COTTON GIN TRASH AVAILABILITY ON THE TEXAS HIGH PLAINS FOR BIOENERGY PRODUCTION

Curtis Wilde
Texas Tech University
Lubbock, TX
Jeff Johnson
Texas Agricultural Experiment Station
Lubbock, TX
Michael Farmer
Texas Tech University
Lubbock, TX

Abstract

As the demand for bioenergy increases, agricultural products are being studied to determine their feasibility for use in producing bioenergy. One of the most important factors in the feasibility of the use of any product for bioenergy production is that crop's availability. Gin trash has been shown to have potential as a boiler or combustion unit fuel, useful in electricity production; additionally, it has also shown to have potential use in ethanol production. Therefore, the objective of this study is to determine the availability of cotton gin trash in 30 counties located on the Texas High Plains (THP). In these 30 counties, 994,736 short tons of cotton gin trash were produced annually. Ten counties were responsible for 55.67% of the cotton gin trash production in this 30 county area.

Introduction

There has been a call to reduce the United States' reliance on foreign energy. To reduce this reliance, agricultural crops are being called on to help create bioenergy. Cotton gin trash could help by providing a source from which to create bioenergy. The first step in determining the feasibility of the use of cotton gin trash in the production of bioenergy is to determine cotton gin trash availability. Thus, the objective of this study is to determine the availability of cotton gin trash for thirty counties on the Texas High Plains (THP). The counties considered in this study are: Andrews, Armstrong, Bailey, Borden, Briscoe, Castro, Cochran, Crosby, Dawson, Deaf Smith, Dickens, Floyd, Gaines, Garza, Glasscock, Hale, Hall, Hockley, Howard, Lamb, Lubbock, Lynn, Martin, Midland, Motley, Parmer, Randall, Swisher, Terry, and Yoakum counties. These counties represent 64.21% of the total cotton production in Texas from 2001 to 2006 (U.S. Department of Agriculture, 2007).

Literature Review

Cohen and Lansford (1992) determined that most cotton gin trash was disposed of by spreading on the land, composting, feeding to livestock, landfill disposal, incineration, conversion to energy, making pellets for fuel in heat stoves, building materials, and insulation. Incineration is rapidly being phased out due to regulations such as the 1970 Clean Air Act. In Texas, most cotton gin trash was spread back on farmland or fed to livestock with some being composted. Additionally, most gins gave away the gin trash rather than selling it.

Avant (1982) reported that cotton gin trash has immediate potential as a boiler or combustion unit fuel for regional processing industries and utilities; while long term possibilities included methanol and ethanol production.

A study of combustion and gasification of cotton gin trash was conducted by LePori, et al. (1982). They determined that cotton gin trash collected at a gin has potential of supplying all the energy needed for the gin in stripper harvesting areas.

Lacewell, Moore, and Parnell (1982) reported that each pound of trash could yield 7,000 Btu's. They determined in the major cotton producing counties of the THP produced a yearly average of 596,988 short tons of gin trash with a Btu potential of 8,357,832 million Btu's from 1970 to 1974.

Results from Beck and Clements (1982), showed that ethanol production from cotton gin residue is both technically and economically feasible. It was also determined that gin residue varies widely from crop year to crop year. In their study, the Texas South Plains counties produced an annual average of approximately 900,000 tons of cotton gin

residue. Their conclusion was that it was economically feasible to produce ethanol from cotton gin residue in large-scale plants. Additionally, their research demonstrated that 37.8 gallons of ethanol can be produced per ton of gin trash.

