V(A). Planned Program (Summary)

Program # 8

1. Name of the Planned Program

Plants Systems (OARDC Led)

☑ 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	0%		10%	
202	Plant Genetic Resources	0%		15%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	0%		5%	
204	Plant Product Quality and Utility (Preharvest)	0%		20%	
205	Plant Management Systems	0%		10%	
206	Basic Plant Biology	0%		5%	
211	Insects, Mites, and Other Arthropods Affecting Plants	0%		5%	
212	Diseases and Nematodes Affecting Plants	0%		5%	
213	Weeds Affecting Plants	0%		5%	
214	Vertebrates, Mollusks, and Other Pests Affecting Plants	0%		5%	
216	Integrated Pest Management Systems	0%		15%	
	Total	0%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2014	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	18.9	0.0
Actual Paid	0.0	0.0	22.8	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	2873066	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
0	0	3505360	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

OARDC's on-going research activities to advance plant systems goals include both basic and applied research. Both laboratory and multiple field sites/research stations are available throughout state to permit data gathering and to continue long-term experiments, such as commodity yields. On-farm research takes place, as do national and international studies. All functional laboratories and sites are improved over time as program need and resources available warrant. OARDC faculty and staff engage in appropriate levels of outreach, engagement, and consultation, with both internal stakeholders, such as fellow Extension personnel, and with external stakeholders.

2. Brief description of the target audience

Audiences targeted by OARDC include, but are not limited to:

- Specific individuals or groups who have expressed a need for plant systems information that is to be derived through new research, extracted from on-going research, or is derived from scientific literature. Often those requests are communicated to OARDC by an intermediary such as a staffer at a USDA office, NRCS, or a county Extension agent;
- Fellow agencies or support organizations who will not only use the information but will also be brokers of that information, including embedding it into groups to encourage change;
- Populations who have not requested the information but will likely benefit from that information, e.g. home gardeners;
- Other scientists and scientific groups;
- Political entities;
- Extension personnel;
- Students from pre-school to post doctorate studies;
- News organizations.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2014	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: 2014

Actual: 3

Patents listed

1. Agrobacterium Strains for Plant Transformation and Related Materials and Methods
2. A Convenient and Effective Device for Efficient Delivery of Agriculturally-Relevant Microbial Inoculants
3. System for Delivery of Microbial Inoculants and Related Materials and Methods

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	0	86	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of graduate students completed
  Not reporting on this Output for this Annual Report

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Meet or exceed the demand of fellow scientists and stakeholders within the next ten years for materials relating to plant genetics and plant breeding technologies, including identification of molecular markers for elite germplasms.
2	Advance germplasm science over the next ten years to the extent that the genetic resources targeted for acquisition are preserved and can be considered secure in terms of systems preservation, e.g. short season crops or for studying rice pathogens.
3	Enrich the gene pool, and knowledge thereof, to meet identified stakeholder needs.
4	Annually provide adequate preharvest research findings, including field trial data, to support Ohio's status as a top soybean and corn producer
5	Release or support release by others of special cultivars to enhance Ohio agriculture, e.g. grapes to replace tobacco in southeastern Ohio, low maintenance turf grass, nitrogen uptake efficient crops including foliar based fertilization, field crop cultivars.
6	Annually contribute to and report a basic or applied understanding of IPM, including all physical, biological, and chemical components of the plant system, to reduce environmental stresses, improve production, and lower costs when employed.
7	Enrich the gene pool and knowledge thereof in disease/pest resistance, and gene recombination and interaction studies
8	Enrich the gene pool and knowledge thereof in the areas of molecular studies to better understand how immune systems in plants inhibit diseases and how bacteria perturb the immune system.

Outcome #1

1. **Outcome Measures**

   Meet or exceed the demand of fellow scientists and stakeholders within the next ten years for materials relating to plant genetics and plant breeding technologies, including identification of molecular markers for elite germplasms.

   Not Reporting on this Outcome Measure

Outcome #2

1. **Outcome Measures**

   Advance germplasm science over the next ten years to the extent that the genetic resources targeted for acquisition are preserved and can be considered secure in terms of systems preservation, e.g. short season crops or for studying rice pathogens.

