

V(A). Planned Program (Summary)

Program # 5

1. Name of the Planned Program

Food Safety And Food Security

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
101	Appraisal of Soil Resources	5%		0%	
111	Conservation and Efficient Use of Water	10%		10%	
201	Plant Genome, Genetics, and Genetic Mechanisms	0%		5%	
205	Plant Management Systems	10%		0%	
216	Integrated Pest Management Systems	5%		0%	
501	New and Improved Food Processing Technologies	0%		10%	
502	New and Improved Food Products	0%		10%	
503	Quality Maintenance in Storing and Marketing Food Products	10%		10%	
603	Market Economics	5%		0%	
701	Nutrient Composition of Food	0%		10%	
702	Requirements and Function of Nutrients and Other Food Components	0%		10%	
703	Nutrition Education and Behavior	0%		10%	
704	Nutrition and Hunger in the Population	10%		15%	
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources	20%		0%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	20%		10%	
806	Youth Development	5%		0%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2012	Extension		Research	
	1862	1890	1862	1890

Plan	20.0	0.0	7.0	0.0
Actual Paid Professional	0.0	0.0	6.4	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
801270	0	1277869	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
801270	0	1277869	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
7519640	0	2549065	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research activities included research into the use of continuous-flow ultrasonic washing of fresh produce [which has the potential to provide the produce industry with a means to significantly enhance microbial safety], the application of research findings to improve an industrial process of zein manufacture, research that resulted in the development of new flavor encapsulation processes by industry groups, development of Nutrigems as a feasible technology to deliver a known and stable amount of micronutrients [now ready for efficacy testing in Honduras], assessment of trade barriers for agricultural products, a project that allowed for growing markets around the world to build awareness about health benefits and food applications of soy protein products [by increasing private voluntary organization, policy maker, and consumer awareness about the importance of increasing protein content in weaning foods and diets of children, there exists an increase in opportunities for the export of U.S. soybeans and soy protein products to the developing world], and results that will allow for development of higher quality food products and associated materials by evaluation of important flavor-related quality indices for product development/improvement and shelf-life estimation.

Additional activities include efforts to measure the effect of the **Supplemental Nutrition Assistance Program [SNAP]** on poverty in the United States, studies that showed proof of the concept of using dry puffed pellets to deliver iron into a wet material such as nixtamalized corn [using dry puffed pellets is advantageous in developing countries as these are easy to make and well-known by local food processors and the target populations], improved understanding of the ingredient-product relationship of soy/whey-based high protein snack products [with a greater amount of soy protein, the high protein snacks have more acceptable physical and sensory properties], an evaluation of methods of sampling and measuring flavor and nutrition of fresh-cut products to facilitate comparison to traditional shelf life factors, the development of new strategies to improve and better maintain inherent fresh-cut product quality and nutrition, and the application of photonic crystal technology to build a low-cost, easy-to-use, rough diagnostic device to assess real-time micronutrient status [a major challenge to improving health in at-risk populations is the lack of current and reliable health and nutrition information].

Conference presentations included the Biennial Molecular and Cellular Biology of Soybean Meetings,

Illinois Specialty Crops, Agritourism, and Organics Conference, Institute of Food Technologists, Korean Society of Food Science and Technology, International Society for the Study of Fatty Acids and Lipids, Western Extension and Research Activities Committee on Agribusiness, Agricultural and Applied Economics Association, and the American Chemical Society.

Food safety training for employees of establishments and volunteers that prepare or serve food to the public was again delivered at a much reduced level this year while searches were launched to fill Extension educator positions with expertise in safe food preparation. Approximately 100 individuals were trained primarily through the first of the following three programs: [1] the Illinois Department of Public Health five-hour **Refresher Course for Food Handlers** designed for food service sanitation managers who must maintain their certification every three years; [2] a fifteen-hour **Food Services Sanitation Manager's Certification Course** for those seeking initial certification; and [3] **Serve it Safely**, a food class for volunteers who serve food for fundraisers, community organizations and family events. Findings are described in the outcome and evaluation sections of this planned program. The **Supplemental Nutrition Assistance Program-Education [SNAP-Ed]** curriculum for both youth and adults included an emphasis on proper hand-washing and cleanliness habits when preparing food.

During this past year, four **Enhancing Specialty Food Safety** programs were offered to specialty growers in northeastern Illinois addressing safe food production and handling in order to ensure that fresh produce is free from contamination by microorganisms that cause foodborne illness. Information on good agricultural practices to ensure food safety was also included as a topic for a statewide webinar and commercial fruit and vegetable production schools were held throughout the state. In addition, several Extension educators assigned to provide programs in small farms and local food systems shared updates of rules and regulations regarding farmers' markets, pesticide spraying, and open water systems.

State and regional Extension conferences/clinics and field days reach large numbers of corn and soybean producers with information on fertility and pest management. **Corn and Soybean Classics** [seven regional-based meetings] that featured eight faculty presentations on the latest research concerning weed management, fertility, stewardship, and pest management reached 981 producers and agricultural consultants. The multi-state **AGMasters Conference** was held on campus and two-day **Regional Crop Management Conferences** were held in four locations in 2012. The primary audience was certified crop advisers. Extension of research to the public also includes the **Varietal Information Program for Soybeans**, a website and publication that provided information on yield, protein and oil, and disease and pest susceptibility. Annual research farm field days [9] were held in the summer to showcase research plots to producers.

