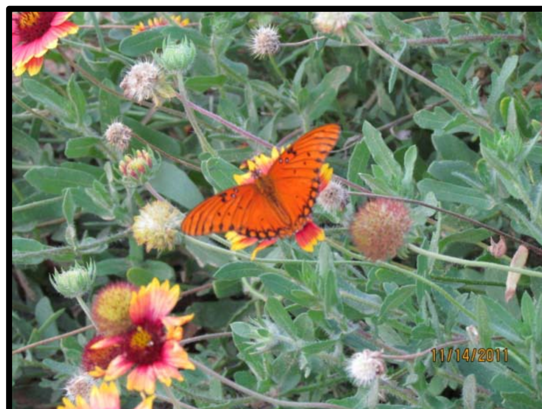
USDA NRCS Natural Resources Conservation Service

East Texas Plant Materials Center

2011 Technical Report



Nacogdoches, Texas *April 2011*

Helping People Help the Land

Table of Contents

Introduction

Who We Are

The East Texas Plant Materials Center (ETPMC) located at the Stephen F. Austin Experimental Forest near Nacogdoches, Texas is part of the Natural Resources Conservation Service (NRCS), United States Department of Agriculture. The Center is a joint venture between Soil and Water Conservation Districts in east Texas and northwestern Louisiana, NRCS, Stephen F. Austin State University, and US Forest Service.

What We Do

The mission of the NRCS Plant Materials Program is to develop and transfer plant materials and plant technology for the conservation of natural resources. In working with a broad range of plant species, including grasses, forbs, trees, and shrubs, the program seeks to address priority needs of field offices and land managers in both public and private sectors. Emphasis is focused on using native plants as a healthy way to solve conservation problems and protect ecosystems. Center personnel also develop research projects and technical reports for use in developing technical guides for agency personnel and landowners on the use of plant materials in various conservation practices.

The Center cooperates with other agencies and organizations to develop plant materials and technology. Cooperators include the US Forest Service, Soil and Water Conservation Districts in east Texas and western Louisiana, entities within NRCS, and the Arthur Temple College of Forestry and Agriculture at Stephen F. Austin State University at Nacogdoches, Texas.

Priorities of the East Texas Plant Materials Center:

PMC activities are directed to develop plant materials and corresponding technology for the following seven high priorities:

- Erosion control and improvement of water quality and quantity
- Domestic livestock and wildlife food and cover
- Revegetation, water quality improvement and erosion control following timber harvests.
- Revegetation and stabilization of surface mined areas
- Stream bank stabilization and frequently inundated bottomlands
- Saline areas and high water table soils
- Wetland environments using adapted herbaceous and woody aquatic species

Service Area

The Plant Materials Center serves 48.2 million acres in east Texas and northwestern Louisiana. The topography is diverse ranging from level floodplains to strongly sloping forestlands and prairies. Soils in the service area range from deep, coarse textured sands to heavy clay bottomlands. Average yearly rainfall amounts vary from 32 inches to 56 inches near the Gulf coast. Humidity and temperature are usually high during the growing season. The average growing season ranges from 228 days to 260 days from north to south. The Center is one of 27 USDA, Natural Resources Conservation Service, Plant Materials Centers strategically located across the nation. Centers are located to serve areas with similar soils, plants, and climate.

PMC Site Information

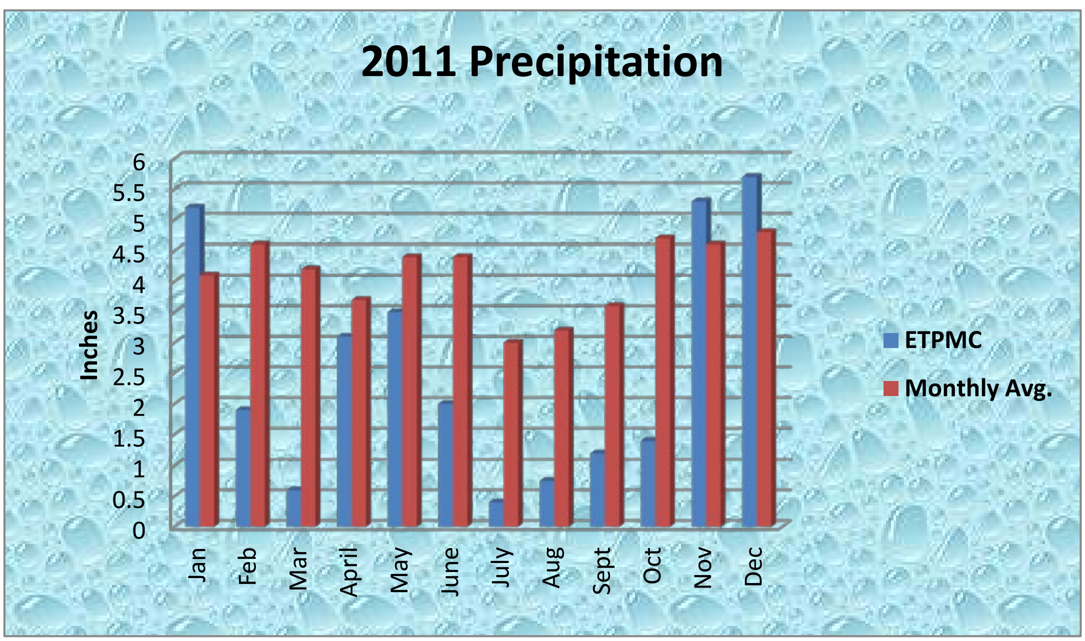
The PMC is located at the US Forest Service Stephen F. Austin Experimental Forest about ten miles southwest of Nacogdoches, Texas. Presently, 26 acres are utilized for plant evaluation studies and foundation seed production. Soils at the PMC are acidic, but considered productive. The soils are: Attoyac fine sandy loam, Bernaldo fine sandy loam, Woden fine sandy loam, and Bernaldo-Besner complex. These soils are gently sloping (0 to 4 percent) and will develop fragipans.

