

V(A). Planned Program (Summary)

Program # 8

1. Name of the Planned Program

Turfgrass Development and 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
111	Conservation and Efficient Use of Water	15%		10%	
201	Plant Genome, Genetics, and Genetic Mechanisms	0%		5%	
202	Plant Genetic Resources	8%		10%	
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	10%		10%	
204	Plant Product Quality and Utility (Preharvest)	10%		5%	
205	Plant Management Systems	20%		15%	
206	Basic Plant Biology	2%		5%	
211	Insects, Mites, and Other Arthropods Affecting Plants	10%		10%	
212	Pathogens and Nematodes Affecting Plants	15%		10%	
216	Integrated Pest Management Systems	10%		20%	
	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
Plan	1.5	0.0	2.0	0.0
Actual Paid Professional	3.0	0.0	1.9	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
75000	0	81982	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
75000	0	81982	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
325000	0	466340	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Continued efforts to generate new turf germplasm/varieties. Some new germplasm is being further developed into marketable products that have improved abiotic and biotic stress resistance/tolerance.

Research was conducted to identify the elite performing species and varieties from both our program and from industry. Research will identify new or refined integrated management practices and comprehensive management systems. Educational materials were developed featuring improved varieties and how to properly maintain them. Intense and effective educational programming were conducted to help integrate this information into existing management programs. Research and extension activities were conducted to improved efficiency of water application and to reduce runoff.

2. Brief description of the target audience

Audiences include governmental, private industry and multiple end-user areas. Research audiences: basic and applied plant science/turf science researchers, including those from the CSSA, and ASHS. Funding agency audiences: USGA, GCSAA, USDA, OTRF and many private corporations. New cultivars developed as well as products such as trade articles, fact sheets, and educational programming will be provided to the target audiences characterized as the turfgrass production sector (sod and seed producers), service sector (landscape/lawncare and pest control operators) and turf managers (which include the golf course, parks & grounds, right of way managers and home consumers).

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2013	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	1819	51554	400	1000

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

Year: 2013
 Actual: 1

Patents listed

'NorthBridge Turf Bermudagrass?(Cynodon dactylon X C.

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2013	Extension	Research	Total
Actual	13	11	24

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of peer-reviewed journal articles manuscripts submitted

Year	Actual
2013	8

Output #2

Output Measure

- Number of final stage experimental bermudagrasses sent to national testing phase in the NTEP bermudagrass trial once every 5 years

Year	Actual
2013	9

Output #3

Output Measure

- Number of fine turf program and roadside vegetation management workshops conducted and

trade presentations presented each year.

Year	Actual
2013	107

Output #4

Output Measure

- Number of new bermudagrasses developed by our program that are commercially released to the trade for production.

Year	Actual
2013	0

Output #5

Output Measure

- Number of new licensees recruited for production of improved bermudagrass released from our program.

Year	Actual
2013	15

Output #6

Output Measure

- Number of cultivar evaluation trials; weed control trials; management factor trials; and physiological, morphological or other investigations conducted on turfgrass.

Year	Actual
2013	63

Output #7

Output Measure

- Number of scientific abstracts, posters or oral presentations presented to scientific audiences.

Year	Actual
2013	13

Output #8

Output Measure

- Number of turfgrass managers trained in recognition and selection of improved varieties and implementation of integrated turfgrass management systems

Year	Actual
2013	1573

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of sod/seed producers growing OSU turf bermudagrasses
2	Number of out-of-state sod/seed producers growing OSU turf bermudagrasses
3	Number of sod/seed producers growing Oklahoma proven turf bermudagrasses
4	Percentage of professionally managed properties using improved turfgrasses
5	Percentage of professional fine turf managers continuing adoption of BMPs and IPM
6	Percentage of ODOT roadside vegetation managers continuing adoption of BMPs and IPM

