

V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

Global Food Security - Plant Production Systems and Health

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
201	Plant Genome, Genetics, and Genetic Mechanisms	10%	10%	10%	20%
202	Plant Genetic Resources	10%	10%	10%	10%
204	Plant Product Quality and Utility (Preharvest)	5%	5%	5%	10%
205	Plant Management Systems	10%	20%	15%	20%
206	Basic Plant Biology	10%	10%	10%	20%
211	Insects, Mites, and Other Arthropods Affecting Plants	10%	10%	10%	10%
212	Pathogens and Nematodes Affecting Plants	10%	15%	10%	0%
213	Weeds Affecting Plants	12%	15%	10%	0%
216	Integrated Pest Management Systems	5%	5%	5%	10%
404	Instrumentation and Control Systems	1%	0%	0%	0%
511	New and Improved Non-Food Products and Processes	1%	0%	0%	0%
512	Quality Maintenance in Storing and Marketing Non-Food Products	1%	0%	0%	0%
601	Economics of Agricultural Production and Farm Management	6%	0%	5%	0%
602	Business Management, Finance, and Taxation	3%	0%	5%	0%
604	Marketing and Distribution Practices	6%	0%	5%	0%
	Total	100%	100%	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	102.0	9.0	160.0	7.0

Actual Paid Professional	136.0	18.0	190.0	6.0
Actual Volunteer	61.0	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
1339074	894192	2758803	554223
1862 Matching	1890 Matching	1862 Matching	1890 Matching
1339074	832386	2758803	55020
1862 All Other	1890 All Other	1862 All Other	1890 All Other
10308426	135518	21411410	48358

V(D). Planned Program (Activity)

1. Brief description of the Activity

•Conduct discovery research on plants and plant systems using tools genomics, metabolomics, and proteomics

- Develop improved crop varieties using traditional and genomic approaches
- Introduce/discover new plants for food use and the green industry
- Develop systems for production of plants for biofuels
- Seek new uses for plants and plant byproducts
- Develop production systems for organic farmers
- Develop diagnostic techniques for indigenous and introduced pathogens
- Partner with industry
- Develop sustainable production systems for both large scale and limited resource farmers
- Enhance IPM programs through new techniques and strategies
- Set up applied research/demonstration plots
- Write papers for scientific community
- Prepare publications for grower and homeowner audiences
- Develop web sites to deliver information to grower and homeowner audiences
- Conduct workshops, meetings, and other focused educational programs for farmers, commodity groups, and industry.

2. Brief description of the target audience

- The scientific community
- Regulatory agencies
- Agricultural chemical companies
- Agribusiness
- Commercial and limited resource farmers
- New and Part-time farmers
- Homeowners
- Consultants
- News media
- General public
- Non-governmental organizations

- Other public agency staff

3. How was eXtension used?

Communities of Practice are available in eXtension for an array of field, horticultural and ornamental crops and related areas that provide a resource for producers, handlers, processors and marketers.

V(E). Planned Program (Outputs)

1. Standard output measures

2012	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	418211	1227962	0	0

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

Patent Applications Submitted

Year: 2012

Actual: 20

Patents listed

Crop Resistance to Nematodes by Disrupting Host Plant Receptors of Cyst Nematodes Secreted CLE Peptides

Alteration of tobacco alkaloid content through modification to specific cytochrome p450 genes(Hong Kong)

Inhibition of Biofilms in Living Plants by Use of Triazole Derivatives

Methods of Inhibiting Ethylene Responses in Plants Using Cyclopropene Amine Compounds

Tobacco Inbred Plants NCBEX1F, NCBEX1MS and NC EX90(US)

Calycanthus 'Aphrodite'(US)

Buddleja NC2006-6 'Lilac Chip'

Buddelja NC2006-10 'Ice Chip'

Alteration of tobacco alkaloid content through modification of specific cytochrome p450 genes(US)