Personnel

Alan Shadow – ETPMC Manager
Michael Woody – Biological Technician
Melinda Brakie – Soil Conservationist
Max McCormack – WAE

Table 1. Temperature information for 2011

	Average High	Monthly High	Average Low	Monthly Low
January	58	72	36	18
February	62	81	39	14
March	69	88	45	30
April	77	93	53	34
May	84	97	63	41
June	90	102	70	64
July	93	104	72	70
August	95	108	72	68
September	89	104	65	48
October	79	91	54	34
November	69	82	45	27
December	60	72	37	16



Plant Studies

Title: Seed Production Comparison of Three Eastern Gamagrasses in East Texas
Study No: ETPMC-T-0671-PA
Study Leader: R. Alan Shadow
Duration: 2006-2009

Introduction

Eastern gamagrass is a native warm season perennial adapted throughout most of the eastern United States. The primary use of this plant is as a livestock forage but it has potential as vegetative barriers for controlling erosion on sloping cropland (Ball et al. 2002; Dewald et al. 1996). Low seed production has limited its acceptance in the commercial seed market. The USDA-NRCS ETPMC, Nacogdoches, TX, has released two eastern gamagrass cultivars, Medina and Jackson. A third accession 9043629 was identified as a potential release during initial testing and appeared to have better seed production potential than Medina and Jackson. The objective of this study was to determine if accession 9043629 had equal or superior seed yield and quality compared to Jackson and Medina.

Materials and Methods

The study was conducted at the ETPMC near Nacogdoches, Texas on an Attoyac fine sandy loam. The experimental design was a randomized complete block with three replications. Each plot consisted of 20 plants vegetatively established in a 5 x 4 arrangement on 3 ft centers. Irrigation water was used to accelerate establishment during the first year only. Plots were fertilized with ammonium nitrate (34-0-0) at a rate of 75 lb/acre each spring to ensure adequate fertility for fertile culms and increased seed yields (Wheeler and Hill 1957). Phosphorus and potassium were maintained at a medium to high level according to soil test recommendation. Weed control was obtained by manual cultivation and spot spraying with a 2% glyphosate solution.

Data was collected from three plants on the interior of each plot to minimize edge effect. Reproductive and vegetative tillers were counted, and seed harvested from 3 plants in each plot. Seed was harvested when approximately 75% of the stamens had dropped from the inflorescence. Seed was hand cleaned to remove anthers, stamens, and other stem material. Seed was allowed to dry at ambient temperature until there was no change in seed weight due to moisture loss. Weight from each plot was then recorded as bulk yield. Bulk seed from each plot was separated into light and heavy seed fractions with a South Dakota Seed Blower. The air flow regulator was 70% open to allow enough air flow through the plastic column to allow for efficient separation of filled and unfilled seed (Ahring and Franks, 1968). Seed from the heavy and light fractions were re-run through the South Dakota Seed Blower and randomly sampled to determine the absence or presence of a mature grain to ensure air flow was effective in separating filled and unfilled seed. The weight of each fraction was recorded and the heaviest fraction was then compared to the bulk weight of the sample to determine the percent fill. Germination tests were conducted on the heavy fraction by stratifying the seed in a cool, 5^{o}C, moist environment for 6 week (Ahring and Franks 1968). Four replicates of 100 seed were then placed in germination boxes and placed in a controlled germination chamber set for 8 hours of light at 30^{o}C and 16 hours of dark at 20^{o} C. Counts were made at 14, 21, 28, and 35 days. Only the 35 day germination percentage is reported in this paper. Evaluation began in the spring of 2007 and ended in the spring of 2010. An analysis of variance was used to determine significant differences in plant morphology and seed production characteristics at the P<0.05.

Results and Discussion

There were significant differences in the number of vegetative and reproductive tillers between 9043629, Medina, and Jackson in 2007 and 2008 (Table 1). Accession 9043629 produced a significantly lower percentage of vegetative tillers than Medina and Jackson but a higher percentage of reproductive tillers. This trend was also observed in 2009 but the increase tiller production was not significant. Previous work has shown the increased number of reproductive tillers and fewer vegetative tillers had no adverse effect on the forage quality of 9043629 compared to Medina and Jackson (Table 2). Accession 9043629 had significantly more axillary seed heads along its reproductive tillers in 2008, and though not significant, this trend was also noted in 2007 and 2009 (Table 1).

Figure 1. Top to Bottom, Nacogdoches, 'Jackson', 'Medina' showing varying degrees of rust infection, USDA-NRCS ETPMC

Figure 2. Medina, seen left and front, was visually stunted during the 2008 growing season compared to surrounding 'Jackson' and Nacogdoches plots, USDA-NRCS ETPMC

It was also noted in 2007 that Jackson and 9043629 were less affected by the rust pathogen, *Puccinia tripsaci*. Medina was heavily infected during the 2007 growing season (Figure 1). Medina was visually stunted at the beginning of the 2008 growing season (Figure 2), and was the last cultivar to mature in 2008. In contrast, it was the earliest maturing cultivar in 2007 and 2009. The heavy rust infection could account for the decrease in its performance and productivity during the 2008 growing season (Handley et al. 1990).

Table 1: Vegetative and Reproductive Tiller Analysis of Three Eastern Gamagrass Cultivars in 2007-2009, USDA-NRCS Nacogdoches, TX.

Gamagrass Source	Vegetative			Reproductive			Axillary Seed Heads		
	2007	2008	2009	2007	2008	2009	2007	2008	2009
	------------------------% per plot------------------------						--Average No/Plant--		
9043629	63 c*	57 b	59 a	37 a	43 a	41 a	3.9 a	5.5 a	3.6 a
Jackson	82 a	81 a	72 a	18 c	21 b	28 a	2.9 a	3.1 b	2.9 a
Medina	75 b	95 a	70 a	25 b	5 b	30 a	2.5 a	2.1 c	2.7 a

*Means followed by the same letter are not significantly different at P<0.05.

Table 2: Average Forage Quality Comparisons of 9043629 and Eastern Gamagrass Cultivars Harvested on 45 day clipping frequency and fertilized with 120 lb/acre N (adapted from Brakie, 1998).

	Forage Quality	
Gamagrass source	CP[1/]	TDN[2/]
	------------%-------------	
9043629	9 a[3/]	56 a
Jackson	8 a	56 a
Medina	8 a	56 a

[1/] crude protein; [2/] total digestible nutrients; [3/] means in columns followed by the same letter are not significantly different at P<0.05.

Accession 9043629 significantly increased seed yield in 2008 and 2009 as compared to Jackson and Medina but the increase was not significant in 2007. This increase in seed yield would be expected because of the higher percentage of reproductive tillers (Table 1), which would result in more primary and axillary inflorescences; thus, greater seed yields. Seed fill is an indication of seed quality. The higher the percent fill the greater the potential for better and more uniform plant stands. Accession 9043629 had a higher percentage of filled seed as compared to Medina and Jackson but the increase was not significant (Table 3). Differences in germination were significant in 2008 and 2009, with 9043629 having greater seed germination (Table 3). Only filled seed was used in the germination test due to the earlier separation; the increase in germination suggests less seed dormancy in 9043629 compared to Jackson and Medina. Less dormancy would aid in the rapid establishments of plantings.

