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Natural Resources Conservation Service

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2010 ANNUAL TECHNICAL REPORT

Booneville Plant Materials Center

The Booneville Plant Materials Center is growing switchgrass between rows of shortleaf pine for livestock forage and biofuel as an Agroforestry practice for western Arkansas, eastern Oklahoma and southwestern Missouri.

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
BOONEVILLE PLANT MATERIALS CENTER

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2010 Annual Technical Report
Booneville, AR

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Introduction

The Booneville Plant Materials Center (PMC) was established and became part of the national system of PMC's in 1987 and serves the plant material needs of the Southern Ozarks, the Arkansas River Valley, the Boston and the Ouachita Mountains. The Center's priorities include protection and enhancement of water quality, protection and enhancement of pastureland, critical area treatment, protection and enhancement of woodlands, and protection and enhancement of wildlife land.

Location

The Booneville Plant Materials Center is located along the Petit Jean River in Logan County, Arkansas. The Center lies along north edge of the Ouachita National Forest. Mt. Magazine (2823 ft.) is to the northeast of the PMC and is well known as being the highest mountain between the Appalachian and Rocky Mountains. The PMC leases 282 acres from the State of Arkansas.

Service Area

The primary service area of the Booneville Plant Materials Center (PMC) includes portions of Arkansas, Oklahoma, and Missouri (approximately 54 million acres). This area includes the following Major Land Resource Area's:

Ozark Highland	116A	Ouachita Mountains	119
Ozark Border	116B	Western Coastal Plain	133B
Boston Mountains	117	Backland Prairie	135
Arkansas Valley and Ridges	118		

Much of the service area is characterized by rugged terrain with elevations from 300 to 2,800 feet. Average annual rainfall varies from 36 inches in the west to 53 inches in the eastern higher mountain areas. Forage production and woodlands are the major land uses, and small family farms characterize the agriculture.

Soils on the Center Include

Leadville silt loam, 1 to 3 percent slopes. This is a deep, moderately well drained, nearly level soil on old stream terraces in broad valleys. Individual areas range from about 10 to 400 acres in size.

Taft silt loam, 0 to 2 percent slopes. This is a deep, somewhat poorly drained, level to nearly level soil on old stream terraces in broad valleys. Individual areas range from about 10 to 400 acres.

Linker fine sandy loam, 3 to 8 percent slopes. This is a moderately deep, well-drained, gently sloping soil on hilltops. Individual areas range from about 5 to 200 acres.

Enders-Mountainburg association, rolling. This association consists of well-drained soils in a regular and repeating pattern on rolling hillsides. Slopes are 8 to 20 percent. The mapped areas on this association range from about 50 to 700 acres.

2010 Rainfall and Temperature Data

2010 Weather Summary

Month	Monthly Rainfall Total	Average Rainfall	Average High	Average Low
	--------Inches-------		----------F°--------	
January	3.23	4.11	49	29
February	3.07	2.45	57	34
March	4.06	3.77	66	41
April	4.33	4.55	75	49
May	5.75	5.41	81	58
June	4.21	4.44	89	65
July	3.5	3.24	94	69
August	2.32	3.39	94	68
September	4.06	3.52	86	61
October	3.9	3.44	76	51
November	5.08	3.40	62	40
December	4.25	3.32	52	32
Total/Avg.	47.8	45.04	73	50

2010 Summary of Studies

Indiangrass Initial Evaluation Study

Introduction

Indiangrass (*Sorghastrum nutans*) is a native warm-season perennial grass, and a major component of the tall grass vegetation which once dominated the prairies of the central and eastern United States. Indiangrass grows three to five feet tall. Even as an immature plant, it can be distinguished from other native grasses by the "rifle-site" ligules at the point where the leaf attaches to the stem. The seed head is a single, narrow, plume-like panicle of a golden brown color. The seed is light and fluffy with small awns attached.

Indiangrass is adapted to the northeast, west to Texas, and North Dakota. It grows best in deep, well drained soils, however is highly tolerant of poorly to excessively well drained soils, acid to alkaline conditions and textures ranging from sand to clay. It is being recognized as a potential bio-fuel feedstock, a grass species for wildlife habitat, and water quality. Preliminary studies and plant surveys indicate that Indiangrass is will adapted to the service area of the Booneville Plant Materials Center (PMC).

Indiangrass that is drought tolerant and has increased dry-matter production may one day contribute to reducing our dependence on foreign oil and ease the energy crisis. Since Indiangrass is a renewable resource which is produced on American farms it has great relevance as a top current economic and environmental issue. Indiangrass is also used for wildlife habitat improvement; livestock forage, and a component of buffer systems to improve water quality.

Development of a substantially improved Indiangrass cultivar to use as a perennial crop for livestock consumption, wildlife enhancement, to use as a buffer crop to trap nutrients and possibly as a bio-fuel feedstock could benefit our agricultural economy by providing an important new source of income for farmers. Bio-fuel production from perennial cropping systems would help reduce loss of agricultural soils, reduce our dependence on imported oil supplies, and lower greenhouse gas emissions and other toxic material into the atmosphere.

Methods and Materials

The Booneville Plant Materials Center (PMC) has initiated a study to examine the possibility of developing a new Indiangrass cultivar. In the fall of 2006, numerous Indiangrass seed collections were made from western Arkansas, eastern Oklahoma, and southern Missouri. Each collection of seed was assigned an accession number. In February of 2006 the seed was planted in cones and maintained in the greenhouse for five to six weeks. The vegetative material was then transplanted to the field for initial evaluation. The transplants were established in five plant subplots, replicated three times. The middle three plants are used for evaluation. The ratings for the study consist of disease resistance, insect resistance, drought tolerance, basal distribution, plant height, leaf width, leafiness, and boot/bloom date. Ratings for the Indiangrass accessions were based on a numerical value from one to ten, ten being the highest. Visual ratings for the three replications were then averaged for a final numerical value, which is reported in the tables (2007-2008) at the end of this report.

The study was irrigated in 2007 to insure establishment. No future irrigation will be applied. The plots were burned March 3, 2008. Two hundred and fifty pounds per acre of 17-17-17 fertilizer was applied on April 14, 2008.

Results

2007-2008

All accessions in the study exhibited slight or no evidence of insect infestation in 2007 and 2008. The leaves of Indiangrass accessions were found to be infected with rust in 2007 but were 75% rust free during 2008. Accessions with a rating of 7 to 8 would be considered more disease resistant than accessions with lower ratings. Drought tolerance is an important characteristic that will determine if the accession is selected for further evaluation. Rainfall amounts during the growing season 2008 were sufficient enough that no drought evaluations were performed. Basal diameter, plant height, leaf width and leafiness are all characteristics which are used to determine dry-matter production. Values of 5.7 and above are important in basal diameter selection. Visual ratings of 5.3 or higher are important for height and leaf width. Ten accessions had ratings of 5.7 or higher for leafiness in 2007, and nine accessions had a rating of nine or higher in 2008. The average bloom date in 2007 was September 4th and August 27th, in 2008. Some entries bloomed as late as September 20th in both years.

