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: 2012	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	7.0	0.0
Actual Paid Professional	0.0	0.0	12.0	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	543018	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	543018	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	3003720	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

2012	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:	2012
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2012	Extension	Research	Total
Actual	0	37	37

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Grant proposals written and submitted

Year	Actual
2012	29

Output #2

Output Measure

- Peer-reviewed publications including journal articles

Year	Actual
2012	37

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Graduate students graduated
2	Microorganisms and agricultural crops
3	Plant pathogen identification
4	Plant genes involved with stress signaling
5	Emergence of viral diseases
6	Aphid resistance

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
2012	6

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Advanced degreed students are required to continue development of society and a major objective of research universities is to train students to use their creativity through the scientific methods to conduct research.

What has been done
M.S. and Ph.D. degree programs are conducted and students mentored in research methods by scientists.

Results
Students matriculate with advanced degrees and move on to careers in science, technology and engineering.

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

Microorganisms and agricultural crops

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)
Plant productivity is critical for putting food on the table and for providing for the economic and social well-being of society. The bottom line is that the food supply must double by 2050 to meet the needs of a burgeoning world population. To do this, new technologies and understandings focused on improving plant productivity needs development. The vast majority of research on plant productivity is associated with the above ground plant parts. Much less is understood concerning the below ground portion of the plant. Manipulation of root characteristics and soil microbial communities are an obvious area where progress can be made in enhancing wheat productivity. Microorganisms are essential for the productive development of agricultural crops. The complexity of the system has stymied researchers on tying specific microorganisms to crop productivity.

What has been done
We recently developed and published an approach to identify specific microorganisms that are directly associated with wheat productivity, including those that promote or reduce productivity.

Results
We identified 42 positive and 39 negative productivity associated organisms as well as which taxonomic groups are more likely to contain positive or negative productivity associated organisms. Furthermore, overall analysis revealed that plant productivity is intimately associated with the plant microbial community.

4. Associated Knowledge Areas

KA Code	Knowledge Area
206	Basic Plant Biology

Outcome #3

1. Outcome Measures

Plant pathogen identification

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 military and defense communities seek robust capability to identify pathogens (of humans, animals or plants) in a field setting with high reliability and sensitivity, but with technology that is portable and electricity-free.

What has been done
NIMFFAB worked with government support to adapt and validate real-time PCR protocols for plant pathogens to a small, field-deployable thermocycler in which reagents are provided in lyophilized pouches.

Results
The technology and specific protocols allow operators having minimal training to perform reliable assays in remote and possibly dangerous settings.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
212	Pathogens and Nematodes Affecting Plants

Outcome #4

1. Outcome Measures

Plant genes involved with stress signaling

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)
Understanding the function of key plant genes involved in stress signaling will provide novel biotechnological solutions for crop improvement. Plants face the threat of multiple stresses simultaneously under field conditions. However, most studies on stress are done using single stressor at a time. Drought and ozone are two common stresses that can co-occur during summer times. In the wake of the current drought conditions prevalent in the state and the increasing levels of tropospheric ozone, an understanding of the combined occurrence of these two stressors is relevant especially for crops like soybeans.

What has been done
We have analyzed the biochemical, physiological and molecular responses to combined ozone and drought in Medicago truncatula. We demonstrate that there are novel coping mechanisms in extant germplasm that can help plants overcome the combined stresses effectively. We are pursuing a similar study in soybeans using two cultivars that show contrasting phenotypic responses to combined ozone, drought and heat. A proposal to the AFRI foundational program is currently under review.

Results
An Arabidopsis RNA binding protein was shown to be important during ozone-induced oxidative stress, heat stress and also drought. We are in the process of identifying the RNA targets of this protein. We also are analyzing the interactions of this protein with other plant proteins. Identifying key regulatory factors during combined stresses will provide rational targets for engineering resistance to multiple stresses that operate under 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

Outcome #5

1. Outcome Measures

Emergence of viral diseases

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 demands of society and the prospect of global climate change are leading to the planting of novel crops in new areas, setting the new ventures up for outbreaks of previously unrecognized diseases caused by viruses and other plant pathogens. Understanding of emergence of new viral diseases can blunt the effects of such outbreaks. Those responsible for plant biosecurity in various countries and jurisdictions now consider the implications of the virus diversity project findings of the existence of many more viruses than are currently recognized.

What has been done
The universal plant virus microarray probes have been used as e-probes of metagenomic databases from plants carrying a disease of unknown etiology.

Results
Universal plant virus microarray assay of plant extracts correctly identified whether extracts had viruses detectable by dot immunoassay, and many cases supported the serological identification suggesting that it may be used in screening plant material for virus infection.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
206	Basic Plant Biology

212 Pathogens and Nematodes Affecting Plants

Outcome #6

1. Outcome Measures

Aphid 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)
Over 250 species of aphids (Hemiptera: Aphididae) are known to feed on crop plants world-wide and thus, they are one of the most important families of agricultural pests. Aphids damage crops by not only depleting photoassimilates but also by transmitting pathogenic viruses. Aphis gossypii is an economically import pest on a wide range of crops, greenhouse vegetables, and ornamentals, placing it among the most destructive insects to agriculture.

What has been done
Differential gene expression studies detailing the transcriptional responses to aphid infestation in resistant melon plants have shown that aphid herbivory activates several defense pathways. Emerging data indicates that small RNAs, especially microRNAs, have diverse and important roles in regulating gene expression by translational repression in both plants and animals, including responses to insect herbivory. This project is designed to test the hypothesis that specific small RNAs regulate gene expression under the biotic stress caused by aphid feeding and are components of the resistance mechanism both as gene expression regulators and as plant defense molecules. Five small RNA libraries (3 plant & 2 aphid) have been constructed and sequenced using GAII Illumina Analyzer. Bioinformatic analyses have been conducted to identify microRNAs that are differentially responding to aphid feeding.

Results
The comparative analyses between aphid resistant and susceptible melon lines revealed that most of the conserved miRNA families were differentially regulated during the early stages of aphid infestation in the resistant and susceptible interactions. Along with the conserved miRNA families, 18 cucurbit-specific miRNAs were expressed during the different stages of aphid herbivory. The comparison of the miRNA profiles in the resistant and susceptible interactions provides insight into the miRNA-dependent post-transcriptional gene regulation in aphid

resistance. These results from miRNA analysis would assist breeding programs by serving these altered miRNAs as markers.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
206	Basic Plant Biology
211	Insects, Mites, and Other Arthropods Affecting Plants

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

- The area of plant microbe interactions is a complex interdisciplinary endeavor. Despite recent programs and the areas relative importance there are still too few programs that target the plant-microbe interface.
- Tranformative advances such as those initiated by the PIs often take time to be understood and evaluated by the mostly conservative government grant panels in order to fund further progress.
- Limited and decreased funding for basic research.
- Added administrative burdens.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

- NIMFFAB faculty were awarded **3rd place** in the OSU Provost's **2012 Creativity in Research Award Competition**.
- Mali Mahalingam was awarded the 2012 Phoenix award for Outstanding Graduate Faculty awarded by the OSU Graduate College and GPSGA.
- Ramanjulu Sunkar was invited to become Review Editor for the Journal Frontiers in Plant Genetics and Genomics.
- Published articles in high impact journals: PloS ONE and Molecular Plant Microbe Interactions.

Key Items of Evaluation