Outcome #1

1. Outcome Measures

Number of sod/seed producers growing OSU turf bermudagrasses

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	49

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Severe winter-kill plagued warm-season turfgrasses in Oklahoma and across the US transition zone in the late 1970s, early 1980s and again in 1990 and 2010. Proper management of the earlier selections of bermudagrasses could only provide limited protection against losses of bermudagrass to winter-kill and its financial impact when sports fields and golf courses required resodding or reseeding. Following particularly bad winters, sod production facilities would be hit by winter-kill and operators could not fully take advantage of the opportunity to meet market demand for bermudagrass sod since their production fields were damaged and limited sod was available for harvest. Consequently, improved high quality seeded and vegetatively propagated turf-type bermudagrasses were needed to better resist the effects of harsh winters and less damage from severe winter-kill events.

What has been done

The Oklahoma State University Bermudagrass Development Team with funding and support from the Oklahoma Agricultural Experimental Station (OAES) and the United States Golf Association from 1986 to date has bred tens of thousands of lines of experimental bermudagrasses for intensive testing. These bermudagrasses have been screened in-depth in Oklahoma for improved winter-hardiness, seed set, establishment rate, pest resistance and overall quality. Only a handful of the most elite performers were sent on for national testing with the National Turfgrass Evaluation Program (NTEP). Additional on-site testing was performed with selected sod and seed producers interested in future production of high quality, improved bermudagrasses with potential for improved profit margins.

Results

To date, we have commercialized and obtained proprietary protection on Yukon and Riviera seeded bermudagrasses as well as Patriot, Latitude 36 and NorthBridge vegetatively propagated

bermudagrasses. Seed production licenses for large scale production were granted to one national firm each for Yukon and Riviera seeded bermudagrasses. The licensed seed producer of Riviera bermudagrass has allowed four quality-minded sod producers to produce Riviera bermudagrass sod. These two seeded bermudagrass lines were adopted as standards in the 2013-2018 NTEP bermudagrass trial due to excellent performance and their first-class winter hardiness in seeded turf-type bermudagrass options. Nine sod producers in eight states produce and sell Patriot bermudagrass. Latitude 36 and NorthBridge bermudagrasses were licensed to Sod Solutions who has sublicensed each product to 19 sod producers in eight states. Patriot and Latitude 36 remain a standard for cold hardiness in vegetatively propagated turf bermudagrass in the current 2013-2018 NTEP bermudagrass. Sod producers are able to make at least a three to five cent per square foot premium on production of high quality winter-hardy bermudagrasses and to somewhat escape the "commodity-like" market place of variety-not-stated common bermudagrass sod production which keeps sale prices and grower profits reduced in the industry as a whole. In 2013, 6 and 7 new sublicensees of NorthBridge and Latitude 36 Turf bermudagrasses, respectively, were licensed by our representative, Sod Solutions LLC outside of Oklahoma. The first sod and sprigs from the 2013 producers should be available in the marketplace in late 2014. In 2013, the OSU generated bermudagrass Latitude 36 was installed on two NFL stadiums while NorthBridge was installed on the playing surface at one Major League Baseball stadium and one NFL stadium. These installs show the high level of acceptance of the OSU bermudagrasses that demonstrated improved winter hardiness, visual quality and high levels of traffic tolerance. Replacement of winter-susceptible type bermudagrass will be a multi-year, on-going process.

Due to outstanding national performance by Latitude 36 in the 2007-2012 NTEP bermudagrass trial, this grass was selected as a new standard for cold hardy, high quality bermudagrass by the NTEP for the 2013-2018 NTEP bermudagrass trial being conducted across the US. The NTEP also selected older but still outstanding performing OSU turf bermudagrasses Patriot, Yukon and Riviera for inclusion in this national trial due to their continued high national performance rankings. Utilization of OSU released bermudagrasses with improved winter-tolerance results in decreased winter-kill in years where winters at a given location are more severe. Decreasing winter-kill results in less weedy turf, since a dense cover of turfgrass results in less invasion by winter and summer annual weeds. Reductions in weed cover and percentage results in less use of herbicide for weed control as well as a resultant higher quality turfgrass surface earlier in the growing season. Based on NTEP trial research in 2010, approximately 20% less winter-kill of turfgrass area can be expected using winter-hardy turf bermudagrass varieties developed by Oklahoma State University. This can result in 15 to 20 % less fertilizer being used and a reduction in need for purchase of replacement seed or sod to repair damaged areas of turfgrass. Damaged turf can often result in negative player preference towards golf courses that suffered winter-kill if other courses in the same area did not have winter-kill and if golfing fees are otherwise the same on both courses under comparison. Latitude 36 and Northbridge have the highest traffic tolerance of any hybrid bermudagrasses with improved cold tolerance. Consequently, they are receiving increased use on professional, college and high school playing surfaces.