2009

The plots were burned in early March of 2009 and 250 lbs/acre of 17-17-17 complete fertilizer applied April 10th. Accessions (12) were selected, based on data collected in 2008 and 2009, for advanced evaluation. Forage samples were harvested in June 2009 and analyzed for forage quality (Table 3) by the University of Arkansas Forages Lab in Fayetteville, Arkansas. These selected plants will be transplanted to an advanced evaluation nursery in the spring of 2011. Selections will be evaluated based on seed production and seed quality, and forage dry matter yield.

2010

Indiangrass initial evaluation plots were burned March 12, 2010. Two hundred fifty pounds per acre of 17-17-17 complete fertilizer was applied on April 5. Accessions (9) selected in 2009 for advanced evaluation were harvested (grab sample) on June 11 and analyzed for forage quality by the University of Arkansas, Fayetteville forages lab (table 4). These selected plants will be transplanted to an advanced evaluation nursery in the spring of 2011. Selections will be evaluated based on seed production, seed quality, and forage dry matter yield/quality.

Table 1. Observation Ratings for Indiangrass Accessions, 2007

Number	Disease Resistant	Insect Resistant	Drought Tolerance	Basal Distribution	Height	Leaf Width	Leafiness	Bloom Date
Americus	6	9	6	6	5.3	6.7	6.3	18-Sept
Cheyenne	7	9	5.7	5.3	5	4.7	5.3	4-Sept
761	8	9	6.3	6.3	6.3	5.7	6.3	4-Sept
762	5	9	5	4.3	4.7	4.7	4.7	18-Sept
763	8	9	6.7	6	6.7	5.3	6	19-Sept
764	6	9	5.7	6	5.7	5.7	5.7	4-Sept
765	6	9	3.7	5.3	5	4.7	5.7	3-Sept
766	4	9	6.3	5.7	5.7	5	5.7	4-Sept
767	5	9	4	4	4	4	4	2-Sept
768	6	9	5.7	6	6	5.3	5.7	4-Sept
769	4	9	4.7	4	4.7	5.3	4	19-Sept
770	7	9	4.7	4.3	4	4	4.3	20-Sept
771	6	9	3	4	4	2.3	22.3	19-Sept
776	4	9	4.3	4	4	4	4	19-Sept
777	4	9	5	4.3	4	4.3	4.3	4-Sept
778	5	9	4	4	4	4	4	4-Sept
779	4	9	3.3	3.7	3.7	3.3	3.7	5-Sept
780	4	9	4	4	4	4	4	6-Sept
781	5	9	5.7	5	4.7	5	6.3	6-Sept
783	5	9	4	4	4	4	4	4-Sept
785	5	9	5	5	4.7	5	5	4-Sept
790	4	9	4.3	4.3	4.3	5	4.7	4-Sept
791	6	9	4.7	5	4	4	4	4-Sept
793	5	9	4.7	4	4	4	4.3	5-Sept
796	6	9	5	5	5	6	5	4-Sept
797	5	9	5	5.7	5	5.3	5.7	4-Sept
802	4	9	4.3	4.3	4	4	3.7	3-Sept
803	5	9	4	3.7	3.7	4	4	4-Sept
807	6	9	5	6	5	5.3	6.3	4-Sept
809	4	9	4.7	4.3	4.3	4	4.3	5-Sept
810	8	9	5.3	5.7	5.7	5.7	6	5-Sept
811	5	9	5	3	3	4	4	4-Sept
812	8	9	4.7	5	4.7	5	5	6-Sept
813	4	9	3	3	3	3	3	3-Sept
815	5	9	5	5.3	5	5	5.7	5-Sept
816	4	9	4.7	4	4.3	4.3	4	4-Sept
817	8	9	6	5.7	5	4.7	5.7	10-Sept
820	3	9	3	3	3	3	3	2-Sept
827	5	9	4	4	4	4	4	3-Sept
829	4	9	4	4	4	4	4	5-Sept
831	5	9	5	4	4	4	4	5-Sept
832	5	9	6	6	6	6	6	4-Sept
835	8	9	5.7	5.3	5.3	5.7	5.3	4-Sept
836	4	9	4	3.3	3.7	3.7	3.7	5-Sept

Table 1. (con't). Observation Ratings for Indiangrass Accessions, 2007

Number	Disease Resistant	Insect Resistant	Drought Tolerance	Basal Distribution	Height	Leaf Width	Leafiness	Bloom Date
837	4	9	4.7	3.7	3.7	3.7	3.7	7-Sept
838	5	9	5	5	5	4	4	4-Sept
840	5	9	4	4	4	4	4	2-Sept

Table 2. Observation Ratings for Indiangrass Accessions, 2008

Number	Disease Resistant	Insect Resistant	Drought Tolerance	Basal Distribution	Height	Leafiness	Bloom Date
Americus	9	10	N/A	8.5	34.5	8.5	25-Aug
Cheyenne	9	10	N/A	8.5	32	9	19-Aug
761	10	10	N/A	8.7	33.3	8.3	3-Sept
762	9	10	N/A	7.7	35.3	8	7-Sept
763	9.7	10	N/A	8.3	37	8.3	29-Aug
764	9	10	N/A	7	29.7	7	18-Aug
765	9.4	9.7	N/A	7.3	33.7	8	25-Aug
766	9.7	10	N/A	9	44.4	9	25-Aug
767	9	10	N/A	8.5	32.5	7.5	5-Sept
768	9.7	10	N/A	9.7	37.3	9.7	25-Aug
769	9	10	N/A	7.7	33	7.3	5-Sept
770	9.7	10	N/A	9.3	36.7	9.3	5-Sept
771	10	10	N/A	10	33	9	29-Aug
776	9	10	N/A	8	31.3	7.7	18-Aug
777	9.3	10	N/A	9	34	9	10-Sept
778	9	10	N/A	7	28	6	5-Sept
779	9	10	N/A	8	34	8	30-Aug
780	9	10	N/A	8	34	8	20-Aug
781	9	10	N/A	8	32.7	7.3	5-Sept
783	9	10	N/A	7	34	6	10-Sept
785	9	10	N/A	8.5	35.5	8.5	5-Sept
790	9	9.7	N/A	6.7	29.7	6.3	8-Sept
791	9.5	10	N/A	8	35.5	7.5	20-Aug
793	9	9.7	N/A	6.7	27	6.7	10-Sept
796	9	10	N/A	8.7	35.3	8	29-Aug
797	9.7	10	N/A	8	37	8.3	21-Aug
802	9.3	10	N/A	5.7	25.7	5.3	25-Aug
803	9	10	N/A	6.3	28.7	5.7	25-Aug
807	9.3	10	N/A	9	37	9	22-Aug
809	9	10	N/A	6.5	32.5	6	29-Aug
810	9.7	10	N/A	9	32.3	9	10-Sept
811	9	10	N/A	6	29.5	6	10-Sept
812	9.3	10	N/A	8	34	7.3	20-Aug