The higher seed yields reported for accession 9043629 in this study also agrees with yields from seed production fields at the PMC of 9043629 and Medina at the ETPMC in 2007- 2009. Production field of 9043629 produced greater than three times the yield of Medina in 2007-2009. Medina production field produced 30, 50, and 18 lb/acre, respectively between 2007 and 2009, while 9043629 produced 98, 176, and 60 lb/acre, respectively during the same period. Jackson production fields were not harvested during this time frame.

Table 3: Seed Yield, Fill, and Germination Percentage of Three Eastern Grass Cultivars in 2007-2009, USDA-NRCS, Nacogdoches, TX.

Gamagrass Source	Yield			Fill			Germination		
	2007	2008	2009	2007	2008	2009	2007	2008	2009
	--------------g/plot------------			---------------------------------%------------------------------					
9043629	159a*	408 a	224 a	82 a	90 a	76 a	54 a	65 a	38 a
Jackson	106 a	151 b	59 c	73 a	76 a	55 a	72 a	46 b	19 b
Medina	78 a	29 c	139 b	84 a	84 a	65 a	62 a	58 ab	31 a

*Means followed by same letter are not significantly different at P<0.05; 2/

Summary

Accession 9043629 had greater seed yield potential than Jackson and Medina. This is evident by the significant increase in the number of reproductive tillers and the number of axillary seed heads per reproductive tiller. These attributes contribute to the differences in yield seen in the study and production fields at the ETPMC. Seed quality of 9043629 was also slightly better than Medina and Jackson as seen by the differences in seed germination and fill. Increased germination percentage aids in rapid establishment and suggests less seed dormancy in 9043629 when compared to Medina and Jackson. Visual observations during the study also suggested 9043629 was less susceptible to infection from the fungal pathogen, *Puccinia tripsaci.* Further work would be needed to determine the amount of seed dormancy and disease resistance associated with 9043629 compared to other cultivars of eastern gamagrass. Due to its increased seed production 9043629 will be raised to cultivar status and released by the ETPMC under the name 'Nacogdoches' in 2012.

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Title: Rust Resistance Screening of Indiangrass (*Sorghastrum nutans*)
Study No: ETPMC-P-0774-WL
Study Leader: R. Alan Shadow
Duration: 2007-2010

Introduction

Rust (*Puccinia sp*.), is a common fungal pathogen that attacks many warm season grasses, lowering productivity. In extreme cases, especially when coupled with other environmental stressors such as drought, it can lead to stand *reduction* and death. The East Texas Plant Materials Center recently screened through a large, genetically diverse, collection of Indiangrass (*Sorghastrum nutans*) from the Native Prairie Association of Texas, NPAT. Many of the plants in this collection were highly susceptible to rust, however, some exhibited little to no infection. This material was collected for inclusion in a rust screening study in an attempt to discover rust resistant Indiangrasses for release and use in future breeding projects.

Materials and Methods

25 plants were planted in a complete randomized block design on 4 foot centers. Each block was replicated 4 times for a total of 100 plants. The 25 plants consisted of 23 plants selected from the NPAT Indian Grass field at the ETPMC based on visual assessment of their rust resistance. Another plant from the NPAT field that showed heavy rust infection was also included as a disease indicator, rust spreader, and to act as a control along with ‘Lometa’. A border of rust susceptible plants collected from the NPAT field at the ETPMC was planted around the experiment to inhibit “edge effect” and to aid in spreading rust.

The plants were rated on their rust resistance and growth characteristics. Plant height, spread, vigor, tiller density, bloom date, rust resistance data were collected 2007-2010. Electron micrographs were also used to map the guard cell structure of some of the elite individuals as well as the poorer performing plants in hopes of determining what, if any, physical plant structures aid in rust resistance. This information will be analyzed to select superior plants. Superior material will then be planted into a Latin Square Design breeding block for advanced evaluation and seed production. The seed will be harvested and used to establish a production field of rust resistant Indiangrass with broad spectrum genetics.

Results and Discussion

Dry matter yield was harvested during the fall of 2008 and analyzed in the spring of 2009. Significant differences were detected (Table 1). Accession 10 was the top performing accession for dry matter yield with a mean of 3.16 pounds of dry matter per plot. Accession 1 scored third highest yield with 2.51 pounds of dry matter per plot, and is noteworthy because it also had an excellent rust resistance score, 1.375.

Table 1: Rust Resistant Indiangrass Vegetative and Disease Resistance Analysis 2007-2009, USDA-NRCS Nacogdoches, TX.

Accession	Rust[1/] Index Rating	Vigor[1/] Index Rating	Dry Yield	Growth Rate
			lb/plot	In^2/year
1	1.34	1.00	2.51	11.75
2	1.83	1.38	1.65	8.75
3	1.92	2.38	2.05	8.50
4	1.83	1.75	1.61	12.75
5	4.08	2.75	1.06	15.63
6	1.75	2.13	1.53	4.00
7	2.83	2.13	1.55	12.13
8	2.00	2.50	2.25	9.50
9	1.58	1.50	2.04	8.00
10	1.92	1.63	3.16	10.06
11	3.00	2.00	2.00	9.38
12	3.83	2.38	1.84	8.50
13	1.84	2.38	2.32	11.13
14	2.17	1.75	2.13	10.75
15	2.75	2.50	1.93	7.00
16	2.17	2.00	2.83	9.63
17	2.25	2.88	.94	9.38
18	1.25	2.00	2.04	8.13
19	1.92	1.50	1.15	7.25
20	2.09	1.88	1.63	5.00
21	2.08	2.88	1.94	7.25
22	1.50	1.38	1.50	6.25
23	2.25	1.88	1.71	11.88
24	2.08	2.75	1.32	10.88
25	2.25	3.38	1.16	7.00
Mean	2.18	2.12	1.83	9.23
$LSD_{(0.05)}$[2/]	.761	.808	.769	4.88

1/Rust and vigor were rated on a 1 to 5 scale with 1 being most disease free and vigorous.
2/ Least significant difference at P<0.05.

Significant differences were also detected for rust resistance (Table 1). The rust ratings from 2007, 2008, and 2009 were averaged together to form a "rust index" rating. Accession 18 has shown to be the most resistant plant in the study followed by accessions 1, 22, and 9.

The rate of growth for each accession also showed significant differences (Table 1). Growth Rate was calculated by measuring the spread of each plot in a North to South direction and then in an East to West direction. These measurements were multiplied together to estimate total area of each plot. The total area from 2009 was subtracted from the 2007 figures to determine the amount of change. Accession 5, the rust spreader, showed the greatest growth rate at 15.625 in^2. 'Lometa' grew 7 in^2, and was one of the weaker plants in this category. Twenty-one other plants ranked higher than 'Lometa' in terms of growth rate. The fact that accession 5, the rust spreader, performed so well in this category is odd. Increased disease stress may be forcing this plant to produce seed in an attempt to survive; causing increase tillering and spreading compared to other plants that showed little to no signs of rust infection. Though it covered more ground space than any other plant in the study, accession 5 ranked in the bottom two for dry matter yield.