The electronic **Pest Management and Crop Development Bulletin** series was prepared biweekly during the growing season by entomologists, agronomists, and plant pathologists to report on the current agricultural conditions with advice on pest management. Of the 4,552 plant samples diagnosed by the **University of Illinois Plant Clinic**, the significant field crop disease issues evaluated were corn nematodes, soybean cyst nematode, and soybean vein necrosis virus. Samples diagnosed included client-submitted samples, phytosanitary inspection samples, and soybean cyst nematode egg extraction samples for private industry.

Statewide Extension conferences related to produce production included the Illiana Vegetable Growers School, Southern and Southwestern Tree Fruit School, Western Illinois Vegetable School, Illinois-Wisconsin Fruit and Vegetable School, Southern Illinois Commercial Vegetable School, and the Small Fruit and Strawberry School. Additional state and regional conferences focused specifically on growing horseradish, small fruits, and strawberries. Extension also provided leadership for the Specialty, Agritourism and Organic Conference and distributed 22 issues of **Fruit and Vegetable News**.

Pesticide safety education was conducted using presentations at numerous locations with teaching

contacts numbering 9,724 through commercial training and another 3,914 through private training. Information is also disseminated electronically via a quarterly multi-state newsletter focused on integrated pest management successes and activities.

Extension activities that addressed hunger within Illinois are delivered by **Expanded Food and Nutrition Education Program [EFNEP]** staff and **Supplemental Nutrition Assistance Program Education [SNAP-Ed]** staff members who conduct hands-on activities with children and their parents with limited incomes. These activities include using food stamps, meal planning, wise shopping, and use of food pantries. More than 550,000 teaching contacts including 345,728 youth were made through the **SNAP-Ed** program and 16,353 family members were reached through **EFNEP** this past year.

2. Brief description of the target audience

Members of the target audience include food scientists, pharmaceutical scientists, chemical engineers, biologists, plant scientists, food engineers, food product developers, physical chemists, microbiologists, personnel in academia, government, and the food industry, parents, physicians, infant formula manufacturers, fruit and vegetable producers [including seasonal workers], farmers' market managers, produce aggregators, food banks, policymakers charged with improving the well-being of low-income Americans, and administrators overseeing food assistance programs. Extension targeted youth, certified food handlers, volunteers who serve food to the public, producers of food distributed through local systems, producers of commercial fruit and vegetable crops, producers of feedstuffs for livestock, certified crop advisers, and limited-resource audiences that are food stamp eligible.

3. How was eXtension used?

Eight Extension and University of Illinois faculty are members of various eXtension Communities of Practice that address food safety and security.

V(E). Planned Program (Outputs)

1. Standard output measures

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	43511	211162	29727	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2012
 Actual: 1

Patents listed

TF11068-US - Microfluidic Device Comprising A Biodegradable Material And Method Of Making Such A Microfluidic Device

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	1	27	28

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number Of Completed Hatch Research Projects

Year	Actual
2012	11

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number Increasing Knowledge Of New Corn And Soybean Crop Management Techniques
2	Number Changing Application Of Recommended Pest Control Practices For Corn And Soybean Production
3	Dollars Saved Through Safe And Effective Pesticide Application
4	Improvement Of Soybean Cultivars To Meet Market Needs And Provide New Tools For Studying The Effects Of Soy Isoflavones On Human Health
5	Knowledge Gained Toward Improving The Availability Of Fresh Fruits And Vegetables To Low-Income Americans
6	Development Of Fortification Technologies For Developing Countries
7	Development Of High-Protein Snack Products And Packaging
8	Enhancement Of Microbial Safety In Fresh Produce
9	Development Of A Non-Field Screening Method For Charcoal Rot Resistance
10	Increase Knowledge Of Personal Cleanliness Habits That Prevent The Spread Of Disease Through Food
11	Using Appropriate Hygiene Procedures When Handling Food [Fresh Or Processed]
12	Practices Adopted That Prevent Foodborne Illness Contamination During The Production And Distribution Of Fresh Produce
13	Number Of Food Preparers Reporting Using Proper Time And Temperature Controls
14	Increased Knowledge Of Fresh Fruit And Vegetable Production Practices

Outcome #1

1. Outcome Measures

Number Increasing Knowledge Of New Corn And Soybean Crop Management Techniques

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Number Changing Application Of Recommended Pest Control Practices For Corn And Soybean Production

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Dollars Saved Through Safe And Effective Pesticide Application

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Improvement Of Soybean Cultivars To Meet Market Needs And Provide New Tools For Studying The Effects Of Soy Isoflavones On Human Health

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The goal of this project is to develop soybean cultivars with either high or low levels of seed isoflavones or with altered isoflavone composition to meet market needs and provide new research tools for studying the effects of soy isoflavones on human health. Soybean breeders will get information about the changes needed and germplasm available to accomplish the desired changes that would increase soybean disease resistance and also health-promoting and nutritional value. Soybean processors and manufactures will get these unique lines with health-promoting properties that should help to expand the soy product market. It would also help to have uniformity in the food products.