Several methods have been studied to convert cotton gin trash into energy. One method is direct combustion, which was concluded that it was not the best method for conversion. Additionally, gasification was considered as a method of conversion where a low energy combustible gas is formed in the process. The gasification method showed to be a more feasible conversion, in which the produced gas can be used to run a turbine generator (LePori, et al., 1982).
Production of ethanol is characterized in many steps outlined in this paragraph. Beginning with feedstock preparation, where inorganic compounds are removed. Next is hemicellulose hydrolysis and recovery, where hemicellulose is converted into their individual constituent sugars. Followed by xylose conversion, this is where xylose is converted to furfural. Then cellulose hydrolysis, where there is an addition of a water molecule at each oxygen linkage, causing the oxygen link to break and form individual glucose units. Next is fermentation of the glucose, from cellulose hydrolysis, to ethanol where glucose is fermented by conventional methods. Also ethanol purification, which is when the ethanol is then purified to greater than 99.5% purity, and lastly, byproduct recovery and utilization. The purified ethanol can be sold, and the solid residues from the cellulose hydrolysis have two potential uses. The first use is using of them as a boiler fuel after drying the solids. The second is using the solids as a type of feed roughage (Beck and Clements, 1982).

Methods and Procedures

County cotton production data, from 2001 to 2006, was retrieved from USDA's National Agricultural Statistics Service for the 30 counties listed above (U.S. Department of Agriculture, 2007). The production data from these counties was used to determine the gin trash production based on lint, seed, and trash turnout percentages, from a study of cotton seed to lint ratios (Mitchell, Johnson and Wilde, 2007). Lint, seed, and trash turnout percentages from varieties released in 2000 and later were used along with county production data to determine the average, minimum and maximum tonnage of gin trash for each county for the included years.

Results

The 30 counties were determined to produce an annual average of 994,736 short tons of cotton gin trash with a minimum of 606,156 short tons and a maximum of 1,485,929 short tons for the period from 2001 to 2006. Data for individual counties along with totals are shown in Table 1. The seven counties of Gaines, Hale, Hockley, Lamb, Lubbock, Lynn, and Terry each produced an annual average of over 60,000 short tons. These seven counties also produced 39.32% of cotton gin trash for the 30 county area. Hale County produced the highest yearly average cotton gin trash with 104,080 short tons. Crosby, Dawson, and Floyd counties each averaged at least 40,000 short tons per year. Together these three counties produced 16.34% of the average yearly cotton gin trash in the 30 county area. Castro, Cochran, Martin, Swisher, Parmer, and Yoakum each had an average annual production of at least 20,000 short tons of cotton gin trash. In the 30 county area, these six counties accounted for 19.03% of average yearly cotton gin trash production. The 16 counties annually producing at least 20,000 short tons of cotton gin trash produced 74.68% of the cotton gin trash in the observed counties. The average, minimum, and maximum yearly cotton gin trash produced for each county is shown in Figure 1. The counties with the highest cotton gin trash production in the 30 county area are centered on the Southern High Plains of Texas, shown in Figure 2.

Further study is warranted in order to determine the energy potential that would be available, along with the economic feasibility, of the use of cotton gin trash for energy production.

References

Avant, R. V. 1982. Energy From Cotton Gin Trash A Perspective. *Proceedings of the Symposium on Cotton Gin Trash Utilization Alternatives*. Lubbock, Texas. April 8, 1982.

Beck, S. R., and L. D. Clements. 1982. Ethanol Production From Cotton Gin Trash. *Proceedings of the Symposium on Cotton Gin Trash Utilization Alternatives*. Lubbock, Texas. April 8, 1982.

Cohen, T. M., and R. R. Lansford. 1992. *Survey of Cotton Gin and Oil Seed Trash Disposal Practices and Preferences in the Western U.S*. Las Cruces, New Mexico: New Mexico State University Agricultural Experiment Station.

Lacewell, R. D., D. S. Moore, and C. B. Parnell. 1982. Pelleting Cotton Gin Trash for Energy. *Proceedings of the Symposium on Cotton Gin Trash Utilization Alternatives*. Lubbock, Texas. April 8, 1982.

LePori, W. A., D. B. Carney, J. C. B. Parnell, and R. D. Lacewell. 1982. Energy From Cotton Gin Trash. *Proceedings of the Symposium on Cotton Gin Trash Utilization Alternatives*. Lubbock, Texas. April 8, 1982.

Mitchell, D. M., J. Johnson, and C. Wilde. 2007. "Impacts of Decreasing Cottonseed to Lint Ration on Cottonseed Markets." *Proceedings of the Beltwide Cotton Conferences*: 797-800.