   Not Reporting on this Outcome Measure

Outcome #3

1. **Outcome Measures**

   Enrich the gene pool, and knowledge thereof, to meet identified stakeholder needs.

   Not Reporting on this Outcome Measure

Outcome #4

1. **Outcome Measures**

   Annually provide adequate preharvest research findings, including field trial data, to support Ohio's status as a top soybean and corn producer

   Not Reporting on this Outcome Measure

Outcome #5

1. **Outcome Measures**

   Release or support release by others of special cultivars to enhance Ohio agriculture, e.g. grapes to replace tobacco in southeastern Ohio, low maintenance turf grass, nitrogen uptake efficient crops including foliar based fertilization, field crop cultivars.

   Not Reporting on this Outcome Measure

Outcome #6

1. Outcome Measures

Annually contribute to and report a basic or applied understanding of IPM, including all physical, biological, and chemical components of the plant system, to reduce environmental stresses, improve production, and lower costs when employed.

Not Reporting on this Outcome Measure

Outcome #7

1. Outcome Measures

Enrich the gene pool and knowledge thereof in disease/pest resistance, and gene recombination and interaction studies

2. Associated Institution Types

- 1862 Research

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)

Introduced species cause major environmental changes and dramatically reshape forest ecosystems in ways we are only beginning to understand. The hemlock woolly adelgid (HWA) arrived in southeastern Ohio in 2011 and is currently causing near complete mortality of eastern hemlock across the eastern United States. This is a significant environmental concern for Ohio as hemlock dominates many of the important natural and recreational areas including the Cuyahoga Valley National Park, Mohican State Forest, and the Hocking Hills region. Hemlock forests support a unique microclimate and suite of species, and significantly contribute to landscape diversity, particularly in Ohio where hemlock ravines add diversity and scenic value to many state public lands.

Unfortunately, there is no known treatment to control HWA, and this impending threat to Ohio's forests will be extensive as it is estimated that visitors to Ohio's state parks contribute over $1 billion to the state and local economies. Consequently, it is important to understand the effects of hemlock decline on Ohio's forests so resource managers and scientists can develop techniques

and strategies to help moderate the effects of HWA on hemlock-dominated forests.

What has been done
A comparison of infected hemlock stands in Virginia and West Virginia with un-invaded forests in Ohio show that hemlock is in severe decline in areas where HWA is present. However, hemlock continues to dominate both the overstory and sapling layers of these forests. Results also suggest that the future forest depends on the current mix of species associated with hemlock. The loss of hemlock trees and thus their associated canopy results in greater solar exposure of the forest floor with a rise in soil temperature and increased nutrient cycling. These changes result in a different ecosystem than previously existed resulting in the loss of the forest canopy.

Results
With the assistance of OSU Extension, these findings are being shared with forest managers and other stakeholders in southeastern Ohio. Efforts are ongoing and include training opportunities focusing on hemlock ecosystems, hemlock inventory, HWA survey methods, and HWA management strategies. These efforts have reached approximately 800 individuals at more than 20 events. Monitoring will continue in order to refine predictions about forest development and extend efforts to focus on how HWA influences downed wood located both in and along streams. We also intend to continue our outreach to public resource managers and private landowners to educate them on the potential impacts of HWA on Ohio's forests and develop strategies to help mitigate the impending loss of this important forest tree species.

4. Associated Knowledge Areas

KA Code	Knowledge Area
211	Insects, Mites, and Other Arthropods Affecting Plants

Outcome #8

1. Outcome Measures

Enrich the gene pool and knowledge thereof in the areas of molecular studies to better understand how immune systems in plants inhibit diseases and how bacteria perturb the immune system.

