tolerance, specifically triasulfuron and metsulfuron-methyl.
<u>Cotton</u>	1	Glyphosate herbicide tolerance.
<u>Cotton</u>	1	Phosphinothricin (PPT) herbicide tolerance, specifically glufosinate ammonium.
<u>Cotton</u>	4	Resistance to lepidopteran pests.
<u>Cotton</u>	1	Glyphosate herbicide tolerance.
<u>Cotton</u>	5	Resistance to lepidopteran pests and glyphosate herbicide tolerance
<u>Cotton</u>	1	Phosphinothricin (PPT) herbicide tolerance, specifically glufosinate ammonium, and resistance to lepidopteran insect pests.

<u>Creeping Bentgrass</u>	1	Glyphosate herbicide tolerance.
<u>Flax, Linseed</u>	1	Sulfonylurea herbicide tolerance, specifically triasulfuron and metsulfuron-methyl.
<u>Lentil</u>	1	Imidazolinone herbicide tolerance, specifically imazethapyr.
<u>Maize</u>	3	Glyphosate herbicide tolerance.
<u>Maize</u>	1	Imidazolinone herbicide tolerance, specifically imazethapyr.
<u>Maize</u>	2	Resistance to European corn borer (<i>Ostrinia nubilalis</i>); glyphosate herbicide tolerance.
<u>Maize</u>	2	Phosphinothricin (PPT) herbicide tolerance, specifically glufosinate ammonium.
<u>Maize</u>	5	Resistance to European corn borer (<i>Ostrinia nubilalis</i>); phosphinothricin (PPT) herbicide tolerance, specifically glufosinate ammonium.
<u>Maize</u>	1	Resistance to European corn borer (<i>Ostrinia nubilalis</i>).
<u>Maize</u>	2	Glufosinate ammonium herbicide tolerance and male sterility
<u>Maize</u>	2	Imidazolinone herbicide tolerance.
<u>Maize</u>	1	Cyclohexanone herbicide tolerance, specifically sethoxydim.
<u>Maize</u>	1	Glufosinate ammonium herbicide tolerance and fertility restored.
<u>Maize</u>	1	Resistance to European corn borer (<i>Ostrinia nubilalis</i>).
<u>Maize</u>	1	Resistance to corn root worm (Coleopteran, <i>Diabrotica sp.</i>)
<u>Maize</u>	1	Resistance to lepidopteran pests.
<u>Maize</u>	1	Phosphinothricin (PPT) herbicide tolerance, specifically glufosinate ammonium, and resistance to corn root worm (Coleoptera, <i>Diabrotica spp.</i>
<u>Maize</u>	1	Glyphosate herbicide tolerance and resistance to corn root worm (Coleoptera, <i>Diabrotica sp.</i>).
<u>Maize</u>	1	Resistance to corn root worm (Coleopteran, <i>Diabrotica sp.</i>) and European corn borer (<i>Ostrinia nubilalis</i>).
<u>Maize</u>	2	Resistance to coleopteran pests and glyphosate herbicide tolerance
<u>Maize</u>	2	Resistance to coleopteran and lepidopteran pests, and glyphosate herbicide tolerance
<u>Maize</u>	2	Resistance to lepidopteran pests and glyphosate herbicide tolerance
<u>Maize</u>	1	Resistance to lepidopteran pests and glufosinate ammonium herbicide tolerance

<u>Maize</u>	2	Resistance to lepidopteran pests, and stacked tolerance to glufosinate ammonium and glyphosate herbicides
<u>Maize</u>	1	Enhanced lysine level.
<u>Maize</u>	1	Enhanced lysine level and resistance to European corn borer
<u>Maize</u>	1	Resistance to corn root worm (Coleopteran, <i>Diabrotica sp.</i>)
<u>Maize</u>	1	Resistance to coleopteran and lepidopteran pests, and glufosinate ammonium tolerance
<u>Maize</u>	1	Resistance to coleopteran and lepidopteran pests, and glyphosate and glufosinate ammonium tolerance
<u>Melon</u>	1	Delayed ripening by introduction of a gene that results in degradation of a precursor of the plant hormone, ethylene.
<u>Papaya</u>	1	Resistance to viral infection, papaya ringspot virus (PRSV).
<u>Polish Canola</u>	1	Glyphosate herbicide tolerance.
<u>Polish Canola</u>	1	Phosphinothricin (PPT) herbicide tolerance, specifically glufosinate ammonium.
<u>Potato</u>	2	Resistance to Colorado potato beetle (<i>Leptinotarsa decemlineata</i> , Say).
<u>Potato</u>	1	Resistance to Colorado potato beetle (<i>Leptinotarsa decemlineata</i> , Say); resistance to potato leafroll luteovirus (PLRV).
<u>Potato</u>	1	Resistance to Colorado potato beetle (<i>Leptinotarsa decemlineata</i> , Say); resistance to potato virus Y (PVY).
<u>Rice</u>	2	Phosphinothricin (PPT) herbicide tolerance, specifically glufosinate ammonium.
<u>Rice</u>	2	Imidazolinone herbicide tolerance.
<u>Rice</u>	1	Imidazolinone herbicide tolerance, specifically imazethapyr.
<u>Soybean</u>	2	Glyphosate herbicide tolerance.
<u>Soybean</u>	4	Phosphinothricin (PPT) herbicide tolerance, specifically glufosinate ammonium.
<u>Soybean</u>	1	Modified seed fatty acid content, specifically high oleic acid expression.
<u>Soybean</u>	1	Modified seed fatty acid content, specifically low linolenic acid
<u>Squash</u>	1	Resistance to viral infection, watermelon mosaic virus (WMV) 2, zucchini yellow mosaic virus (ZYMV).
<u>Squash</u>	1	Resistance to viral infection, cucumber mosaic virus (CMV), watermelon mosaic virus (WMV) 2, zucchini yellow mosaic virus (ZYMV).

