From: [redacted]
To: wlr@tamu.edu
Subject: Re: Sorghum conversion program
Date: Friday, October 02, 2009 3:07:59 PM

Hi Bill

Thanks for your response

Is there a list of some type, with information about the material, that would help in the selection.

The expert in the project is unavailable for a few days. He may want all but I will have to check.

I will get back to you.
BR
Bob

-----Original Message-----
From: Bill Rooney <wlr@tamu.edu>
To: [redacted]
Sent: Fri, Oct 2, 2009 2:36 pm
Subject: RE: Sorghum conversion program

Robert:

We have most of the converted lines; there are over 800 of them. Are you looking for all of them?

While the lines are publicly available, preparing and packaging seed of 800 accessions is not a minimal task. It would require a processing fee of approximately $500.

If you are looking for only a few, we can provide those at no charge.

Let me know what you are interested in.

Regards,

Bill

Dr. William L. Rooney
Professor, Sorghum Breeding and Genetics
Chair, Plant Release Committee
Texas A&M University
College Station, Texas 77843-2474
979 845 2151

From: [redacted] [redacted]]
Sent: Friday, October 02, 2009 2:33 PM
To: wlr@tamu.edu

Subject: Sorghum conversion program

Dear Dr. Rooney

I was told to contact you by Dr. Jeff Dahlberg.

I am interested in obtaining the accessions from the Sorghum Conversion Program.

Can you help me with this request?

I will gladly answer any questions you may have.

I look forward to your reply.

Thank you

Robert Slings
GM of G and S Crop Services

From:	Stelly, David
To:	Avant, Bob
Cc:	Stelly, David; Helms, Adam; Mullet, John E.; Bill Rooney; ssearcy@tamu.edu; Juerg Blumenthal; McCutchen, Bill
Subject:	Re: STO slides
Date:	Thursday, October 15, 2009 11:09:49 AM

Adam,

Looks good. For slides, less text is almost always better; here, too, I would think less text would be more desirable, one can paste full text into speaker notes).

Toward that end, as example, I shortened Metrics for

Goal-1 18-month (tentative) (original text is pasted into speaker notes)

Goal-3 18- and 36-month (I merely shorted text and in some cases separated distinct metrics). (I would actually think it might be even better to reduce the text further than I have done here -- closer to what is shown for Goal 1 18-months). However, time grows short.

David

On Oct 15, 2009, at 10:31 AM, Avant, Bob wrote:

> This is excellent Adam
>
> Sent from my iPhone
>
> On Oct 15, 2009, at 9:53 AM, "Helms, Adam" <ahelms@dsmail.tamu.edu>
> wrote:
>
>> Please review updated slideset to include key 18 mo/36 mo metrics
>> and budget slides. I tried to be as succinct as possible in the
>> slides. Bob – we discussed keeping it to 15 slides, but I do not
>> know if that is possible due to the shear size and diversity of
>> this project – right now it sits at 20 slides, so by my math that
>> is $1.1 million per slide. (Current estimate project cost -
>> $22,096,094)
>>
>>
>>
>> There is a chance Dr. Giroir will not have the opportunity to
>> review this before submission tomorrow due to his travels.
>>
>>
>>
>> Adam Helms
>>
>> AgriLife Research Corporate Relations
>>
>> 979-255-0752 (mobile)
>>

>> 979-458-2677 (office)
>>
>> _____
>>
>> From: Avant, Bob
>> Sent: Thursday, October 15, 2009 7:44 AM
>> To: Mullet, John E.
>> Cc: McCutchen, Bill; Helms, Adam
>> Subject: Re: STO slides
>>
>>
>>
>> Also need to include budget and timeline slides. The PPT may be
>> the most important thing we submit because it will be used to sell
>> our proposal internally. I'm traveling today but can look at
>> changes on my Iphone throughout the day
>>
>> Sent from my iPhone
>>
>>
>> On Oct 15, 2009, at 6:53 AM, "John Mullet" <jmullet@tamu.edu> wrote:
>>
>> Bob,
>>
>> The STO slides need to be reviewed by Brett to get his input.
>>
>> John
>> On Oct 14, 2009, at 5:41 PM, Avant, Bob wrote:
>>
>> > Adam,
>> >
>> > I just checked the Gantt chart on Project. It is well done.
>> But the
>> > Goals do not agree with the current narrative version. You
>> need to
>> > make
>> > sure that the Gantt chart and PPT agree with the narrative
>> before you
>> > send it out.
>> >
>> > Everyone: you need to scan all documents for fatal flaws and
>> provide
>> > comments to Adam before COB tomorrow.
>> >
>> > Bob Avant
>> > Program Director
>> > Texas AgriLife Research
>> > 979/845-2908
>> > 512/422-6171 (Cell)
>> > <mailto:bavant@tamu.edu> bavant@tamu.edu
>> > <http://agbioenergy.tamu.edu> http://agbioenergy.tamu.edu
>> >
>> > -----Original Message-----
>> > From: Avant, Bob
>> > Sent: Wednesday, October 14, 2009 4:10 PM
>> > To: Mullet, John E.
>> > Cc: Helms, Adam; McCutchen, Bill; Avant, Bob
>> > Subject: Re: STO slides
>> >
>> > Adam

