V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Climate Change

☑ 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	10%		10%	
112	Watershed Protection and Management	5%		5%	
123	Management and Sustainability of Forest Resources	10%		10%	
132	Weather and Climate	10%		10%	
135	Aquatic and Terrestrial Wildlife	10%		10%	
201	Plant Genome, Genetics, and Genetic Mechanisms	10%		10%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	10%		10%	
212	Diseases and Nematodes Affecting Plants	5%		5%	
213	Weeds Affecting Plants	5%		5%	
306	Environmental Stress in Animals	5%		5%	
605	Natural Resource and Environmental Economics	15%		15%	
610	Domestic Policy Analysis	5%		5%	
	Total	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	5.9	0.0	12.3	0.0
Actual Paid	2.1	0.0	7.7	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**
815874	0	335319	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
2437688	0	1592791	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
242586	0	1284257	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

- Conduct meetings, conferences, workshops
- Publish research and extension publications
- Establish web sites
- Organize field days
- Consultations
- Work with mass media

2. Brief description of the target audience

- Producers
- Consumers
- Youth
- Elected officials and policy makers
- Professionals involved in weather and climate

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	630	332	18	0

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

Patent Applications Submitted

Year:	2014
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	6	24	30

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of Extension publications, written, new or revised

Year	Actual
2014	2

Output #2

Output Measure

- Number of research publications

Year	Actual
2014	24

Output #3

Output Measure

- Number of research projects

Year	Actual
2014	9

Output #4

Output Measure

- Number of consultations

Year	Actual
2014	24

Output #5

Output Measure

- Number of educational workshops or seminars conducted

Year	Actual
2014	36

Output #6

Output Measure

- Number of volunteers

Year	Actual
2014	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of observers monitoring weather and climate
2	Number of research-based studies, publications, and reports for policy organization members and legislators on climate change
3	Number of participants who increase their knowledge about climate change
4	Number of participants who reduce pesticide, nutrient and water inputs while maintaining high quality turf
5	Number of participants who increase knowledge of pesticides, nutrients and water inputs for maintaining high quality turf
6	Number of participants who increase knowledge of management practices that maximize environmental stewardship
7	Number of participants who adopt management practices that maximize environmental stewardship
8	Number of participants who increase their knowledge of opportunities and challenges for agriculture under carbon dioxide emissions policies to address climate change
9	An impact of new knowledge about crop management related to climate change and decision making.
10	An impact of new knowledge of plant molecular and physiological functions relating to climate change.
11	An impact of plant genetic and/or epigenetic functions relating to climate change.

Outcome #1

1. Outcome Measures

Number of observers monitoring weather and climate

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	1000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
132	Weather and Climate

Outcome #2

1. Outcome Measures

Number of research-based studies, publications, and reports for policy organization members and legislators on climate change

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Number of participants who increase their knowledge about climate change

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	654

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Purdue Extension Educators are uncertain as to their role in communicating climate science, as evidenced by multiple recent surveys of educators in other states. In many cases, uncertainty stems from a lack of knowledge of climate and the tools available for use with their clientele.

What has been done
A team of Purdue Extension educators, researchers and specialists organized workshops across Indiana on communicating climate science, including content information and learning activities, discussion of web-based tools (including Purdue's Useful 2 Usable decision support tools) and new 4-H curricula. The workshops were designed to increase confidence of Extension educators in discussing climate with clients, increase knowledge of resources and where to refer clients, and enhance their ability to teach climate subject matter. Team members and climate professionals from U2U and the Midwest Regional Climate Center in Illinois provided climate content, resources and information.

Results
Educators completed an evaluation at the end of the workshop. They found the climate data presentation to be the most effective, and felt the activities helped them better understand changes in the climate system. Most would participate in an advanced workshop on climate and climate change. Educators in the workshop will use what they learned in discussions or consultations with clients, for referrals to key resources and information, and in implementing workshops to teach climate to youth and adults in their communities.