Table 2. (con't). Observation Ratings for Indiangrass Accessions, 2008

Number	Disease Resistant	Insect Resistant	Drought Tolerance	Basal Distribution	Height	Leafiness	Bloom Date
837	9	9.3	N/A	8	35.7	8	25-Aug
838	9	10	N/A	9	40	10	20-Aug
840	9	10	N/A	7	28	7	5-Sept
813	N/A	N/A	N/A	N/A	N/A	N/A	N/A
815	9.7	10	N/A	7.3	30.7	7.3	10-Sept
816	9	9.7	N/A	5.3	31.7	5.3	10-Aug
817	9	10	N/A	7.7	35	7.6	29-Aug
820	9	10	N/A	6	29.5	5	20-Aug
827	9	9.5	N/A	6	30.5	6	20-Aug
829	9	10	N/A	6	28	6	25-Aug
831	10	10	N/A	9	39	9	5-Sept
832	9	9.7	N/A	6.7	35.7	6.3	18-Aug
835	10	10	N/A	10	38.7	10	29-Aug
836	9	8.7	N/A	6.7	34.7	5.7	25-Aug

Table 4. Forage Quality Estimates of Selected Indiangrass Accessions, June 2009 Harvest

Accession/Cultivar	Crude Protein	Acid Detergent fiber (ADF)	Neutral detergent fiber (NDF)	Total Digestible Nutrients (TDN)
	----------%----------			
905762	8.17	34.97	60.32	53.74
905763	7.36	35.09	61.87	53.15
905763	7.81	34.66	62.96	53.74
905768	7.14	35.71	64.16	52.58
905777	8.21	35.22	66.54	53.58
905802	6.41	37.97	66.36	50.51
905812	9.06	36.92	62.58	52.91
905812	7.99	35.90	62.80	52.96
905817	7.55	35.44	64.99	53.02
905835	8.09	36.27	62.11	52.76
905835	7.13	34.76	63.90	53.24
905837	5.93	33.90	60.22	53.11

Table 5. Forage quality Estimates of Selected Indiangrass accessions, June 2010 Harvest

Accession/Cultivar1[1]	Crude Protein	Acid Detergent Fiber (ADF)	Neutral Detergent Fiber (NDF)	Total Digestible Nutrients (TDN)
	----------%----------			
Americus	6	40	66	49
Cheyenne	8	35	63	53
R1-R1-763-4	7	36	63	54
R1-R1-768-1	7	34	63	53
R1-R1-817-2	7	35	66	52
R1-R1-835-4	6	35	67	54
R1-R2-777-1	8	34	65	51
R2-R1-835-1	6	36	66	51
R2-R2-762-3	7	37	67	52
R2-R2-763-1	7	36	66	52
R3-R2-837-2	6	37	65	51
Mean	7	36	65	52
1 – Samples taken in late vegetative growth stage (June 2010)				

Virginia Wildrye Initial Evaluation Study

Introduction

Virginia wildrye (*Elymus virginicus*) is a native, cool season, perennial bunchgrass which grows two to three feet in height. It reproduces by tillers and seed. Virginia wildrye self-fertilizes, but has been known to hybridize andintrogress (outcrossing depression). Virginia wildrye can be found throughout the United States except for Nevada, California, and Oregon. In Texas, it can be found occasionally throughout most regions with the exception of the most western fifth of the state. It can be found scattered on shaded banks, along fencerows and in open woodlands. Virginia wildrye prefers moist soils, high soil fertility, heavier soil textures, and it is shade tolerant.

Virginia wildrye is very palatable and nutritious, and is readily eaten by all classes of livestock in the spring and fall while it is green. It can be used in range restoration as a cool season grass, and in native range seed mixes. It can also be used as a cool season pasture grass in shaded, wooded, or riparian areas. Virginia wildrye is a good forage producer. It can produce as much as 3,300 lbs of dry weight forage per dryland acre.

Methods and Materials

The Booneville Plant Materials Center (PMC) has initiated a study to examine the possibility of developing a new Virginia wildrye cultivar. In the fall of 2009, eighty eight Virginia widlrye seed collections were made from western Arkansas. Each collection of seed was assigned an accession number. In January the seed was planted in cones and maintained in the greenhouse for five to six weeks. The vegetative material was then transplanted to the field for initial evaluation. The transplants were established in five plant subplots, replicated three times. Plots were irrigated during the spring and summer 2010. The middle three plants are used for evaluation. The ratings for the study will consist of disease resistance, insect resistance, drought tolerance, basal distribution, plant height, leaf width, leafiness, and boot/bloom date.

2010 Results

Survival data was collected during the 2010 growing season. Fifty six percent of the accessions survived the summer. Those accessions will be transplanted into a polycross nursery in the fall of 2011.

Yield and Persistence of Eleven Big Bluestem Sources in Kansas, Missouri, Arkansas and Mississippi

Introduction

Big bluestem (*Andropogon gerardii*) is a native, perennial, warm season grass that occurs from the short grass prairie region to the Atlantic Ocean. It is tufted, forms sod, and has short, scaly rhizomes. Big bluestem is tall, reaching a height of six to eight feet on most sites where it is protected from grazing. It is very leafy at the base, with some leaves carried up on the stem. Seed heads normally have a three spikelet bloom that resembles a "turkey's foot".

There have been several prevarietal releases of big bluestem made in recent years by Booneville, Arkansas Plant Materials Center and Elsberry, Missouri Plant Materials Center. Comparative evaluations of these prevarietal releases and a selection from the Manhattan, Kansas Plant Materials Center are needed to further document their performance and adaptation in other geographical regions. Information gained from these plantings may be used to provide data to support elevating low class releases (e.g. source if and selected class) to a higher release category (e.g. tested class or cultivar).

In addition to these releases, standard big bluestem cultivars commonly used in the USDA, Natural Resources Conservation Service conservation plantings and programs will be included in the trial along with other cultivars developed by the USDA-Agricultural Research Service in Lincoln, Nebraska.

Methods and Materials

Big bluestem entries were established in 6-ft X 9-ft plots at the PMC in Booneville, Arkansas; Elsberry, Missouri; Coffeeville, Mississippi; and Manhattan, Kansas in 2008. Experimental design is "Randomized Complete Block", with four replications. Soil fertility (P and K) were adjusted for medium production. Nitrogen fertilizer was applied at a rate of 60 lbs/acre when the plants reached the third leaf stage in 2009. Irrigation water was applied to insure survival during the establishment year.

Evaluation factors include; vigor*, disease resistance*, insect resistance*, and plant height* Subjective ratings: 1 = excellent; 3 = good; 5 = fair, 7 = poor.

2009 Results and Summary

An evaluation rating was performed prior to the first harvest (see Table 1). Forage yield data was collected when 50% of the first entry reached the late boot state (1st seed head emerging) of growth. Average plant height was recorded from the center four plants of each entry in each replication. Yield was determined by sampling four plants from the center of each row at a cutting height of 8". Average plot weight was determined for each entry by replication and a grab sample collected for day-matter calculation. Yield per acre was determined by multiplying average plot weight by percentage dry-matter then by 3630. All remaining plants were removed from the plot after harvest.

