

V(A). Planned Program (Summary)

Program # 10

1. Name of the Planned Program

Integrated Pest Management

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
133	Pollution Prevention and Mitigation	5%		10%	
202	Plant Genetic Resources	5%		5%	
205	Plant Management Systems	10%		10%	
211	Insects, Mites, and Other Arthropods Affecting Plants	16%		20%	
212	Diseases and Nematodes Affecting Plants	10%		20%	
213	Weeds Affecting Plants	16%		5%	
215	Biological Control of Pests Affecting Plants	11%		5%	
216	Integrated Pest Management Systems	20%		20%	
601	Economics of Agricultural Production and Farm Management	4%		5%	
901	Program and Project Design, and Statistics	3%		0%	
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	4.0	0.0	5.0	0.0
Actual Paid	6.0	0.0	3.1	0.0
Actual Volunteer	0.1	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
60000	0	156369	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
60000	0	156369	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
684600	0	775011	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

- Fulfill the specific Inputs and Activities outlined in the "Oklahoma State University Coordination Program for IPM Oklahoma!" (as made to USDA-NIFA "Extension Integrated Pest Management Coordination and Support Program (EIPM-CS)"), including the identification of new program priorities for future funding.

- Provide information on IPM upon request to stakeholder groups, and attend stakeholder sponsored meetings as invited.

- Conduct targeted research on pest status, suppression and IPM approaches for crop, animal, and urban systems in Oklahoma.

- Develop and deliver extension IPM programs to stakeholders, in the form of workshops, field demonstrations and meetings

- Develop pesticide applicator education and pesticide information through printed media, fact sheets and current reports.

- Assess impact of educational activities on stakeholder IPM

2. Brief description of the target audience

Agricultural Producers, Agricultural Groups, Commercial Growers, Retailers, Agricultural Professionals (private, commercial and non-commercial), and landowners, nurseries, individual stakeholders, stors and handlers of grain

3. How was eXtension used?

Dr. Boman is the subject matter editor for the Ginning and Classing section for the Cotton Community of Practice. All subject matter sections were updated in the fall of 2012 by the various editors. Dr. Guy Collins of the University of Georgia is handling coordination of content updating. We have a direct link on both websites we manage. URL: www.extension.org. Dr. Talley is a member and contributor of the eXtension Beef and eXtension Goat COP.

V(E). Planned Program (Outputs)

1. Standard output measures

2014	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	3300	256180	204	10005

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

Patent Applications Submitted

Year: 2014
 Actual: 1

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2014	Extension	Research	Total
Actual	21	45	66

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Stakeholder assessment

Year	Actual
2014	2

Output #2

Output Measure

- Pesticide applicator education schools and workshops

Year	Actual
2014	42

Output #3

Output Measure

- County-based variety field tours of canola and wheat for growers

Year	Actual
2014	41

Output #4

Output Measure

- Research demonstrations will be conducted on confined poultry farms demonstrating IPM strategies for managing litter beetles.

Year	Actual
2014	1

Output #5

Output Measure

- Extension publications will be created or revised

Year	Actual
2014	21

Output #6

Output Measure

- News releases on the subject of IPM in schools, horticulture crops, livestock, and agronomic crops

Year	Actual
2014	7

Output #7

Output Measure

- A summarized annual report will be developed for distribution to involved stakeholders demonstrating the impact of IPM programs to Oklahoma citizens.

Year	Actual
2014	1

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Increased use of pest management approaches for targeted cropping system acres
2	Number of trained certified pesticide applicators
3	Poultry producers will be informed on the utility of alternative IPM strategies for managing litter beetles.
4	Increase in percent of growers with knowledge and adoption of iWheat program for winter wheat.
5	Home gardeners will gain knowledge about IPM practices for their home gardens.
6	People will gain knowledge about IPM programs by visiting the IPM Oklahoma! booth at various meetings, including the Oklahoma Ag Expo and the Oklahoma School Plant Managers Association.
7	Biological Control of Musk Thistle
8	IPM Implementation for Agronomic Crops: Hessian Fly Management
9	Survey for phorid flies in SE Oklahoma

Outcome #1

1. Outcome Measures

Increased use of pest management approaches for targeted cropping system acres

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	12000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Sorghum is grown on 250,000-300,000 acres in Oklahoma. In 2013, sugarcane aphid "switched" to infesting sorghum in 2013, causing significant yield losses in sorghum in Texas, Louisiana, and Mississippi. Research conducted in 2013 indicated that currently registered products for aphid control in sorghum were ineffective. The aphid was found in one Oklahoma county in 2013.