Graduate student Paul Gray started his thesis project by sampling the top 5 performing rust resistant plants, plant 5, 'Lometa', and 2 of the worst rated plants for rust resistance. Paul started examining leaf cell structure with electron microscopy and has provided several images of accessions within the study. It is hoped that detailed analysis of the leaf structure done by Paul will yield quantitative measurements that reinforce the results seen in the qualitative rust ratings.

Electron Micrographs Showing Differences in Plant Leaf Morphology

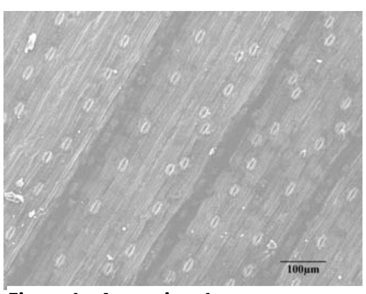


Figure1. Accession 1

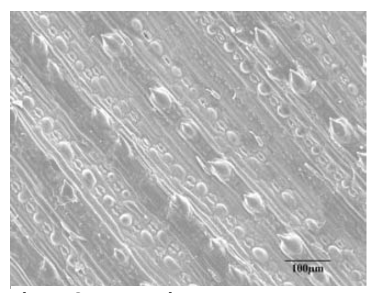


Figure2. Accession 7

Summary

The plants selected in this study are performing well, with many outperforming 'Lometa' by a wide margin. Additional, quantitative, data is being evaluated, and is hoped to back up some of the qualitative rating data. The top 5 accessions in terms of rust resistance and biomass are 1, 9, 10, 18, and 22. These plants will be moved into a Latin Square breeding block for advanced evaluation and cross pollination in 2010. F1 seed from 2011 growing season has been harvested and will be planted and evaluated for rust resistance performance and genetic diversity. F2 seed will be harvested from the F1 block at the end of 2012 and 2013 growing season and planted to monitor performance before release.

Title: Screening of NPAT Switchgrass Collection for Forage and Biofuel Potential
Study No: ETPMC-T-0889-BFPA
Study Leader: R. Alan Shadow
Duration: 2008-2011

Introduction

Switchgrass, *Panicum virgatum*, is a native, warm season, perennial grass with a very broad range of adaptation. There are several released varieties of Switchgrass. 'Alamo' and 'Kanlow' are two varieties that have sparked much interest recently with the advancement of cellulosic ethanol production. 'Alamo' and 'Kanlow' are capable of producing large amounts of biomass, up to 20 tons per acre, in a growing season, and are very high in cellulose. This makes them excellent choices for use in ethanol production; however, their high cellulose content makes them poor forage when compared to other Switchgrass varieties with less cellulose. A Switchgrass variety that produced moderate levels of cellulose while still maintaining moderate forage qualities would be a useful tool in East Texas. It would provide growers with two markets for their crop, and allow them some flexibility should there be delays or problems getting ethanol plants on line near East Texas.

Materials and Methods

The NPAT collection of Switchgrass at the ETPMC was screened for plants that exhibited rapid growth and favorable forage qualities such as large leaf to stem ratios. 19 plants were selected from the NPAT field based on these attributes. These plants were collected and split into plugs with 20 stems per plug. This material was planted on 4foot centers in a Randomized Complete Block Design with 4 replications. The plants were spaced on 4 foot centers. 'Kanlow', 'Alamo', 'Blackwell', 'Cave-in-Rock', and a line from the Coffeeville Plant Materials Center were also used in the experiment as controls. These lines represent upland and lowland types of Switchgrass. A boarder row of NPAT material was planted around the study to help eliminate and edge effects.

The plants will be monitored for their growth characteristics and biomass production. Information will be gathered in form of plant height, rate of spread, disease resistance, vigor, dry matter yield, forage quality and bloom date. Select material will then be moved to a Latin Square Design breeding block. Seed will be collected from the breeding block and an F1 generation will be planted to insure genetic diversity and establishment of a production area. This material will be used as a potential release.

Results and Discussion

There was a 98% survival rate on the transplanted material. Controls consist of accession 15 (‘Cave-in-Rock’), accession 16 (‘Kanlow’), accession 17 (‘Blackwell’), accession 18 (MS Line), and accession 19 (‘Alamo’). There were 11 accessions that produced greater dry matter yields than ‘Alamo’; with Accession 2 being significantly greater; the highest yielding accession of the study (Table 2). Accession 21 was notable and performed well in many categories. It had a dry matter yield that ranked near the top, on par with ‘Alamo’. This is surprising due to the fact that it had lowest growth rate and was significantly shorter than most of the plants in the study (Table 1). Accession 21 ranked in the highest mean groupings for tiller density, leaf width, leaf length, vigor and had a perfect disease score (Table 2). Accession 21 also had the lowest ADF, and highest protein content of any of the accessions (Table 2). It shows excellent potential as a good biomass producing switchgrass with improved forage quality.

Table 1: Forage/Biofuel Switchgrass Screening Analysis Plant Characteristics 2007-2009, USDA-NRCS Nacogdoches, TX.