>> >
>> > Check PPT carefully against narrative re goals. They are
>> different.
>> > Also at end there are several Goal 3 slides. Also make sure
>> > milestones and metrics agree.
>> >
>> > Sent from my iPhone
>> >
>> > On Oct 14, 2009, at 3:51 PM, "John Mullet" <jmullet@tamu.edu>
>> wrote:
>> >
>> >> Adam,
>> >>
>> >> Attached is a revised STO slide set. We will need Dr.
>> Giroir's input
>> >> before finalizing. Right now there are two versions of the
>> Vision
>> >> slide (slides 2, 3), and three versions of GOAL 3 Deliverables/
>> >> Metrics. Not sure exactly how much detail is needed or who
>> will be
>> >> using the slides.
>> >>
>> >> Thanks,
>> >>
>> >> John
>> >>
>> >> <DARPA_STO slides_081409.ppt>
>> >>
>>
>> <DARPA_STO slides_081209jm ds wlr ajh.ppt>

From:	Helms, Adam
To:	Avant, Bob; Mullet, John E.; Bill Rooney; Stelly, David; ssearcy@tamu.edu; Juerg Blumenthal
Cc:	McCutchen, Bill
Subject:	RE: STO slides
Date:	Thursday, October 15, 2009 9:53:28 AM
Importance:	High

Please review updated slideset to include key 18 mo/36 mo metrics and budget slides. I tried to be as succinct as possible in the slides. Bob – we discussed keeping it to 15 slides, but I do not know if that is possible due to the shear size and diversity of this project – right now it sits at 20 slides, so by my math that is $1.1 million per slide. (Current estimate project cost - $22,096,094)

There is a chance Dr. Giroir will not have the opportunity to review this before submission tomorrow due to his travels.

Adam Helms
AgriLife Research Corporate Relations
979-255-0752 (mobile)
979-458-2677 (office)

From: Avant, Bob
Sent: Thursday, October 15, 2009 7:44 AM
To: Mullet, John E.
Cc: McCutchen, Bill; Helms, Adam
Subject: Re: STO slides

Also need to include budget and timeline slides. The PPT may be the most important thing we submit because it will be used to sell our proposal internally. I'm traveling today but can look at changes on my Iphone throughout the day

Sent from my iPhone

On Oct 15, 2009, at 6:53 AM, "John Mullet" <jmullet@tamu.edu> wrote:

> Bob,
>
> The STO slides need to be reviewed by Brett to get his input.
>
> John
> On Oct 14, 2009, at 5:41 PM, Avant, Bob wrote:
>
> > Adam,
> >
> > I just checked the Gantt chart on Project. It is well done. But the
> > Goals do not agree with the current narrative version. You need to
> > make
> > sure that the Gantt chart and PPT agree with the narrative before you
> > send it out.
> >
> > Everyone: you need to scan all documents for fatal flaws and provide
> > comments to Adam before COB tomorrow.
> >
> > Bob Avant
> > Program Director

> Texas AgriLife Research
> 979/845-2908
> 512/422-6171 (Cell)
> bavant@tamu.edu
> http://agbioenergy.tamu.edu
>
> -----Original Message-----
> From: Avant, Bob
> Sent: Wednesday, October 14, 2009 4:10 PM
> To: Mullet, John E.
> Cc: Helms, Adam; McCutchen, Bill; Avant, Bob
> Subject: Re: STO slides
>
> Adam
>
> Check PPT carefully against narrative re goals. They are different.
> Also at end there are several Goal 3 slides. Also make sure
> milestones and metrics agree.
>
> Sent from my iPhone
>
> On Oct 14, 2009, at 3:51 PM, "John Mullet" <jmullet@tamu.edu> wrote:
>
>> Adam,
>>
>> Attached is a revised STO slide set. We will need Dr. Giroir's input
>> before finalizing. Right now there are two versions of the Vision
>> slide (slides 2, 3), and three versions of GOAL 3 Deliverables/
>> Metrics. Not sure exactly how much detail is needed or who will be
>> using the slides.
>>
>> Thanks,
>>
>> John
>>
>> <DARPA_STO slides_081409.ppt>
>>

From: Scott Vajdak
To: Bill L Rooney
Subject: Re: verizon id and password
Date: Friday, October 02, 2009 5:50:03 PM

Hello Bill,

They don't use passwords on their connections. The SIM chip in your PC has an ID that authenticates automatically when you access their network connection.

-Scott-

>>> "Bill Rooney" <wlr@tamu.edu> 10/2/2009 4:50 PM >>>
Scott:

There was one other thing to ask you - the 3G service is with Verizon. I assume that the account has a Verizon user Id and password, but I don't know that. So, is there one and if so, how do I get the information.

Regards,

Bill

Dr. William L. Rooney

Professor, Sorghum Breeding and Genetics

Chair, Plant Release Committee

Texas A&M University

College Station, Texas 77843-2474

979 845 2151

From: Donghai Wang
To: Bill Rooney
Subject: Re: Acception of your paper
Date: Tuesday, October 06, 2009 10:57:11 AM

Bill,

Attached is the latest version of our manuscript,

Best Regards,

Donghai,

Bill Rooney wrote:
> Donghai:
>
> Can you send me the citation on this manuscript (authors, title) so I can
> add it to my documentation?
>
> Thanks,
>
> Bill
>
> Dr. William L. Rooney
> Professor, Sorghum Breeding and Genetics
> Chair, Plant Release Committee
> Texas A&M University
> College Station, Texas 77843-2474
> 979 845 2151
> -----Original Message-----
> From: Donghai Wang [mailto:dwang@k-state.edu]
> Sent: Saturday, October 03, 2009 5:22 PM
> To: Xiaorong Wu; Scott Staggenborg; Jianming Yu; Bill Rooney
> Cc: Donghai Wang
> Subject: Fwd: Acception of your paper
>
> All,
>
> Just want to let you know that our paper was accepted for publication at
> Industrial Crops and Products(impact factor is about 2),
>
> Best Regards,
>
> Donghai,
>
>
> ----- Forwarded Message -----
> From: "Naceur Belgacem" <[redacted]>
> To: dwang@ksu.edu
> Cc: "Naceur Belgacem" <[redacted]>
> Sent: Saturday, October 3, 2009 2:04:23 PM GMT -05:00 US/Canada Eastern
> Subject: Your Submission
>
> Ms. Ref. No.: INDCRO-D-09-00376R1
> Title: Features of Sweet Sorghum Juice and Their Performance in Ethanol
> Fermentation
> Industrial Crops and Products

