V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Plants and Their 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
201	Plant Genome, Genetics, and Genetic Mechanisms	0%		19%	
202	Plant Genetic Resources	0%		13%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	0%		25%	
204	Plant Product Quality and Utility (Preharvest)	10%		5%	
205	Plant Management Systems	15%		12%	
206	Basic Plant Biology	0%		2%	
211	Insects, Mites, and Other Arthropods Affecting Plants	38%		9%	
212	Pathogens and Nematodes Affecting Plants	0%		10%	
213	Weeds Affecting Plants	0%		1%	
214	Vertebrates, Mollusks, and Other Pests Affecting Plants	0%		1%	
215	Biological Control of Pests Affecting Plants	0%		2%	
216	Integrated Pest Management Systems	37%		1%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2013	Extension		Research	
	1862	1890	1862	1890
Actual Paid Professional	10.2	0.0	65.7	0.0
Actual Volunteer	8.0	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**
556970	0	459812	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
556970	0	622911	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

- Collaborate with Master Gardeners
- Develop Improved Wheat Cultivars
- Conduct Research on Economic Impacts of Fungal Diseases
- Develop Superior Sunflower Germplasms
- Develop New Cultivars of Prairie Cordgrass for Bioenergy Production
- Analyze and Map Genes for Soybean Resistance of Aphids
- Develop New Multi-Purpose Oat Varieties
- Conduct Pesticide Applicator Training Sessions
- Deliver Integrated Pest Management Resources
- Partner with the South Dakota Agri-Business Association

2. Brief description of the target audience

- Home Gardeners
- Research Community
- Soybean Growers
- Wheat Growers
- Corn Growers
- Biofuels Crop Industry
- Producers
- Graduate Students
- Private and Commercial Pesticide Applicators
- Specialty Crop Growers
- Agronomy Professionals

3. How was eXtension used?

Ask an Expert is linked to the Gardening section of SDSU Extension's iGrow online teaching platform.

V(E). Planned Program (Outputs)

1. Standard output measures

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	15739	3300764	1238	10891

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

Patent Applications Submitted

Year: 2013

Actual: 3

Patents listed

Variety: Advance, Crop - Wheat
Variety: Goliath, Crop - Oat
Variety: Horsepower, Crop - Oat

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2013	Extension	Research	Total
Actual	4	33	37

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Percentage of all Hatch Research Projects in Plants and Their Systems

Year	Actual
2013	30

Output #2

Output Measure

- Identified Proteins in Corn and Wheat

Year	Actual
2013	0

Output #3

Output Measure

- Number of Pesticide Applicator Training Sessions

Year	Actual
2013	110

Output #4

Output Measure

- Number of Master Gardener Training Sessions

Year	Actual
2013	35

Output #5

Output Measure

- Number of IPM Training Events Conducted

Year	Actual
2013	79

Output #6

Output Measure

- Increase Pollinator and Pollinator Habitat Knowledge

Year	Actual
2013	0

Output #7

Output Measure

- Number of Publications Posted on iGrow Website

Year	Actual
2013	129

Output #8

Output Measure

- Number of Articles Posted on iGrow Website

Year	Actual

2013	241

Output #9

Output Measure

- Number of Podcasts Posted on iGrow Website

Year	Actual
2013	34

Output #10

Output Measure

- Number of Radio Programs Posted on iGrow Website

Year	Actual
2013	102

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of Plants and Their Systems Hatch Research Projects
2	Enhanced the Understanding of Biotic and Abiotic Stress Resistance in Crop Plants
3	Number of Pesticide Applicator Training Participants
4	Number of Participants Completing Master Gardener Training
5	Number of IPM Participants
6	Number of Citizen Science Volunteers

Outcome #1

1. Outcome Measures

Number of Plants and Their Systems Hatch Research Projects

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	38

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Crop diseases, insect pests, drought, changing climatic conditions, soil erosion, and fewer acres of land available for farming are all serious production constraints for all crops produced in South Dakota.

What has been done
Within the College of Agriculture and Biological Sciences, there are 38 Hatch projects that are categorized in the Planned Program of Plants and Their Systems. The research activities in this program are primarily supported by our Department of Plant Science and our Department of Biology and Microbiology. Projects include but are not limited to research studies in disease management, wheat genetics and genomics, gene mapping for soybeans, drought tolerant seeds, wine grape cultivars, oat variety development, and sunflower germplasms.

Results
Through research, we continue to build a scientific knowledge base to improve and understand plant varieties, increased agricultural productivity, plant diseases, impacts of tillage on soil carbon levels, and the genomic basis of grape quality. In addition, graduate students gain valuable knowledge and skills while collaborating on research projects.

