1-17-2018

Sweet Sorghum as an Ethanol Feedstock in Western Nebraska – Could It Happen?

Richard Perrin
University of Nebraska-Lincoln

Lilyan Fulginiti
University of Nebraska-Lincoln

Subir Bairagi
International Rice Research Institute

Ismail Dweikat
University of Nebraska-Lincoln

AGRICULTURAL ECONOMICS

January 17, 2018

agecon.unl.edu/cornhuskereconomics

Cornhusker Economics

Sweet Sorghum as an Ethanol Feedstock in Western Nebraska – Could It Happen?

Market Report	Year Ago	4 Wks Ago	1-12-18
Livestock and Products, Weekly Average			
Nebraska Slaughter Steers, 35-65% Choice, Live Weight.	118.50	116.00	117.00
Nebraska Feeder Steers, Med. & Large Frame, 550-600 lb.	161.90	178.98	184.09
Nebraska Feeder Steers, Med. & Large Frame 750-800 lb.	135.71	165.87	149.93
Choice Boxed Beef, 600-750 lb. Carcass.	192.00	206.87	209.61
Western Corn Belt Base Hog Price Carcass, Negotiated	62.55	58.50	69.76
Pork Carcass Cutout, 185 lb. Carcass 51-52% Lean.	79.17	82.53	78.68
Slaughter Lambs, wooled and shorn, 135-165 lb. National.	141.01	132.18	136.02
National Carcass Lamb Cutout FOB.	346.52	386.01	373.06
3.09Crops, Daily Spot Prices			
Wheat, No. 1, H.W. Imperial, bu.	3.11	3.09	3.40
Corn, No. 2, Yellow **Columbus**, bu.	3.17	3.14	3.19
Soybeans, No. 1, Yellow **Columbus,** bu.	9.51	8.97	8.75
Grain Sorghum, No.2, Yellow Dorchester, cwt.	4.83	5.61	6.18
Oats, No. 2, Heavy Minneapolis, Mn, bu.	3.05	2.68	2.85
Feed			
Alfalfa, Large Square Bales, Good to Premium, RFV 160-185 Northeast Nebraska, ton.	*	165.00	*
Alfalfa, Large Rounds, Good Platte Valley, ton.	70.00	87.50	90.00
Grass Hay, Large Rounds, Good Nebraska, ton.	65.00	82.50	82.50
Dried Distillers Grains, 10% Moisture Nebraska Average.	107.50	147.50	145.50
Wet Distillers Grains, 65-70% Moisture Nebraska Average.	42.00	44.25	46.25

*** No Market**

It has been proposed that non-irrigated sweet sorghum might be grown in western Nebraska as a seasonal substitute for corn grain in corn ethanol plants. In the research summarized here[1], we examine the economic feasibility of this possibility, based on the technical data that are currently available about sweet sorghum production.

As we report below, at current nominal prices and technology, the sweet sorghum ethanol pathway is barely a break-even prospect. But if we consider the extra value of sweet sorghum ethanol over corn ethanol due to the Renewable Fuels Standard (RFS), new benefits to farmers ($14/ac) and plants ($0.06/gal) would be sufficient to warrant investing in the pathway, if it were not for the market and political risks associated with the RFS. Alternatively, if expected sweet sorghum yields could be increased by 30% over our estimate of 20t/ac, similar levels of return could be realized, making adoption by some plants likely. These results are summarized in Table 1.

How would this pathway work?

The sweet sorghum ethanol pathway we examine consists of farmers contracting to produce a field of standing sweet sorghum, which the ethanol plant harvests and transports to substitute for corn grain during the two-month sorghum harvest period.

For economic feasibility, the farmer must be expected to earn more per acre than from corn (the most likely alternative to sweet sorghum), and the ethanol plant

[1] Details of this research are reported in the January 2018, issue of the Journal of Agricultural and Resource Economics as "Sweet Sorghum as Feedstock in Great Plains Corn Ethanol Plants: The Role of Biofuel Policy".

Table 1. Feasibility of sweet sorghum ethanol pathway: minimum farmer willingness to accept (WTA), maximum ethanol plant willingness to pay, and benefits to each party

	Price of Sweet Sorghum, in the Field				
Circumstances	Minimum Farmer WTA, $/t	Maximum Plant WTP, $/t	Feasible Contract Price	Farmer Return Above Corn Crop, $/ac	Reduction in Ethanol Cost, $/gal
Best estimates for average outcome	3.73	3.96	3.84	2.34	0.01
With 30% increase in yield/ac	2.87	3.96	3.41	14.22	0.05
With $0.10/gal premium for sweet sorghum ethanol	3.73	5.16	4.44	14.34	0.06

must expect to earn more when sweet sorghum is the feedstock rather than corn grain. In Table 1 we show a summary of our calculations with respect to this view of feasibility.

Non-irrigated corn production in western Nebraska yields an average yield of 65 bu/ac. Given our estimate of $209/ac in production costs and a market price of $3.50/bu, expected earnings from corn are $18.50/ac. Based on current information about non-irrigated sweet sorghum production in western Nebraska, we estimate an average fresh stalk yield of 20 t/ac (equivalent to about 240 gal/ac of ethanol). Our estimate of production costs, $56/ac, are much lower than for corn, because no fertilizer is required and the farmer incurs no harvest costs.

How little would farmers be willing to accept for a sweet sorghum contract?