>
> Dear Dr D. Wang,
>
> I am pleased to inform you that your paper "Features of Sweet Sorghum
> Juice and Their Performance in Ethanol Fermentation" has been accepted for
> publication in Industrial Crops and Products.
>
> Thank you for submitting your work to Industrial Crops and Products.
>
> Yours sincerely,
>
> Naceur Mohamed Belgacem, PhD
> Editor-in-Chief
> Industrial Crops and Products
>
> **
> For any technical queries about using EES, please contact Elsevier Author
> Support at [redacted]
> Global telephone support is available 24/7:
> For The Americas: +1 888 834 7287 (toll-free for US & Canadian customers)
> For Asia & Pacific: +81 3 5561 5032
> For Europe & rest of the world: +353 61 709190
>
>
>

--

Donghai Wang Ph.D.
Associate Professor
Biological & Agricultural Engineering
150 Seaton Hall
Kansas State University
Manhattan, KS 66506
Office: 785-532-2919
Fax: 785-532-5825

Features of Sweet Sorghum Juice and Their Performance in Ethanol Fermentation

Xiaorong Wu[1], Scott Staggenborg[2], Johathan L. Propheter[2], William L. Rooney[3], Jianming Yu[2], Donghai Wang[1]

[1] Department of Biological & Agricultural Engineering, Kansas State University, Manhattan, KS 66506

[2] Department of Agronomy, Kansas State University, Manhattan, KS 66502,

[3] Department of Soil & Crop Sciences, Texas A&M University, College Station, TX 77845

Department of Biological and Agricultural Engineering, Kansas State University, Manhattan, KS 66506, E-mail: dwang@ksu.edu.

Abstract. As demand for and production of fuel ethanol increase to unprecedented levels, feedstocks for ethanol production will become more diverse. Sweet sorghum is an ideal feedstock for fuel ethanol production in the Southeast and Midwest. Sweet sorghum juices usually contain approximately 16-18% fermentable sugar, which can be directly fermented into ethanol by yeast. Technical challenges of using sweet sorghum for biofuels are a short harvest period for highest sugar content and fast sugar degradation during storage. This study showed that as much as 20% of the fermentable sugars can be lost in 3 days at room temperature because of activities of contaminating bacteria, which lead to significant increases in bacterial count and decreases in pH values. No significant changes in pH value, sugar contents, and sugar profiles were observed in juices stored in a refrigerator. Fermentation efficiencies of fresh juice, autoclaved juice, and concentrated juice with 20% sugar were higher than 93% in the laboratory shake flask batch process. Fermentation of concentrated juices with 25% and 30% sugars were

not complete. Significant amount of fermentable sugars remained in the finished beers of these concentrated juices. Glycerol contents in finished beers from concentrated juices were higher than in beers from normal juices. These results help identify the most important factors affecting the quality of sweet sorghum juice under different processing and storage conditions, enabling development of effective strategies to process the juice, preserve fermentable sugars, and retain the processing properties of the juice during processing, transportation, and storage.

Keywords. Sweet sorghum juice, ethanol, fermentation, sugar profile, organic acids.

Introduction

The US fuel ethanol industry is growing at an unprecedented speed. Ethanol yield reached 9.0 billion gallons in 2008, a 38% increase from 6.5 billion gallons in 2007 according to the renewable fuel association (RFA, http://www.ethanolrfa.org/industry/statistics/). Currently, corn is the major feedstock used for fuel ethanol production in the United States (RFA, 2008). Construction of new ethanol facilities also is proceeding rapidly, particularly across the Corn Belt, which is nearly saturated with ethanol facilities. Opportunities for continued expansion of ethanol production exist in other agricultural regions. One area with high potential for increasing contribution is the sorghum production region of the central Plains. Currently, feedstock for commercial ethanol production is ≈95% from corn grain and ≈4% from sorghum grain. Sorghum is a reasonable feedstock for ethanol production and could make a larger contribution to the nation's fuel ethanol requirements. Climate variability and continuing decreases in water availability make conserving available energy resources and enhancing sustainable economic development increasingly important. Using dryland areas to grow grain sorghum, forage sorghum, and sweet sorghum can help achieve these goals.

Sweet sorghum is a type of sorghum that has a high concentration of soluble sugars in the plant sap, or juice. Sweet sorghum is attractive for bioethanol production because of its high fermentable sugars and very high yield of green biomass (20-30 dry ton/ha), low requirement for fertilizer, high efficiency in water usage (⅓ of sugarcane, ½ of corn), and short growth period (120-150 days); and, it is well adapted to diverse climate and soil conditions. These desirable agricultural characteristics make sweet sorghum a promising alternative feedstock for fuel ethanol production in the southern United States (Gibbons et al., 1986; Prasad et al., 2007; Rooney et al., 2007; Steduto et al., 1997). Sweet sorghum can produce readily fermentable sugars (sucrose, glucose, and fructose) in its juice, starch in its grain, and lignocellulose, that can be used in both current starch-based ethanol plants and future cellulosic ethanol plants. Of the 20-30 dry tons/ha of biomass, approximately 40-45% are fermentable sugars and starch, equivalent to more than 200 bu/acre of corn yield. If all fermentable sugars in sweet sorghum are converted to ethanol, potential ethanol yield could be 600-650 gal/acre. However, normal pressing can recover only $\approx$50% of the total sugars in the sorghum stalk (Bryan et al., 1985). Increasing the juice yield or making proper use of remaining sugars in the bagasse is crucial for realizing the high ethanol yield of sweet sorghum and is of important economical value.