Accession	Stem Length	Leaf No.	Stem Diameter	Leaf Width	Leaf Length	Disease[1/]	Growth Rate	Vigor[1/]	Height
	in		mm	mm	in		in^2		in
1	63.00	6.47	6.22	18.50	24.47	1	166.50	2.75	62.6
2	60.58	6.64	4.91	16.32	21.38	1.50	214.50	1	63.1
3	69.33	7.13	6.23	18.87	24.33	2.50	239.50	1	69.4
4	60.50	6.40	4.98	20.01	24.35	1.75	178.50	2	67.5
5	66.83	6.93	6.22	18.10	25.64	1.25	254.50	1	68.3
6	64.83	7.02	6.07	16.63	22.50	1.50	280.75	1.25	70.1
7	70.00	7.20	5.82	19.08	28.33	1.50	248.75	1.5	71.8
8	69.95	6.19	5.77	18.00	22.70	1.27	197.87	2.96	69.0
9	62.50	7.40	6.50	17.57	25.36	1.50	267.00	1.25	63.5
10	64.33	7.00	6.98	17.94	26.43	1.50	233.50	1.75	68.1
11	63.33	6.53	6.25	18.90	23.58	1.50	150.50	3.25	63.3
12	70.25	6.93	5.94	16.58	25.49	1	174.75	1.75	69.1
13	66.50	7.48	7.40	20.41	22.21	1.75	216.75	1	71.1
14	70.00	7.95	6.54	17.57	28.94	2.00	255.25	1	73.8
15	42.50	5.33	3.90	11.31	20.12	2.75	289.00	1.5	52.1
16	70.83	7.17	5.98	17.69	25.01	2.25	223.00	3	71.9
17	54.08	5.47	4.35	13.72	21.06	2.25	258.75	2	50.0
18	65.33	5.95	5.69	14.94	19.85	1.50	264.00	1.25	77.3
19	73.00	6.40	6.53	17.68	21.20	2.50	408.00	2	78
20	60.17	5.68	6.17	19.97	25.05	1.75	213.50	1.5	61.4
21	54.06	5.43	5.55	20.41	25.89	1	107.50	3.33	53.8
22	66.50	6.91	5.94	13.41	25.71	2.00	234.50	1	72.0
23	65.33	6.67	6.77	18.96	24.88	1.75	233.75	2	65.6
24	65.17	6.87	5.83	17.40	21.45	1.50	255.00	2.5	65.3
Mean	64.12	6.63	5.94	17.5	23.99	1.70	231.90	1.8	66.6
$LSD_{(0.05)}$[2/]	9.760	.856	.988	3.334	3.510	.782	88.68	1.21	6.36

1/ Rated on a 1 through 5 scale with 1 being the best and 5 being worst
2/ Least significant difference at P<0.05.

Accession 3 was also notable in that it ranked in the same mean category as 'Alamo' in terms of dry matter yield (Table 1), and had a significantly greater ADF value than 'Alamo', the highest of the study (Table 2).

Table 2: Forage/Biofuel Switchgrass Screening Analysis Forage Quality 2009, USDA-NRCS Nacogdoches, TX.

Accession	ADF	TDN	Protein	Dry Yield
	%	%	%	lb/plot
1	49.02	42.34	5.87	8.19
2	49.15	42.42	6.15	12.41
3	52.92	39.52	5.80	9.99
4	48.77	42.85	6.42	8.52
5	49.00	42.33	5.84	11.28
6	45.30	45.37	6.50	9.49
7	44.56	45.63	6.07	9.73
8	46.16	44.73	6.46	9.13
9	43.37	46.48	6.08	10.87
10	42.70	46.98	6.11	9.45
11	45.79	45.37	7.07	8.14
12	46.52	44.08	5.82	9.62
13	46.76	44.03	6.00	9.85
14	46.14	44.57	6.18	10.65
15	44.95	46.66	8.19	6.11
16	48.43	42.71	5.80	8.49
17	47.25	43.78	6.17	7.04
18	43.55	47.05	7.21	10.62
19	44.22	46.31	6.78	9.60
20	46.00	45.27	7.15	8.91
21	41.36	49.26	8.28	9.79
22	46.96	44.05	6.28	10.55
23	47.32	43.99	6.59	8.40
24	46.36	44.99	6.87	8.78
Mean	46.35	44.62	6.49	9.40
$LSD_{(0.05)}$ [1/]	2.66	2.29	1.03	2.57

1/ Least significant difference at P<0.05.

Summary

This three year study is in its second year of evaluation. Germination of each accession is scheduled for the summer of 2010. Top performing accessions are scheduled to be carried into advanced evaluations in 2011. This material will be planted into a Latin Square breeding block and used to develop a seed source with a broad genetic base. Any accessions exhibiting exceptional qualities for either biomass production of forage quality will be isolated and clonally reproduced to develop a foundation seed source for those particular attributes.

Title: Development of Little bluestem Germplasm Release
Study No: ETPMC-T-0879-PA
Study Leader: M. Brakie
Study Duration: 2008-2012

Introduction

Little bluestem (*Schizachyrium scoparium*) is a native perennial warm season grass adapted throughout the United States. This species provides livestock forage and wildlife cover. The objective of this study is to develop a germplasm release using a combination of accessions adapted to the ETPMC service area.

Figure 1. Little Bluestem advanced evaluation plots

Materials and Methods

Five little bluestem accessions were chosen from an initial evaluation conducted from 2005 to 2007. Based upon visual observation scores, these accessions exhibited better seed production, disease resistance, foliage abundance, seed emergence, and transplant survival. These accessions are; #9067345 from Robertson Co., TX, #9067257 from Robertson Co., TX, #9067292 from Guadalupe Co., TX, #9067279 from Burleson Co., TX, and #9067237 from Leon Co., TX. The accessions were planted in a randomized complete block design with four replications in May 2008. In each replication, there were four plants per accession.

In April 2011, the plot was fertilized at a rate of 75 lbs. /acre (8-8-8). Seed development stages for each plant were recorded throughout the growing season. During October and November, the plants were harvested at maturity.

Table 1.Little bluestem Vigor and Disease Resistance Scores by Replication (7/13/2011)

	Vigor Replication #				Disease Resistance Replication #			
Accession #	1	2	3	4	1	2	3	4
345	5	5	5	5	6	6	5	5
237	6	6	5	5	7	5	6	6
257	6	5	5	4	6	5	5	5
292	5	5	5	5	5	5	5	5
279	6	5	5	5	6	5	5	5

Visual observation ratings: 1=excellent 3=good 5=average 7=poor

Title: Effect of Storage Treatments on Seed Germination of Harrison Germplasm Florida paspalum
Study Number: ETPMC-T-0670-WL
Study Leader: M. Brakie

Introduction

Florida paspalum, (*Paspalum floridanum)*, is a warm season perennial grass native to the southeastern United States. In 2004, the USDA-Natural Resources Conservation Service East Texas Plant Materials Center released Harrison germplasm Florida paspalum. Freshly harvested seeds of Harrison germplasm have exhibited various degrees of dormancy which can adversely affect stand establishment. The objective of this study is to examine the effect of various storage treatments on the germination of Harrison germplasm Florida paspalum.