Given these estimates, the minimum contract price which the farmer would be willing to accept (WTA) to contract to produce sweet sorghum is $3.73/t. At this price, the expected return from growing an acre of sweet sorghum is equal to the expected return from growing corn. A higher price would be necessary to entice farmers to contract for sweet sorghum, because of the uncertainties related to the new crop and the likely requirement that the contract would be written for more than one year.

What is the most that an ethanol plant would be willing to pay for sweet sorghum feedstock?

As for the ethanol plant, we estimate from survey data that with $3.50/bu corn, the net cost of producing corn ethanol is about $1.25/gal. Net production cost for sweet sorghum ethanol, including amortized cost of new equipment but excluding feedstock cost, we estimate at $0.92/gal. About .08t of sweet sorghum feedstock is needed to produce a gallon of ethanol. Given these estimates, the most that the plant would be willing to pay (WTP) farmers for this feedstock, in order to break even with the corn feedstock alternative, is $3.96/t of stalks standing in the field. This is just a breakeven price and, as is true for farmers, a lower price would be necessary to convince the plant to undertake the $30 million investment costs for a new activity subject to many risks.

Is there a price for sweet sorghum that would benefit both farmers and ethanol plants?

These estimates tell us that the plant would pay at most $3.96/t, while the farmers would be willing to accept no less than $3.73, a difference of $0.23/t. Negotiations between farmers and the ethanol plant would determine the contract price – i.e., how the $0.23/t might be shared between the two parties. If negotiations led to a 50-50 split of this difference, the exchange price would be $3.84/t -- $0.125/t more than the farmers' minimum WTA, and $0.125/t less than the plant's maximum WTP. With this split, both parties would benefit. but the farmer benefit would translate to only $2.34/ac more than expected from corn production, while the ethanol plant would reduce production costs by only about $0.01/gal. We believe these benefits would not be sufficient to persuade either party to adopt the sweet sorghum ethanol pathway.

The impact of higher-yielding sweet sorghum

The pathway might be made viable under some alternative circumstances. Sweet sorghum yields might be increased by new research on the crop under the auspices of a $13.5 million research effort led by UNL[2] to improve sweet sorghum for biofuel, which heretofore has received little research attention. If the research effort either shows yields to be 30% higher than our es-

[2] See the research award announcement at *http://research.unl.edu/researchnews/october2015/*

timate, or raises yields by 30%, farmer WTA falls from $3.73/t to $2.87/t. Continuing with an assumed 50-50 split of this price spread between WTA and WTP, farmer benefits increase from $2.34 above returns from a corn crop to $12/ac, while plant benefits increase from $0.01/gal to $0.04/gal. This level of benefits to each of the parties makes the probability of adoption much higher.

The impact of the price premium for sweet sorghum ethanol due to the RFS

A second factor that improves the potential viability of the pathway is the possibility that the plant can obtain a premium for sweet sorghum ethanol compared to corn ethanol. This prospect may seem improbable given that the ethanol molecules from the two feedstocks are identical, but it is almost a certainty because of the RFS created by the Energy Independence and Security Act of 2007. The RFS mandates that specific levels of various categories of renewable fuels be blended into the transportation fuel supply. The RFS would identify sweet sorghum ethanol as an *advanced biofuel*, and identifies corn ethanol as a generic *renewable fuel*.

Because the mandated levels of these fuels differ and their production costs differ, the fuels have different market values that are reflected in different values for the Renewable Identification Numbers (RINs) associated with the production of each gallon. RINs for corn ethanol are assigned D6 RINs, while RINs for advanced biofuels are labeled D5 RINs. RINs are tradeable, and their market values are regularly reported. During 2017, D5 RINs were worth as much as $0.50/gal more than D6 RINs, but this price spread ended the year at about $0.10/gal, indicating that sweet sorghum ethanol should have a market value $0.10/gal higher than corn ethanol.

A premium of $0.10/gal for sweet sorghum ethanol would increase the ethanol plant WTP for sweet sorghum from $3.96/t to $5.16/t. Still assuming that the negotiated price would split the difference between WTP and WTA, the contract price would be $4.44/t, farmers would expect to earn about $14/ac more than they would from a corn crop and ethanol plants would earn about $0.06/gal more by producing sweet sorghum ethanol than by continuing to produce corn ethanol. This level of benefits for the two parties would seem to be sufficient for them to adopt the pathway.

But the RIN spread has been volatile, and though it might rise, it also could fall below the $0.10 year-end value (which was also the low for the year). Furthermore, the entire RFS has been under relentless political attack from the oil industry, and there is a risk that it could be modified or eliminated entirely.

Summary of our results

Our analysis indicates that with current sweet sorghum yields and prices, the sweet sorghum ethanol pathway is barely a break-even prospect for western Nebraska. However, the current RFS premium expected for sweet sorghum ethanol over corn ethanol, or a 30% increase in sweet sorghum yields, would increase benefits to both parties sufficiently to make adoption a strong possibility. At this point in time, the RFS premium entails considerable risk, and sweet sorghum yield increases are yet to be established, so it seems unlikely that any ethanol plant would initiate the pathway within the next year or two.

Richard Perrin
Jim Roberts Professor
Department of Agricultural Economics
University of Nebraska-Lincoln
rperrin1@unl.edu, 402-472-9818

Lilyan Fulginiti
Professor
Department of Agricultural Economics
University of Nebraska-Lincoln

Subir Bairagi
Post-doctoral Fellow
International Rice Research Institute
Baños, Philippines

Ismail Dweikat
Professor
Department of Agronomy and Horticulture
University of Nebraska-Lincoln