U.S. Department of Agriculture. 2007. Texas County Data - Crops. NASS. http://www.nass.usda.gov/QuickStats/. Accessed 8/16/2007.

Table 1. County Average, Minimum, and Maximum Cotton Gin Trash

County	5 yr Avg Gin Trash (short ton)	Minimum Gin Trash (short ton)	Maximum Gin Trash (short ton)
Hale	104,080	48,975	133,924
Gaines	82,160	49,601	120,349
Lubbock	73,763	38,115	121,915
Lamb	71,113	24,514	88,630
Hockley	66,797	35,243	99,464
Terry	61,188	31,197	106,774
Lynn	60,018	16,055	111,995
Dawson	58,943	21,407	104,424
Crosby	54,157	25,845	86,411
Floyd	49,488	16,812	69,181
Parmer	37,323	9,764	49,915
Castro	36,970	22,373	45,581
Yoakum	33,285	21,276	50,385
Cochran	33,129	8,667	50,907
Swisher	27,281	15,951	31,588
Martin	21,268	4,830	46,730
Bailey	18,083	3,185	29,239
Glasscock	18,078	9,137	39,159
Hall	17,513	8,354	29,239
Howard	16,529	2,088	32,293
Deaf Smith	12,614	6,292	15,455
Garza	9,085	4,177	18,666
Briscoe	7,745	4,307	10,730
Andrews	5,578	3,133	9,868
Midland	4,521	2,350	7,440
Dickens	4,290	2,088	6,944
Borden	4,281	966	9,372
Motely	3,964	2,428	6,996
Randall	922	574	1,175
Armstrong	570	0	1,358
Total for 30 Counties	**994,736**	**606,156**	**1,485,929**

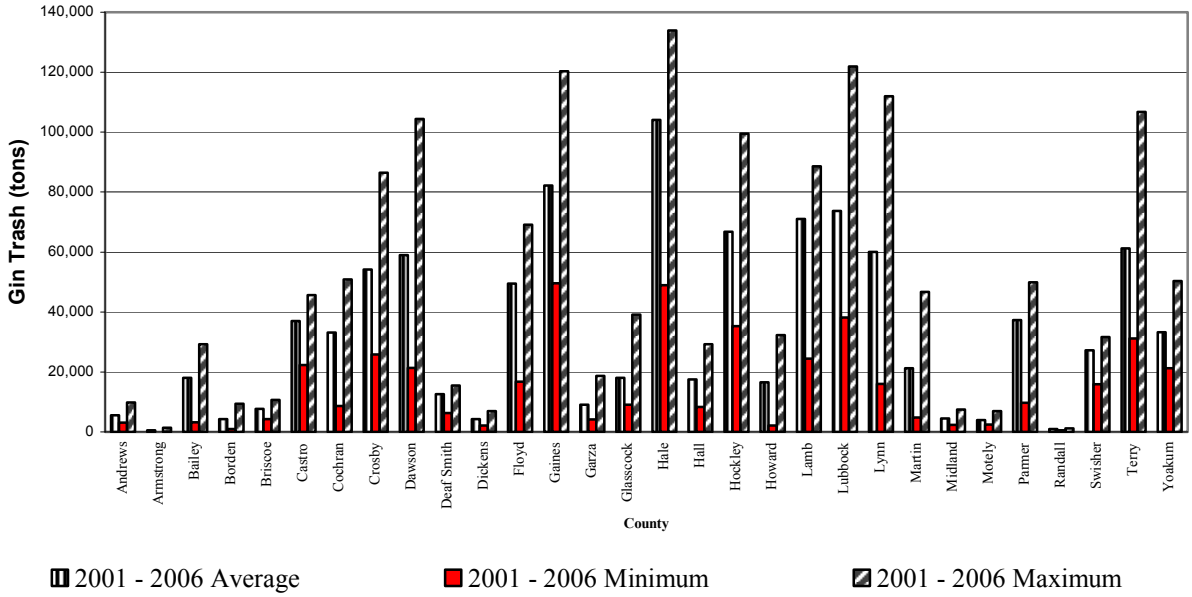

Figure 1. County Cotton Gin Trash Availability 2001-2006; Average, Minimum, and Maximum