<u>Sugar Beet</u>	1	Phosphinothricin (PPT) herbicide tolerance, specifically glufosinate ammonium.
<u>Sugar Beet</u>	1	Glyphosate herbicide tolerance.
<u>Sugar Beet</u>	1	Glyphosate herbicide tolerance.
<u>Sunflower</u>	1	Imidazolinone herbicide tolerance.
<u>Tobacco</u>	1	Oxynil herbicide tolerance, including bromoxynil and ioxynil.
<u>Tobacco</u>	1	Nicotine reduced.
<u>Tomato</u>	1	Increased shelf-life (delayed ripening) due to reduced ethylene accumulation through introduction of truncated aminocyclopropane cyclase (ACC) synthase gene.
<u>Tomato</u>	1	Resistance to lepidopteran pests including, but not limited to, cotton bollworm, pink bollworm, tobacco budworm.
<u>Tomato</u>	1	Delayed ripening by introduction of a gene that results in degradation of a precursor of the plant hormone, ethylene.
<u>Tomato</u>	1	Delayed ripening by introduction of a gene that results in degradation of a precursor of the plant hormone, ethylene.
<u>Tomato</u>	2	Delayed softening through suppression of polygalacturonase (PG) enzyme activity.
<u>Wheat</u>	3	Imidazolinone herbicide tolerance, specifically Cyanamid AC299 263 (imazamox, active ingredient).
<u>Wheat</u>	1	Glyphosate herbicide tolerance.
<u>Wheat</u>	1	Imidazolinone herbicide tolerance, specifically imazethapyr.
<u>Wheat</u>	1	Imidazolinone herbicide tolerance.

Source:

<http://todayyesterdayandtomorrow.wordpress.com/2007/06/09/crops-and-traits/>

Appendix E: Handout with Discussion Guide, Group #3

<i>Agrostis stolonifera</i> (Creeping Bentgrass)		
Event	Company	Description
ASR368	Scotts Seeds	Glyphosate tolerance derived by inserting a modified 5-enolpyruvylshikimate-3-phosphate synthase (EPSPS) encoding gene from <i>Agrobacterium tumefaciens</i> .
▲ top :: <i>Beta vulgaris</i> (Sugar Beet)		
Event	Company	Description
GTSB77	Novartis Seeds; Monsanto Company	Glyphosate herbicide tolerant sugar beet produced by inserting a gene encoding the enzyme 5-enolpyruvylshikimate-3-phosphate synthase (EPSPS) from the CP4 strain of <i>Agrobacterium tumefaciens</i> .
H7-1	Monsanto Company	Glyphosate herbicide tolerant sugar beet produced by inserting a gene encoding the enzyme 5-enolpyruvylshikimate-3-phosphate synthase (EPSPS) from the CP4 strain of <i>Agrobacterium tumefaciens</i> .
T120-7	Bayer CropScience (Aventis CropScience(AgrEvo))	Introduction of the PPT-acetyltransferase (PAT) encoding gene from <i>Streptomyces viridochromogenes</i> , an aerobic soil bacteria. PPT normally acts to inhibit glutamine synthetase, causing a fatal accumulation of ammonia. Acetylated PPT is inactive.
▲ top :: <i>Brassica napus</i> (Argentine Canola)		
Event	Company	Description
23-18-17, 23-198	Monsanto Company	High laurate (12:0) and myristate (14:0) canola produced by inserting a thioesterase encoding gene from the California bay laurel (<i>Umbellularia californica</i>).
GT200	Monsanto Company	Glyphosate herbicide tolerant canola produced by inserting genes encoding the enzymes 5-enolpyruvylshikimate-3-phosphate synthase (EPSPS) from the CP4 strain of <i>Agrobacterium tumefaciens</i> and glyphosate oxidase from <i>Ochrobactrum anthropi</i> .
GT73, RT73	Monsanto Company	Glyphosate herbicide tolerant canola produced by inserting genes encoding the enzymes 5-enolpyruvylshikimate-3-phosphate synthase (EPSPS) from the CP4 strain of <i>Agrobacterium tumefaciens</i> and glyphosate oxidase from <i>Ochrobactrum anthropi</i> .
HCN10	Aventis CropScience	Introduction of the PPT-acetyltransferase (PAT) encoding gene from <i>Streptomyces viridochromogenes</i> , an aerobic soil bacteria. PPT normally acts to inhibit glutamine synthetase, causing a fatal accumulation of ammonia. Acetylated PPT is inactive.
HCN92	Bayer CropScience (Aventis CropScience(AgrEvo))	Introduction of the PPT-acetyltransferase (PAT) encoding gene from <i>Streptomyces viridochromogenes</i> , an aerobic soil bacteria. PPT normally acts to inhibit glutamine synthetase, causing a fatal accumulation of ammonia. Acetylated PPT is inactive.
MS1, RF1 =>PGS1	Aventis CropScience (formerly Plant Genetic Systems)	Male-sterility, fertility restoration, pollination control system displaying glufosinate herbicide tolerance. MS lines contained the <i>barnase</i> gene from <i>Bacillus amyloliquefaciens</i> , RF lines contained the <i>barstar</i> gene from the same bacteria, and both lines contained the phosphinothricin N-acetyltransferase (PAT) encoding gene from <i>Streptomyces hygroscopicus</i> .
MS1, RF2 =>PGS2	Aventis CropScience (formerly Plant Genetic Systems)	Male-sterility, fertility restoration, pollination control system displaying glufosinate herbicide tolerance. MS lines contained the <i>barnase</i> gene from <i>Bacillus amyloliquefaciens</i> , RF lines contained the <i>barstar</i> gene from the same bacteria, and both lines contained the phosphinothricin N-acetyltransferase (PAT) encoding gene from <i>Streptomyces hygroscopicus</i> .
MS8xRF3	Bayer CropScience (Aventis CropScience(AgrEvo))	Male-sterility, fertility restoration, pollination control system displaying glufosinate herbicide tolerance. MS lines contained the <i>barnase</i> gene from <i>Bacillus amyloliquefaciens</i> , RF lines contained the <i>barstar</i> gene from the same bacteria, and both lines contained the phosphinothricin N-acetyltransferase (PAT) encoding gene from <i>Streptomyces hygroscopicus</i> .
OXY-235	Aventis CropScience (formerly Rhône Poulenc Inc.)	Tolerance to the herbicides bromoxynil and ioxynil by incorporation of the nitrilase gene from <i>Klebsiella pneumoniae</i> .
T45 (HCN28)	Bayer CropScience (Aventis CropScience(AgrEvo))	Introduction of the PPT-acetyltransferase (PAT) encoding gene from <i>Streptomyces viridochromogenes</i> , an aerobic soil bacteria. PPT normally acts to inhibit glutamine synthetase, causing a fatal