What has been done

The discovery of this aphid in 2013 prompted the Oklahoma Sorghum Growers to ask the OSU IPM coordinator and the Pesticide Education Program coordinator to support an emergency Section 18 registration for the use of sulfoxaflor to help control them. In addition, a research/extension demonstration was established to evaluate chemical control options and the impact of the aphid on production. Two news releases were provided through OSU to assist growers in identifying sugarcane aphid, with suggestions for determining the need for control. In 2014, sugarcane aphid was found in 17 counties, infesting a minimum of 10,000 acres statewide. Based on the results of the research/extension demonstration that evaluated impact on yield, an uncontrolled infestation of sugarcane aphid reduced yield by an average of 18 bushels per acre.

Results

Sulfoxaflor was applied to 10,000-12,000 acres of grain sorghum in 2014. Based on an extension demonstration coordinated by the IPM Crops Insect Pest Management Team, this Emergency registration, the efforts of the Oklahoma State Row-crops Pest Management Team saved Oklahoma sorghum growers ca. \$500,000.00 to \$700,000.00 in lost grain yield.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Diseases and Nematodes Affecting Plants
213	Weeds Affecting Plants
215	Biological Control of Pests Affecting Plants
216	Integrated Pest Management Systems
601	Economics of Agricultural Production and Farm Management

Outcome #2

1. Outcome Measures

Number of trained certified pesticide applicators

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	3430

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Pesticide safety education provides classes for pesticide applicators to maintain and receive certification. This is in order to promote pesticide safety, protect our environment through responsible pesticide application, promote adhering to all Oklahoma Department of Agriculture, Food, and Forestry requirements, and sustain our pest control industry.

What has been done

Oklahoma Pesticide safety education program has provided certification courses for 230 individuals and continuing education for over 3,200 individuals in many different pesticide applicator categories. We continue to produce a monthly newsletter and maintain a website for the public and applicators to access important information related to pesticide safety and applicator training. We continue providing test help sessions and master gardener training. We

also coordinate a container recycling program that resulted in 56,000 lbs of plastic collected in 2014

Results

It is estimated that the 230 individuals certified through our programs will bring over \$17 million to the Oklahoma economy through starting new businesses and providing services related to pest control. We provided education to 3,200 individuals to maintain their certification which represents \$240 million to the Oklahoma economy based on industry estimates. Complaints to the department of Agriculture continue to decline based on our educational programming.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Diseases and Nematodes Affecting Plants
213	Weeds Affecting Plants
216	Integrated Pest Management Systems
901	Program and Project Design, and Statistics

Outcome #3

1. Outcome Measures

Poultry producers will be informed on the utility of alternative IPM strategies for managing litter beetles.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	120

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

In the United States 17 states accounts for about 94% of broiler production. These states are primarily in the southeast part of the country. In Oklahoma broiler production is focused near the Arkansas border. The Economic Research Service estimates 2015 broiler meat production to be ~ 39.6 billion pounds. A typical poultry house will be between 12 and 19 m in width and about 90 to 180 m in length housing up to 25,000 broiler birds. The litter beetles *Alphitobius diaperinus* (Panzer) originated from Sub-Saharan Africa and are currently found often in poultry buildings in the United States, Britain, Denmark, and Australia. Litter beetles cause damage to the poultry facility that results in \$4,000 worth of damage to facility insulation annually. Windrowing litter is a potential method to control litter beetles especially when utilized with chemical control, which may prove to be a more effective control program. Windrowing is a technique used inside poultry houses to compost the litter.

What has been done

The Oklahoma State University Integrated Pest Management Team has conducted field research to determine the effect of windrowing on litter beetle populations in broiler houses in Eastern Oklahoma. The field demonstrations were the only litter beetle work being done for the Oklahoma Broiler industry within the state of Oklahoma.

Results

The field demonstrations resulted in a new management option for Oklahoma Broiler Operators that also encourages limiting insecticide inputs which is the most commonly used method in controlling litter beetles in broiler houses. The results and updated litter beetle management techniques were presented to poultry operators at the Eastern Oklahoma Ag. Expo. Meeting in Poteau, OK which had approximately 120 attendees with at last 25% of the audience being Asian in descent.

