EVALUATION OF FORAGE SORGHUMS FOR ETHANOL PRODUCTION

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SUMMARY:

Forage and sweet sorghum potential for future ethanol production is being researched as a possible solution to the energy crisis. Local forage sorghum production yields were from 2.6 – 12.6 tons/acre of dry matter which can be utilized for cellulosic ethanol production. Local forage sorghum production yields for sugar ethanol production were 2.6 – 10 tons/acre producing from 237 – 898 gallons/acre of sorghum juice which ranged from 11.3 – 21.3 percent BRIX.

OBJECTIVE:

To evaluate various types of sorghums for their biomass and sugar production potential for either cellulosic or sugar ethanol production.

MATERIALS and METHODS:

Twenty-two forage type sorghum varieties were planted March 25, 2008 using a Deere Max-Emerge planter. Varieties were planted in three row plots (12' long) on 38" rows. The seeding was rate 12 seeds per foot. Fertilizer applied at planting included 425 lbs/acre of 24-4-2 plus micro-nutrients.

Harvest of plant material occurred from the middle row of the three rows planted of each variety. One harvest date was made on the sugar ethanol sorghums at about 4 weeks after bloom on the selected varieties. Two harvest dates were made on the cellulosic ethanol sorghums, each about 4 weeks after bloom on the selected varieties. The sorghums were hand harvested, cut 4 - 6 inches from the ground and a green weight was recorded at harvest followed by a dry weight seven days later. Sugar and juice measurements were collected on the sugar ethanol sorghums from at least five plants per variety squeezed through a sorghum press. Brix levels were noted on the sweet sorghum varieties.

RESULTS and DISCUSSIONS:

The sorghums grew well reaching heights from 78 - 122 inches. Field conditions were dry though as rainfall was minimal throughout the growing season. Low plot yields occurred on the second cutting date due to drought conditions. Plots cut only once were better able to withstand the drought, therefore yields were higher. Percent dry weights on July 3 and August 6 cuttings were high due to plants being very mature when harvested. Juice volumes were also low due to hot, dry conditions causing plants to mature and dry down faster.

BMR noted plants in several entries are plants that have the Brown Mid-Rib characteristic. This results in a lower lignin content in the cell walls and the interior of the stalks are brown. This characteristic makes the cell walls break down easier and ethanol extraction should require less effort. The plants are also more palatable to livestock.

The “headless” variety notation is a characteristic that causes the plants not to head out as long as they are planted after the day length is over 12 hours and 15 minutes. If planted before days are this long, then the plants will head out.

BRIX is a reading taken on plant juices and is an indication of percent sugar in the juices. This reading was taken only on the sugar sorghums. BRIX levels ranged from 11.3 – 21.3 percent sugar.

Overall, yields ranged from 2.6 – 12.6 tons of dry matter per acre. Cutting the forage sorghums twice verses once decreased the yield due to dry conditions conversely from last year when soil moisture was ample and it increased the yield.

Prior research indicates that a 17% sugar content and a yield of 25 tons/acre could yield approximately 400 gallons of ethanol per acre depending on the expression of the juices from the plant. Thus with the yields recorded at this demonstration, there is a potential for around 400 gallons ethanol to be produced per acre. With the future leading to cellulosic ethanol production, some research has shown a potential conversion rate of about 90 gallons ethanol per dry ton or possibly up to 900 gallons per acre.

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DISCLAIMER CLAUSE:

Trade names of commercial products used in this report are included only for better understanding and clarity. Reference to commercial products or trade names is made with the understanding that no discrimination is intended and no endorsement by the Texas A&M University System is implied. Readers should realize that results from one experiment do not represent conclusive evidence that the same response would occur where conditions vary.

Table 1. Evaluation of sorghum forages for cellulosic ethanol production. Dr. Leon Clement, Sorghum Partners, Cooperator. Victoria County, Texas, 2008.

HYBRID/VARIETY	TYPE	DAYS TO BLOOM	HARVEST PLANT HEIGHT (inches)			YIELD (b) Dry Weight Tons/Acre						
			Multiple Cuts		One Cut	Multiple Cuttings					One Cutting	
			May 21	July 31	July 31	May 21	% Dry	July 31	% Dry	Total Yield	August 6	% Dry
Trudan 8	Hybrid Sudangrass	61	69	22	84	2.8	16.4	1.7	34.4	4.5	6.7	53.8
Trudan BMR	Hybrid Sudangrass		51	23	89	3.4	18.5	1.8	31.2	5.2	9.4	32.4
Trudan Headless	Hybrid Sudangrass		51	17	97	2.7	16.4	0.8	28.9	3.5	10.7	38.6
Sordan Headless	Hybrid (Sorghum X Sudan)		58	19	100	2.9	15.0	1.0	27.1	3.9	12.6	38.2
Sordan BMR	Hybrid (Sorghum X Sudan)		50	24	95	3.0	15.4	1.6	28.6	4.6	7.6	32.4
Hi Kane BMR	Hybrid Silage	66	58	18	78	2.6	16.0	0.9	29.0	3.5	5.2	31.0
Hi Kane II	Hybrid Silage	64	64	20	79	3.4	17.1	0.8	22.9	4.2	5.3	29.9

Table 2. Evaluation of sorghum forages for sugar ethanol production. Dr. Leon Clement, Sorghum Partners, Cooperator. Victoria County, Texas, 2008.

HYBRID/VARIETY	TYPE	DAYS TO BLOOM	HARVEST DATA (one cutting)								
			PLANT HEIGHT (inches)		BRIX	YIELD Green Weight Tons/Acre		YIELD Dry Weight Tons/Acre			
			June 27	Aug 4	% SUGAR	June 27	Aug 4	June 27	Aug 4	% Dry Wt.	Gallons Juice/Ac
Top 76-6	Sweet Sorghum	87		120	17.8		33.1		10	30.3	898
G1990	Hybrid Headless Silage	-		101	12.7		34.5		7.9	23	745
Rio	Sweet Sorghum	71	95		19.6	16.6		2.6		33.8	526
Sugar Sorghum	Sweet Sorghum	66	80		12.6	15.2		4.9		32	476
M81-E	Sweet Sorghum	86		106	18.7		26.2		7	26.6	441
Theis	Sweet Sorghum	71	89		16.8	15.2		4.7		30.7	428
Della	Sweet Sorghum	69	115		15.3	19.3		6.4		33.3	386
Wiley	Sweet Sorghum	84		100	15.3		20.9		6.3	30.2	379
Dale	Sweet Sorghum	74	95		15.1	16.6		5		30	373
Keller	Sweet Sorghum	65	94		19.5	16.6		5.4		32.5	371
Ramada	Sweet Sorghum	83		95	21.3		20.7		5.7	27.4	359
Tracy	Sweet Sorghum	74	91		15.9	19.3		5.4		27.8	331
Hi Kane II	Hybrid Silage	64	86		15.8	15.2		4.3		28	262
Hi Kane BMR	Hybrid Silage	66	84		17.3	13.8		3.9		27.9	248
Sucro Sorgo 405	Hybrid Silage	87		122	11.3		24.8		7.5	30.1	237