		accumulation of ammonia. Acetylated PPT is inactive.
▲ top 🌿 Carica papaya (Papaya)		
Event	Company	Description
55-1/63-1	Cornell University	Papaya ringspot virus (PRSV) resistant papaya produced by inserting the coat protein (CP) encoding sequences from this plant potyvirus.
X17-2	University of Florida	Papaya ringspot virus (PRSV) resistant papaya produced by inserting the coat protein (CP) encoding sequences from PRSV isolate H1K with a thymidine inserted after the initiation codon to yield a frameshift. Also contains <i>nptII</i> as a selectable marker.
▲ top 🌿 Cichorium intybus (Chicory)		
Event	Company	Description
RM3-3, RM3-4, RM3-6	Bejo Zaden BV	Male sterility was via insertion of the barnase ribonuclease gene from <i>Bacillus amyloliquefaciens</i> ; PPT resistance was via the bar gene from <i>S. hygroscopicus</i> , which encodes the PAT enzyme.
▲ top 🌿 Cucumis melo (Melon)		
Event	Company	Description
A, B	Agrotepe Inc.	Reduced accumulation of S-adenosylmethionine (SAM), and consequently reduced ethylene synthesis, by introduction of the gene encoding S-adenosylmethionine hydrolase.
▲ top 🌿 Cucurbita pepo (Squash)		
Event	Company	Description
CZW-3	Asgrow (USA); Seminis Vegetable Inc. (Canada)	Cucumber mosaic virus (CMV), zucchini yellows mosaic (ZYMV) and watermelon mosaic virus (WMV) 2 resistant squash (<i>Cucurbita pepo</i>) produced by inserting the coat protein (CP) encoding sequences from each of these plant viruses into the host genome.
ZW20	Upjohn (USA); Seminis Vegetable Inc. (Canada)	Zucchini yellows mosaic (ZYMV) and watermelon mosaic virus (WMV) 2 resistant squash (<i>Cucurbita pepo</i>) produced by inserting the coat protein (CP) encoding sequences from each of these plant potyviruses into the host genome.
▲ top 🌿 Glycine max L. (Soybean)		
Event	Company	Description
A2704-12, A2704-21, A5547-35	Bayer CropScience (Aventis CropScience(AgrEvo))	Glufosinate ammonium herbicide tolerant soybean produced by inserting a modified phosphinothricin acetyltransferase (PAT) encoding gene from the soil bacterium <i>Streptomyces viridochromogenes</i> .
A5547-127	Bayer CropScience (Aventis CropScience(AgrEvo))	Glufosinate ammonium herbicide tolerant soybean produced by inserting a modified phosphinothricin acetyltransferase (PAT) encoding gene from the soil bacterium <i>Streptomyces viridochromogenes</i> .
DP-305423	Pioneer Hi-Bred International Inc.	High oleic acid soybean produced by inserting additional copies of a portion of the omega-6 desaturase encoding gene, <i>gm-fad2-1</i> resulting in silencing of the endogenous omega-6 desaturase gene (<i>FAD2-1</i>).
DP356043	Pioneer Hi-Bred International Inc.	Soybean event with two herbicide tolerance genes: glyphosate N-acetyltransferase, which detoxifies glyphosate, and a modified acetolactate synthase (ALS) gene which is tolerant to ALS-inhibiting herbicides.
G94-1, G94-19, G168	DuPont Canada Agricultural Products	High oleic acid soybean produced by inserting a second copy of the fatty acid desaturase (GmFad2-1) encoding gene from soybean, which resulted in "silencing" of the endogenous host gene.
GTS 40-3-2	Monsanto Company	Glyphosate tolerant soybean variety produced by inserting a modified 5-enolpyruvylshikimate-3-phosphate synthase (EPSPS) encoding gene from the soil bacterium <i>Agrobacterium tumefaciens</i> .
GU262	Bayer CropScience (Aventis CropScience(AgrEvo))	Glufosinate ammonium herbicide tolerant soybean produced by inserting a modified phosphinothricin acetyltransferase (PAT) encoding gene from the soil bacterium <i>Streptomyces viridochromogenes</i> .
MON89788	Monsanto Company	Glyphosate-tolerant soybean produced by inserting a modified 5-enolpyruvylshikimate-3-phosphate synthase (EPSPS) encoding <i>aroA (epsps)</i> gene from <i>Agrobacterium tumefaciens</i> CP4.
W62, W98	Bayer CropScience (Aventis CropScience(AgrEvo))	Glufosinate ammonium herbicide tolerant soybean produced by inserting a modified phosphinothricin acetyltransferase (PAT) encoding gene from the soil bacterium <i>Streptomyces hygroscopicus</i> .
▲ top 🌿 Gossypium hirsutum L. (Cotton)		