The second harvest was made after the first killing frost (Fall 2009). Yield was determined by the same methods as Harvest 1.

Table 1. Plant Vigor, Environmental Influences and Plant Height of Big Bluestem Cultivars and Sources, 9 June 2009

Cultivar/Source	Vigor	Disease Resistant	Insect Resistant	Plant Height (inches)
Rountree	2	1	1	24
Hampton Germplasm	1	1	1	19
Kaw	3	1	1	19
483446	3	1	1	24
9083274	2	1	1	20
Goldmine	1	1	1	21
OZ-70	3	1	1	22
Pawnee	3	1	1	19
Bonanza	1	1	1	21
Refuge	3	1	1	19
EPIC	2	1	1	23
Mean	2	1	1	21
1 = Rating Scale 1 = Excellent; 3 = Good; 5 = Fair; 7 = Poor				

Table 2. Yield and Forage Quality of Big Bluestem Sources, 2009

Entry	Harvest Mean 22 June	Harvest Mean 21 Dec	Crude[1/] Protein (CP)	Total Digestible[1/] Nutrients (TDN)
	----------lb/acre----------		----------%----------	
Hampton	4,480	2,774	8.63	52.92
OZ-70	5,828	1,854	7.43	52.36
Refuge	2,389	1,384	8.85	53.94
9083274	4,279	1,963	8.15	53.91
Epic	4,061	1,887	8.32	52.95
Rountree	6,792	1,295	7.91	53.8
Kaw	3,898	2,407	8.82	52.54
483446	4,403	2,354	7.4	55.4
Pawnee	3,112	1,704	7.74	52.6
Bonanza	2,283	1,534	8.34	54.37
Goldmine	2,583	1,006	8.11	54.26
1 – CP and TDN estimates are for 22 June harvest.				

2010 Results and Summary

Yield

Yield of each big bluestem entry by harvest date and season total is presented in Table 3. Hampton Germplasm, 'Rountree' and 'Kaw' produced the greatest yield in the 15 June harvest (boot stage), averaging over 2.5 ton/acre. Biomass accumulation from 15 June to 8 December is shown in Table 3. 'Kaw', 483446 and Hampton germplasm accumulated the most biomass during this time with an average yield of over .6 ton/acre. In the season total yield (1st harvest + 2nd harvest), 'Kaw', Hampton Germplasm and Rountree produced the greatest season total yield compared to the other entries (Table 3).

Quality Estimates

Forage quality estimates of big bluestem sources at the 15 June harvest is presented in Table 5. Crude protein was similar for all entries (average 7%) with 'Rountree' and 'Goldmine' having the lowest CP. Average ADF and NDF of bluestem entries was 35% and 67%, respectively. 'Pawnee' EPIC and Refuge had the lowest ADF and NDF percentages, resulting in a higher TDN percentage (53%) compared to entries with higher ADF and NDF percentages.

Vigor, Height and Environmental Influences

There distinct differences in plant vigor between the bluestem entries (Table 4). Hampton Germplasm and OZ 70 ranked the highest plant vigor. Refuge and Goldmine ranked the lowest. All entries ranked exceptional in resistance to insect and diseases. Height varied among the entries with a major between 40 to 50 inches tall. The tallest entry was 9083274 and the shortest was EPIC.

Table 4. Plant Vigor, Environmental Influences and Plant height of Big Bluestem Cultivars and Sources, 15 June 2010

Cultivar/Source	Vigor	Disease Resistant	Insect Resistant	Plant Height (inches)
Rountree	4"	1"	1"	51
Hampton Germplasm	1	1	1	51
Kaw	3	1	1	48
483446	3	1	1	50
9083274	3	2	1	58
Goldmine	6	2	1	40
OZ-70	2	1	1	48
Pawnee	5	2	1	44
Bonanza	5	1	1	43
Refuge	7	2	1	32
EPIC	6	1	1	41
Mean	4	1	1	46
1 = Rating Scale 1 = Excellent; 3 = Good; 5 = Fair; 7 = Poor				

Table 3. Yield of Big Bluestem Sources by Harvest date and Season Total, 2010

Cultivar/Source	Dry Matter Harvest 1 (June 15)	Dry Matter Harvest 2 (Dec 8)	Season Total Dry Matter
	----------lb/acre----------		
Rountree	5516	997	**6513**
Hampton Germplasm	5426	1371	**6797**
Kaw	5143	1751	**6895**
483446	4759	1687	**6446**
9083274	4751	1037	**5788**
Goldmine	4636	1401	**6038**
OZ-70	4558	1304	**5862**
Pawnee	4493	825	**5318**
Bonanza	4470	791	**5260**
Refuge	3082	550	**3632**
EPIC	2713	1182	**3638**
Mean	4504	1172	**5653**
LSD $_{(0.05)}$	NS	588	**NS**
CV	32	34	**30**
LSD = least significant difference			
NS = not significant			

Table 5. Forage Quality Estimates of Big Bluestem Sources Harvested 15 June 2010

Cultivar/Source	Crude Protein (CP)	Acid Detergent Fiber (ADF)	Neutral Detergent Fiber (NDF)	Total Digestible Nutrients (TDN)
	----------%----------			
Rountree	6 c[1]	39 a	68 a	49
Hampton Germplasm	8 a	39 a	68 a	51
Kaw	7 abc	37 bcd	65 bc	51
483446	8 a	37 bc	65 bc	52
9083274	7 ab	38 ab	68 a	51
Goldmine	6 bc	36 cde	64 c	52
OZ-70	7 ab	37 bcd	65 bc	52
Pawnee	7 abc	35 e	65 bc	53
Bonanza	7 abc	37 bcd	64 c	52
Refuge	7 ab	35 de	64 bc	53
EPIC	8 ab	34 e	63 c	53
Mean	**7**	**37**	**65**	**52**

1 – Means in columns followed by the same letters are not significantly different at P<0.05

Switchgrass Biofuel Study

Introduction

Switchgrass (*Panicum virgatum*) is native to all of the United States except California and the Pacific Northwest. It is a perennial sod-forming grass that grows three to five feet tall and can be distinguished from other warm season grasses, even when plants are immature, by the white patch of hair at the point where the leaf attaches to the stem. The stem is round and usually has a reddish tint. The seed head is an open, spreading panicle.

It is being recognized as a potential renewable energy source and an alternative cash crop. Preliminary studies indicate that switchgrass has potential for significant biomass production.

Switchgrass may one day help ease the heartburn that the American motorist has been experiencing every time they go to the gas pump. The ability to use energy crops produced on America farms as a source of renewable fuels is a concept with great relevance to current economic and environmental issues. In the near future, switchgrass may provide an answer to this problem.

Development of a substantial capacity to use perennial forage crops such as switchgrass for biofuels feedstock could benefit our agricultural economy by providing an important new source of income for farmers. Biofuel production from perennial cropping systems would help reduce loss of agricultural soils, reduce our dependence on imported oil supplies, and lower greenhouse gas emissions and other toxic materials in the atmosphere.