4. Associated Knowledge Areas

KA Code	Knowledge Area
202	Plant Genetic Resources
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
205	Plant Management Systems

Outcome #2

1. Outcome Measures

Number of out-of-state sod/seed producers growing OSU turf bermudagrasses

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	44

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Severe winter-kill plagued warm-season turfgrasses across the US transition zone in the late 1970s, early 1980s and again in 1990 and 2010. Proper management of the earlier selections of bermudagrasses could only provide limited protection against losses of bermudagrass to winter-kill and its financial impact when sports fields and golf courses required resodding or reseeding. Following particularly bad winters, sod production facilities would be hit by winter-kill and operators could not fully take advantage of the opportunity to meet market demand for bermudagrass sod since their production fields were damaged and limited sod was available for harvest. Consequently, improved high quality seeded and vegetatively propagated turf-type bermudagrasses were needed to better resist the effects of harsh winters and less damage from severe winter-kill events.

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4. Associated Knowledge Areas

KA Code	Knowledge Area
202	Plant Genetic Resources
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
205	Plant Management Systems

Outcome #3

1. Outcome Measures

Number of sod/seed producers growing Oklahoma proven turf bermudagrasses

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	6

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

For 5 decades, 90% of the square footage of warm-season varieties produced and sold as bermudagrass and zoysiagrass sod in Oklahoma consisted of common bermudagrass sold as U-3, Tifway (419) hybrid bermudagrass and Meyer (Z-52) zoysiagrass. These grasses were considered the standards for operating a successful sod production business and standards understood by the purchasing lawn and landscape industry. However, turfgrass cultivar development programs both within and outside of Oklahoma had generated a number of cultivars with superior quality and stand persistence that were either equal or better in performance than the long term standards in addition to exhibiting higher genetic purity than the old standards.

What has been done

Research, demonstration and extension education efforts intensified in the early 1990s and continue today in an effort to increase product choice available for the consumer and professional alike. A series of 10 trials with newly commercialized and old standard variety bermudagrasses and zoysiagrasses were conducted over the last 24 years to demonstrate to sod producers, seed producers and end users the field performance of newly commercialized varieties compared to old industry standard types. A yearly turfgrass conference and trade show as well as alternate year field day, extension fact sheets and over 14,000 one on one consultations (average of 608 per year) have been conducted over 23 years to these customer groups to discuss new turfgrass options available for licensing, production and purchase.

Results

While U-3, Tifway and Meyer zoysiagrass still make up the greatest majority of square footage of sales to the construction market, approximately 15% (9 of 60 total producers) of the sod production industry in Oklahoma have diversified production to include Astro hybrid bermudagrass, El Toro zoysiagrass and various new tall fescue/Kentucky bluegrass blends. Additionally, 5% of the total producers (3 of 60) producers have diversified to include new proprietary bermudagrasses Riviera, Patriot, Latitude 36 and Northbridge which have superior performance traits compared to old standard types. The new proprietary types offer a 3 to 5 cent per square foot profit potential over older standard types. Adoption of proprietary types is limited based on market structure, requirement for pedigree stock production standards and a cap set on number of producers licensed and in some cases limited access to markets due to presence of "no sole source bid" restrictions. It is hoped that the visibility of successes in production of new proprietary types will lead to increased willingness by producers to adopt additional new varieties in the future as they become available for production.