Studies on many aspects of ethanol production from sweet sorghum have been conducted during the past two decades. Buxton et al. (1999) studied the effects of different agricultural practices on performance of sweet sorghum and demonstrated that double cropping sweet sorghum with winter rye might improve soil and water conservation but not sweet sorghum yield. The effects of different harvest approaches (Worley and Cundiff, 1991) and juice processing techniques (Reidenbach and Coble, 1985; Weitzel et al., 1989) on juice recovery and ethanol yield have been investigated. Several other research groups (Day and Sarkar, 1982; De

Mancilha et al., 1984) evaluated performance of several yeast strains in ethanol fermentation of sweet sorghum juices. Day and Sarkar (1982) reported that ethanol productivity varied significantly among different yeast strains; ethanol yields differed among juice batches. However, most tested strains showed a sugar to ethanol conversion efficiency of more than 90% (De Mancilha et al., 1984). Different fermentation techniques also have been tested. Solid phase fermentation using the shredder mill system generated higher ethanol yield (78% of theoretical yield) than the forage harvest system (75% of theoretical yield) (Bryan et al., 1985). Farm-scale fermentation processes using shredded sweet sorghum in solid-phase fermentation (Gibbons et al., 1986) and sweet sorghum juice in liquid batch fermentation (Kundiyana et al., 2006; Oklahoma State University, 2007) have been developed and tested. Fed-batch fermentation had a higher conversion efficiency than batch fermentation (Laopaiboon et al., 2007), and application of immobilized yeast in a fluidized bed reactor not only shortened fermentation time significantly but also increased conversion efficiency (Liu et al., 2008).

No research data on chemical, physical, and microbial changes of sweet sorghum juices as affected by preprocessing and storage condition are available. The objectives of this study were to investigate chemical, physical, and microbial characteristics of sweet sorghum juices under different preprocessing and storage conditions and performance of these juices in ethanol fermentation.

Materials and Methods

Materials

Sweet sorghum (M81E) was planted in May at two Kansas locations (Riley and Doniphan, KS) with four replicates at each location. Plots were non-irrigated dryland with 160

lb/acre nitrogen. Plant populations were between 12,000 and 21,000/acre. Stalks were hand harvested in late October and pressed after heads and leaves were removed. Juices were stored in a refrigerator (4 °C) and freezer (-20 °C) immediately after harvest. The bacterial load and pH values of juices stored in the refrigerator and at room temperature were monitored for 2 weeks to evaluate storage stability of the juices under different temperatures.

Potassium phosphate monobasic, magnesium sulfate, dextrose, hydrochloric acid, and sodium hydroxide were purchased from Fisher Scientific (Fairlawn, NJ). Difco yeast extract was from Becton-Dickinson (Sparks, MD). Sucrose, glucose, and fructose standards were from ordered from Supelco (Bellefonte, PA). All chemicals were reagent grade or better.

The dry alcohol yeast Ethanol Red, which was provided by Fermentis in vacuum-packed bags (Lesaffre Yeast Corp., Milwaukee, WI), was used for ethanol fermentation.

Bacterial counts

Sweet sorghum juices were serial diluted with sterile water (1:10 dilution). One milliliter of each diluted suspension was pipetted onto a 3M Petrifilm aerobic count plate and evenly distributed using a plastic spreader. Petrifilms were then incubated at 35 °C for 48±3 h following the manufacturer's instructions (3M Corporate Headquarters, St. Paul, MN) (Garry et al., 2004) . At the end of the storage period, bacteria in the juices stored at room temperature tended to be mostly lactic bacteria, which were enumerated by diluting the juices in MRS broth and incubating the Petrifilm plates under the same conditions but in a GasPack jar with an EZ anaerobe pouch. Plates with colony numbers between 25 and 250 were chosen for colony counting.

111 ***Ethanol fermentation***

112 One hundred milliliters of each sweet sorghum juice (fresh, autoclaved, or concentrated)
113 were weighted into 250-mL Erlenmeyer flasks and supplemented with 0.3 g of yeast extract per
114 flask. After adjusting pH values to 4.2-4.3 with 2N hydrochloric acid, juices were inoculated
115 with 1.0 mL freshly activated dry yeast (Ethanol Red). Activation of dry yeast was conducted by
116 adding 1.0 g of dry yeast into 19 mL of preculture broth (containing 20 g glucose, 5.0 g peptone,
117 3.0 g yeast extracts, 1.0 g KH_2PO_4, and 0.5 g $MgSO_4 \cdot 7H_2O$ per liter) and shaking at 200 rpm in
118 an incubator at 38 °C for 25-30 min. The activated yeast culture had a cell concentration of
119 $\approx 1 \times 10^9$ cells/mL, which ensured the inoculated juice a yeast concentration of $\approx 1 \times 10^7$ cells/mL.
120 Ethanol fermentation was performed in an incubator shaker (Model I2400, New Brunswick
121 Scientific Inc., Edison, NJ) at 30 °C for 72 h at 150 rpm. Conversion efficiency was calculated
122 by dividing the actual ethanol yield with theoretical yield of 51.1 g of ethanol generated from
123 100 g of glucose (Wu et al., 2006).

