

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Agronomic Crop Systems

- 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
102	Soil, Plant, Water, Nutrient Relationships	0%	0%	10%	
104	Protect Soil from Harmful Effects of Natural Elements	0%	0%	2%	
111	Conservation and Efficient Use of Water	0%	0%	2%	
112	Watershed Protection and Management	0%	0%	2%	
132	Weather and Climate	0%	0%	1%	
133	Pollution Prevention and Mitigation	0%	0%	1%	
201	Plant Genome, Genetics, and Genetic Mechanisms	0%	0%	13%	
202	Plant Genetic Resources	0%	0%	17%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	0%	0%	8%	
204	Plant Product Quality and Utility (Preharvest)	0%	0%	1%	
205	Plant Management Systems	50%	50%	12%	
211	Insects, Mites, and Other Arthropods Affecting Plants	5%	5%	5%	
212	Diseases and Nematodes Affecting Plants	5%	5%	10%	
213	Weeds Affecting Plants	0%	0%	5%	
402	Engineering Systems and Equipment	0%	0%	5%	
405	Drainage and Irrigation Systems and Facilities	0%	0%	1%	
511	New and Improved Non-Food Products and Processes	0%	0%	3%	
601	Economics of Agricultural Production and Farm Management	40%	40%	0%	
611	Foreign Policy and Programs	0%	0%	2%	
	Total	100%	100%	100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	4.0	1.0	46.0	0.0
Actual Paid	43.0	9.0	62.0	0.0
Actual Volunteer	12.0	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
856501	278787	1334384	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
3654958	374787	9255289	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
100000	0	1961320	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

The Extension portion of this report includes cotton, corn, soybeans, wheat, irrigation, entomology, plant pathology and row crops management and marketing issues. The increase in FTEs assigned to Agronomic Crop Systems reflects the previous Global Food Security planned program which has been fully incorporated into this Agronomic Crop Systems planned program.

Based on needs assessments conducted by Extension Specialists, the following practices were targeted: conservation-tillage; planting insect-tolerant crops; planting herbicide-tolerant crops; spaying crops with foliar fungicide to manage disease; using recommended varieties (based on UT field trial results). The Innovation-Decision Process (Rogers, 1995) provides a masterful way to organize the agronomic crop systems planned program.

Knowledge: Newspaper articles, radio programs, websites and newsletters were used to build awareness of UT Extension resources and practices for more profitable production. Mass media was used to highlight pests and pesticides in a timely manner.

Persuasion: Farm visits and group meetings were used to showcase practices.

Decision: Group meetings and classes were held in which Extension specialists will provided detailed instruction to producers.

Implementation: On-farm demonstrations were conducted, particularly in the 31 West Tennessee counties, to highlight research-based practices. To the extent possible, integrated research and Extension programs were conducted such as result demonstrations and test plots in all 31 West Tennessee counties.

Confirmation: Farm visits and telephone calls by Extension Agents assisted producers to continue

use of the practices, respond to environmental factors, and realize greater profits.

UT AgResearch helps agronomic producers in a variety of areas. Producers of corn, soybeans, wheat, and commercial vegetables are challenged each year with high costs of production, relatively low profit margins, and a host of other issues such as plant diseases, weather, and competition from other countries in world markets. Because farmers often operate with a relatively low profit margin, economic feasibility as well as efficacy of new genetics or technology for pest and disease control is of paramount importance. Farmers need to be aware of the comparative performance of new technologies in order to make appropriate decisions on pest and disease management. Little information exists about the economics of those technologies and systems under differing production conditions. In addition, the economics of systems vary as the combination of system and production environment change, and as relative prices and costs change.

2. Brief description of the target audience

The primary audience for this program was Tennessee row crop producers, and the secondary audience were the professionals, business owners/cooperatives, and government officials who serve row crop producers.

3. How was eXtension used?

This Agronomic Crop Systems Planned Program was enhanced through the service of three Tennessee Extension personnel and one stakeholder on the "Cotton" CoP and one extension professional and one stakeholder on the "Pesticide Environmental Stewardship" CoP. Tennessee Extension personnel shared implementation strategies, outcome measurement, and evaluation protocols with their CoP colleagues.

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	56204	13260414	1390	0

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

Patent Applications Submitted

Year: 2014
 Actual: 6

Patents listed

Computational discovery of soybean promoter cis-regulatory elements for the construction of soybean cyst nematode inducible synthetic promoters. Stewart, Jr., C. N., M. Mazarei, and W. Liu.