What has been done

For the first time the genetic biodiversity of several important phytochemicals was determined by simultaneous analyses of isoflavones, phytosterols, sphingolipids and saponins in different soybean genotypes that have high or low levels of protein and oil. Since soy-based protein products contain isoflavones and saponins co-extracted during seed processing and the oil fraction contains sphingolipids and sterols, the information generated during this study could be valuable for application in breeding programs aimed at soy health added values. The information will be also useful for future testing of the target individual bioactive compounds and their combinations for their health effects. Genetic engineering targeted to enhance the capacity of native [glyceollin] and non-native [resveratrol and pterostilbene] phytoalexin production in response to pathogen invasion and/or the capacity to prevent phytoalexin degradation by pathogens could increase soybean innate resistance to multiple pathogens.

Results

It is conceivable that new soybean cultivars with stronger innate resistance would have a superior ability to accumulate antibiotics in response to general pathogen invasion, and not just to specific pathogens only. Cultivars with such enhanced innate resistance could help stabilize soybean production in the presence of diseases. Increased synthesis in the seeds of the soybean native fungicidal chemical glyceollin, or the non-native chemicals resveratrol and pterostilbene, will lead to better germination of healthy seeds and production of more vigorous seedlings due to reduced infection.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
603	Market Economics
701	Nutrient Composition of Food
704	Nutrition and Hunger in the Population
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #5

1. Outcome Measures

Knowledge Gained Toward Improving The Availability Of Fresh Fruits And Vegetables To Low-Income Americans

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	3000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The diets of many Americans, especially low-income Americans, do not include sufficient quantities of fruits and vegetables, and fresh produce is not readily available in many low-income communities. Increased local production of fruits and vegetables would enhance state and local economies, contribute to better health, and increase food security, but the development of local food systems lags behind need in many regions. We will form multidisciplinary teams to develop specific research and outreach programs to support and increase the production and availability of fresh, local fruits and vegetables and an expansion in the number of farmers who supply fresh produce to enhance local economies, consumer health, and food security.

What has been done

Accomplishments include: [1] coordinated the Illinois Specialty Crops, Agritourism and Organics Conference [this conference included relevant programming for farmers' market directors, connecting buyers and producers to scale-up local food systems, food safety, and food sales to institutional buyers, including Farm-to-School programs, and using social media to connect producers and consumers]; [2] expanded the capabilities and geographic coverage of MarketMaker; [3] developed and offered a new course on Local Food Systems at the University of Illinois; [4] contributed food systems-related presentations and discussions at the Sustainable Living Expo in southern Illinois; [5] consulted with school districts and communities on building local food systems; and [6] participated in meetings of the Illinois Local Foods Working Group. We also established or continued a range of research and Extension projects to improve food production, marketing, and distribution, including projects on pest management, post-harvest handling, organic certification, and urban farming. Products included articles in the Illinois Fruit and Vegetable News newsletter and updates to MarketMaker.

Results

Over 400 attendees at the Illinois Specialty Crops, Agritourism, and Organics Conference acquired knowledge to better understand production, marketing, and purchase of fruits and vegetables for local food systems. Over 500 subscribers to the Illinois Fruit and Vegetable News gained knowledge of necessary steps to link production and marketing in local food systems. Over 2,000 attendees at the Sustainable Living Expo gained information about local food systems. The number of farmers' markets in Illinois increased to over 300 in 2012.

4. Associated Knowledge Areas

KA Code	Knowledge Area
503	Quality Maintenance in Storing and Marketing Food Products
603	Market Economics
701	Nutrient Composition of Food
703	Nutrition Education and Behavior
704	Nutrition and Hunger in the Population
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #6

1. Outcome Measures

Development Of Fortification Technologies For Developing Countries

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The overall goal of this project is to develop and field test new effective fortification technologies that are low-cost, easy to use and that do not change feeding habits of populations in developing countries. In the Central American region iron deficiency anemia is major health concern. Most populations in this region consume tortillas. Thus, fortification of nixtamalized corn for tortillas at

the point of wet grinding could be an effective strategy against IDA in rural Central America.

What has been done

We are working on a process to fortify nixtamalized corn tortillas at the point of wet grinding using a stealth approach. In this process, we used extrusion to create puffed pellets fortified with iron. These pellets are added to nixtamalized corn prior to grinding at wet milling facilities. The iron source changed color in pellets, but it did not affect final masa color. Iron distributed well in masa fortified with both pellets types.

Results

These studies showed proof of the concept of using dry puffed pellets to deliver iron into a wet material [i.e. nixtamalized corn]. Using dry puffed pellets is advantageous in developing countries as these are easy to make and well-known by local food processors and the target populations. Also, the pellets have low water activity and do not require specialized packaging, making it a stable product under the conditions of use. Nixtamalized corn tortillas are consumed in more than 90% of households in most Central American countries, but in lesser amounts in Costa Rica and Panama. Nonetheless, traditional corn masa tortillas are almost exclusively consumed by low-income populations living in rural areas of Honduras, Guatemala, Nicaragua, and El Salvador.