4. Associated Knowledge Areas

KA Code	Knowledge Area
211	Insects, Mites, and Other Arthropods Affecting Plants
216	Integrated Pest Management Systems

Outcome #4

1. Outcome Measures

Increase in percent of growers with knowledge and adoption of iWheat program for winter wheat.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	15

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Diseases and Nematodes Affecting Plants
213	Weeds Affecting Plants
216	Integrated Pest Management Systems
601	Economics of Agricultural Production and Farm Management

Outcome #5

1. Outcome Measures

Home gardeners will gain knowledge about IPM practices for their home gardens.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	54

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Oklahoma home gardeners are interested in applying IPM principles to their yard, garden and landscape; however, they often have limited knowledge of what tactics are available, and how they can apply them.

What has been done

In 2014, the IPM team developed and delivered an Advanced IPM Workshop for Master Gardeners. 54 Master Gardeners were trained in 2 sessions lasting 6 hours each that included information on Scouting, Diagnosing problems, Cultural, Biological, Mechanical and Chemical Controls.

Results

Participants were allowed to evaluate the program and we measured changes using a pre and a post-test that evaluated Knowledge, Attitude and Skills changes of the participants with a Likert Scale:

Quality of instruction 1=Very High, 5 = Very low, Objective met 1 = Strongly Agree, 5 = Strongly Disagree. Participants agreed that the Instruction, Instructors were knowledgeable (1.15), organized (1.28), and Responsive (1.21). Participants believed that the workshop met the objectives (1.20) AND learned a lot from the workshop (1.31).

We also measured their Understanding of IPM, 1 = none, 5 = Complete, Attitude towards IPM, 1 = Strongly not Favor, 5 = Strongly Favor, and Skills Change 1 = Low, 5 = High.

On average, participants increased their Understanding of IPM (Before 2.85, After 4.13), and had a positive attitude change towards using IPM (3.13 Before, 3.69 After). They also increased their confidence about using and applying and teaching IPM principles (Skills Change) to their clientele (2.42 Before, 3.64 After).

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Diseases and Nematodes Affecting Plants
213	Weeds Affecting Plants
215	Biological Control of Pests Affecting Plants
216	Integrated Pest Management Systems

Outcome #6

1. Outcome Measures

People will gain knowledge about IPM programs by visiting the IPM Oklahoma! booth at various meetings, including the Oklahoma Ag Expo and the Oklahoma School Plant Managers Association.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	101

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
216	Integrated Pest Management Systems

Outcome #7

1. Outcome Measures

Biological Control of Musk Thistle

2. Associated Institution Types

- 1862 Extension
- 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)

The invasive weed, Musk thistle (*Carduus nutans* L) was first identified in Oklahoma in 1944, and is currently found in more than 62 counties. Infestations of musk thistle in improved pastures cause significant economic losses in Oklahoma. In 1998, Oklahoma legislators passed a law designating musk thistle, along with scotch and Canada thistles, as noxious weeds in all counties of the state.

What has been done

A musk thistle IPM program was developed in the early 1990s and has been implemented statewide through cooperative efforts of OSU researchers, OSU Extension personnel, and landowners. It focuses on increasing public awareness of the problem, development of educational information, demonstrating various control options, and introducing new biological control agents. One demonstration and educational meeting was conducted in 2014 for landowners and NRCS employees. OSU Extension educators, landowners and NRCS personnel collected approximately 14,000 musk thistle head weevils and 1,000 musk thistle rosette weevils in Alfalfa and Grant counties in spring of 2014 for redistribution.

Results

To date, this program collected and redistributed more than 914,000 musk thistle head weevils and 46,710 musk thistle rosette weevils across the state. Landowners in NE Oklahoma have noted from 80% to 95 % decrease in number of musk thistle plants in areas where they are using an integrated approach that includes use of the musk thistle weevils. If the typical landowner applies 1 lb. active ingredient of herbicides per acre annually, biological control has decreased the amount of herbicides applied to the environment by 7.1 million lbs per year.

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
213	Weeds Affecting Plants
215	Biological Control of Pests Affecting Plants
216	Integrated Pest Management Systems

Outcome #8

1. Outcome Measures

IPM Implementation for Agronomic Crops: Hessian Fly Management

2. Associated Institution Types

- 1862 Extension
- 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)

Winter wheat is grown on 5.6 million acres in Oklahoma for pasture, grain and dual purpose (pasture + grain). Hessian fly has become a more prominent pest due to fly-susceptible varieties. Traditional fly free planting dates that were developed in the 1930s appear to be ineffective.