American produced ethanol can help reduce imports of oil by 1.5 billion barrels a year. Corn which has been used to produce ethanol must first be converted to sugar and the sugar than fermented into alcohol for marketing as ethanol. Cellulosic material, which can be produced directly from switchgrass, may be directly converted into ethanol and this requires less energy to produce.

The Plant Materials Center initiated a study with two cultivars ('Alamo' and 'Cave-in-Rock') of switchgrass, using irrigated/non-irrigated and commercial fertilizer/animal waste fertility treatments to determine the optimum combination of these variables to maximize production of annual biomass. Since currently, there are no cellulosic biofuels feedstock markets in western Arkansas or eastern Oklahoma, harvested materials are being analyzed for forage quality. Ranchers, who want to produce switchgrass for the biofuels market, can utilize it as high quality, high yielding forage until those markets become available.

Methods and Materials

The 'Alamo' and 'Cave-in-Rock' switchgrass cultivars were established in 40' X 40' plots (randomized complete block design with three replications) in the spring of 2007. Soil samples were collected from each treatment/replication prior to planting. Samples were analyzed by the University of Arkansas soils lab in Fayetteville, Arkansas. Soil amendments were applied to bring nutrient levels up to medium production prior to planting.

A clean firm seedbed was prepared. The cultivars were then planted on March 5, 2007 at a rate of five lbs/acre/Pure Live Seed (PLS), using a Marliss Grain Drill. The seedbed was then rolled with a water filled roller.

A permanent irrigation system was installed in replicated irrigation treatments in the summer of 2007. Rain gauges were placed in the irrigated plots to enable technicians to calibrate the delivery system. Rainfall data

is collected by Dr. David Burner with the Agricultural Research Service, located at the Dale Bumpers Small Farms Research Service

Fertility was applied at green up in early April, 2008. The animal waste treatment plots received four tons/acre of dry broiler litter. Commercial fertility treatment was 300 lbs/acre of 13-13-13.

The study is designed to be harvested on multiple dates and also an annual harvest after a killing frost. The two harvest plans will identify harvest dates that yield the greatest amount of annual biomass with the least harvest cost.

2008-2009 Results and Summary

The first harvest (see Table 1) was made on June 17, 2008. No irrigation water was applied prior to the June 17th harvest. Samples were collected and dry matter production calculated from plot weight, wet weight, and dry weight data. The dry samples were then prepared by PMC staff and analyzed by the University of Arkansas Forage Labs in Fayetteville, Arkansas for forage quality (see Table 1 below). Fall samples were collected in November 2008 after frost. Plots harvested in June were again harvested in November, along with plots harvested for the first time in 2008. This data was collected to determine if annual biomass production was increased/decreased by multiple vs. single season harvest.

2010 Results and Summary

The first harvest (see table 2) was made on June 16, 2010. Irrigation water was applied as needed in 1" per week applications. Dry matter production was calculated, and forage quality (see table 3) analysis performed by the University of Arkansas Forage lab in Fayetteville. In 2010 there was no significant yield difference (see table 2) between multiple vs single annual harvests. There was no significant difference in forage quality (see table 3) between dry broiler litter and commercial fertilizer, either irrigated or non irrigated. this study will be concluded in 2012.

Table 1. Yield of Alamo and Cave-in-Rock Switchgrass by Fertility Treatment and Harvest System, 2008 and 2009

Treatment	2008 Dry Matter Mean Harvest 1 (June 19)	2008 Dry Matter Mean Harvest 2 (Nov. 17)	2008 Two Harvest Mean Total	2008 Single Harvest Mean (Nov. 17)	2009 Dry Matter Mean Harvest 1 (June 16)	2009 Dry Matter Mean Harvest 2 (Dec. 14)	2009 Two Harvest Total Mean	2009 Single Harvest Mean (Dec. 14)
	----------	----------	----------	----lb/acre	----------	----------	----------	----------
Alamo Comm. Fert.	10820	4873	**15693**	**10400**	20221	4865	**25086**	**15815**
Alamo Litter	12487	6507	**18993**	**11853**	18566	5163	**23732**	**15423**
Alamo Irrig. Comm. Fert.	7460	3880	**11340**	**10633**	19732	5116	**24846**	**13411**
Alamo Irrig. Litter	12220	5807	**18027**	**14600**	21498	6967	**27460**	**12467**
Cave-In-Rock Comm. Fert.	8360	2393	**10753**	**7280**	21250	2958	**24211**	**7313**
Cave-in-Rock Litter	9633	3900	**13533**	**8227**	16861	3887	**20747**	**9643**
Cave-In-Rock Irrig. Comm. Fert.	9440	2907	**12347**	**8440**	17495	4580	**22076**	**9438**
Cave-In-Rock Irrig. Litter	12093	4713	**16807**	**8287**	17533	4579	**23516**	**8619**
Mean	**10314**	**4373**	**14687**	**9965**	**19147**	**4812**	**23959**	**11156**
LSD $_{(0.05)}$	**2414**	**1466**	**3323**	**2277**	**NS**	**NS**	**NS**	**3330**

Litter = Dry broiler litter

Comm. Fert. = Commercial Fertilizer

LSD = least significant difference

NS = not significant

Table 2. Yield of Alamo and Cave-in-Rock Switchgrass by Fertility Treatment and Harvest System, 2010

Treatment	2010 Dry Matter Mean Harvest 1 (June 16)	2010 Dry Matte Mean Harvest 2 (Dec 2)	2010 Two Harvest Mean Total	2010 Single Harvest Mean (Dec 2)
	----------lb/acre----------			
Alamo Comm. Fert.	11110	3043	**14153**	**12976**
Alamo Litter	9382	3495	**12877**	**12664**
Alamo Irrig. Comm. Fert.	9602	3922	**13524**	**14632**
Alamo Irrig. Litter	10631	6011	**16642**	**14892**
Cave-In-Rock Comm. Fert.	10142	1940	**12082**	**7858**
Cave-in-Rock Litter	8349	2222	**10571**	**8971**
Cave-In-Rock Irrig. Comm. Fert.	8474	2962	**11436**	**8447**
Cave-In-Rock Irrig. Litter	8310	3705	**12012**	**10524**
Mean	9500	3413	**12912**	**11371**
LSD $_{(0.05)}$	NS	1472	**3539**	**3461**
Litter = Dry broiler litter				
Comm. Fert. = Commercial Fertilizer				
LSD = least significant difference				
NS = not significant				

Table 3. Forage quality estimates of Alamo and Cave-in-Rock Switchgrass by Fertility Treatment, 16 June 2010

Treatment	Crude Protein (CP)	Acid Detergent Fiber (ADF)	Neutral Detergent Fiber (NDF)	Total Digestible Nutrients (TDN)
Alamo Comm. Fert.	9a[1]	36a	68a	54
Alamo Litter	6a	34bc	66a	53
Alamo Irrig. Comm. Fert	8a	36a	68a	53
Alamo Irrig. Litter	7a	35ab	67a	53
Cave-In-Rock Comm. Fert.	8a	37a	65ab	52
Cave-In-Rock Litter	7a	32c	60c	55
Cave-In-Rock Irrig. Comm. Fert.	9a	33bc	60c	56
Cave-In-Rock Irrig. Litter	7a	35abc	63bc	53
Mean	8	35	65	54