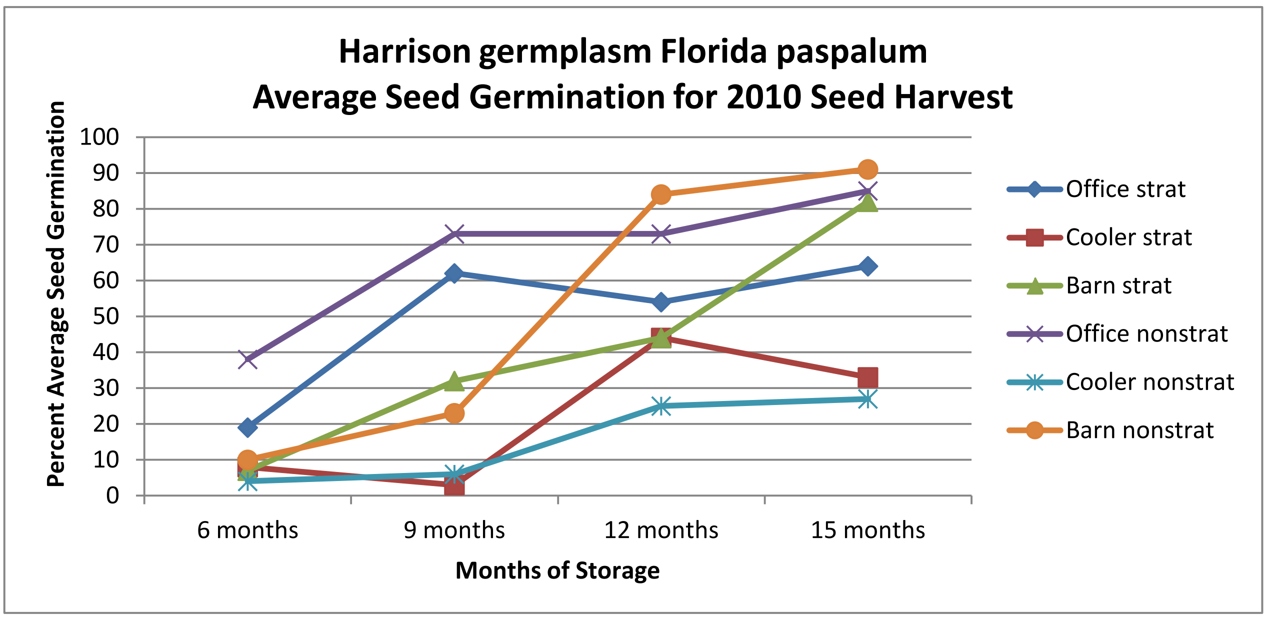
Materials and Methods

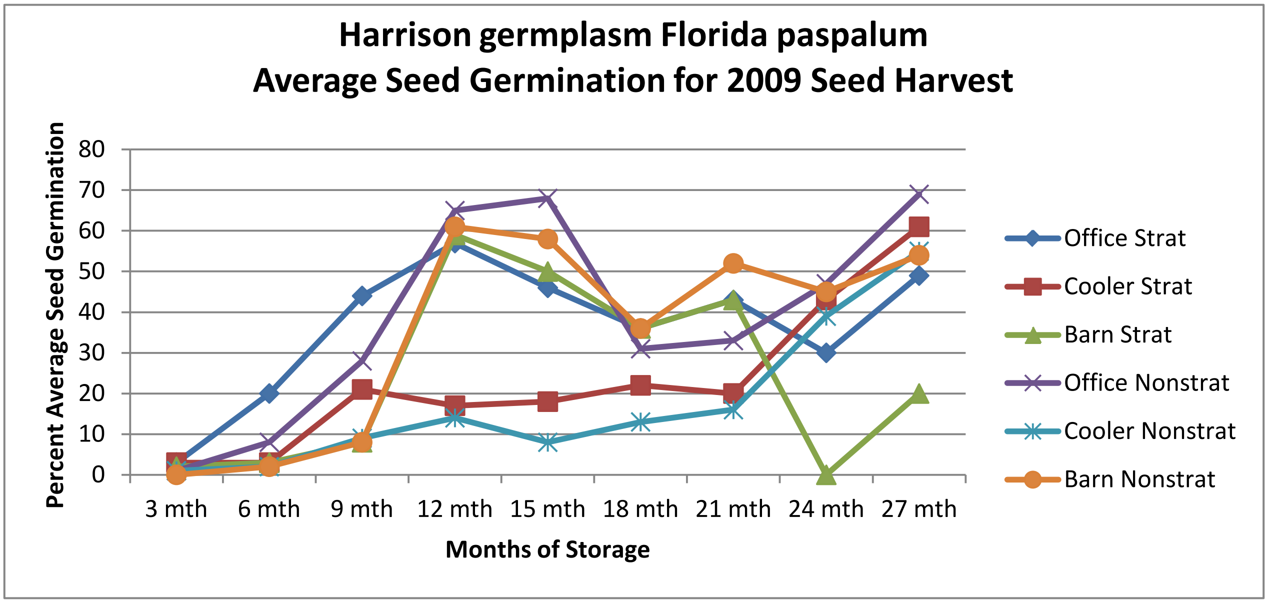
Figure 1. 'Harrison' Florida paspalum seed germinating

Seed of Harrison germplasm was collected in 2009 and 2010 from the seed production field at the USDA/NRCS East Texas Plant Materials Center near Nacogdoches, Texas. Seed was separated into heavy and light fractions with a South Dakota seed blower. Only the heavy fraction was used for germination tests and divided into three portions and stored in heavy paper envelopes. The first portion was stored in the Plant Materials Center office at approx. 70^0 F. A second portion was stored in a controlled environment of ~50^0F and relative humidity of ~ 50%. The third portion was stored in an uncontrolled environment in the seed processing barn. One hundred seed of each treatment combination was placed on a paper substrate moistened with 2% KNO_3. The prechilled seed was stratified for 14 days at 38^0 F (AOSA, 1993) prior to germination testing. During germination testing seed was placed in a germinator for 28 days with alternating day/night temperatures of $86^0/68^0$F and 8 hour day/16 hour night. The experiment was arranged in a randomized complete block with four replications. Germinated seeds were counted and discarded at 7, 14, 21, and 28 days. Germination tests were conducted every three months. Results presented in this report are 28 day totals and averages for each treatment.

Results

As shown below in these two graphs, cooler storage appears to prolong seed dormancy. Seed germination for cooler storage did not increase above 20 percent until the 24 month test for the 2009 seed harvest. Both seed harvest years have increased germination at the 12 and 15 months tests for the office storage and barn storage treatments. However, germination decreases at 18 months for the 2009 seed harvest and does not increase significantly until the 27 month test.





References

Association of Official Seed Analysts. 1993. Rules for testing seeds. J. Seed Technol. 16:3 p. 59

Title: Initial Evaluation of Purple coneflower (Echinacea sp.) Seed Collections
Study No: ETPMC-P-1093-WL
Study Leader: M. Brakie

Introduction

Echinacea purpurea (purple coneflower) is a native warm season perennial forb which grows to 3.5 feet tall. The dark green leaves grow up to six inches long and three inches across. The daisy-like flower is three to four inches wide, with a reddish brown central core surrounded by ten to twenty purple ray florets. This plant is found in fields, prairies, and open woods in sites with full to partial sun and moist soil conditions.