2. Associated Institution Types

- 1862 Research

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)

Plant diseases are one of the main limiting factors in crop production worldwide, causing billions of dollars in yield loss and tremendous historical human suffering. The two most important agricultural crops in the world are wheat and rice. Availability of these two grains historically has more impact on human health, regional economic stability, and social unrest than any other crop. One of the most important diseases of rice is rice blast, caused by the fungal pathogen Magnaporthe oryzae. Significantly, Magnaporthe has recently jumped to become a pathogen of wheat in South America causing wheat blast disease. Currently, wheat blast is present in all wheat-growing regions of Brazil and surrounding countries. A major outbreak in 2009 pushed losses over 40% in many parts of the region. The impact of this disease in South America is acute, and there is every expectation that it will continue to move north and dramatically affect U.S. wheat fields.

What has been done

The goal of this project was to elucidate how this pathogen gains entry into its host and the basic etiology of infection, to screen Ohio wheat germplasm for susceptibility to the pathogen, and to use genomics to begin to understand the origin of the pathogen in Brazil and how to detect it.

The genomes of two isolates of the wheat blast pathogen from Brazil were sequenced and analyzed. The analysis revealed that the pathogen most likely did not originate from rice infecting versions of the fungus, but rather a ryegrass infecting version. This result was revealed after collaboration with investigators at the University of Kentucky and Kansas State University. These genome data were the first sequences available for this pathogen and have now been combined with a new, larger national effort to understand its origin and develop detection methods.

A pilot study screened 86 cultivars of soft red winter wheat for susceptibility. The goal of this study was threefold: to identify highly resistant and susceptible varieties of wheat for use as future reference groups; refine inoculation techniques; and re-isolate M. oryzae from infected plants.

Results

All three goals were achieved. These and other isolates will be used for labeling the pathogen with a florescent protein for tracking in the plant during all phases of growth, penetration, and infection. The results of the studies performed as part of this project were a major factor in the ability of the investigators to be invited to participate in a million dollar USDA NIFA grant studying this pathogen.

4. Associated Knowledge Areas

KA Code	Knowledge Area
212	Diseases and Nematodes 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
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

Pests, pathogens, diseases, weeds, and climate change, among other factors can impact outcomes within plant systems. As the food, fiber, and environmental economy adjust to the global marketplace, in conjunction with public policy shifts, regulations, and shifts in demand, outcomes will be impacted. Production agriculture is most sensitive to these shifts. Research that is conducted well before its outcomes are needed and formative evaluation to identify opportunities and problems can have returns throughout the life of the program. Factors such as the availability of base funding to ensure a core faculty and staff, availability of extramural funds, and programmatic demands exceed resources are affecting outcomes.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

For 2014, CFAES-OARDC has conducted no formal studies regarding evaluation of our research program. Surrogate evaluation metrics--inclusive but not limited to--that are considered indicators of research success are:

- Research contracts and awards received/ongoing/completed ($166 million plus in active projects during 2014);
- Number of referred publications reported elsewhere in this report;
- Number of business, industries an groups engaged in CFAES's research programs;
- Number of patents received;
- Economic impact of this college's research program as reported elsewhere in this report;
- The level of base funding from USDA-NIFA and the State of Ohio in 2014;
- Impacts submitted in this report, and the continued robustness of CFAES' research program throughout 2014, both in terms of breadth of programs and depth of new knowledge generated and applied.

The research reported herein is also supported by an informal yet effective formative evaluation. Very little research is conducted at OARDC without early engagement of business, industry, commodity groups, special interest or community groups, or other

interested parties given these are the individuals who have the need for and will be the adopters of our research output/impacts. Even in the case of very theoretical research, fellow researchers in industry, government, and academic institutions are consulted (formative evaluation/needs assessment) in the formulation of studies.

Key Items of Evaluation

Meeting the needs of growers and stakeholders in terms of both research and Extension is a long-established program. In managing the infestation of the hemlock woolly adelgid, one of our Extension specialists has praised CFAES' response:

"OSU Extension, OARDC and CFAES bring a broad range of expertise on forest ecosystems and invasive pests to the table. We've been able to use this expertise to help our partners to evaluate the management practices that have been developed and utilized in other states to formulate strategies for managing HWA in Ohio."

--Dave Apsley, natural resources specialist, Jackson County Extension