PVP for 'NC-Cape Fear'

Tobacco Inbred Plants NCBEX1F, NCBEX1MS and NC EX90(International)

Peptide Aptamers that Bind to the Rep Proteins of ssDNA Viruses

Method of Inhibiting Ethylene Response in Plants Using Dicyclopropene Compounds(Europe)

Nanotechnology System for Agricultural Applications

Method of Inhibiting Ethylene Response in Plants Using Dicyclopropene Compounds(New Zealand)

Calycanthus x 'Aphrodite'

Use of bio-pesticide for control of dollar spot and anthracnose in turfgrasses

PVP application for 'Gerard 229' (NC03-8331) winter oat

PVP for 'Gerard 224' (NC03-2421)

PVP for 'SS 76-50' (NC01-3497)

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	105	412	517

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Studies conducted to identify new germplasm and develop new and improved varieties of crops and ornamentals

Year	Actual
2012	31

Output #2

Output Measure

- Clients to receive plant information via printed publications, fax, e-mails, phone and other contacts via known non-face to face delivery means.

Year	Actual
2012	1227962

Output #3

Output Measure

- Educate growers and other clientele through highly focused non-degree credit workshops and other formalized group educational sessions.

Year	Actual
2012	85563

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Increased Income as a Result of Production of New or Alternative Crops/Enterprises
2	Increased profit through the adoption of improved nutrient management practices
3	Number of releases of germplasm and varieties with improved yield potential and other qualities
4	New techniques and products developed and released that can be commercialized
5	Increased profit through the adoption of new production practices
6	More informed growers through highly focused non-degree credit workshops and other formalized group educational sessions.
7	Increased acreage of organic crops and specialty crops.
8	Number of discoveries of mechanisms that regulate the productivity of plants and the microorganisms that interact with them
9	Increased profit through the adoption of new production practices *and marketing locally*
10	New organic, farmers and agritourism markets established by individual entrepreneurs
11	Growers Adopting Improved Business Management Practices

Outcome #1

1. Outcome Measures

Increased Income as a Result of Production of New or Alternative Crops/Enterprises

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	20000000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

High feed prices for pigs and poultry created a need to produce more feed grains locally to save freight costs and ensure a reliable local supply.

What has been done

A collaborative effort involving private industry, the land grant university, commodity organizations, NC Department of Agriculture and other stakeholders initiated an effort to increase feed grain production in the state, but increasing yields of corn and wheat, and by significantly increased grain sorghum acreage. The private company committed to making the market for increased sorghum produced.

Results

A pilot sorghum project in 2011 growing season saw about 10,000 acres grown. With significant funding from the partners, active research and extension/technical assistance programs, the 2012 growing season saw an estimated 70,000 acres grown, with plans for increasing acreage again in 2013. Conservative estimates of the value of the added production amount to over \$20 million for this crop alone.

4. Associated Knowledge Areas

KA Code	Knowledge Area
202	Plant Genetic Resources
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems

211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants
216	Integrated Pest Management Systems
512	Quality Maintenance in Storing and Marketing Non-Food Products
601	Economics of Agricultural Production and Farm Management
602	Business Management, Finance, and Taxation
604	Marketing and Distribution Practices

Outcome #2

1. Outcome Measures

Increased profit through the adoption of improved nutrient management practices

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	20000000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Identification of the factor(s) affecting Fraser fir growth and development is essential to maintaining and improving the North Carolina Christmas tree industry. Establishment of preferential ground covers in Fraser fir plantations has gained significant interest in recent years. Previous demonstrative research has indicated a significant positive effect of clover establishment in relation to soil N availability. However, the N contribution of selective cover crops in Fraser plantations is not well understood. Positive effects of preferential ground covers in regards to soil nutrient status can have a significant effect on Fraser fir production profitability, particularly with recent increases in fertilizer prices. No scientific studies to date have documented the effects of clover cover crops on soil properties in Fraser fir plantations.