Event	Company	Description
15985	Monsanto Company	Insect resistant cotton derived by transformation of the DP50B parent variety, which contained event 531 (expressing Cry1Ac protein), with purified plasmid DNA containing the <i>cry2Ab</i> gene from <i>B. thuringiensis</i> subsp. <i>kurstaki</i> .
19-51A	DuPont Canada Agricultural Products	Introduction of a variant form of acetolactate synthase (ALS).
281-24-236	DOW AgroSciences LLC	Insect-resistant cotton produced by inserting the <i>cry1F</i> gene from <i>Bacillus thuringiensis</i> var. <i>aizawai</i> . The PAT encoding gene from <i>Streptomyces viridochromogenes</i> was introduced as a selectable marker.
3006-210-23	DOW AgroSciences LLC	Insect-resistant cotton produced by inserting the <i>cry1Ac</i> gene from <i>Bacillus thuringiensis</i> subsp. <i>kurstaki</i> . The PAT encoding gene from <i>Streptomyces viridochromogenes</i> was introduced as a selectable marker.
31807/31808	Calgene Inc.	Insect-resistant and bromoxynil herbicide tolerant cotton produced by inserting the <i>cry1Ac</i> gene from <i>Bacillus thuringiensis</i> and a nitrilase encoding gene from <i>Klebsiella pneumoniae</i> .
BXN	Calgene Inc.	Bromoxynil herbicide tolerant cotton produced by inserting a nitrilase encoding gene from <i>Klebsiella pneumoniae</i> .
COT102	Syngenta Seeds, Inc.	Insect-resistant cotton produced by inserting the <i>vip3A(a)</i> gene from <i>Bacillus thuringiensis</i> AB88. The APH4 encoding gene from <i>E. coli</i> was introduced as a selectable marker.
COT67B	Syngenta Seeds, Inc.	Insect-resistant cotton produced by inserting a full-length <i>cry1Ab</i> gene from <i>Bacillus thuringiensis</i> . The APH4 encoding gene from <i>E. coli</i> was introduced as a selectable marker.
DAS-21Ø23-5 x DAS-24236-5	DOW AgroSciences LLC	WideStrike™, a stacked insect-resistant cotton derived from conventional cross-breeding of parental lines 3006-210-23 (OECD identifier: DAS-21Ø23-5) and 281-24-236 (OECD identifier: DAS-24236-5).
GHB614	Bayer CropScience USA LP	Glyphosate herbicide tolerant cotton produced by inserting a double-mutated form of the enzyme 5-enolpyruvyl shikimate-3-phosphate synthase (EPSPS) from <i>Zea mays</i> .
LLCotton25	Bayer CropScience (Aventis CropScience(AgrEvo))	Glufosinate ammonium herbicide tolerant cotton produced by inserting a modified phosphinothricin acetyltransferase (PAT) encoding gene from the soil bacterium <i>Streptomyces hygroscopicus</i> .
MON1445/1698	Monsanto Company	Glyphosate herbicide tolerant cotton produced by inserting a naturally glyphosate tolerant form of the enzyme 5-enolpyruvyl shikimate-3-phosphate synthase (EPSPS) from <i>A. tumefaciens</i> strain CP4.
MON531/757/1076	Monsanto Company	Insect-resistant cotton produced by inserting the <i>cry1Ac</i> gene from <i>Bacillus thuringiensis</i> subsp. <i>kurstaki</i> HD-73 (B.t.k.).
MON88913	Monsanto Company	Glyphosate herbicide tolerant cotton produced by inserting two genes encoding the enzyme 5-enolpyruvylshikimate-3-phosphate synthase (EPSPS) from the CP4 strain of <i>Agrobacterium tumefaciens</i> .
⚠ top 🇨🇦 <i>Linum usitatissimum</i> L. (Flax, Linseed)		
Event	Company	Description
FP967	University of Saskatchewan, Crop Dev. Centre	A variant form of acetolactate synthase (ALS) was obtained from a chlorsulfuron tolerant line of <i>A. thaliana</i> and used to transform flax.
⚠ top 🇨🇦 <i>Lycopersicon esculentum</i> (Tomato)		
Event	Company	Description
1345-4	DNA Plant Technology Corporation	Delayed ripening tomatoes produced by inserting an additional copy of a truncated gene encoding 1-aminocyclopropane-1-carboxylic acid (ACC) synthase, which resulted in downregulation of the endogenous ACC synthase and reduced ethylene accumulation.
35.1.N	AgriTope Inc.	Introduction of a gene sequence encoding the enzyme S-adenosylmethionine hydrolase that metabolizes the precursor of the fruit ripening hormone ethylene
5345	Monsanto Company	Resistance to lepidopteran pests through the introduction of the <i>cry1Ac</i> gene from <i>Bacillus thuringiensis</i> subsp. <i>Kurstaki</i> .
8338	Monsanto Company	Introduction of a gene sequence encoding the enzyme 1-aminocyclopropane-1-carboxylic acid deaminase (ACCd) that metabolizes the precursor of the fruit ripening hormone ethylene.
B, Da, F	Zeneca Seeds	Delayed softening tomatoes produced by inserting a truncated