1 – Means in columns followed by the same letters are not significantly different at $P<0.05$
Litter = Dry Broiler Litter
Comm. Fert. = Commercial Fertilizer

Evaluation of Warm Season Grass for Biofuel

Introduction

Switchgrass has been designated as one of the primary biofuel species for combustion, gasification, and liquid fuel production. The PMC staff and Dr. David Burner, USDA-ARS Dale Bumpers Small Research Farm, partnered together to evaluate other warm season grasses for biofuel potential in western Arkansas and eastern Oklahoma. Perennial grasses included *Miscanthus sacchariflorus*, which was used in the development of *M. giganteus*, a sterile hybrid resulting from a cross between *M. sinensis,* sugarcane plume grass (*Saccharum giganteum*). Also included in the study was Hampton Germplasm big bluestem (*Andropogon gerardii*), which was released by the PMC in 2008.

Materials and Methods

Plots of miscanthus, (5'X12') sugarcane plume grass, Hampton Germplasm and Alamo were established in May 2008 in a randomized complete block design with 3 replications on a Leadvale silt loam soil at the PMC. Weeds were controlled mechanically or by spot spraying with glyphosate throughout the growing season. No data was collected in 2008. In 2009 and 2010, fertilizer was broadcast applied to each plot at a rate of 200 lb/acre of 17-17-17. Biomass was harvested 2 December 2009 and 14 December 2010 by taking a 3' x 10' swath from the center of each plot. A subsample was collected from each plot and dried at 60°C for 24 hours and used to determine percent dry matter.

2009-2010 Results and Summary

Alamo and miscanthus were the highest yielding grasses in 2009-2010 (Table 1). Both grasses produced similar yields with Alamo producing significantly higher yield in 2009. These grasses produced three times the biomass of Hampton Germplasm big bluestem and sugarcane plumegrass over the 2 years. Because big bluestem and sugarcane plumegrass were substantially lower yielding than miscanthus and Alamo, the PMC will discontinue this study in 2011.

Table 1. Comparison of Biomass Production of Warm Season Grasses, 2009-2010

Entry	2009[1]	2010[2]	2 Year Average
	--------Yield (lb/acre)-------		
Alamo switchgrass	19 678 a[3]	20 500 a	**20 089**
M. *sacchariflorus*	22 499 a	18 308 b	**20 404**
Sugarcane plumegrass	4535 b	7584 c	**6060**
Hampton Germplasm big bluestem	7792 b	4014 d	**5903**
Mean	13 626	12 602	**13 114**

1 Harvested 12/2/2009
2 Harvested 12/14/2010
3 Means in columns followed by the same letters are not significantly different (P<0.05).

Alamo Switchgrass Residue Measurements for the Revised Universal Soil Loss Equation (RUSLE 2)

Introduction

The Revised Universal Soil Loss Equation is model developed to guide conservation planning, inventory erosion rates and sediment delivery. It will be used in developing conservation plans to evaluate erosion potential on land used for the production of biomass for direct combustion or conversion into liquid fuel. The PMC began a study in 2010, in cooperation with Dr. Seth Dabney at the USDA-ARS National Sedimentation Laboratory in Oxford, MS, to collect biomass samples and residue, which consists of standing stubble and surface residue, from an established stand of 'Alamo' switchgrass.

Methods and Materials

A three acre field of 'Alamo' switchgrass planted in 2000 at the PMC on a Leadvale silt loam was used for biomass and residue collection. Biomass samples were collected monthly beginning in April and ending in November (after the first frost) to a height of 6 inches. A 1 m^2 frame is used to collect early spring growth and a forage harvester (3' x 10') for later months at three (3) random locations in the field. A subsample is collected from each harvest and dried at 60°C for 24 hours for dry matter determination. Yield, plant height and percent growth are reported monthly. Phenological growth stage will be reported 2011. Standing stubble is determined every other month beginning in May and ending in November by harvesting the remaining six inches of stubble to near ground level in the same portion of the field used to determine biomass production. Stubble is collected using 1/4 m^2 frame. Surface litter (leaves, stems, etc) is collected within the same area as the stubble height using a 1/4 m^2. Both residue components are dried at 60°C for 24 hours (see next page for protocol used for data collection).

2010 Results and Summary

Monthly yield, percent growth and height for 'Alamo' are presented in Table 1. Peak yield occurred in September (13,517 lb/acre) with the greatest percentage of growth occurring in June (38%). No additional growth occurred after September.

Table 1. Monthly yield, percent growth and height of 'Alamo' Switchgrass, 2010

Month Date	Yield (lb/acre)	% Monthly Growth	Plant Height (inches)
12 Apr	398	3	15
5 May	4823	33	35
16 Jun	9907	38	missing
21 Jul	11 083	9	66
17 Aug	12 986	14	72
20 Sept	13 517	4	72
21 Oct	9906	0	75
17 Nov	9285	0	missing

Stubble and Surface residue of Alamo are presented in Table 2. Stubble yield varied slightly during the season but generally increased from May to November. This trend was also evident in the surface residue measurement, which stands to reason because as the grass matures leaves and other plant part fall from the plant and accumulate below the canopy. This data was sent to Dr. Seth Dabney for inclusion into the RUSLE2 database.

Table 2. Stubble and Surface Residue of Alamo switchgrass, 2010.

Date	Sample	Stubble	Surface Litter
		----------lb/acre----------	
05/18/2010	1a	1731	87
05/18/2010	1b	1919	109
05/18/2010	2a	2063	11
05/18/2010	2b	2296	104
05/18/2010	3a	1032	19
05/18/2010	3b	1770	18
07/21/2010	1a	2194	1095
07/21/2010	1b	2535	1582
07/21/2010	2a	2951	1107
07/21/2010	2b	2497	1074
07/21/2010	3a	3922	1234
07/21/2010	3b	2481	1096
09/20/2010	1a	2701	1782
09/20/2010	1b	3062	1416
09/20/2010	2a	3347	1880
09/20/2010	2b	3633	1577
09/20/2010	3a	3089	1451
09/20/2010	3b	2125	1938
11/17/2010	1a	2015	2485
11/17/2010	1b	1603	2253
11/17/2010	2a	1647	1445
11/17/2010	2b	1957	1973
11/17/2010	3a	1903	1352
11/17/2010	3b	1893	1649

Stubble and Residual Surface Biomass Collection Procedure after Harvesting the Above Ground Biomass for Growth Curve

The residue left in the field (leaves, stems, standing stubble), following removal of the above ground biomass used to establish a growth curve of a particular grass species, is referred to as *stubble* and *surface residue* biomass. This residue is important in predicting water and wind erosion using the Revised Universal Soil Loss Equation and the Wind Erosion Prediction System.