Glyphosate inducible plant promoter to confer glyphosate resistance and useful for sensing glyphosate. Stewart, Jr., C. N., Y.i Peng.

Methods of plant transformation using transformable cell suspension cultures and uses thereof. Willis, J., N. Stewart, J. Burris and M. Mazarei.

Resistance genes to soybean cyst nematode based on epigenetics. Hwezi, T., A. Rambani, C.N. Stewart, M. Mazarei and V. Pantalone.

Increasing soybean defense against pathogens. Stewart, Jr., C. N., J. Lin, M. Mazarei, and F. Chen.

Application of light-emitting diodes at specific angles and light quality for the growth and maintenance of turfgrass in low-light environments. Kopsell, D.A., J.C. Sorochan, and C.E. Sams.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	15	85	100

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of exhibits displayed to promote awareness and participation in this planned program.

Year	Actual
2014	31

Output #2

Output Measure

- Number of research-based publications distributed as part of this program.

Year	Actual
2014	38448

Output #3

Output Measure

- Research on new micro nutrient fertilizer products (Micro Essentials and Zn-core technology) may provide new methods to improve crop productivity and food mineral nutrition. (Yin)

Year	Actual
2014	2

Output #4

Output Measure

- UT researchers hope to reduce the incidence of soybean and snap bean seedling diseases and maximize grower farm receipts by increasing the calcium content of very young soybean and snap bean seedlings. (Canada)
- Not reporting on this Output for this Annual Report

Output #5

Output Measure

- Determined break-even irrigated corn field sizes (Larson)

Year	Actual
2014	0

Output #6

Output Measure

- Examined factors associated with African household participation in maize markets as a vendor or buyer, and the subsequent quantity of maize transacted (Lambert)

Year	Actual
2014	0

Output #7

Output Measure

- Found that cover crop mixtures were no more effective in supplying ground cover and did not enhance yields over single species cover (Tyler).

Year	Actual
2014	0

Output #8

Output Measure

- Developed cross-sterile corn lines to prevent cross pollination, increasing profitability and reducing risk to corn production (West).

Year	Actual
2014	0

Output #9

Output Measure

- Demonstrated the ability to successfully improve specialty crop nutritional values through simple changes in cultural management activities -- most notably narrow-band light from LED's (Kopsell).

Year	Actual
2014	0

Output #10

Output Measure

- Published horseweed genome paper, representing the first draft genome elucidated for an agronomic weed, which has important implications for identifying non-target resistance genes (Stewart).

Year	Actual
2014	0

Output #11

Output Measure

- Identified a number of natural product-producing genes with a function in plant defense. (Chen)

Year	Actual
2014	0

Output #12

Output Measure

- Characterized the mode of action of novel insecticidal proteins and compared them to currently available proteins produced by transgenic crops (Oppert).

Year	Actual
2014	0

Output #13

Output Measure

- Determined that differential susceptibility to Bt in rice is associated to differences in the concentration of binding sites for Bt toxins in different insects (Jurat-Fuentes).

Year	Actual
-------------	---------------

2014 0

Output #14

Output Measure

- Identified a herbicide program which adequately suppresses knotroot foxtail, resulting in clean hay (Rhodes).

Year	Actual
2014	0

Output #15

Output Measure

- Identified wheat varieties that are genetically susceptible to metribuzin (West).

Year	Actual
2014	0

Output #16

Output Measure

- Demonstrated a positive nutritional impact of bioactive compounds and common pesticides (herbicides, fungicides, and insecticides) currently labeled for use on specialty crops (Kopsell, Arnel).

Year	Actual
2014	0

Output #17

Output Measure

- Developed germplasm and conventional soybean lines optimized for yield and pathogen resistance (Pantalone).

Year	Actual
2014	0

Output #18

Output Measure

- Pipelining soybean lines targeted for high oleic acid, which would eliminate the need for the oil to be hydrogenated, and would provide exceptional oxidative stability in food and industrial applications (Pantalone).

Year	Actual
-------------	---------------

2014 0

Output #19

Output Measure

- Helped assemble a transcriptome for the tobacco budworm. This significant and much needed genomic resource opens new avenues of research using this insect as model (Jurat-Fuentes).

Year	Actual
2014	0

Output #20

Output Measure

- Developed soybean mosaic virus (SMV)/resistant soybean genotypes as a model system to understand how this virus overcomes resistance (Hajimorad).