2011 Activity

In late January, seed samples from forty-two accessions were cold-moist stratified at 38^{o}F for 28 days and then placed in a germinator. The percent of germinated seeds were calculated for each collection. Seedlings from the collections were transplanted into plant bands and then repotted to larger containers during the year.

Echinacea Initial Evaluation Collections			Percent Seed Germination - April 2011		
Accession	County of Origin (TX)	Seed Germination %	Accession	County of Origin (TX)	Seed Germination %
9094892	Gray	84.8%	9094891	Collingsworth	43.3%
9067368	Donley	80.0%	9094945	Freestone	42.0%
9094888	Shackelford	77.3%	9094915	Montgomery	41.7%
9094893	Parmer	75.3%	9094875	Leon	38.7%
9094918	Polk	70.7%	9094868	Nacogdoches	36.7%
9094835	Grimes	62.0%	9094858	Houston	32.7%
9067357	Nacogdoches	59.3%	9094860	Polk	32.7%
9094923	Nacogdoches	59.3%	9094836	Nacogdoches	32.0%
9094919	Lipscomb	58.7%	9094938	Hartley	27.3%
9094872	Parker	56.0%	9093052	Deaf Smith	25.3%
9094862	Freestone	54.7%	9094838	Nacogdoches	20.7%
9094917	Dickens	54.7%	9094870	Nacogdoches	20.7%
9094921	Donley	54.7%	9094837	Nacogdoches	18.7%
9067360	Randall	53.3%	9094925	Nacogdoches	13.3%
9094863	Hardin	52.7%	9094877	Leon	10.0%
9094900	Hopkins	52.7%	9094869	Nacogdoches	8.0%
9094866	Nacogdoches	51.3%	9094924	Nacogdoches	7.3%
9067358	Nacogdoches	50.7%	9094922	Nacogdoches	4.7%
9094852	Angelina	47.3%	9067356	Nacogdoches	0.0%
9067366	Nacogdoches	46.7%	9094920	Hansford	0.0%
9094832	Moore	45.5%			
9094812	Armstrong	44.7%			

Title: Evaluation of Prairie acacia (*Acacia angustissima* var. hirta), Panicled tick clover (*Desmodium paniculatum*), and Herbaceous mimosa (*Mimosa strigillosa*) Germplasm

Study No: ETPMC-T-0880-PA

Study Leader: M. Brakie

Study Duration: 2008-2010

Introduction

This study is cooperative project with Dr. Jim Muir, Texas Agrilife Research, to evaluate the adaptation of three native perennial legumes. There is a need for a greater variety of native legumes for forage, rangeland, and wildlife seed mixes throughout the southern Great Plains. The prairie acacia selections include a composite developed at the Kika de la Garza Plant Materials Center (PMC), Plains germplasm from the James E. 'Bud' Smith PMC at Knox City, Texas, and STPA05 from Texas Agrilife Research in Stephenville, Texas. The panicled tick clover seed source is STPTCO1 from Texas AgriLife Research in Stephenville, and Crockett germplasm herbaceous mimosa from the East Texas PMC near Nacogdoches, Texas.

Materials and Methods

The study plot at the East Texas PMC was planted in the spring of 2008. The fifteen plots are arranged in a randomized complete block design with three replications. These plots were divided into subplots with one side designated for forage clippings and the other for seed production. Forage samples were clipped from the inside four rows (1 m^2) when 25% of the plants reach sixteen inches in height. Seed was collected from the inside four rows (1 m^2) throughout the growing season. The study was not irrigated and weeds were controlled in the plots.

2011 Activity

A final evaluation of percent cover and winter survival was completed in May.

Percent Cover for Study Plots – May 2, 2011

Collection	Rep.1	Rep.2	Rep.3
Plains prairie acacia	100	100	100
STPA05 prairie acacia	100	90	90
Kingsville prairie acacia composite	100	100	100
Crocket germplasm herbaceous mimosa	100	100	100
Panicled tickclover	50	50	70

Title: Using Cool Season Annual Legumes for Sustainable Yields in 'Alamo' Switchgrass for Biomass Production
Study No: ETPMC-0883PA
Study Leader: R. Alan Shadow
Study Duration: 2008-2012

Introduction

Biofuels are becoming increasingly popular as the cost of fossil fuels and awareness of global warming potential increase. Currently, most biofuel production revolves around bio-diesel from vegetable oils and ethanol from corn (*Zea mays*) fermentation. However, with the discovery of new enzymes, ethanol production from cellulose is becoming more efficient as a viable fuel source.

Switchgrass (*Panicum virgatum*) is a native, perennial, warm season grass that has a wide distribution throughout the United States and Canada. It is very prolific and produces vast quantities of bio-mass annually. Corn and vegetable oils are directly tied to the food industry. As demand for biofuels increases; so will the price of food products made from these materials. Corn is an annual and has large nitrogen and water inputs requirements to produce high yields. Nitrogen fertilizer, being directly tied to the petroleum industry, will rise in costs with fossil fuels. As a perennial, Switchgrass does not require establishment every year. Once established, a stand can be used as a renewable resource, if properly managed, and carbon that is sequestered in standing crops will help offset carbon produced from burning ethanol as a fuel. Switchgrass requires far less in terms of fertilization and water inputs compared to corn. The use of cold season legumes for their nitrogen input will further offset the potential costs of production. The cultivar 'Alamo' from the Knox City Plant Materials Center has the greatest amount of cellulose of the released switchgrasses, and has the greatest potential for biofuel production from cellulose conversion.

Materials and Methods

'Alamo' switchgrass will be drilled on 8" rows in to a study area at the ETPMC in the summer of 2008. Irrigation will be used to help the switchgrass establish. The switchgrass will be cut in the fall of 2008 to a height of 6 inches, and the residue will be removed. Twenty four plots, 15'x13.5', will be established with 3 foot alley ways between plots using a tiller. Glyphosate will be used to maintain these alleys. There will be 4 legume plots in the study consisting of Ball Clover, variety not specified, 'Dixie' crimson clover, 'Apache' arrowleaf clover, and hairy vetch, variety not specified. Seeding rates for the legumes will be doubled to insure a good stand the. All the legumes, except hairy vetch will be planted by hand broadcast after running a disk, set straight, across the study area. A cultipacker will then be used to insure seed to soil contact. The hairy vetch will be drilled on 8" rows since it is a much larger seed. All legume seed will be freshly inoculated with the appropriate inoculants. Control plots will consist of a plot with no legumes or nitrogen input and a plot with no legumes that receives 100# of N per acre. The N plots will be fertilized each year in early spring when the Switchgrass begins to green up.