4. Associated Knowledge Areas

KA Code	Knowledge Area
202	Plant Genetic Resources
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
205	Plant Management Systems

Outcome #4

1. Outcome Measures

Percentage of professionally managed properties using improved turfgrasses

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	13

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

Outcome #5

1. Outcome Measures

Percentage of professional fine turf managers continuing adoption of BMPs and IPM

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	96

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

A majority of both biotic and abiotic problems facing turfgrass managers can be reduced or completely controlled through the use of Best Management Practices (BMPs) and Integrated Pest Management (IPM) strategies. Use of the best adapted cultivars of turfgrass is the cornerstone of both a successful BMP and IPM program. Pests continue to evolve to exploit weaknesses in defense systems posed by turfgrasses. Because of this arms race between predator and prey or pest and host plant, continued development of and implementation of use of improved turfgrasses and improved management practices will be required for the foreseeable future, just as in any cropping system.

What has been done

Each year over 200 turfgrass industry professionals attend the annual Oklahoma Turfgrass Conference and Trade Show, while another 300 attend various approximately 15 pest management sessions offered by various Turfgrass team members around the state. Over 1,100 professionals receive one-on-one consultations by either phone, email or site visits each year. Simple post conference surveys are administered at several of the sessions and following the annual Turfgrass conference to perform a simple assessment of adoption of improved turf management practices.

Results

Recent surveys following yearly education sessions to professional Turfgrass managers have revealed that 96% of attendees are employing techniques that are Best Management Practices. These practices can involve use of newer or best adapted cultivars/species, soil-test based fertility programs, selection of proper mowing and irrigation regimes as well as regular pest scouting and use of economic thresholds concerning treat or no treat decisions. Use of BMPs and IPM helps reduce un-necessary pesticide and reduce over use of fertilizers and irrigation, yield an acceptable Turfgrass stand at an affordable/acceptable cost.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
216	Integrated Pest Management Systems

Outcome #6

1. Outcome Measures

Percentage of ODOT roadside vegetation managers continuing adoption of BMPs and IPM

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2013	100

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

An erosion resistant, aesthetically pleasing, low growing, low maintenance vegetation is required for the 240,000 acres of state department of transportation maintained right of way adjacent to concrete and asphalt roads in Oklahoma.

What has been done

For 27 years the Oklahoma State University Roadside Vegetation Management Team has been performing annual research and extension education aimed at development of Best Management Practices (BMP) as well as Integrated Pest Management Practices (IPM) for Oklahoma Department of Transportation vegetation management employees.

Results

The OSU RVM team annually trains over 700 ODOT employees in BMPs and IPM. Each employee has adopted at least one (and often several more) of the BMP and IPM techniques transferred through the 3 annual initial pesticide applicator certification schools, 3 annual herbicide sprayer calibration workshops and 15 annual continuing education workshops. There is no single practice or always a ridge set of practices to solve any given problem. ODOT uses an integrated vegetation selection, mowing and herbicide application program to manage the 240,000 acres of right of way. Each ODOT employee engaged in roadside management is using at the minimum at least one integrated practice. Adoption of BMPs and IPM techniques coupled with integration of the latest research results into product bid specifications followed by competitive bid process results annually in a savings of over \$120,000 in ODOT roadside vegetation maintenance costs.

4. Associated Knowledge Areas

KA Code	Knowledge Area
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205	Plant Management Systems
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
- Competing Public priorities
- Competing Programmatic Challenges

Brief Explanation

Drought continues to have negative effects on research and demonstration.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Recent surveys following yearly education sessions to professional Turfgrass managers have revealed that 96% of attendees are employing techniques that are Best Management Practices. These practices can involve use of newer or best adapted cultivars/species, soil-test based fertility programs, selection of proper mowing and irrigation regimes as well as regular pest scouting and use of economic thresholds concerning treat or no treat decisions. Use of BMPs and IPM helps reduce un-necessary pesticide and reduce over use of fertilizers and irrigation, yield an acceptable Turfgrass stand at an affordable/acceptable cost.

Key Items of Evaluation