Year	Actual
2014	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Row Crops Production: Number of participants who implemented one or more management practices based on data provided by UT (e.g., conservation tillage, plant population, growth retardants, IPM strategies, disease and weed control).
2	Row Crops Production: Number of producers, farm workers and other ag professionals who received pesticide certification, recertification and pesticide safety training.
3	Row Crops Production: Number of participants who improved their income by following the recommended best management practices for crop production, including plant pest management.
4	We hope continuous evaluation of transgenic soybean can lead to development of drought tolerant soybeans. (Cheng)
5	Economic Impact of Extension Row Crop Programs Estimated at \$141.3 million for 2014
6	Rollover Protection Systems (Ayers)
7	Genetically improve soybean yields (Pantalone)
8	Assays to diagnose soybean viruses (Hajimorad)

Outcome #1

1. Outcome Measures

Row Crops Production: Number of participants who implemented one or more management practices based on data provided by UT (e.g., conservation tillage, plant population, growth retardants, IPM strategies, disease and weed control).

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	2075

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems

Outcome #2

1. Outcome Measures

Row Crops Production: Number of producers, farm workers and other ag professionals who received pesticide certification, recertification and pesticide safety training.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	6473

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Commercial and private applicators, structural pest control operators, farmers, landscapers and others need training in pesticide safety to ensure Federal and state regulations are followed for public safety.

What has been done

Online materials were developed to provide individuals information concerning the Pesticide Safety Education Program as well as current pest related issues. Pesticide Safety and Education Training sessions were taught at 17 separate meetings.

Results

Well-educated pesticide applicators are better equipped to control pest problems safer and more effectively. Pesticide safety education helps reduce the incidence of pesticide misuse, spills and undesirable damage to non-target organisms.

*The Pesticide Safety Education Program had 1041 certifications and 5459 re-certifications.

*Research has estimated annual benefits of \$38 million for the Pesticide Safety Education Program.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants

Outcome #3

1. Outcome Measures

Row Crops Production: Number of participants who improved their income by following the recommended best management practices for crop production, including plant pest management.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	1061

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
211	Insects, Mites, and Other Arthropods Affecting Plants
601	Economics of Agricultural Production and Farm Management

Outcome #4

1. Outcome Measures

We hope continuous evaluation of transgenic soybean can lead to development of drought tolerant soybeans. (Cheng)

Not Reporting on this Outcome Measure

Outcome #5

1. Outcome Measures

Economic Impact of Extension Row Crop Programs Estimated at \$141.3 million for 2014

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Challenges facing the row crops industry include understanding and adopting changes in technology, integrated pest management, sustainable agronomic practices, and profitability. Row crop producers in Tennessee need unbiased information on which to base their management decisions including variety performance data, irrigation, forward pricing, and no-till production.

What has been done

Extension programs reached more than 57,000 contacts with row crops producers through group meetings, demonstrations, farm visits, and visits to the Extension Office. Replicated variety tests were conducted on corn, soybeans, wheat, and some specialty crops at seven of UT's Research & Education Centers located in the different regions of Tennessee. Furthermore, County Standardized Variety Trials were conducted on corn (71 hybrids), soybeans (79 varieties) and wheat (20 varieties) in large strip-trials on producer's farms in approximately 28 counties throughout the state as well as five Kentucky counties.

Results

The combined economic impact of Extension row crop programs were estimated at \$141.3 million in 2014:

*UT Extension crop variety testing data is used extensively by 80% of Tennessee farmers to select the seed that they use to plant their oilseed, grain and cotton crops. Results from the variety testing program have helped farmers increase yields by identifying the varieties that will perform best in their farming operations. In 2014, the higher yields resulted in approximately \$102.4 million in additional income to Tennessee farmers.

*Again this year, farmers increased the number of irrigated acres used for corn, cotton, and soybean production. Based on UT research, average yield increases from irrigation resulted in an

additional \$18.3 million in farm income.

*Based on an average cost of \$900 per acre, Tennessee row crop producers invested more than \$59 million in their local economy by purchasing center pivot irrigation equipment.

*Row crop producers increased returns by \$2.6 million on 94,100 acres by using forward pricing market opportunities as compared to selling at harvest.

*By using no-till production as a best management practice, it is estimated that production costs were reduced by more than \$18 million.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
213	Weeds Affecting Plants
601	Economics of Agricultural Production and Farm Management

Outcome #6

1. Outcome Measures

Rollover Protection Systems (Ayers)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The RollOver Protective Structure (ROPS) design standard includes modeling for compliance without actual field testing, however mower deck influence is ignored.