124 ***Analytical methods***

125 Moisture contents of bagasses were determined by drying approximately 2 g of ground
126 bagasse in a forced-air oven at 105 ± 3 °C until constant weight (Sluiter et al., 2005).
127 Concentrations of sucrose, glucose, fructose, and ethanol in juices and finished beers were
128 determined by HPLC with a Rezex RCM-monosaccharide column (300×7.8 mm; Phenomenex,
129 Torrence, CA, USA) and a refractive index detector (Shimadzu RID-10A, Columbia, MD, USA).
130 The mobile phase was 0.6 mL/min of deionized water and oven temperature was 80 °C (Wu et
131 al., 2006). Organic acids in stored juices were analyzed by the same HPLC with a Rezex ROA
132 organic acid column (300×7.8 mm; Phenomenex, Torrence, CA, USA) and a UV-VIS detector at

210 nm (Shimadzu SPD-10AV VP, Columbia, MD, USA). The mobile phase was 0.6 mL/min of 5 mM sulfuric acid and the oven temperature was 65 °C.

Statistical Analysis

Differences between means were compared using the ANOVA function in Microsoft Excel at the 0.05 significance level.

Results and Discussion

Juice yield, sugar profile and sugar contents

Average dry mass yield for sweet sorghum in Riley County (KS) was 24,366 kg/ha; mass ranged from 20,373 kg/ha to 25,750 kg/ha. Dry mass yield for the same sweet sorghum in Doniphan County (KS) ranged from 18,142 kg/ha to 32,024 kg/ha with an average of 26,343 kg/ha (Table 1). Although yields varied numerically in different plots, there was no significant difference between average yields harvested from the two counties. Yields from the two test locations were in the upper range of reported dry mass yields (Smith et al., 1987; Weitzel et al., 1989).

Weitzel et al. (1989) reported juice yields between 46% and 54% if non-stripped stalks were pressed by roller mills, and yield increased to 58% if stalks were stripped before pressing. In the present study, all stalks were stripped before pressing. Average juice yields were 57.4% and 60.9% for sorghum grown in Riley and Doniphan Counties, respectively (Table 1), which is comparable to reported juice yields from roller mills. This means that approximately 40% of fermentable sugars in sweet sorghum are still in the bagasse. Increasing juice yield or finding

ways to make use of residual sugars in bagasse will be of great economical value when sweet sorghum is used as a feedstock for fuel ethanol production.

Using a screw press could increase sugar yield in juice to 63-70%, about 10% higher than the roller mill pressing process (Weitzel et al., 1989). If combined with pith and rind-leaf separation, total sugar yield in juice could reach 75%. This is an extra 400 to 600 L of ethanol per hectare of sweet sorghum from an average sugar yield of 8000 kg/ha based on a modest 90% of the theoretical sugar to ethanol conversion efficiency. A recent patent application (Badalov, 2008) claimed more than 95% recovery of sugars from sweet sorghum stem using two step emulsifiers and double press operation. A procedure used in Northeastern China (Lu et al., 1994, integrated energy systems in China - the cold Northeastern region experience, available at URL http://www.fao.org/docrep/T4470E/t4470e07.htm#4.2) using three-roller squeezer juice-extracting system could extract more than 97% of the juice (not sugar) from sweet sorghum stem. If this process is commercialized, ethanol yield per acre from sweet sorghum (total of 565 gallons from a modest yields of 8000 kg sugar and 1750 kg grain per hectare, approximately 485 gallons from juice and 80 gallons from grain) will be a lot higher than that from corn (464 gallon/acre assuming 160 bushels/acre and 2.9 gallons per bushel), which will make sweet sorghum a more attractive energy crop.

Fermentable sugars in sweet sorghum are mainly sucrose, glucose, and fructose. Contents of total fermentable sugars in juices from Riley County sorghum stalks ranged from 13.77% to 15.89% with an average of 15.14% and standard deviation of 0.94%. Sugar contents in juices from Doniphan County sorghum stalks ranged from 14.44% to 16.87% with an average of 15.57% and standard deviation of 1.02%. There was no significant difference between average sugar contents in juices from Riley County and Doniphan County sorghum. Relative percentages

of each sugar were approximately 70%, 20%, and 10% for sucrose, glucose, and fructose, respectively. Sugar content and profile in sweet sorghum juice of different varieties can be very different (Prasad et al., 2007). Fortunately, the sorghum variety (M81E) used in this study had consistent high sugar content and a similar sugar profile in both growing locations.

Sugar Content and Profile Changes during Storage

At room temperature (≈25 °C), sugar content and profile of sweet sorghum juice changed dramatically over time. Average sugar losses for Riley County samples were 12.3%, 31.4%, 46.3%, and 52.8% after 3, 5, 8, and 15 days, respectively, and the Doniphan samples lost 29.6%, 38.6%, and 44.5% of fermentable sugars after 3, 6, and 13 days, respectively. Sucrose content decreased quickly during storage and essentially disappeared after 5 days, whereas fructose content slightly increased over time (Figure 1, left). Ethanol (Figure 1, left) and organic acids (Figure 2) started to appear after 5 days at room temperature, demonstrating that sweet sorghum juice cannot be stored at room temperature.

When stored in a refrigerator, sugar losses were less than 1% and 3% after 1 and 2 weeks of storage, respectively. Average reduction in sugar content in Riley County juice samples was 0.16%, 0.53%, 0.65%, and 2.3% after 3, 5, 8, and 15 days, respectively, sugar losses in Doniphan County samples were 0.9%, 1.0%, and 2.9% after 3, 6, and 13 days, respectively. Although sugar loss increased over time, fermentable sugar contents in the refrigerated juices were reduced less than 1% in a week, which was not significantly different from starting sugar contents. There was no noticeable change in sugar profile in the refrigerated juices within the 2-week testing period (Figure 1, right). No significant difference in ethanol yields and sugar conversion efficiencies was observed for refrigerated juices during the 2-week storage period (data not shown).