A double tiered electric fence consisting of a 4 strand inner fence and double strand outer fence will be constructed around the study area to reduce deer browse on the study. Percent cover for the legumes will be recorded once they have established. Dry matter yields will be collected by cutting a sample area from each plot after the first frost, weighing the sample wet, and then dry to determine moisture content. The entire plot will then be harvested to determine plot yield, and its dry matter yield will be calculated using the dry matter sample. Soil tests will be taken each spring before switchgrass green up to determine the amount of N available for the switchgrass and to monitor any changes. Percent cover for the legumes will then be recorded each spring to determine which legumes are best at reseeding to use in a sustainable system.

Results and Discussions

There was a solid, uniform stand of 'Alamo' switchgrass. Soil tests were used to calculate rates of lime applied to each plot to limit the soil pH variation as much as possible. The legumes were planted in the fall of 2008 and monitored through the spring of 2009. Nitrogen was applied in early spring of 2009 when the switchgrass reached approximately 12 inches in height. There were uniform, complete stands for each legume species.

Figure 1. Solid stand of 'Dixie' crimson clover in 'Alamo' switchgrass

Crimson clover was the earliest maturing legume followed by hairy vetch, ball clover, and arrowleaf clover. Crimson clover and ball clover appeared to be the most compatible species in the study. The hairy vetch completely smothered the plots and greatly reduced the stand of switchgrass. Arrowleaf clover was very aggressive and obtained a height of approximately 4 ft before reaching maturity. At maturity, half the plots lodged, falling toward the center of the plot, reducing the switchgrass stand.

Figure 2. 'Apache' arrowleaf clover seen lodging near maturity, smothering the switchgrass stand

The data confirms some of the observations with ball clover performing very well. It provided significantly better it terms of switchgrass yield, return stands of switchgrass and legume species, and the highest soil N rate (table 1).

Table 1: 'Alamo' Switchgrass Yield, Legume, Stand, and Soil Data 2009-2010, USDA NRCS Nacogdoches TX.

Treatment	'Alamo' Dry Yield	2010 'Alamo'	2010 Legume	N	P	K	pH
	gram/ m^2	----------% Stand----------		------------ppm------------			
Ball Clover	228.93 a[1]	92.5 a	56.6 a	481.5 a	14.6 a	56.7 a	6.8 a
Arrowleaf Clover	219.13 ab	91.3 a	9 b	448 a	12.5 a	67 a	6.8 a
control	215.12 ab	93.8 a	Na[2]	464.3 a	11.8 a	62.0 a	6.7 a
100# N	206.65 ab	82.5 ab	Na	464 a	14.3 a	68.9 a	6.7 a
Crimson Clover	203.08 ab	65 ab	16.7 ab	485.5 a	13.1 a	61.7 a	6.6 a
Hairy Vetch	76.60 b	78.8 b	.5 b	470.5 a	12.6 a	59.1 a	6.7 a

[1] Means followed by the same letter are not significantly different at the $p < 0.05$ level

[2] Not applicable

Being the earliest to mature, the crimson clover did not produce near the same biomass yield as the other legumes. The low yields for the hairy vetch plots were anticipated due to the smothering of the switchgrass. The low reseeding rate of the vetch is probably due in part to the biomass removal of the switchgrass at the end of the season. It was bush hogged to a 6 inch height and then raked out of the study area with a hay rake. The vetch had wilted down to nearly that level before bush hogging, and most of the seed pods were probably removed from the plots with the biomass when the study was raked clean.

The ETPMC did not receive a killing frost until December 5, 2009. The switchgrass was left standing for two weeks after the frost, and then 2 half meter square samples were randomly cut from each plot. In order to get a better stand of legumes, the switchgrass crop needs to be removed earlier in the fall so that the legumes can begin growing, and be established by spring.

Summary

Preliminary results are favorable for ball clover; though more work need to be done to work out a management plan in terms of removing the switchgrass biomass early enough in the fall for the legumes to establish. Future work should avoid using a double seeding rate for hairy vetch.

2010 Publications

Publications for ETPMC Listing

Paul M. Gray, John D. Matula, Josephine Taylor, James A. Stevens, and R. Alan Shadow 2011. Disease of Native Grasses. SFASU and ETPMC, Nacogdoches, Texas. 5th Lone Star regional native Plants Conference. 3p.

Paul Gray and Josephine Taylor 2011. Investigation of Morphological Differences Leading to Rust Resistance in Indiangrass. SFASU and ETPMC, Nacogdoches, Texas. J. Micros 41(1):10.(abstract). 1p.

Paul Gray and co author Alan Shadow 2011. Investigation of Morphological Differences Leading to Rust Resistance in Sorghastrum Nutans. Paul Gray and Dr. Jo Taylor of Steven F Austin State University, Nacogdoches, Texas. August 2010. 80p.

Melinda Brakie 2011. Plant fact sheet for herbaceous mimosa. ETPMC, Nacogdoches, TX. April 2011. 2p.

Melinda Brakie 2011. Plant Guide for herbaceous mimosa. ETPMC, Nacogdoches, Texas. April 2011. 3p.

East Texas PMC 2011. 2011 Winter newsletter. East Texas PMC, Nacogdoches, Texas. February 2011. 2p.

Andrew Brosig and Alan Shadow 2011. Eyes to the future. ETPMC, Alan Shadow, Nacogdoches, TX. 5/23/2011. 2p.

Alan Shadow, Melinda Brakie 2011. 2011 Spring newsletter. ETPMC, Nacogdoches, Texas. May 2011. 3p.

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Alan Shadow 2011. Harrison Germplasm Florida Paspalum (Paspalum floridanum Michx.). ETPMC and Rickey Linex, Nacogdoches, TX. March-April Issue no. 8. 1p.

Alan Shadow 2011. Plant Collection Sheet Desmodium sp.. ETPMC, Nacogdoches, TX. June 2011. 2p.

Alan Shadow 2011. Plant Collection Sheet Echinochloa waltteri. ETPMC, Nacogdoches, TX. June 2011. 2p.

Alan Shadow 2011. Plant Collection Sheet Polygonum sp.. ETPMC, Nacogdoches, TX. June 2011. 2p.

Alan Shadow 2011. Plant Collection Sheet Ratibida columnifera. ETPMC, Nacogdoches, TX. June 2011. 2p.

Alan Shadow 2010. Seed Production Comparison of Three Eastern Gamagrasses in East Texas. 10th Annual Texas Plant Conservation Conference and Texas Native Plant Conservation Alliance Meeting, Texas. October 15, 2010. 18p.

Alan Shadow 2011. Yaupon, Ilex vomitoria, Plant Fact Sheet. ETPMC, Nacogdoches, TX. June 21, 2011. 2p.

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