What has been done

Researchers and extension personnel conducted preliminary on-farm studies documenting reduced nitrogen fertilizer needs with implementation of preferential ground cover management

strategies. Additional studies funded by the North Carolina Christmas Tree Growers Association were initiated in 2009 to quantify the effects of preferential ground cover establishment on soil nutrient status and other select soil properties. These studies have been monitored since inception.

Results

Quantifying the benefits of selected ground covers will provide production information that will likely reduce input costs through reductions in both nitrogen fertilizer applications and herbicides. Proven successful, adoption of this type of management system will improve the sustainability of Christmas tree production systems in NC compared with traditional herbicide practices and tree fertility maintenance.

4. Associated Knowledge Areas

KA Code	Knowledge Area
202	Plant Genetic Resources
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants

Outcome #3

1. Outcome Measures

Number of releases of germplasm and varieties with improved yield potential and other qualities

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	11

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

New peanut varieties, including those with high oleic acid content, are being released for commercial use. Peanuts with this trait potentially have longer shelf life and thus more desirable in the market.

What has been done

Two new high yielding varieties have been released (Bailey and Sugg), and over a two year period essentially will represent almost the entire crops produced in North and South Carolina and Virginia. The 2013 season will be the first season where sufficient seed is available to meet the demand for these varieties.

Results

The increased yields and value of these new varieties has generated an estimated \$16 million benefit to growers in these three states, compared to existing varieties.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
206	Basic Plant Biology
212	Pathogens and Nematodes Affecting Plants

Outcome #4

1. Outcome Measures

New techniques and products developed and released that can be commercialized

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	20

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Arthropod borne viruses (arboviruses) are major sources of disease for humans and domestic animals. They are collectively second only to malaria as the world's number one health problem. About 700 of these agents are presently known, with emerging strains appearing annually. For one of these agents, Dengue Fever, approximately 100 million cases are reported annually with many more cases unreported. About 2.5 billion people are at risk of contracting this disease annually.

What has been done

Despite the enormous economic and medical impact of these agents very few effective vaccines exist for their control. Live virus vaccines, which are the most effective forms of vaccines, have been particularly difficult to produce. We have developed a technique for the production of live virus vaccines for arthropod vectored viruses. This technology is based on the discovery that evolution has provided these viruses with genetic information essential for replication in one of the two hosts (mammals and insects) but not the other. We have identified genetic elements required for efficient replication in the mammalian host and removed them. These deletion mutations restrict the growth of the virus to the insect host resulting in a host range mutation that is a deletion with little prospect of reversion to wild type.

Results

Injection of the insect-produced virus into mammals results in the production of high titers of neutralizing antibody and protection against challenge with wild type virus in the absence of disease. We have demonstrated that this strategy works in monkeys. The vaccine is ready for human trials. In principle this technology will produce a live virus vaccine against any of these arthropod vectored diseases for which a cDNA clone can be produced. This technology is now being applied to West Nile virus and Chikungunya virus.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
204	Plant Product Quality and Utility (Preharvest)
206	Basic Plant Biology
212	Pathogens and Nematodes Affecting Plants

Outcome #5

1. Outcome Measures

Increased profit through the adoption of new production practices

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
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2012 20000000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The billbug is a unique insect pest that is native to North Carolina and not found in the Midwest. Over the years, it has caused average yield losses of 25% to 40% in corn with little growers could do about it. The most common method of attempted control was with the use of a highly toxic insecticide which caused some environmental contamination.

What has been done

Research at NCSU identified a new approach to billbug control. Applying a very low rate of a tobacco extract (neonicitinoid) to corn seed proved to be extremely effective at complete control of billbug in corn.

Results

This research improved corn yields in the eastern counties of the state by 30%, resulting in growers returning to corn production and increasing farm income by \$25 million dollars annually.