198 Originally, there was essentially no acetic acid and only trace amounts of lactic acid and
199 formic acid in the juices (Figure 2). After 3-5 days of room temperature storage, noticeable
200 amounts of lactic acid, acetic acid, and ethanol (Figure 2) were detected in all juices, but the
201 amount of formic acid remained the same, obviously a metabolic result of heterofermentative
202 lactic acid bacteria. By the end of the 2-week storage period, formic acid contents in the juices
203 were still the same, the amounts of acetic acid and ethanol showed a very slight increase, but
204 concentrations of lactic acid increased dramatically to 5 to 10 times the concentrations of formic
205 and acetic acids (Figure 2). This suggested that the activity of heterofermentative lactic acid
206 bacteria almost stopped. However, homolactic acid bacteria were active during the second week
207 of storage at room temperature; this is evident because metabolic products of hexoses by
208 heterofermentative lactic acid bacteria are lactic acid, acetic acids, ethanol and carbon dioxide,
209 and the product of homofermentative lactic acid bacteria is lactic acid (Axelsson, 2004;
210 Hofvendahl and Hahn-Hagerdal, 2000). Bacterial count results supported this.

211 Under refrigerated temperature, no significant change in organic acid profile was
212 observed in juices during the 2-week storage period. Concentrations of formic acid and lactic
213 acid remained the same, and no noticeable acetic acid was detected in juices (Figure 3).

214 ***Change in pH Value and Bacterial Counts during Storage***

215 The pH values of juices stored at room temperature decreased from an average of 4.7 on
216 day 1 to 3.8 after 1 week and remained at ≈3.8 during the second week. The pH values of
217 refrigerated juices increased slightly from 4.7 to 5.1. Because lowering temperature can increase
218 the pH value of a weak acid solution and the original pH values of juices were measured at room

219 temperature, pH of the refrigerated juices essentially were not changed during the 2-week storage
220 period if effects of lower temperature (15-20 °C lower) on pH value were excluded.

221 Bacteria counts in juice samples during the 2-week period are shown in figure 4.
222 Bacterial counts in juices stored at room temperature increased by 30- to 300-fold in the first
223 week and then declined to 20- to 200- fold of original levels after 2 weeks of storage. Bacteria in
224 the original juices might be very diverse, only a few species can be active under the low pH
225 (≈4.7) and anaerobic (still and sealed bottles) conditions. Judged by the viscous appearance
226 (extracellular polysaccharides), large amount of gas, and ethanol and organic acids (lactic acid
227 and acetic acid) profile (figure 1, left and figure 2), bacteria active during the first week were
228 heterofermentative lactic acid bacteria (Cerning, 1990). More than 95% of bacteria in the juice
229 after 1 week were homofermentative, as indicated by the colony characteristics on the 3M
230 Petridishes. This was confirmed by the chromatographs in figure 2.

231 Bacterial counts in the refrigerated juices increased to about 5- to 10-fold of original
232 counts by the end of the 2-week storage period. As shown by the chromatograms of sugar and
233 organic acid profiles (figure 1, right and figure 2), activity of bacteria in the refrigerated juices
234 did not cause much change in the sugar and organic acid profiles. Results showed that if bacterial
235 counts and pH values of sweet sorghum juices are reasonably low, juices can be safely stored for
236 1 to 2 weeks under refrigerator temperature without significant loss in fermentable sugar and
237 fermentation quality. However, it is hard to predict quality of juice refrigerated for a longer time.

238 ***Fermentation Efficiency of Juices with Different Sugar Contents***

239 Fermentation efficiencies of frozen juices, autoclaved juices, and concentrated juices with
240 different sugar contents are listed in Table 2.

241 Fermentation efficiencies of frozen juices were a little higher than those of the autoclaved
242 juices, which is different from a previous report (Rein et al., 1989). Rein et al. (1989) reported
243 fermentation efficiencies for unheated raw juices of 17.9% to 41.1% and for heated (30 min at 60
244 or 85 °C) juices of higher than 90%. Several factors could have contributed to the higher
245 efficiency of frozen fresh juice in the present study. First, hand harvest and leaf-stripping
246 resulted in a significantly low bacterial load ($< 10^6$/mL vs the reported 10^8/mL) in juices; second,
247 the low initial pH (average of 4.7 vs the reported ≈6.0) kept most contaminated bacteria from
248 actively growing during handling; and third, adjusting pH to 4.2 before inoculation of yeast
249 further prevented contaminated bacteria from competing with the inoculated yeast (1×10^7/mL).
250 Autoclaving juices could cause loss of some heat-sensitive nutrients and generate inhibitors,
251 which can lower fermentation efficiencies of autoclaved juices.

252 Fermentation efficiencies of concentrated juices were significantly lower than those of
253 the frozen or autoclaved juices, except those with 20% sugar contents (Table 3). The lower
254 fermentation efficiencies from concentrated juices with high sugar contents could be due to the
255 inhibiting effects of high ethanol concentration, aconitic acid, or the combination of both on
256 yeast.

257 There were essentially no fermentable sugars left in the finished beer of normal sweet
258 sorghum juices (fresh, frozen, or autoclaved), and residual sugars in the finished beer from
259 concentrated juices with 20% sugars were very low. A significant amount of residual sugars
260 (approximately 4-17% of the original sugars) remained in the finished beers from concentrated
261 juices with 25% and 30% sugars (Table 3 and Figure 5). The residual sugar amounts in the
262 finished beers of higher original sugar contents were similar to those (1.8%-8.5%, w/v) reported
263 by Laopaiboon et al. (2009) in high gravity sweet sorghum juice fermentation. This indicates that

normal yeast used for ethanol production (brewing and distillers yeast), although can ferment essentially all the fermentable sugars (glucose and maltose) of similar concentrations in normal SSF process of maize mash (Devantier et al., 2005), may not be able to convert all the fermentable sugars in concentrated sweet sorghum juices into ethanol.