4. Associated Knowledge Areas

KA Code	Knowledge Area
201	Plant Genome, Genetics, and Genetic Mechanisms
202	Plant Genetic Resources
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
204	Plant Product Quality and Utility (Preharvest)

205	Plant Management Systems
206	Basic Plant Biology
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants
214	Vertebrates, Mollusks, and Other Pests Affecting Plants
215	Biological Control of Pests Affecting Plants
216	Integrated Pest Management Systems

Outcome #2

1. Outcome Measures

Enhanced the Understanding of Biotic and Abiotic Stress Resistance in Crop Plants

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)
Stress is a major factor in limiting plant growth, development and crop productivity. The discovery of unique proteins in resistant cultivars is important for plant breeders to develop better crop plants. Improved crop tolerance plants are necessary to keep pace with future food demands.

What has been done
Proteins involved in lignin biosynthesis were identified in corn and 90 proteins in wheat were identified that are differentially expressed as a result of drought and heat stress. An interesting discovery was made for Fusarium attack on wheat plant. A set of six genes (proteins) were found to be responsible for providing scab resistance to wheat. Out of six genes, two were revalidated by an independent technique and by an independent lab.

Results
Results have been disseminated in formal class teaching, seminars, poster presentations, peer reviewed journal articles, book chapters and visiting scientists. The results of the proteins identified in corn were published in the Journal of Proteomics. The discovery made for Fusarium attack on wheat was presented at a national forum for scab. The project provides excellent

professional development opportunities for graduate and undergraduate students. Research is ongoing with this project.

4. Associated Knowledge Areas

KA Code	Knowledge Area
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
206	Basic Plant Biology

Outcome #3

1. Outcome Measures

Number of Pesticide Applicator Training Participants

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	3500

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Producers planning to apply any pesticide to a commodity worth $1,000 or more must be certified as a private applicator. Anyone that applies pesticides for hire must be certified and licensed as a commercial applicator.

What has been done
SDSU Extension organized and participated in 74 commercial applicator sessions and 36 private applicator training sessions across the state. Fifteen commercial categories were covered. Speakers at the sessions included SDSU Extension Specialists, State Department of Agriculture representatives, and State Department of Environment and Natural Resources.

Results
Participants enhanced their knowledge and understanding of safe and sustainable methods to apply pesticides. Topics covered during these trainings include proper selection of personal protective equipment, understanding and comprehension of label languages, resistance development on weeds and insects and ways to prevent its development, proper technique to measure pesticides and calibrate pesticide application equipment.

4. Associated Knowledge Areas

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

Outcome #4

1. Outcome Measures

Number of Participants Completing Master Gardener Training

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	73

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
High food costs and lack of ability in small rural communities to obtain high quality fresh fruits and vegetables has led to the need for increased garden education. Schools, community groups, the elderly, and service groups are requesting information on basic gardening skills, assistance with starting gardens, and having basic garden questions answered.

What has been done
The Master Gardener program provides horticulture training to individuals who then volunteer in their communities ? teaching neighbors, friends and others valuable gardening skills. In South Dakota and in many other states across the country, there is a movement to offer Master Gardener training utilizing online learning with hands-on learning, albeit less hands-on than in previous years. There is some skepticism to this new approach, but the training is more accessible to more people ? people in remote locations, younger people, and people that are not able to take time during daytime hours. In the first year of this approach, 73 Master Gardeners completed the training and are now engaged in the volunteer service in their communities. Additionally, more than 60 Master Gardeners received optional hands-on training through workshops or other training sessions.

Results
Through the close partnership of SDSU Extension and Master Gardeners, citizens across South Dakota have access to public education that enables them to improve their health and lifestyle by growing nutritious foods. Adults and youth have gained confidence that their gardening skills are

based on accurate, research-based information. By growing their own food, gardeners are saving money, eating fresher produce, and making their own decisions about pesticide use. During this reporting period, Master Gardeners volunteered nearly 11,000 hours, a value of approximately $175,000.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems

Outcome #5

1. Outcome Measures

Number of IPM Participants

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	1910

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In the past decade, new invasive pests have been identified through the work of the SDSU Plant Diagnostic Lab, SDSU Extension Specialists, and the SDSU IPM program. And there is evidence that several common pests are becoming pesticide resistant. The proper identification of pests and the pest control measures used have a direct influence on the profitability of the farm operation. Without the improved knowledge of pest biology, unacceptable levels of pest damage can occur and pose risks to people, property and the environment.