		version of the polygalacturonase (PG) encoding gene in the sense or anti-sense orientation in order to reduce expression of the endogenous PG gene, and thus reduce pectin degradation.
FLAVR SAVR	Calgene Inc.	Delayed softening tomatoes produced by inserting an additional copy of the polygalacturonase (PG) encoding gene in the anti-sense orientation in order to reduce expression of the endogenous PG gene and thus reduce pectin degradation.
⚡ top :: Medicago sativa (Alfalfa)		
Event	Company	Description
J101, J163	Monsanto Company and Forage Genetics International	Glyphosate herbicide tolerant alfalfa (lucerne) produced by inserting a gene encoding the enzyme 5-enolpyruvylshikimate-3-phosphate synthase (EPSPS) from the CP4 strain of <i>Agrobacterium tumefaciens</i> .
⚡ top :: Nicotiana tabacum L. (Tobacco)		
Event	Company	Description
Vector 21-41	Vector Tobacco Inc.	Reduced nicotine content through introduction of a second copy of the tobacco quinolinic acid phosphoribosyltransferase (QTPase) in the antisense orientation. The NPTII encoding gene from <i>E. coli</i> was introduced as a selectable marker to identify transformants.
⚡ top :: Oryza sativa (Rice)		
Event	Company	Description
LLRICE06, LLRICE62	Aventis CropScience	Glufosinate ammonium herbicide tolerant rice produced by inserting a modified phosphinothricin acetyltransferase (PAT) encoding gene from the soil bacterium <i>Streptomyces hygroscopicus</i> .
LLRICE601	Bayer CropScience (Aventis CropScience(AgrEvo))	Glufosinate ammonium herbicide tolerant rice produced by inserting a modified phosphinothricin acetyltransferase (PAT) encoding gene from the soil bacterium <i>Streptomyces hygroscopicus</i> .
⚡ top :: Prunus domestica (Plum)		
Event	Company	Description
C5	United States Department of Agriculture - Agricultural Research Service	Plum pox virus (PPV) resistant plum tree produced through <i>Agrobacterium</i> -mediated transformation with a coat protein (CP) gene from the virus.
⚡ top :: Solanum tuberosum L. (Potato)		
Event	Company	Description
ATBT04-6, ATBT04-27, ATBT04-30, ATBT04-31, ATBT04-36, SPBT02-5, SPBT02-7	Monsanto Company	Colorado potato beetle resistant potatoes produced by inserting the <i>cry3A</i> gene from <i>Bacillus thuringiensis</i> (subsp. Tenebrionis).
BT6, BT10, BT12, BT16, BT17, BT18, BT23	Monsanto Company	Colorado potato beetle resistant potatoes produced by inserting the <i>cry3A</i> gene from <i>Bacillus thuringiensis</i> (subsp. Tenebrionis).
RBMT15-101, SEMT15-02, SEMT15-15	Monsanto Company	Colorado potato beetle and potato virus Y (PVY) resistant potatoes produced by inserting the <i>cry3A</i> gene from <i>Bacillus thuringiensis</i> (subsp. Tenebrionis) and the coat protein encoding gene from PVY.
RBMT21-129, RBMT21-350, RBMT22-082	Monsanto Company	Colorado potato beetle and potato leafroll virus (PLRV) resistant potatoes produced by inserting the <i>cry3A</i> gene from <i>Bacillus thuringiensis</i> (subsp. Tenebrionis) and the replicase encoding gene from PLRV.
⚡ top :: Triticum aestivum (Wheat)		
Event	Company	Description
MON71800	Monsanto Company	Glyphosate tolerant wheat variety produced by inserting a modified 5-enolpyruvylshikimate-3-phosphate synthase (EPSPS) encoding gene from the soil bacterium <i>Agrobacterium tumefaciens</i> , strain CP4.
⚡ top :: Zea mays L. (Maize)		
Event	Company	Description
176	Syngenta Seeds, Inc.	Insect-resistant maize produced by inserting the <i>cry1Ab</i> gene from <i>Bacillus thuringiensis</i> subsp. kurstaki. The genetic modification affords resistance to attack by the European corn borer (ECB).
676, 678, 680	Pioneer Hi-Bred International Inc.	Male-sterile and glufosinate ammonium herbicide tolerant maize produced by inserting genes encoding DNA adenine methylase and