Method of Data Collection

1. Collect above ground biomass from plots with a plot harvester or similar harvesting method. A 3ft x 10ft swath taken from the center of the plot is common with a sickle bar mowers or plot harvester. Determine plot weight and collect subsamples (grab sample) for percent dry matter determination.
2. Place a 0.25 m^2 (50 cm x 50 cm; 19.7" x 19.7") sampling frame in the harvested plot area and collect the remaining plant residue. The residue is separated into 2 components: (1) stubble and (2) surface residue. The *stubble* refers to crowns and standing stubble and the *surface residue* refers to unattached stems and leaves. When selecting an area within the harvested swath or strip to sample, avoid areas with too little or too much residue. The goal is to select a representative area within the harvested strip.
3. Harvest the stubble as close to the ground as possible (at ground level) and place sample in a paper bag*.

   **It is anticipated that clipping the plant this close may result in severe plant damage or possible death. Avoid sampling these plants in subsequent years.*
4. Collect surface residue in the same 0.25 m^2. Avoid soil contamination in the surface residue samples. Place sample in a paper bag.
5. Repeat the above procedure, selecting a minimum of 6 random locations in a large block planting or replicated plots. Keep samples separate.
6. Weigh the stubble and surface residue samples and dry in a forced air oven at 55-60°C for 16-24 hrs or until dry. (report wet and dry weight)
7. Express the amount of stubble and surface residue in lb/acre and kg/ha.
8. Report the date of the first killing frost and the spring regrowth date (50% green up)

Forage Distribution Pattern of 'Alamo' Switchgrass, 'Bumpers' Eastern Gamagrass and Hampton Germplasm Big Bluestem

Introduction

Warm season grasses provide multiple conservation uses including forage for livestock, biomass for energy conversion processes, soil conservation and wildlife habitat. Growth patterns or growth curves of different vegetation types is important for conservation planning and decision support tools used by NRCS field offices to assist landowners and land managers. For example, a grazing module has been added to RUSLE2 to improve soil erosion prediction in pastures for grazing livestock. However, monthly forage distribution patterns of grasses are required for the model/module to operate efficiently in predicting soil erosion.

Methods and Materials

A three acre field of 'Alamo' switchgrass, and 1 acre of 'Bumpers' eastern gamagrass and 1 acre of Hampton Germplasm big bluestem is used for this study. Biomass samples are collected monthly beginning in April and ending in November (after the first frost) to a height of 6 inches. A 1 m^2 frame is used to collect early spring growth and a forage harvester (3' x 10') for later months. Samples were taken at three (3) random locations in the field. A subsample is collected from each harvest and dried at 60°C for 24 hours for dry matter determination. Yield, plant height and percent growth are reported monthly. Phenological growth stage will be reported 2011.

2010 Results and Summary

'Alamo' switchgrass

Monthly yield, percent growth and height for 'Alamo' are presented in Table 1. Peak yield occurred in September (13 517 lb/acre) with the greatest percentage of growth occurring in June (38%). No additional increase in biomass or growth occurred after September.

Table 1. Monthly Yield, Percent Growth and Height of 'Alamo' Switchgrass, 2010

Month Date	Yield (lb/acre)	% Monthly Growth	Plant Height (inches)
12 Apr	398	3	15
5 May	4823	33	35
16 Jun	9907	38	missing
21 Jul	11 083	9	66
17 Aug	12 986	14	72
20 Sept	13 517	4	72
21 Oct	9906	0	75
17 Nov	9285	0	missing

'Bumpers' eastern gamagrass

Monthly yield, percent growth and height for 'Bumpers' are presented in Table 2. Peak yield occurred in July (12 644 lb/acre) with the greatest percentage of growth occurring in June (58%). No substantial increase in production or growth occurred after August .

Table 2. Monthly Yield, Percent Growth and Height of 'Bumpers' Eastern Gamagrass, 2010

Month	Yield (lb/acre)	% Monthly Growth	Plant Height (inches)
Apr	538	4	12
May	4147	29	30
Jun	11 423	58	Missing
Jul	12 644	10	45
Aug	12 232	0	41
Sept	9810	0	36
Oct	9008	0	37
Nov	8034	0	30

Hampton Germplasm Big Bluestem

Monthly yield, percent growth and height for 'Bumpers' are presented in Table 3. Peak yield occurred in July (11 148 lb/acre) with the greatest percentage of growth occurring in June (32%). No substantial increase in production or growth occurred after August. This growth pattern followed the same trend as 'Bumpers'.

Table 3. Monthly Yield, Percent Growth and Height of 'Hampton Germplasm Big Bluestem, 2010

Month	Yield (lb/acre)	% Monthly Growth	Plant Height (inches)
Apr	277	2	7
May	3887	28	22
Jun	8123	32	Missing
Jul	11 148	23	32
Aug	9456	0	33
Sept	7350	0	32
Oct	9244	15	40
Nov	7349	0	27

Vegetative Rehabilitation of Highway Cut Slopes

Introduction

Areas of moderate to severe erosion are occurring on highway rights of way in eastern Oklahoma. The silt from this erosion is filling ditch bottoms causing drainage problems. It is very expensive for the Oklahoma Department of Transportation (ODOT) to remove and dispose of this material, only to have to do it again in the future. The answer to this problem is to research techniques to permanently vegetate the erosive areas so that the soil remains on the slope and out of the drainage system.

The USDA-NRCS Booneville Plant Materials Center (PMC) has specialized in critical area treatments. The PMC has researched and developed Critical Area Vegetation Specifications for the Bureau of Mines, Office of Surface Mines, Corps of Engineers, Arkansas Highway and Transportation Department, Arkansas Game and Fish Commission, and the US Forest Service.

Scope of work: Heavener and Poteau

The Heavener site was prepared and planted April 17th and 18th of 2007. The Poteau site was prepared and planted on April 19th and 20th of 2007. Site preparation was tillage (8' tractor mounted tiller was used) on half of each plot (300 X 60'). A mixture of 'Cheyenne' Indiangrass, 'Kaw' big bluestem, 'Aldous' little bluestem, and 'Alamo' switchgrass was applied by means of a hydro-seeder. The seeding rate was: big bluestem @ 2 lbs Pure Live Seed (PLS)/acre, switchgrass @ 2 lbs PLS/ac, Indiangrass @ 2 lbs PLS/ac and little bluestem @ 2 lbs PLS/ac. The sites were mulched immediately after seeding with ½ ton, and 1 ton, of wood fiber mulch treatments. Each mulch treatment was replicated three times at each site, on both tilled and non-tilled plots.

Scope of work: State Hwy128 (Sugar Creek)

The PMC staff performed site characterization on SH-128 at Sugar Creek, during October 2007. Soil samples were collected at the site and analyzed by the University of Arkansas at Fayetteville. There was no recommendation for lime, based on species to be planted, but phosphorus and potassium were required for each site. These elements were to be applied in the spring of 2008, when seed germinated.

