V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

Plant Biological Technologies

☑ 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
123	Management and Sustainability of Forest Resources	0%		5%	
132	Weather and Climate	0%		5%	
201	Plant Genome, Genetics, and Genetic Mechanisms	0%		25%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	0%		13%	
206	Basic Plant Biology	0%		14%	
211	Insects, Mites, and Other Arthropods Affecting Plants	0%		5%	
212	Pathogens and Nematodes Affecting Plants	0%		33%	
	Total	0%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	12.0	0.0
Actual Paid Professional	0.0	0.0	11.5	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**
0	0	511390	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	511390	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	2908953	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

•Design and conduct research, including the development of methods and procedures •Write and submit grant proposals to private, state and federal agencies •Generate scientific publications - communicating scientific results to a wide range of scientists •Training of professional scientists - graduate and undergraduate students, technicians and post docs in the scientific discipline •File patents

2. Brief description of the target audience

Scientists and scientific societies
Governmental science organizations
Educational institutions
Applied researchers and extension specialists
Students
Private, federal, state, and industrial funding agencies
Other stakeholders (producers, consumers, educators, public)

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

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

Patent Applications Submitted

Year: 2013

Actual: 4

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2013	Extension	Research	Total
Actual	0	36	36

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Grant proposals written and submitted

Year	Actual
2013	37

Output #2

Output Measure

- Peer-reviewed publications including journal articles

Year	Actual
2013	36

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Graduate students graduated
2	Improving biomass yield and stress tolerance of bioenergy crops
3	Identifying molecular markers to predict heat stress in crops

Outcome #1

1. Outcome Measures

Graduate students graduated

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	4

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
206	Basic Plant Biology
212	Pathogens and Nematodes Affecting Plants

Outcome #2

1. Outcome Measures

Improving biomass yield and stress tolerance of bioenergy crops

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Improving biomass yield and abiotic stress tolerance of the bioenergy crop species are the major target traits for sustainable biofuel production. However little progress has been made to date, because relevant genes/factors that control these traits are unknown. MicroRNAs, a class of small non coding RNAs, are well known for their gene regulatory roles by destroying or repressing translation of the mRNA targets.

What has been done
Research was conducted to identify critical miRNAs that might be important for adaptation to abiotic stresses such as drought and heat.

Results
We have identified 32 conserved and 67 novel miRNA families from the small RNA libraries generated from switchgrass leaves exposed to abiotic (drought and heat) stress. Interestingly 11 conserved and 25 novel families were up-regulated in response to both stresses. Similarly 4 conserved and 4 novel miRNA families also down-regulated in response to both stresses.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
206	Basic Plant Biology

<u>Outcome #3</u>

1. Outcome Measures

Identifying molecular markers to predict heat stress in crops

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Increase in global temperature, air pollutants such as ozone and the erratic rainfall regimes leading to extended drought pose significant threats to agricultural production not only in Oklahoma, but the entire world. The decrease in arable land compounded by the climate change issues has led to significant reductions in crop yields that will ultimately impact the cost of food, fuels and fodder. Understanding the molecular processes in plants that leads to this decrease in production will provide us with tools for tweaking those pathways and ensure sustainable production in the wake of climate change.

What has been done
We have identified a suite of 16 genes that are induced in response to heat stress. These genes are upregulated in all the cereals analyzed (wheat, maize, rice) and also in the bioenergy crop, switchgrass. These genes can serve as molecular markers to predict heat stress in crops and can help in estimating yield losses when high temperatures are in the forecast during a cropping season.

Results
Our group has identified several regulatory and signaling genes that are important for high tiller number in switchgrass using gene expression profiling in inbred lines with contrasting tiller number trait. Increasing tiller number provides an avenue for increasing the switchgrass biomass yield, that inturn can translate into increasing profits to farmers and help reduce the dependence on foreign oil.

Plants are exposed to multiple stresses simultaneously in nature. Yet, most studies of plant stress responses are conducted using a single stressor at a time. A combination of drought and ozone stress simultaneously in Medicago truncatula evoked unique sets of genes that were not identified when the stressors were applied singly. This indicates plants perceive combined stress as a new stress state and not just an additive effect of the single stresses. These results indicate that studies on stress tolerance should consider co-occuring stresses that are likely to occur in field conditions.

4. Associated Knowledge Areas

KA Code	Knowledge Area

201	Plant Genome, Genetics, and Genetic Mechanisms
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
206	Basic Plant Biology

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

Research in plant biotechnology and crop improvement has been negatively impacted by the very limited federal funding for agricultural research in general. Further, irrational levels of government regulation, mostly at the international level, regarding transgenic plants has a serious chilling effect on research progress in this area

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Member of the iCrest team that was awarded the President Cup for meritorious interdisciplinary research at OSU.

Key Items of Evaluation

Member of the iCrest team that was awarded the President Cup for meritorious interdisciplinary research at OSU.