4. Associated Knowledge Areas

KA Code	Knowledge Area
502	New and Improved Food Products
503	Quality Maintenance in Storing and Marketing Food Products
603	Market Economics
701	Nutrient Composition of Food
702	Requirements and Function of Nutrients and Other Food Components
703	Nutrition Education and Behavior
704	Nutrition and Hunger in the Population

Outcome #7

1. Outcome Measures

Development Of High-Protein Snack Products And Packaging

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
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2012

0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The long-term goal was to understand the characteristics of high protein ingredients and the resulting product qualities and to provide a guide for high protein soy foods development, which will provide more choices for better nutrition to consumers. The long-term goal of the study will be achieved by identification and characterization of soy ingredients in various ratios of macronutrients and processing conditions. The specific objectives were to: [1] identify the possible processing parameters of high protein products; [2] characterize the model products and reiterate the process; and [3] correlate sample characteristics to raw material and processing parameters and model the relationship between material and product characteristics.

What has been done

To accomplish these objectives, the high protein snack samples were processed using formulations which include protein amounts that will meet FDA requirements for a claim of being high in protein [10 g per serving]. The protein source was initially soy flour. The protein source was expanded to soy protein concentrate [SPC], soy protein isolate [SPI], whey protein concentrate [WPC], and whey protein isolate [WPI]. The final formulations were prepared with carbohydrate source [corn meal] and protein sources [our total protein amounts [28, 33, 38, 42%] and five whey protein to soy protein ratios [100:0, 75:25, 50:50, 25:75, 0:100]]. The screw configuration and extrusion parameters were identified for the high protein expanded snacks. Based on the high protein snack product characteristics, a model has been set up based on protein content and the source of protein [soy vs. whey] to optimize formulation. The processed snacks were also stored in air tight containers for six months at room temperature. As for the freshly prepared samples, both protein amount and protein type had significant effects on selected properties by instrumental measurements as expected. The significant changes that occurred over a six-month storage period in ambient conditions include texture, water activity and color. The texture of the samples, especially the hardness of the samples, decreased significantly. In general samples can be described as less hard and less crunchy. Water activity increased over time although the absolute water activity values are still low enough so no microorganisms can grow on the samples. Color, in terms of redness and blueness, decreased and resulted in 'faded color' compared to the fresh samples.

Results

The gained knowledge from this project will aid in better understanding of ingredient-product relationship of soy/whey-based high protein snack products. The model suggests that with greater amounts of soy protein, the high protein snacks have more acceptable physical and sensory properties. Soy protein contributed to greater expansion and acceptable texture of the high protein snacks which leads to higher consumer preferences. Blends of soy and whey protein can be a great protein source for this type of expanded snack as long as the ratio of soy to whey protein is controlled carefully. Also, based on the findings from the long-term storage study, target quality factors could be identified to extend shelf life of the high protein snack samples. This is important information to design proper packaging material and storage conditions to decrease product return and waste. The results may be used to develop high protein snack products as well as to design packages, which is extremely important for the soy and snack food industries.

4. Associated Knowledge Areas

KA Code	Knowledge Area
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501	New and Improved Food Processing Technologies
502	New and Improved Food Products
503	Quality Maintenance in Storing and Marketing Food Products
603	Market Economics
701	Nutrient Composition of Food
703	Nutrition Education and Behavior
704	Nutrition and Hunger in the Population
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #8

1. Outcome Measures

Enhancement Of Microbial Safety In Fresh Produce

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The recent outbreaks of Escherichia coli O157:H7 and Listeria infections due to consumption of produce reaffirmed the importance and challenge of produce microbial safety. These outbreaks and recalls have brought significant economic losses to the produce industry, and more importantly, recurring produce-related outbreaks erode consumer confidence in fresh produce and could jeopardize the long term development of the produce industry.

What has been done

A pilot-scale continuous-flow washing system with three pairs of ultrasonic transducers operating at 25, 40, and 75 kHz was designed and fabricated and used to investigate the efficacy of ultrasound treatment for produce sanitization. A uniform ultrasound distribution in the channel was achieved, as shown by pitting on aluminum foil and log reduction of Escherichia coli O157:H7 population on spinach held at different locations in the channel. The inactivation normalized by acoustic power density for one-minute treatments at 25, 40, and 75 kHz was 0.056, 0.061, and

0.057 Log CFU/[W/L], respectively. 'Blockage' reduces the exposure of 'screened' leaves to ultrasound, and results in significantly lower microbial count reduction. Compared to treatment with chlorine alone, combined treatment with chlorine and ultrasound in the continuous-flow system achieved additional log reductions of 1.0 and 0.5 CFU/g for E. coli cells inoculated on spinach, for washing in single-leaf and batch-leaf modes, respectively.

Results

Continuous-flow ultrasonic washing of fresh produce has the potential to provide the produce industry with a means to significantly enhance microbial safety. However, care must be taken to minimize the screening/blockage of ultrasound by produce leaves, minimize the variance in the residence-time distribution, and assure a near-uniform acoustic field distribution in the washing facility.