The PMC staff laid out the research area (approximately 600' X 100'). Supplies (seed, fiber mulch, soils amendments, etc.) were purchased for the research plot in October. On November 5th, 6th, 7th, and 8th, the entire slope was hydro-seeded with 3 lbs/ac 'Alamo' switchgrass, 3 lbs/ac 'Kaw' big bluestem, 3 lbs/ac 'Aldous' little bluestem and 3 lbs/ac 'Cheyenne' Indiangrass. The top twenty feet of the site was mulched with wheat straw at a rate of 1.5 tons/ac, while the lower eighty feet of the slope was hydro-mulched, at a rate of 1 ton/acre.

Results: Heavener and Poteau

The PMC staff visited the Heavener and Poteau sites on ten day intervals (for one month, post planting) to record germination dates, plant vigor, and stand percentages.

The native grasses germinated (in tilled plots) within fifteen days of planting. The stands averaged 85% on the tilled plots. Germination took twenty-five days in no-till plots. The grasses in the tilled plots have grown at twice the rate of plants in the no-till plots. This is a function of inter-species competition for light, moisture, and nutrients.

The PMC staff evaluated these plots twelve times during October, November, and December, of 2007. The fall evaluations produced data that indicated medium to high success for tilled treatments and zero to poor success where no-till seed was applied. Stand success for native warm season grasses is measured by plant density.

The Heavener and Poteau plots received phosphorus and potassium fertilizer (200 lbs/ac of 0-60-60) in April of 2008. These plots were evaluated by PMC staff ten times during March, April, May and June of 2008. The tilled plots are consistently producing 80-85% cover while the no-till treatments have only 0-5% cover. Competition from weed species has contributed to the failure of the no-till treatments. Weed species are present in the tilled treatments, but over the next 2 to 3 growing seasons, the native grasses will eliminate most competition without herbicide treatment. Evaluations (7) conducted between August 1st and September 30th, 2008, indicate native grasses at both Heavener and Poteau (tilled plots) have matured to the point of producing seed. This seed germinated in the spring of 2009 and increased the stand density significantly (5 - 10%). The native species grasses broke dormancy several weeks prior to weed seed germination, allowing the grasses to suppress weed infestation. On May 12, 2009 a complete fertilizer (13-13-13) was applied at rates of 100, 200, and 300 lbs/acre, replicated three times at each site to plots that were established on tilled seedbeds. Evaluations were made during June and July to determine what effect, if any, the added fertility had on grass density, soil protection, and weed populations. Evaluations were made monthly during the 2010 growing season. Stand density was recorded during May – July 2010 (Table 1).

Table 1: Effects of Fertilizer Application on Stand Density May-July 2010 Plant Density Percentage

Heavener Site	Replication 1	Replication 2
100 lbs.	90	85
200 lbs.	95	92
300 lbs.	100	98
Poteau Site	**Replication 1**	**Replication 2**
100 lbs.	88	85
200 lbs.	93	95
300 lbs.	98	100

Agroforestry Practice: Alley Cropping with Shortleaf Pine and Switchgrass

Introduction

Agroforestry combines agriculture and forestry technologies to create diverse, profitable and sustainable land-use system. One Agroforestry practice that may appeal to landowners is alley cropping. Alley cropping is defined as the planting of trees or shrubs in two or more sets of single or multiple rows with agronomic, horticultural or forage crops cultivated in the alleys between the rows of woody plants. Growing switchgrass (*Panicum virgatum* L.) between rows of shortleaf pine (*Pinus echinata* Mill.) for biofuel may have potential as an Agroforestry practice for landowners in western Arkansas. However, there is limited information on the growth and production of shortleaf pine from competition of switchgrass interplanted between the rows in subsequent years following tree establishment. Objective of this study is to determine the effect of switchgrass on growth and survival of shortleaf pine.

Methods and Materials

The study is conducted at the PMC on a Leadvale silt loam. Shortleaf pine was established in a block (14' x14'), double row (8' x 8') and single row (8' x 24') tree arrangement in January 2006. Length and width of block, double row and single row planting was 154' x 378', 152' x 376' and 120' x 376', respectively, with a 40' alley between arrangements. The stocking rate for block, double row and single row tree arrangement was 222, 227 and 226 trees/acre, respectively. Tree arrangements were planted as a randomized complete block with three replications. 'Alamo' switchgrass was interplanted between tree rows at a rate of 5 lb PLS/acre on 13 April 2006. Above average precipitation during the late fall and early spring in 2007-2009 prevented extensive data collection. The first significant data collection began in 2010.

2010 Results and Summary

Four years after planting short-leaf pine and switchgrass on this site in 2006, there has been no negative effect of the switchgrass on the growth and development of the pine trees (Table 1). These findings suggest the landowner could plant trees in the winter and switchgrass the following spring and not be concerned that the switchgrass will hinder the growth and development of shortleaf pine on this type of site. This would enable landowners to transition more quickly into a silvopasture or biofuel production system without a 1 to 2 year delay for tree establishment before planting the switchgrass in the alleys.

Table 1. Height and diameter of shortleaf pine grown with and without Alamo switchgrass between the alleys, 2010

Treatment	Tree Measurements	
	Height (ft)	Diameter (in)
Switchgrass	8.1 a[1]	2.5 a
Control (no switchgrass)	8.0 a	2.5 a
1= means in columns followed by the same letters are not significantly different at P<0.05.		

2010 Presentations and Publications

Title	Location
Switchgrass as a biofuel feedstock and forage	Franklin County Cattlemen's Association, Ozark, AR
Biofuel Feedstock Production	Ozark, AR
In situ ruminal kinetics of dry matter and NDF disappearance of biomass forages	Southern Section, American Society of Animal Scientists
Benefits of Grazing Switchgrass in western AR	Logan County Cattlemen's Association, Paris, AR
Planting and Managing Native Grasses- Master Gardeners	Booneville, AR
FFA Field Day – Overview of PMC	Dale Bumpers Small Research Farm, Booneville, AR
Plant Materials Program	Fort Smith Lawn and Garden Show, Fort Smith, AR
Overview of Booneville PMC	33rd Annual Grazinglands Field Day, Salem, AR
PMC Tour for Master Gardeners	Booneville, AR
6th Annual Waldron Earth Day Festival – PMC Program	Waldron, AR
Grazing Benefits of Eastern Gamagrass	Logan County Cattlemen's Association, Paris, AR
Overview of PMC Activities and Operations	Booneville, AR
What Agriculture Does For US	Booneville, AR
Tour of PMC	Booneville, AR
Plant Materials Training for New NRCS Employees	Booneville, AR
Tour of PMC	Booneville, AR
Tour of PMC	Booneville, AR
Tour of PMC	Booneville, AR

Publication	Date
Booneville Plant Press - Newsletter	August
Booneville Plant Press - Newsletter	June
Booneville Plant Press - Newsletter	Winter Issue
Booneville Plant Press - Newsletter	September
In situ ruminal kinetics of dry matter and NDF disappearance of biomass forages	January
2009 Annual Technical Report	May
Annual Report of Activities	April
Oklahoma Department of Transportation 2009 Annual Report	January
1st Quarter Progress Report Oklahoma Department of Transportation	October

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