		phosphinothricin acetyltransferase (PAT) from <i>Escherichia coli</i> and <i>Streptomyces viridochromogenes</i> , respectively.
B16 (DLL25)	Dekalb Genetics Corporation	Glufosinate ammonium herbicide tolerant maize produced by inserting the gene encoding phosphinothricin acetyltransferase (PAT) from <i>Streptomyces hygroscopicus</i> .
BT11 (X4334CBR, X4734CBR)	Syngenta Seeds, Inc.	Insect-resistant and herbicide tolerant maize produced by inserting the <i>cry1Ab</i> gene from <i>Bacillus thuringiensis</i> subsp. <i>kurstaki</i> , and the phosphinothricin N-acetyltransferase (PAT) encoding gene from <i>S. viridochromogenes</i> .
BT11 x MIR162	Syngenta Seeds, Inc.	Stacked insect resistant and herbicide tolerant maize produced by conventional cross breeding of parental lines BT11 (OECD unique identifier: SYN-BT011-1) and MIR162 (OECD unique identifier: SYN-IR162-4). Resistance to the European Corn Borer and tolerance to the herbicide glufosinate ammonium (Liberty) is derived from BT11, which contains the <i>cry1Ab</i> gene from <i>Bacillus thuringiensis</i> subsp. <i>kurstaki</i> , and the phosphinothricin N-acetyltransferase (PAT) encoding gene from <i>S. viridochromogenes</i> . Resistance to other lepidopteran pests, including <i>H. zea</i> , <i>S. frugiperda</i> , <i>A. ipsilon</i> , and <i>S. albicosta</i> , is derived from MIR162, which contains the <i>vip3Aa</i> gene from <i>Bacillus thuringiensis</i> strain AB88.
BT11 x MIR162 x MIR604	Syngenta Seeds, Inc.	<i>Bacillus thuringiensis</i> Cry1Ab delta-endotoxin protein and the genetic material necessary for its production (via elements of vector pZO1502) in Event Bt11 corn (OECD Unique Identifier: SYN-BT011-1) x <i>Bacillus thuringiensis</i> Vip3Aa20 insecticidal protein and the genetic material necessary for its production (via elements of vector pNOV1300) in Event MIR162 maize (OECD Unique Identifier: SYN-IR162-4) x modified Cry3A protein and the genetic material necessary for its production (via elements of vector pZM26) in Event MIR604 corn (OECD Unique Identifier: SYN-IR604-5).
CBH-351	Aventis CropScience	Insect-resistant and glufosinate ammonium herbicide tolerant maize developed by inserting genes encoding Cry9C protein from <i>Bacillus thuringiensis</i> subsp. <i>tolworthi</i> and phosphinothricin acetyltransferase (PAT) from <i>Streptomyces hygroscopicus</i> .
DAS-06275-8	DOW AgroSciences LLC	Lepidopteran insect resistant and glufosinate ammonium herbicide-tolerant maize variety produced by inserting the <i>cry1F</i> gene from <i>Bacillus thuringiensis</i> var. <i>aizawai</i> and the phosphinothricin acetyltransferase (PAT) from <i>Streptomyces hygroscopicus</i> .
DAS-59122-7	DOW AgroSciences LLC and Pioneer Hi-Bred International Inc.	Corn rootworm-resistant maize produced by inserting the <i>cry34Ab1</i> and <i>cry35Ab1</i> genes from <i>Bacillus thuringiensis</i> strain PS149B1. The PAT encoding gene from <i>Streptomyces viridochromogenes</i> was introduced as a selectable marker.
DBT418	Dekalb Genetics Corporation	Insect-resistant and glufosinate ammonium herbicide tolerant maize developed by inserting genes encoding Cry1AC protein from <i>Bacillus thuringiensis</i> subsp. <i>kurstaki</i> and phosphinothricin acetyltransferase (PAT) from <i>Streptomyces hygroscopicus</i> .
Event 3272	Syngenta Seeds, Inc.	Maize line expressing a heat stable alpha-amylase gene <i>amy797E</i> for use in the dry-grind ethanol process. The phosphomannose isomerase gene from <i>E.coli</i> was used as a selectable marker.
Event 98140	Pioneer Hi-Bred International Inc.	Maize event expressing tolerance to glyphosate herbicide, via expression of a modified bacterial glyphosate N-acetyltransferase, and ALS-inhibiting herbicides, via expression of a modified form of the maize acetolactate synthase enzyme.
GA21	Syngenta Seeds, Inc. (formerly Zeneca Seeds)	Introduction, by particle bombardment, of a modified 5-enolpyruvyl shikimate-3-phosphate synthase (EPSPS), an enzyme involved in the shikimate biochemical pathway for the production of the aromatic amino acids.
LY038	Monsanto Company	Altered amino acid composition, specifically elevated levels of lysine, through the introduction of the <i>cordaA</i> gene, derived from <i>Corynebacterium glutamicum</i> , encoding the enzyme dihydrodipicolinate synthase (cDHDPs).
MIR162	Syngenta Seeds, Inc.	Insect-resistant maize event expressing a Vip3A protein from <i>Bacillus thuringiensis</i> and the <i>Escherichia coli</i> PMI selectable marker
MIR604	Syngenta Seeds, Inc.	Corn rootworm resistant maize produced by transformation with a modified <i>cry3A</i> gene. The phosphomannose isomerase gene from <i>E.coli</i> was used as a selectable marker.
MON80100	Monsanto Company	Insect-resistant maize produced by inserting the <i>cry1Ab</i> gene from <i>Bacillus thuringiensis</i> subsp. <i>kurstaki</i> . The genetic modification affords resistance to attack by the European corn borer (ECB).