4. Associated Knowledge Areas

KA Code	Knowledge Area
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants
216	Integrated Pest Management Systems

Outcome #6

1. Outcome Measures

More informed growers through highly focused non-degree credit workshops and other formalized group educational sessions.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
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2012

85563

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

With the adoption by North Carolina soybean producers of Roundup-Ready soybeans (now on more than 95% of the state's soybean acreage) has come a dramatically higher seed cost. Producers were paying \$12 to \$16 per 50-lb. bag of seed in 1995 (prior to the introduction of Roundup-Ready technology) and now pay \$42 to \$56 per 50-lb. bag.

What has been done

Replicated, statistically sound on-farm tests convincingly demonstrated that yields could be maintained at populations as low as 50,000 plants per acre with May planting dates and as low as 100,000 plants per acre with June and July planting dates. These results have been emphasized extensively at producer meetings, agent and dealer training, field days, farm tours and in the farm press output. A handout titled "Suggested Soybean Plant Populations for North Carolina (CS-SB-21)" has been prepared and distributed.

Results

In 2006, 50 field faculty representing 75.5% of the state's soybean acreage estimated that soybean planting rates were reduced by 16.5 lbs. of seed per acre from 2001 to 2006, with a resulting yield increase of 1.6 Bu/A. If no further changes in planting rate or yield took place from 2006 to 2012, we estimate that N.C. soybean growers realized increased income of more than \$60 million by planting less soybean seed in 2012.

4. Associated Knowledge Areas

KA Code	Knowledge Area
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants
216	Integrated Pest Management Systems

Outcome #7

1. Outcome Measures

Increased acreage of organic crops and specialty crops.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	500

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Interest in growing hops in North Carolina on a commercial scale has increased with an international shortage of hops in 2007 and an increase in the number of small breweries in the state in recent years.

What has been done

Extension agents and specialists and researchers from NCSU, an NC Department of Agriculture and Consumer Services agronomist and others came together to develop research-based information for hops producers and would-be producers. Soils and fertility information was developed and variety tests begun.

Results

Hops workshops, field days and festivals attract hundreds of people, and there are now an estimated 80 commercial hop yards in North Carolina, ranging in size from a tenth to three acres.

4. Associated Knowledge Areas

KA Code	Knowledge Area
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
213	Weeds Affecting Plants
216	Integrated Pest Management Systems

Outcome #8

1. Outcome Measures

Number of discoveries of mechanisms that regulate the productivity of plants and the microorganisms that interact with them

2. Associated Institution Types

- 1862 Research
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	20

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Most crop plants currently used for biofuel production compete with food and feed production for resources like land and water, which has led to increases in food prices. We are working on two different plant systems to generate economical and environmentally sustainable biofuel: a) marine microalgae (*Dunaliella salina*) with rapid growth and no requirement for land or fresh water, and b) *Camelina sativa*, an exceptional biofuel crop because it grows rapidly on poor soils with little water and fertilizer input. However, the productivity of *Camelina* and other biofuel crops is too low to make it economically viable.

What has been done

A team of plant biologists, microbiologists, agricultural engineers and chemical/mechanical and aerospace engineers as well as economists is working to generate biofuel feed stock. This project will generate a heat-tolerant *Camelina* plant. To increase the productivity of *Camelina*, we will engineer the entire carbon flux ? from increasing photosynthetic CO₂ uptake in the leaf to the synthesis of energy rich molecules in the seeds. These energy-rich molecules will mostly consist of modified oils and terpenes. The modified oils are better suited for jet fuels and will reduce the need for hydrogen and energy in the conversion process. The terpenes can be cost-effectively converted into aromatics. Aromatics are essential components of jet fuels, but their chemical synthesis is more costly and energy intensive than their extraction from biological materials.