What has been done

Estimates of yield loss suffered by Hessian fly infestations can reach 5 bushels per acre, when a susceptible variety is infested with 1 fly per stem. A Hessian fly screening program (lab and field) was instituted to evaluate new winter wheat releases through the Oklahoma State winter wheat breeding program. In 2015, 25.9% of the wheat acres in Oklahoma were planted to H fly resistant varieties. Two fully resistant varieties Duster (released in 2006) and Gallagher (released in 2011) are the most planted (14.1%) and 3rd most planted (5.8%) varieties in 2015. Additional varieties, Billings (1.3% planted) which was released in 2009, Ruby Lee (5.0% planted) released in 2011, are partially resistant. Results of H. fly monitoring from 2011-2013 demonstrated that H. fly emergence had two peaks, one in the fall, and one in the spring. Emergence occurred too late for insecticide seed treatments to be effective in the fall, and for too long of a period for foliar insecticides to be reliably effective. This work suggests that host plant resistance coupled with cultural controls will be the predominant method for Hessian fly management in Oklahoma.

Results

Approximately 1.2 million acres of the winter wheat acres were planted to Duster, Billings or Gallagher in 2015. Of that, a minimum of 5% or 60,000 acres were planted in areas where Hessian fly was documented (from 2009-2011) to be a serious problem, resulting in an estimated

\$1.5 million in yield savings.

4. Associated Knowledge Areas

KA Code	Knowledge Area
202	Plant Genetic Resources
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
216	Integrated Pest Management Systems

Outcome #9

1. Outcome Measures

Survey for phorid flies in SE Oklahoma

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2014	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The red imported fire ant (RIFA), *Solenopsis invicta* Buren (Hymenoptera: Formicidae), was recorded in parts of Oklahoma as early as 1985, and has since been found at one time or another in 42 Oklahoma counties as of August 2008. In 2009, an additional 12 counties were added to the eight counties (Bryan, Carter, Choctaw, Comanche, Johnston, Love, Marshall and McCurtain) that are federally quarantined in Oklahoma. Distribution of RIFA occurrence in Oklahoma is disjunct, most likely due to variable climate and continual artificial movement of hay and nursery materials. An area wide RIFA management project was funded through 2007 that included release of two fire ant decapitating flies (*Pseudacteon tricuspis* and *P. curvatis*) as well as an evaluation of fire ant baits. Since red imported fire ant has been establishing in additional counties, it is important to provide updated information on fire ant management to interested ranchers in southern Oklahoma, since establishment is variable, and document the establishment and movement of *Pseudacteon* spp. into fire ant-infested areas of Oklahoma.

What has been done

Pseudacteon tricuspis was released in two counties (Bryan and Atoka) and *P. curvatus* was released in 4 counties (Bryan, LeFlore, Love and Pushmataha). However, establishment was confirmed only in Bryan and LeFlore. OSU researchers conducted a summer-long survey for phorid flies in seven counties (Atoka, Bryan, Carter, Choctaw, LeFlore, McCurtain, and Marshal).

Results

Pseudacteon curvatus was captured in 5 of the seven counties surveyed: (Atoka, Bryan, Carter, Choctaw, McCurtain). New records of establishment were found in Atoka, McCurtain, Carter and Choctaw). No *P. tricuspis* was collected. This survey documents that phorid flies have established and spread from their original release sites.

4. Associated Knowledge Areas

KA Code	Knowledge Area
211	Insects, Mites, and Other Arthropods Affecting Plants
216	Integrated Pest Management Systems

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
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

A severe drought began in 2010 and has significantly impacted our cotton, wheat production and canola production. Cotton production was decreased by more than 50% in 2011-2013, wheat production was reduced by 50% in 2013-2014, and canola production was decreased by more than 40% in 2013-14. Current conditions are that 98.5 percent of Oklahoma is under abnormally dry conditions, 66% is under moderate drought, 48 percent under severe drought, and 28 percent of the state under extreme drought, and 4 counties (Harmon, Jackson, Greer and Tillman are under Exceptional Drought (the highest level of drought).

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Advanced IPM Workshop for Master Gardeners - participants were allowed to evaluate the program and we measured changes using a pre and a post-test that evaluated Knowledge, Attitude and Skills changes of the participants with a Likert Scale:

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Key Items of Evaluation

Master Gardeners want more information on IPM BMPs and other practices and did learn from the workshops. The MGs will share with thousands of other gardeners as they voluntarily present programs and answer questions.