4. Associated Knowledge Areas

KA Code	Knowledge Area
501	New and Improved Food Processing Technologies
503	Quality Maintenance in Storing and Marketing Food Products
704	Nutrition and Hunger in the Population
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #9

1. Outcome Measures

Development Of A Non-Field Screening Method For Charcoal Rot Resistance

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Field screening of soybean for charcoal rot resistance has had variable and inconsistent results. Development of a reliable non-field screening method, such as the new cut stem technique,

significantly facilitates soybean resistance evaluation due to increased throughput and efficiency and control of factors such as plant maturity and environment that contribute to the inconsistency of field results. It can be used in breeding programs to reliably identify plants or lines in segregating populations with increased partial resistance.

What has been done

The soybean rust QPCR method developed in this project was shown to more accurately distinguish colonization in genotypes with incomplete and partial resistance than visual assessment of signs and symptoms. Soybean breeders seeking to identify and incorporate more durable partial rust resistance will apply the quantitative PCR screening method in their rust resistance breeding programs, which will lead to the release of soybean cultivars with a broader spectrum of resistance to soybean rust. Identification of the soybean rust resistance gene Rpp1b provides soybean breeders with another resistance gene to combat the disease worldwide. Information that Rpp1 provides resistance to all soybean rust isolates in the U.S. will encourage soybean breeders to prioritize their rust-resistance breeding efforts toward incorporation of this gene into their elite lines. The soybean aphid resistance gene Rag2, identified and mapped in this project, is currently being stacked with Rag1 and other resistance genes through backcrossing and marker-assisted selection techniques.

Results

Soybean cultivars with stacked resistance genes will broaden the spectrum of resistance against aphid biotypes. Identification and characterization of soybean aphid biotypes found in this project indicated that high virulence variability towards soybean resistance genes is already present in soybean aphid populations. This finding will encourage research into improving integrated management of the pest with other control methods such as application of insecticides and biological controls, and to developing methods to monitor soybean aphid virulence to enable intelligent deployment of resistance genes. Currently, management of SDS has primarily been accomplished by breeders culling highly susceptible soybean cultivars from their portfolios. With knowledge of the new QTL for resistance to SDS identified in this project, soybean breeders have an additional gene providing partial resistance to SDS that can be stacked with the other known SDS resistance genes to improve SDS resistance.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
205	Plant Management Systems
704	Nutrition and Hunger in the Population

Outcome #10

1. Outcome Measures

Increase Knowledge Of Personal Cleanliness Habits That Prevent The Spread Of Disease Through Food

Not Reporting on this Outcome Measure

Outcome #11

1. Outcome Measures

Using Appropriate Hygiene Procedures When Handling Food [Fresh Or Processed]

Not Reporting on this Outcome Measure

Outcome #12

1. Outcome Measures

Practices Adopted That Prevent Foodborne Illness Contamination During The Production And Distribution Of Fresh Produce

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	23

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

In recent times, the safety of fresh produce has become a growing concern to consumers and the horticulture industry. Contamination of produce by microorganisms that cause foodborne illness outbreaks result in significant associated health costs. In addition, these outbreaks have financial consequences for a given producer as well as other producers in the same industry who incur losses when the public refuses to buy any product associated with a given foodborne illness outbreak. As the Food and Drug Administration introduces new regulations regarding production and handling practices for fresh produce, it is imperative that the stakeholders in the food industry become proactive regarding both Good Agricultural Practices [GAPs] and Good Handling Practices [GHPs].

What has been done

In response, four one-day Extension educational programs were conducted in Northern Illinois in the winter and early spring of 2012 on safe food production and handling in order to ensure that fresh produce is free from contamination by microorganisms that cause foodborne illness. Specific topics addressed in these programs included water usage and water testing, worker health and hygiene, facilities and equipment sanitation, manure handling and field application, and record-keeping. More than fifty individuals participated in the conferences representing

specialty crop producers and retailers, including farmers' market managers and vendors, as well as Master Gardeners and local health officials.

Results

An end-of-meeting evaluation form consisting of seven questions was distributed and collected from 47 of the participants. A key question asked respondents to assess the knowledge level gained on specific topics that were covered in the conference using a scale from one to five [1=None/Already knew; 5=Learned a great deal]. The average score for the 47 respondents was above a three rating for all topics. The areas of greatest learning were: [1] preparing for a GAPs audit [4.66 average group scores; 34 of 47 [72%] checked 'a great deal']; [2] manure handling and application [4.36 average score; 26 of 47 [55%] checked 'a great deal']; [3] keeping records [4.32 average group score; 25 of 47 [53%] checked 'a great deal']; and [4] minimizing risks during food production [4.06 average group score; 24 of 47 [51%] checked 'a great deal']. Forty-four of the participants shared comments on actions they plan to take as a result of the training. Although a few of the indicated actions were quite general in nature, multiple respondents planned to create and implement a GAP plan [16], improve record-keeping [6], or share what they learned with workers, fellow gardeners, and students [4]. A follow-up evaluation was not conducted to identify practice implementation. However, the follow-up conducted on identical programs conducted in 2011 revealed that approximately half of the program attendees implemented at least one of 37 specific practices [most often citing worker health and hygiene practices].