4. Associated Knowledge Areas

KA Code	Knowledge Area

132	Weather and Climate
610	Domestic Policy Analysis

Outcome #4

1. **Outcome Measures**

Number of participants who reduce pesticide, nutrient and water inputs while maintaining high quality turf

Not Reporting on this Outcome Measure

Outcome #5

1. **Outcome Measures**

Number of participants who increase knowledge of pesticides, nutrients and water inputs for maintaining high quality turf

Not Reporting on this Outcome Measure

Outcome #6

1. **Outcome Measures**

Number of participants who increase knowledge of management practices that maximize environmental stewardship

Not Reporting on this Outcome Measure

Outcome #7

1. **Outcome Measures**

Number of participants who adopt management practices that maximize environmental stewardship

Not Reporting on this Outcome Measure

Outcome #8

1. **Outcome Measures**

Number of participants who increase their knowledge of opportunities and challenges for agriculture under carbon dioxide emissions policies to address climate change

Not Reporting on this Outcome Measure

Outcome #9

1. Outcome Measures

An impact of new knowledge about crop management related to climate change and decision making.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Weather and climate patterns are a driving force behind the success or failure of cropping systems. With U.S. corn and soybean production accounting for nearly one-third of global supplies and contributing over $50 billion annually to the national economy, the ability to successfully produce crops under more variable climate conditions is critical for food security and rural livelihoods. There have been resources available on historic and future climate, but these are underutilized. Current efforts of the Useful 2 Usable (U2U) project are to determine how to increase use of climate resources for crop decision-making.

What has been done
Since reporting last year, the Useful 2 Usable (U2U) project has made significant progress on modeling production, environmental and financial outcomes of various climate scenarios and farm management strategies on Midwestern corn production systems. An economic modeling framework was developed to demonstrate how climate and crop simulations will be integrated with farm-level economics to evaluate adaptation strategies under future climate scenarios.

The U2U Social Science Working Group completed three climate needs assessment surveys: 1) Producers (4,778 corn farmers in 11 Corn Belt states) to understand concerns about climate impacts, climate information needs, climate change beliefs and adaptation attitudes, and trust in various information sources; 2) Advisors (2,100 public and private farm advisors in four Corn Belt states) to understand concerns about climate impacts, climate information needs, climate change beliefs and adaptation attitudes, and trust in various information sources; and 3) Advisors follow up (860 advisors completed both surveys) to see if/how advisors concerns, beliefs, and attitudes were affected by the severe 2012 Midwestern drought. In addition, focus groups and interviews

were conducted with: 1) farmers, public advisors, and private advisors in Nebraska and Indiana where they provided feedback about current and future U2U decision support tools; 2) corn farmers and advisors were in the Maple River watershed in Michigan to help understand climate information diffusion within the agricultural community; and 3) selected advisors from that group in Michigan to understand how they adjust delivery of climate information to clients with differing levels of concerns about climate change.

Results
As a result of modeling development and in conjunction with feedback from survey participants, there are now four decision support tools available online. One tool, the U2U Corn Split N tool has been approved as a training resource for the Indiana Pesticide Application Recertification Program (PARP) and can be used to fulfill the educational requirements. The unprecedented surveys and interviews of Corn Belt farmers and agricultural advisor groups have improved scientific understanding about climate information needs, climate change beliefs, trusted information sources, and risk management strategies of the agricultural community. Clearly documented in these results is the role of agricultural advisors in guiding on-farm management decisions and as climate information brokers. Based on survey results about effective ways to reach key stakeholders, the approach to sharing information will not be regional expansion workshops as initially planned. Instead, emphasizing the role of the local agriculture advisor, U2U team members and Extension partners throughout the region have been recruited to conduct decision support tool trainings onsite at popular, existing farmer and advisor events, where the role of the local agriculture advisor is central to the event.