Results

The increased productivity of this enhanced ?Jet-Camelina? crop and the development of energy and cost efficient harvesting, extraction and conversion technology will provide an energy-dense liquid transportation fuel as a drop-in replacement for petroleum-based fuels.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
204	Plant Product Quality and Utility (Preharvest)
206	Basic Plant Biology
212	Pathogens and Nematodes Affecting Plants

Outcome #9

1. Outcome Measures

Increased profit through the adoption of new production practices *and marketing locally*

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	45000000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Implementing an integrated pest management program requires timely information about pest populations and available management options. This information is generally not readily available in the field, which hampers nursery crop production managers' ability to make timely decisions.

What has been done

Nursery crop production and pest management specialists have organized the Southern Nursery IPM (SNIPM) working group to develop IPM solutions for growers in the region. SNIPM created two applications for mobile devices, IPMPro and IPMLite, that assist growers, landscapers and homeowners in preventing pest damage by sending text alerts to clients that remind them to scout for a particular pest. The IPMPro application provides chemical recommendations.

Results

The apps were launched in March 2012. To date, more than 200 copies have been sold.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems

Outcome #10

1. Outcome Measures

New organic, farmers and agritourism markets established by individual entrepreneurs

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	35

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The demand for locally grown food in the North Carolina Piedmont is growing, yet people who wish to farm don't always have the information they need to begin farming.

What has been done

The Piedmont Farm School was a seven-month program that taught new, aspiring and transition farmers how to write business plans and develop as farm entrepreneurs. NC Cooperative Extension in six Piedmont counties worked together to develop curriculum, plan and implement the program.

Results

Thirty-two participants completed the program. Twenty-five participants wrote an outline of a business plan and accessed new marketing arenas. Nine participants reported increased farm profit in 2012 as a direct result of practices learned at the school.

4. Associated Knowledge Areas

KA Code	Knowledge Area
511	New and Improved Non-Food Products and Processes
601	Economics of Agricultural Production and Farm Management
602	Business Management, Finance, and Taxation
604	Marketing and Distribution Practices

Outcome #11

1. Outcome Measures

Growers Adopting Improved Business Management Practices

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2012	25557

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Cooperative Extension clients are in need of educational programs and information that will help them make farm business management decisions that result in positive impacts for their own operations and rural communities.

What has been done

A Cooperative Extension associate developed and delivered information in group and individual settings regarding value-added livestock products, whole-farm business plan development, farm business management and risk management regarding corn, soybeans, wheat, dairy, beef, hogs and forage crops.

Results

As a result of this information, clients realized more than \$7 million in net profits. These were the result of both decreased input costs and/or increased profits by implementing recommended marketing and risk management advice.

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management
602	Business Management, Finance, and Taxation
604	Marketing and Distribution Practices

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

Rapidly changing environmental and economic conditions (weather extremes, economic climate) influence producers abilities to adapt to change while ensuring sustainable production systems. Continued effects of the economy on federal, state and local support for research and extension programs continue to challenge our research and extension enterprises. Likewise, regulatory and other governmental policies and rules influence the educational and research capacities of our programs and present challenges to producers, processors and marketers to comply with new and often expensive regulations. And in an environment of reduced funding, the program competition for existing funds becomes a greater challenge to manage. Nevertheless, emphasis is placed on those research and extension opportunities that have the greatest effect on sustainability of farms, families and businesses, i.e., economic, environmental and social and quality of life viability.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Information in this report is compiled from North Carolina Cooperative Extension reporting system, faculty activity reports and impact statements, Office of Technology Transfer and the business offices at the two institutions. The data indicate that, despite continuing budget challenges, our research and extension programs continue to reach significant segments of our audience with relevant research and extension information that has benefit to their enterprises. Based on the impact statements, publications and patents filed, our research and extension faculty on the two campuses and across the state continue to foster and lead change.

Key Items of Evaluation

Research and extension programs have presented North Carolina agriculture with new plant varieties and enterprises, more efficient production systems, and expanded opportunities for more efficient, profitable and competitive operations.