What has been done
The SDSU IPM Program organized or was part of more than 79 training events during this reporting period. A crop consultants? update was held for the South Dakota Independent Crop Consultants and an IPM Field School was co-hosted with and for the SD Agri-Business Association. Extension outreach was conducted for research farm tours, organic field tours, commercial pesticide meetings, county weed and pest control meetings and the Natural Resources Conservation Service. In addition, more than 7,000 people visited SDSU Extension's traveling displays at the state fair, ag shows and conventions. Participants were trained in agronomic and economic areas including, soil fertility, soybean cyst nematode management, disease identification of foliar and root borne diseases, timing for proper fungicide applications,

new and emerging corn insects, thresholds and timing of treatment for soybean insects, herbicide timing and weed control programs, pesticide resistance management, and fertility management and agronomic/climate interactions. The SDSU Extension IPM Program has also been involved with the development of Best Management Practices guides for South Dakota, newsletters, radio programs and the iGrow online teaching platform.

Results
Participants of the SDSU IPM Program have increased their knowledge of pest biology, pesticide label interpretation, pesticide handling, and environmental factors. This leads to increased use of IPM practices and objective, science-based decision-making on reducing risks from pests and preventing unacceptable levels of pest damage in both agricultural and residential settings. Increased use of IPM practices results in better pest management decisions which address the economic aspects of pest management while posing the least possible risk to people, property, resources and the environment. Through this program, SDSU Extension has given professional agronomists the best up-to-date information available to advise their clientele. Producers are then able to make sound crop pest management decisions that are economically beneficial to their operations.

4. Associated Knowledge Areas

KA Code	Knowledge Area
216	Integrated Pest Management Systems

Outcome #6

1. Outcome Measures

Number of Citizen Science Volunteers

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	19

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Pollinators are necessary for fruit production and seed set in many home garden and agricultural crops. Bees are great pollinators, but there has been a decline in their population during the last half century. The disappearance of large numbers of honey bees, called colony collapse disorder, has many people in the industry concerned. Community engagement is needed to help increase

local pollinator population and diversity.

What has been done
The Backyard Biodiversity program uses citizen science (active involvement from everyday people) to improve awareness of pollinators, and create and conserve pollinator habitat. An observation protocol and data sheet was developed for participants. Photos of insects could also be submitted to a Project Noah mission created for Backyard Biodiversity. Training was provided on the data collection methods and basic insect identification through a webinar and live training session. The protocol focused on identifying broad groups of insects like butterflies, flies, beetles and some more specific groups of bees (honey bees, bumble bees, metallic bees, and small bees). Each volunteer completed at least 4, weekly, 20 minute observations of the flowering plants in their yard. Some volunteers also set up bee bowls (small traps of soapy water) to collect insects that might be missed during their regular observations.

Results
Nineteen volunteers submitted data for the project totaling more than 500 insect observations. The volunteers were mostly Master Gardeners. The bee bowl collections were completed at 9 sites and resulted in more than 400 pinned insects that are awaiting identification. The most common bee bowl catches were flies and bees, with a few small butterflies and the occasional beetle. Due to the volume of specimens collected, the final identification data will be available in 2014.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems

V(H). Planned Program (External Factors)

External factors which affected outcomes
- Economy
- Competing Programmatic Challenges

Brief Explanation

SDSU Extension and the SDSU Ag Experiment Station have met or exceeded its goals despite a decrease in state and federal resources. The reduction in funds however, has created challenges across the board with research and outreach. There are fewer faces to greet the customer, there are fewer hands-on projects, and cost recovery has taken the word free out of some programs. But while these challenges may initially seem troublesome, paradoxically they improve service to our stakeholders. Smart classrooms provide video conferencing, web-based learning is available all hours of the day, and new sponsorships create new partnerships. There will be more challenges, but SDSU Extension and the SDSU Ag Experiment Station continue their commitment to excellence and success.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Pesticide Applicator Training

Evaluation was conducted on the change of knowledge using pre- and post-tests at three Agricultural Commercial Pesticide Applicator Trainings (n=507 people):

On the topic of insecticide class recognition (i.e. which product acts in which way), there was an average of 30% increase in correct answers between post- and pre-test.

On the topic of insecticide resistance management (e.g. the practical ways to slow down insecticide resistance development), there was an average of 7% increase in correct answers between post- and pre-test.

This is the second year in a row that the topic of insecticide resistance management is emphasized in these trainings.

Key Items of Evaluation

Pesticide Applicator Training

In the before and after test, there was 30% increase in correct answers on the topic of insecticide class recognition.