The major portion of the residual sugars in finished beers from concentrated juices was fructose. There was little sucrose and barely detectable glucose in finished beers (Figure 5). This indicated that, among the three kinds of sugars in the concentrated sweet sorghum juices, sucrose and glucose were consumed by the yeast; but considerable amount of fructose (1.0-5.1%, w/v) was still in the finished beers from concentrated juices (25% and 30% sugars) and remained essentially unchanged even one month after the completion of normal fermentation process. As previous research showed that common ethanol fermentation yeasts, strains of *Saccharomyces cerevisiae*, utilize sugars in mixtures of fermentable sugars in a certain order. Most brewering yeasts utilize sugars in sugar mixtures in the order of sucrose, glucose, fructose, maltose, and matotriose (Meneses et al., 2002). Because of *Saccharomyces cerevisiae*'s preference in utilizing sucrose and glucose to fructose (Berthels et al., 2004), sucrose and glucose are always first consumed and converted into ethanol before fructose is used if a feedstock with mixed sugars like sweet sorghum juice is used for ethanol fermentation. If the concentrations of sucrose and glucose are not too high as that presented in the original sweet sorghum juices (~15%, and <25%, w/v), the yeast although under inhibitory conditions of moderate ethanol concentration but can still manage to convert the remaining fructose in the fermentation broth into ethanol in time after all the sucrose and glucose have been utilized, therefore the final fermentation efficiency is reasonably high. However, in the concentrated juice cases, because the sugar contents were significantly higher than (about 10% higher) normal juices, ethanol concentrations

in the fermentation broth was so high (~13%, w/v) that it completely represses the fermentation activity of the yeast to further ferment fructose when all the sucrose and glucose were consumed. When sucrose is utilized by yeasts, it is hydrolyzed into glucose and fructose by invertase. Fructose will stay in the broth as long as there is still glucose in the broth. Therefore, residual fructose concentration in the finished beer could be higher than that of the initial concentrated juice.

Several approaches may be used to solve the residual fructose problem in high gravity ethanol fermentation of concentrated sweet sorghum juices: using yeast strains with enhanced fructose metabolism capacity or tolerant to higher ethanol concentrations, or employing fermentation processes that alleviate the unfavorable repression effects of high ethanol and sugar concentrations. Normal *Saccharomyces* strains used in the fuel ethanol production are effective in utilizing glucose, but not so effective with fructose. The winemaking yeast strains, especially those used for making dry wines, are more effective in turning fructose in grape must into ethanol than most baker's yeasts or brewery yeasts (Guillaume et al., 2007). Grape juices usually contains approximately equal amount of glucose and fructose (glucose to fructose ratio of 0.74 to 1.05). Although the ability winemaking yeast to utilize fructose in the late stage of fermentation differs among strains, the residual fructose concentrations in the finished wine are very low (ranging from 0.15% to 0.7%) (Reynolds et al., 2001). These numbers are much lower than those in the finished beers from concentrated juices in the present study.

Most yeast strains can ferment juices or broths with up to approximately 20% sugars (~10-12% ethanol, v/v) with high efficiencies in batch fermentation process (Belloch et al., 2008). With over 25% sugars, normal brewery yeasts will always leave significant amount of residual sugars in the finished beers (Bvochora et al., 2000; Laopaiboon et al., 2009). Some

ethanol, osmo-tolerant yeast strains could ferment high sucrose and fructose juices with high efficiencies (Bertolini et al., 1991; Meneses et al., 2002).

Glycerol contents in finished beers from normal sweet sorghum juices were around 0.2%, whereas glycerol contents in finished beers from concentrated juices were significantly higher (Table 3). This also contributed to the lower fermentation efficiencies of concentrated juices.

Conclusion

Sweet sorghum variety M81E had reasonably good biomass yields (18,000 to 32,000 kg/ha) at both Riley and Doniphan Counties in 2007. Sugar and grain accounted for ≈40% of total dry mass yield. Sugar contents and profiles of the sweet sorghum juices were suitable for ethanol fermentation. Juice samples from both locations showed fermentation efficiencies of 93-94% in laboratory flask shaking tests. The low pH values (average of 4.7) and low bacterial contamination levels ($\leq 1\times10^6$/mL) might have contributed to the good stability under refrigerator temperature. Storing unprocessed sweet sorghum juices can be a challenge. At room temperature, up to 12-30% fermentable sugars can be lost in 3 days, 40-50% in 1 week. To achieve high fermentation efficiency in batch process, sugar contents in juices should not exceed 20%. Otherwise, both the high sugar content and the resulting high ethanol concentration will exert inhibitory effects on yeast, which will result in incomplete fermentation of fructose and higher glycerol contents in finished beers. Use of winemaking yeast strains and immobilization technique may improve fermentation efficiency of concentrated sweet sorghum juices. It is difficult to quantitatively correlate pH value and bacteria count with fermentation quality of juices during storage.

Acknowledgements

The authors would like to thank the Sun Grant Initiative, South Central Region, for providing the fund for this research under the project “evaluating sweet sorghum hybrids as a bioenergy feedstock”.

References

Axelsson, L., 2004. Lactic acid bacteria: classification and physiology. In: Salminen, S., Von Wright, A., Ouwehand, A. (Eds.), Lactic acid bacteria: microbiological and functional aspects. Marcel Dekker Inc., NY, pp. 1-66.

Badalov, A. 2008. Processing of sweet sorghum for bioethanol production. WIPO international publication number, WO 2008/029163 A2.