4. Associated Knowledge Areas

KA Code	Knowledge Area
503	Quality Maintenance in Storing and Marketing Food Products
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #13

1. Outcome Measures

Number Of Food Preparers Reporting Using Proper Time And Temperature Controls

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	37

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Periodic outbreaks of foodborne illnesses have generated public concern about the safety of the food they consume and have serious health consequences for those who eat contaminated foods and economic consequences for individuals who serve fresh or prepared food. As of 1999, the Food Service Sanitation Code required Illinois-certified food service sanitation managers to attend food safety training with a minimum of five hours or to complete a recertification exam to be eligible for re-certification to serve food every five years.

What has been done

Workshops on food safety have been conducted statewide by Extension educators with nutrition and wellness assigned responsibility. Adjustments in the content were initiated to incorporate the 2008 updates in the Illinois Food Sanitation Service code. Due to staff vacancies in the nutrition and wellness educator positions, only 8 workshops involving 102 participants were conducted. University of Illinois Extension Educators conducted the 5-Hour Refresher Course for Food Handlers in four locations in the state. Fifty-one [51] individuals involved in serving food to the public participated in the programs as a requirement to maintain their food service certification by the Illinois Department of Public Health. In addition, 51 volunteers from nine counties attended Serve It Safely programs designed for those not requiring certification statuses. A pre- and post-test consisting of eight multiple choice items focused on 2008 changes in the updates in the Illinois Food Sanitation Service code was distributed and collected from those in the certification course to measure knowledge change and a three month follow-up evaluation was distributed and completed by 30 of the 51 Serve it Safely volunteer participants to identify practice changes.

Results

Impact on knowledge of food safety measured by pre- and post-test scores from participants in the 5-Hour Refresher course revealed increases in one of more of the eight food safety practices by 49 of the 51 participants [96%]. Specific to maintaining proper temperatures of food, 31 [61%] learned the temperature range [danger zone] when food is most susceptible to the growth of bacteria that can cause foodborne illnesses, and 41 [80%] indicated learning that ready-to-eat potentially hazardous foods can be stored in the refrigerator for no more than seven days. A follow-up evaluation to determine practice changes collected from seven attendees at one certification training indicated that five [71%] changed at least one practice as a result of participating in the training. Based on results from a random follow-up study conducted in 2011, an additional twenty are likely to have changed food temperature monitoring practices [study results revealed that one-half of the respondents changed practices related to food temperature monitoring].

Of the 51 participants in Serve It Safety, 30 completed and returned the follow-up evaluation. Nearly one-half of the respondents [13] indicated changing at least one food handling practice. Six now use a thermometer to check temperatures of foods and two now use slow cookers only to hold hot foods hot and not to reheat foods. Additional information is provided in the final [evaluation] section of this planned program.

4. Associated Knowledge Areas

KA Code	Knowledge Area
503	Quality Maintenance in Storing and Marketing Food Products
704	Nutrition and Hunger in the Population

712 Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #14

1. Outcome Measures

Increased Knowledge Of Fresh Fruit And Vegetable Production Practices

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	102

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Fruit and vegetable producers are seeking ways to improve their efficiency of production leading to enhanced profitability of their enterprise. Ultimately, consumers benefit in accessing quality produce that enhances their health and is safe for consumption.

What has been done

A number of annual one-day Extension schools for commercial fruit and vegetable producers are held during the winter months throughout the state, as well as in conjunction with neighboring states. These include vegetable, fruit, strawberry, and small fruit schools. Extension educators and specialists assist in organizing, promoting and teaching the latest research findings related to production, pest management, marketing, and safe food handling. Attendees are also able to visit with vendors and exhibitors. This past year a formal evaluation was designed, distributed and collected from participants at the end of the Southern Illinois Vegetable School and the two Southern Illinois Tree Fruit Schools.

Results

The 159 attendees at the tree fruit schools and 135 attendees at the vegetable school were offered an option to rate the knowledge they gained for each of the individual topic sessions using a 1-5 scale [1=None/Already knew and 5= Learned a great deal]. All but one of the 26 vegetable producers [19% of the attendees] who responded checked at least one topic as a 4 or 5, while 16 checked a 5 rating for at least one session topic. All but four of the 57 fruit producers [36% of the attendees] who responded checked at least one topic as a 4 or 5, while 38 checked a 5 rating for at least one session topic. Topics rated highest by vegetable school respondents were Basics of High Tunnel Production [rated 4 or 5 by 91%] and Scouting/Insect Management [rated 4 or 5 by 89%]. Topics rated highest by fruit school respondents were New Cultivars and Rootstocks [rated

4 or 5 by 84%] and Insect Management [rated 4 or 5 by 79%]. When asked to share comments about their plans for using the information they gained, 47 fruit growers and 14 vegetable growers listed planned actions. These actions will be used in an evaluation distributed in 2013 to identify actual practices implemented by those who attended the previous year. Additional findings are located in the evaluation section of this planned program.