What has been done

A new computer-based ROPS Design program was developed and verified to assist in the ROPS design process.

Results

Rollover Protection Systems (ROPS) software passed test and was distributed to manufacturers.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
402	Engineering Systems and Equipment
511	New and Improved Non-Food Products and Processes
601	Economics of Agricultural Production and Farm Management

Outcome #7

1. Outcome Measures

Genetically improve soybean yields (Pantalone)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

More than half of all gains in USA agricultural production have been through genetic improvement. Genetic improvement of soybeans is vital to sustaining the economic livelihood of farmers in Tennessee and the Mid-South region.

What has been done

Developed and released the new conventional soybean variety Ellis.

Results

Ellis performed exceptionally: It was the top yielding entry in many trials including: the 2014 Arkansas State Variety Test, the 2014 UniSouth Genetics Test, the 2013 Tennessee Elite Yield Test, and previous years Tennessee State Variety Test, and USDA Southern Uniform Test.

4. Associated Knowledge Areas

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

Outcome #8

1. Outcome Measures

Assays to diagnose soybean viruses (Hajimorad)

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

These materials are essential for studies of these viruses and are currently being shared by other soybean virologists nationally.

What has been done

Developed assays for diagnosis of viruses of soybean including antibody-based assays for rapid and reliable detection of alfalfa mosaic virus and soybean vein necrosis-associated virus.

Results

Our developed antibody against SVNaV represents the only immunological tool for the detection of this virus worldwide.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
212	Diseases and Nematodes Affecting Plants

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Competing Programmatic Challenges

Brief Explanation

Corn was harvested on more than 840,000 acres in Tennessee in 2014. The 2014 growing season was optimal in both temperature and rainfall for high corn yields and many growers reported some of the best yields ever in non-irrigated fields. The final state average yield was a record 168 bushels/acre (Jan 2015 USDA crops report). Corn prices were lower than in recent years due to the large U.S. crop with producers receiving less than \$4.00 per bushel for their crop on average. Soybeans were harvested on more than 1.5 million acres in Tennessee in 2014. Moderate temperatures and above normal rainfall created good to excellent yields in most counties across the state and there was a final state average yield of 46 bushels/acre (Jan 2015 USDA crops report). Soybean prices were lower than previous years and most producers received less than \$11.00 per bushel for their crop.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

The combined economic impact of Extension row crop programs were estimated at \$141.3 million in 2014:

*UT Extension crop variety testing data is used extensively by 80% of Tennessee farmers to select the seed that they use to plant their oilseed, grain and cotton crops. Results from the variety testing program have helped farmers increase yields by identifying the varieties that will perform best in their farming operations. In 2014, the higher yields resulted in approximately \$102.4 million in additional income to Tennessee farmers.

*Again this year, farmers increased the number of irrigated acres used for corn, cotton, and soybean production. Based on UT research, average yield increases from irrigation resulted in an additional \$18.3 million in farm income.

*Based on an average cost of \$900 per acre, Tennessee row crop producers invested more than \$59 million in their local economy by purchasing center pivot irrigation equipment.

*Row crop producers increased returns by \$2.6 million on 94,100 acres by using forward pricing market opportunities as compared to selling at harvest.

*By using no-till production as a best management practice, it is estimated that production costs were reduced by more than \$18 million.

Key Items of Evaluation

The combined economic impact of Extension row crop programs were estimated at \$141.3 million in 2014:

*UT Extension crop variety testing data is used extensively by 80% of Tennessee farmers to select the seed that they use to plant their oilseed, grain and cotton crops. Results from the variety testing program have helped farmers increase yields by identifying the varieties that will perform best in their farming operations. In 2014, the higher yields resulted in

approximately \$102.4 million in additional income to Tennessee farmers.

*Again this year, farmers increased the number of irrigated acres used for corn, cotton, and soybean production. Based on UT research, average yield increases from irrigation resulted in an additional \$18.3 million in farm income.

*Based on an average cost of \$900 per acre, Tennessee row crop producers invested more than \$59 million in their local economy by purchasing center pivot irrigation equipment.

*Row crop producers increased returns by \$2.6 million on 94,100 acres by using forward pricing market opportunities as compared to selling at harvest.

*By using no-till production as a best management practice, it is estimated that production costs were reduced by more than \$18 million.