MON802	Monsanto Company	Insect-resistant and glyphosate herbicide tolerant maize produced by inserting the genes encoding the Cry1Ab protein from <i>Bacillus thuringiensis</i> and the 5-enolpyruvylshikimate-3-phosphate synthase (EPSPS) from <i>A. tumefaciens</i> strain CP4.
MON809	Pioneer Hi-Bred International Inc.	Resistance to European corn borer (<i>Ostrinia nubilalis</i>) by introduction of a synthetic cry1Ab gene. Glyphosate resistance via introduction of the bacterial version of a plant enzyme, 5-enolpyruvyl shikimate-3-phosphate synthase (EPSPS).
MON810	Monsanto Company	Insect-resistant maize produced by inserting a truncated form of the <i>cry1Ab</i> gene from <i>Bacillus thuringiensis</i> subsp. <i>kurstaki</i> HD-1. The genetic modification affords resistance to attack by the European corn borer (ECB).
MON863	Monsanto Company	Corn root worm resistant maize produced by inserting the <i>cry3Bb1</i> gene from <i>Bacillus thuringiensis</i> subsp. <i>kumamotoensis</i> .
MON88017	Monsanto Company	Corn rootworm-resistant maize produced by inserting the <i>cry3Bb1</i> gene from <i>Bacillus thuringiensis</i> subspecies <i>kumamotoensis</i> strain EG4691. Glyphosate tolerance derived by inserting a 5-enolpyruvylshikimate-3-phosphate synthase (EPSPS) encoding gene from <i>Agrobacterium tumefaciens</i> strain CP4.
MON89034	Monsanto Company	Maize event expressing two different insecticidal proteins from <i>Bacillus thuringiensis</i> providing resistance to number of lepidopteran pests.
MON89034 x TC1507 x MON88017 x DAS-59122-7	Monsanto Company and Mycogen Seeds c/o Dow AgroSciences LLC	Stacked insect resistant and herbicide tolerant maize produced by conventional cross breeding of parental lines: MON89034, TC1507, MON88017, and DAS-59122. Resistance to the above-ground and below-ground insect pests and tolerance to glyphosate and glufosinate-ammonium containing herbicides.
MS3	Bayer CropScience (Aventis CropScience(AgrEvo))	Male sterility caused by expression of the barnase ribonuclease gene from <i>Bacillus amyloliquefaciens</i> ; PPT resistance was via PPT-acetyltransferase (PAT).
MS6	Bayer CropScience (Aventis CropScience(AgrEvo))	Male sterility caused by expression of the barnase ribonuclease gene from <i>Bacillus amyloliquefaciens</i> ; PPT resistance was via PPT-acetyltransferase (PAT).
NK603	Monsanto Company	Introduction, by particle bombardment, of a modified 5-enolpyruvyl shikimate-3-phosphate synthase (EPSPS), an enzyme involved in the shikimate biochemical pathway for the production of the aromatic amino acids.
T14, T25	Bayer CropScience (Aventis CropScience(AgrEvo))	Glufosinate herbicide tolerant maize produced by inserting the phosphinothricin N-acetyltransferase (PAT) encoding gene from the aerobic actinomycete <i>Streptomyces viridochromogenes</i> .
TC1507	Mycogen (c/o Dow AgroSciences); Pioneer (c/o Dupont)	Insect-resistant and glufosinate ammonium herbicide tolerant maize produced by inserting the <i>cry1F</i> gene from <i>Bacillus thuringiensis</i> var. <i>aizawai</i> and the phosphinothricin N-acetyltransferase encoding gene from <i>Streptomyces viridochromogenes</i> .

Source: <http://www.agbios.com/dbase.php>

Appendix F: Focus Group Handout - Label Options

- Option 1 – Do you think, for example, vegetables should have a simple statement such as “Produced using biotechnology” somewhere on the display? How do you think consumers will respond to such disclosures? Will it make them more or less likely to buy the product?
- Option 2 – Do you think a more product specific kind of disclosure statement might be better, such as “Produced using biotechnology to increase Vitamin A content” or “Using biotechnology to reduce pesticide and herbicide use” or “Fresher and longer shelf life from biotechnology”. Why do you think these kinds of statements might be better or worse than Option 1? What is the added value to you as a consumer from this kind of labeling?
- Option 3 – Do you think that a statement such as “Caution: Produced using biotechnology. Long term effects have not been determined” might be appropriate for vegetables? What is the added value to you as a consumer from this kind of labeling? How do you think consumers will respond to such a statement? Will it make them more or less likely to buy the product?