4. Associated Knowledge Areas

KA Code	Knowledge Area
502	New and Improved Food Products
503	Quality Maintenance in Storing and Marketing Food Products
603	Market Economics
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Appropriations changes
- Government Regulations
- Competing Public priorities

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Food Service Safety Education

University of Illinois Extension Nutrition and Wellness Educators conducted four **Food Service Sanitation Management Certification courses** in 2011-2012. Fifty-one individuals involved in serving food to the public participated in the programs as a requirement to maintain their food service certification by the Illinois Department of Public Health. In order to identify changes in their knowledge of food safety, a revised evaluation was developed that asked participants to answer eight multiple-choice questions at the beginning and at the end of the five-hour course. The questions were designed to address critical practices and recent regulation updates to reduce the risk of bacterial contamination that can cause foodborne illnesses.

All but two of the participants demonstrated an increase in knowledge to prevent food contamination by answering at least one question correctly at the end of the course that they had incorrectly answered before the course began. Forty-one [80%] were able to correctly answer 3-7 additional questions correctly at the end of the training. In addition, more than half of the participants who had answered each question incorrectly before the

program answered it correctly at the end for the following items: 41 [80%] learned that ready-to-eat potentially hazardous foods can be stored in the refrigerator for no more than seven days; 35 [68%] gained knowledge about how to correctly label prepared foods that are stored in the refrigerator or coolers; 31 [61%] learned the temperature range [danger zone] when food is most susceptible to the growth of bacteria that cause foodborne illnesses [however, over one-fourth of the participants were still unable to answer the question correctly at the end of the program]; and 30 [59%] learned to only drink from covered containers when they were involved in serving food. All 51 participants were able to correctly answer this question at the end of the program.

With respect to four additional food handling requirements, participants were already knowledgeable as evidenced by their ability to answer the questions correctly at the beginning of the course. More than half of the participants correctly answered the following questions at the beginning of the course: 38 [74%] could distinguish between potentially hazardous and non-hazardous food [however, five of these individuals incorrectly answered this question at the end of the program]; 34 [67%] already knew the temperature and time needed to reheat potentially hazardous foods; 32 [63%] already recognized the relationship of refrigerator shelf location with respect to variability of foodborne illness risk for various foods; and 27 [53%] already knew what jewelry is acceptable to wear when serving food to the public [an additional 22 were able to correctly answer the question after the program].

Fruit And Vegetable Production

The 159 attendees at the two Southern Illinois Commercial Tree Fruit schools and 135 attendees at the Southern Illinois Commercial Vegetable school were offered an option to rate the knowledge they gained for each of the individual topic sessions using a 1-5 scale [1=None/Already knew and 5= Learned a great deal]. Results are discussed below:

Tree Fruit School Knowledge Gained

All but four of the commercial tree fruits growers who responded [57 of 159] checked at least one topic as a 4 or 5, while 38 checked a 5 rating for at least one session topic. All topics were rated 4 or 5 by over 70% of those fruit growers who responded. The list of topics that follows is arranged from highest to lowest percentage of those responding: [1] New Cultivars & Rootstocks -- rated 4 or 5 by 47 of 56 individuals who responded [84%]; [2] Insect Management -- rated 4 or 5 by 45 of 57 individuals who responded [79%]; [3] Micronutrient Impact on Fruit Quality - rated 4 or 5 by 41 of 55 individuals who responded [75%]; [4] Grafting Fruit Trees -- rated 4 or 5 by 33 of 44 individuals who responded [75%]; and [5] Diseases Updates -- rated 4 or 5 by 40 of 56 individuals who responded [71%].

Twenty individuals provided comments related to knowledge they gained regarding Good Agricultural Practices [GAP]. The following were mentioned by several individuals: [1] status of legislation/policy development and exemptions; [2] importance of safe food production; [3] required recordkeeping; [4] details regarding Listeria contamination of cantaloupe; and [5] need for a GAP plan.

Plan For Using Tree Fruit School Information

Forty-seven responded to a request to share what they plan to do with the

information gained. Twelve referenced insect and disease management practices [use the correct herbicide and fungicides for a problem, try and do better organizing my spray schedule, better control of brown rot, organize orchard records so I can identify problem areas from the previous year, improve disease control, incorporate recommendations in insect and disease control management, do a better job on Woolly Aphid control, use information to help in adjustment of insurance claims, re-evaluate spray schedule, register as having a sensitive crop for spray drift]. Six referenced GAP actions. Five mentioned planting new peach and apple varieties. Four mentioned applying rootstock information [investigate new rootstocks, cultivars and pruning, plant new cultivars and rootstock, find a substitute for cultivars]. Four referenced micro-nutrient actions [use foliage analysis to check micro-nutrient levels on my orchard, take a serious look at my micro-nutrient levels, evaluate my soil micro-nutrients].

Vegetable School Knowledge Gained

All but one of the 26 commercial vegetable growers who completed the evaluation checked at least one topic as a 4 or 5, while 16 checked a 5 rating for at least one session topic. All topics were rated 4 or 5 by more than half of those who responded. The list of topics that follows is arranged from highest to lowest percentage: [1] Basics of High Tunnel Production -- rated 4 or 5 by 10 of 11 individuals who responded [91%]; [2] Scouting/Insect Management -- rated 4 or 5 by 20 of 25 individuals who responded [80%]; [3] Understanding the Tomato and Pumpkin Ripening Process - rated 4 or 5 by 18 of 26 individuals who responded [69%]; [4] Disease Management Updates -- rated 4 or 5 by 16 of 24 individuals who responded [66%]; [5] Sweet Potato Cultivar Trials -- rated 4 or 5 by 17 of 26 individuals who responded [65%]; [6] Adding Herbs to Your Product Line -- rated 4 or 5 by 12 of 23 individuals who responded [52%]; and [7] Foliar Nutrient Applications in Pumpkins -- rated 4 or 5 by 13 of 25 individuals who responded [52%].