4. Associated Knowledge Areas

KA Code	Knowledge Area
132	Weather and Climate

Outcome #10

1. Outcome Measures

An impact of new knowledge of plant molecular and physiological functions relating to climate change.

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)
Perennial ryegrass is an important cool-season grass widely used for pasture and turf in cool climate regions. Perennial ryegrass is highly digestible for all classes of ruminant animals and has high feeding quality for forage. For turf, it is mainly used in sod production, golf courses, athletic fields, parks and lawns. Environmental factors such as drought, salinity and flooding negatively affect growth and persistence of turf grass. The frequency and intensity of these stresses are expected to increase due to climate change, which can be more detrimental to grasses. A better understanding of physiological, genetic and molecular mechanisms of stress tolerance is beneficial to grass improvement and efficient management programs for enhancing stress tolerance.

What has been done
A global collection of 500 diverse perennial ryegrass accessions were planted for investigation of growth responses to variable environments as well as genetic mechanisms underlying the whole-plant response. Salinity stress affects plant growth. As salt accumulates in tissues it kills the leaves and eventually kills whole plants. Salinity reduces water uptake of the plants. Physiological responses to salinity were studied in tolerant and sensitive accessions.

Results
Results showed turf and forage cultivars vary in salinity tolerance. Genes were identified which controlled sodium transport and water movement in grasses influencing salinity tolerance. Research on identified genes will impact grass breeders by providing molecular and genetic markers for marker-assisted breeding and germ plasm enhancement of stress tolerance of perennial grass species. This research will impact grass turf managers by providing basic knowledge of whole-plant responses to stress conditions and can helping them select adequate cultivars for use in turf sites, particularly in salt-affected sites.

4. Associated Knowledge Areas

KA Code	Knowledge Area
132	Weather and Climate
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants

Outcome #11

1. Outcome Measures

An impact of plant genetic and/or epigenetic functions relating to climate change.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
How plants cope genetically with environmental challenges is not fully known. To better understand how plants survive and are productive when there is not enough water, when there is too much salt in the soil, or when temperatures are too cold would be helpful for plant resilience to changes in climate.

What has been done
Trying to improve how crops resist environmental challenges, research was conducted on chemical reactions in plant cells that switch parts of the genetic information off and on at strategic times and locations. Research was conducted on Arabidopsis thaliana (mustard plants) to isolate genetic structures of the plant cells.

Results
Research on genetic and epigenetic mechanisms of plant responses to adverse environments led to identification of genes for modifying the responses of crops to environmental stressors. A signaling pathway was discovered for intracellular sodium and potassium homeostasis in mustard plants in response to high salt conditions, and a core pathway was found for the sensing and signaling of the chemicals that regulate plant growth. A single small molecule can activate multiple receptors and protect plants from drought stress, and amino acids also have important functions in drought stress responses.

4. Associated Knowledge Areas

KA Code	Knowledge Area
132	Weather and Climate
201	Plant Genome, Genetics, and Genetic Mechanisms

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

{No Data Entered}

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Outcome 3 - post-survey of climate knowledge gained
Outcome 9 - Needs assessment surveys, followups, interviews and followups of farmers and agriculture advisors
Outcome 10 - Plot studies of grass cultivars
Outcome 11 - Lab study - isolate genetric structure of cells of mustard plants

Key Items of Evaluation

Outcome 3 - In building the capacity to provide climate science education, Educators felt they learned about climate and available resources and would use information for consultations and for education programs for adults and youth.
Outcome 9 - Farmers trust agriculture advisors for information about climate and crops. Extension approaches need to focus on educating agriculture advisors and getting research findings and information to them.
Outcome 10 - Genes identified that enhance stress tolerance in perennial grasses to help breeders with enhancement and turf managers in selection of cultivars.
Outcome 11 - Identified signaling pathway for sensing, signaling and regulating plant growth in response to salt conditions.