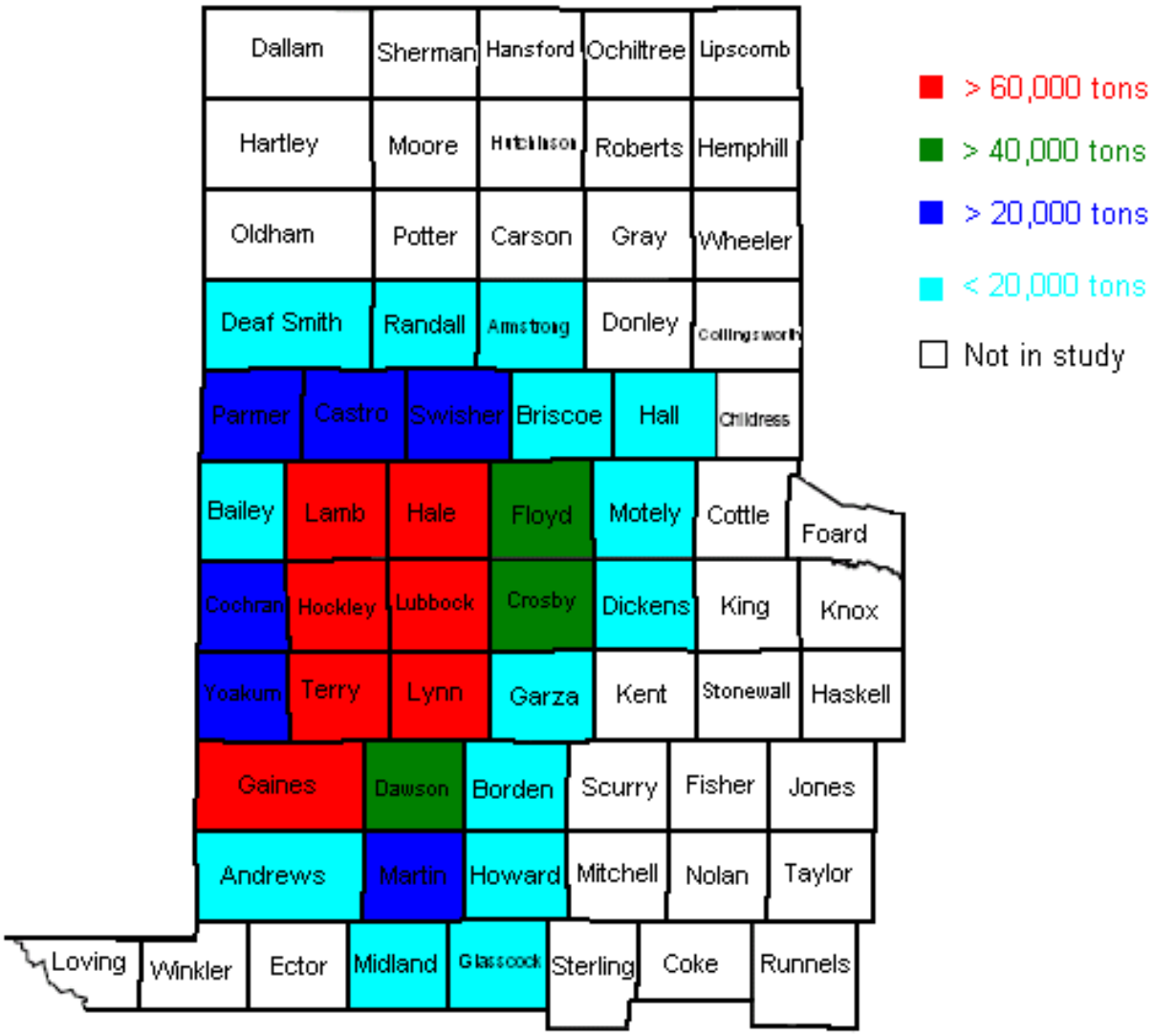

Figure 2. County Map: 2001 – 2006 Yearly Average Short Tons of Cotton Gin Trash