Six individuals provided comments regarding knowledge they gained related to Good Agricultural Practices [GAP]. The following were mentioned: 'vocabulary that is used', 'very important to learn and follow', 'better to have slick floors and walls', 'best to harvest when dry', 'wash and dry equipment', and 'to watch out for future regulations'.

Plan For Using Vegetable School Information

Fourteen individuals shared comments about their plans for using the information they gained. Six related to pest and disease management [better field monitoring, more proactive with my insect scouting, better pest and mildew practices on pumpkins, spray a lot more, change spray schedules for tomatoes]. Four comments related to planting something new [try sweet potato cultivars, start sweet potato vines to sell/plant some sweet potatoes, try some new varieties, try pumpkins]. Two related to GAP [consider the cost of GAP, use Entrust/bleach spray on wires/cages/posts]. One planned to look at tunnel systems.

Nitrogen Calculator

Crop decision support applications for smartphones and tablets were developed in 2011-12 and included Nitrogen Rate Calculator and Crop Nutrient Removal Calculator [P and K] applications. An option to the Nitrogen app was then added to help facilitate farmers' decisions to reduce fall-applied nitrogen and split their nitrogen into multiple applications. This app was updated to Android, and an Apple version was also created.

As of January 2013 the Android version has been downloaded 405 times and the Apple version has surpassed 1,000 downloads. Access to the list of Android users provided an opportunity to conduct a short survey. Thirty-five users responded: 79% rated the app as somewhat to very useful, 17% will switch all acres to split application, 21% will switch some acres to split application, 8% will eliminate fall nitrogen application, and 10% will reduce total nitrogen application amounts.

Key Items of Evaluation

Food Service Safety Education

The responses to questions before and after the food safety programs for individuals involved in retaining certification to serve food to the public indicated that 96% of the 51 participants gained knowledge in handling food safely. Most notably, 41 [80%] of the participants learned that ready-to-eat potentially hazardous foods can be stored in the refrigerator for no more than seven days. In addition, more than half of them [31] learned the temperature range [danger zone] during which food is most susceptible to the growth of bacteria that cause foodborne illnesses.

Using the information collected in 2011 through a University of Illinois Extension random survey that indicated that the conservative number of meals participants reported serving daily was 100 and the annual number of food handlers trained this year, an estimated 10,000 additional meals per day are free of contaminants that can cause foodborne illnesses. Based on the March, 2010 study funded by the Pew Charitable Trust indicating that the average cost of each foodborne illness is \$1,850, this could represent a very significant contribution toward reducing healthcare costs.

Fruit And Vegetable Production

Responses collected through the evaluation forms evidenced a high level of knowledge gained regarding all the topics for the 2012 Southern Illinois Commercial Tree Fruit School and Southern Illinois Commercial Vegetable School. Nearly one-fourth of the commercial tree fruit producers who responded mentioned planning to implement suggested practices related to insect and disease management and several mentioned plans to implement GAP practices, plant new varieties, evaluate soil micro-nutrient levels, and apply rootstock recommendations. For commercial vegetable producers, the highest knowledge gains were for insect and disease management and high tunnel production. In addition, several respondents mentioned planning to implement suggested practices related to insect and disease management as well as planting new vegetables. Those planned actions will be included on the 2013 evaluation to determine actual practice changes by returning participants.

AgMasters Conference

An evaluation was distributed at the end of the **AgMasters Conference**, a two-day event that began with a single general session followed by 1½ days of advanced classes designed to educate participants using the latest information on specialized and relevant

topics. Participants included producers and crop advisers who were asked to answer questions related to the impact of the conference. Fifty participants completed the evaluation; 21 indicated the profit per acre that they believed will result from a practice they will put in place in 2013 that they learned by attending the 2012 conference. Specifically, one indicated projecting more than a \$50 per acre profit; three projected a profit of between \$31 and \$50; two projected a profit of between \$16 and \$30; six projected a profit of between \$10 and \$15 per acre, and nine projected a profit of less than \$10 per acre. Based on responses asking participants to indicate the number of acres farmed or advised, the average for those who did so was slightly less than 70,000 acres and suggests that the projected profit could be substantial. In response to the question asking if the conference worth the time and expense [\$275 registration fee] required to attend, 49 of 50 indicated that it was.

Nitrogen Calculator

Research indicates that fall-applied nitrogen is a major contributor to nitrate impairments in water quality. If farmers and the agricultural industry do not voluntarily reduce nitrates in surface water, future restrictive regulations are likely. An evaluation survey of users of the new Nitrogen Calculator Android app indicated that more than half [56%] of the respondents plan to switch some or all of their acres to split application, reduce total nitrogen amounts, or eliminate fall nitrogen.