Belloch, C., Orlic, S., Barrio, E., Querol, A., 2008. Fermentative stress adaptation of hybrids within the *Saccharomyces sensu* stricto complex. Int. J. Food Microbiol. 122, 188-195.

Berthels, N.J., Otero, R.R.C., Bauer, F.F., Thevelein, J.M., Pretorius, I.S., 2004. Discrepancy in glucose and fructose utilization during fermentation by *Saccharomyces cerevisiae* wine yeast. FEMS Yeast Res. 4, 683-689.

Bertolini, M.C., Ernandes, J.R., Laluce, C., 1991. New yeast strains for alcoholic fermentation at higher sugar concentration. Biotechnol. Lett. 13, 197-20

Bryan, W.L., Monroe, G.E., Caussanel, P.M., 1985. Solid-phase fermentation and juice expression systems for sweet sorghum. TRANS. ASAE 28, 268-274.

Buxton, D.R., Anderson, I.C., Hallam, A., 1999. Performance of sweet and forage sorghum grown continuously, double-cropped with winter rye, or in rotation with soybean and maize. Agron. J. 9 (11), 93-101.

352 Bvochora, J.M., Read, J.S., Zvauya, R., 2000. Application of very high gravity technology to the
353 cofermentation of sweet stem sorghum juice and sorghum grain. Ind. Crop. Prod. 11, 11-17.
354 Cerning, J., 1990. Exocellular polysaccharides produced by lactic acid bacteria. FEMS
355 Microbiol. Lett. 81(1-2), 113-130.
356 Day, D.F., Sarkar, D., 1982, Fuel alcohol from sweet sorghum: microbial aspects. Dev. Ind.
357 Microbiol. 23, 361-366.
358 De Mancilha, I.M., Pearson, A.M., Waller, J., Hogaboam, G.J., 1984. Increasing alcohol yield by
359 selected yeast fermentation of sweet sorghum. I. Evaluation of yeast strains for ethanol
360 production. Biotechnol. Bioeng. 26(6), 632-634.
361 Devantier, R., Pedersen, S., Olsson, L., 2005. Characterization of very high gravity ethanol
362 fermentation of corn mash. Effect of glucoamylase dosage, pre-saccharification and yeast
363 strain. Appl. Microbiol. Biotechnol. 68, 622-629.
364 Garry, E., Pesta, M., Williams, P., 2004. Enumerating 3M^{TM} Petrifilm aerobic count plates using
365 the Petriscan automated colony counter. J. Rapid Methods Auto. Microbiol. 12, 149-153.
366 Gibbons, W.R., Westby, C.A., Dobbs, T.L., 1986. Intermediate-scale, semicontinuous solid-
367 phase fermentation process for production of fuel ethanol from sweet sorghum. Appl.
368 Environ. Microbiol. 51(1), 115-122.
369 Guillaume, C., Delobel, P., Sablayrolles, J.-M., Blondin, B., 2007. Molecular basis of fructose
370 utilization by the wine yeast *Saccharomyces cerevisiae*: a mutated HXT3 allele enhances
371 fructose fermentation. Appl. Environ. Microbiol. 73, 2432-2439.
372 Hofvendahl, K., Hahn-Hägerdal, B., 2000. Factors affecting the fermentative lactic acid
373 production from renewable resources. Enzyme Microbial. Technol. 26(2-4). 87-107.

374 Kundiyana, D., Bellmer, D., Huhnke, R., Wilkins, M., 2006. “Sorganol”: Production of ethanol
375 from sweet sorghum. ASABE Paper No. 066070. ASABE, St. Joseph, MI, available at
376 http://asae.frymulti.com/azdez.asp?JID=5&AID=21449&CID=por2006&T=2 (accessed
377 May 5, 2009).
378 Laopaiboon, L., Thanonkeo, P., Jaisil, P., Laopaiboon, P., 2007. Ethanol production from sweet
379 sorghum juice in batch and fed-batch fermentation by *Saccharomyces cerevisiae*. World J.
380 Micriobiol. Biotechnol. 23, 1497-1501.
381 Laopaiboon, L., Nuanpeng, S., Srinophakun, P., Klanrit, P., Laopaiboon, P. 2009. Ethanol
382 production from sweet sorghum juice using very high gravity technology: effects of carbon
383 and nitrogen supplementations. Bioresource Technol. 100(18), 4176-4182.
384 Liu, R., Li, J., Shen, F., 2008. Refining bioethanol from stalk juice of sweet sorghum by
385 immobilized yeast fermentation. Renew. Energ. 33, 1130-1135.
386 Meneses, F.J., Henschke, P.A., Jiranek, V., 2002. A survey of industrial strains of
387 *Saccharomyces cerevisiae* reveals numerous altered patterns of maltose and sucrose
388 utilization. J. Inst. Brew. 108, 310-321.
389 Oklahoma State University, 2007, Sept. 4, “Sweet” biofuels research goes down on the farm".
390 *ScienceDaily*. Retrieved March 24, 2008 from
391 http://www.sciencedaily.com/releases/2007/08/070829090206.htm
392 Prasad, S., Singh, A., Jain, N., Hoshi, H.C., 2007. Ethanol production from sweet sorghum syrup
393 for utilization as automotive fuel in India. Energy & Fuels 21, 2415-2420.
394 Reidenbach, V.G., Coble, C.G., 1985. Sugarcane or sweet sorghum processing techniques for
395 ethanol production. Trans. ASAE 28, 571-575.

396 Rein, B., Schulte, D., Ogden, R. 1989. Heating and yeast inoculum effects on sweet sorghum
397 juice fermentation. Trans. ASAE 32, 1391-1394.

398 Reynolds, A.G., Edwards, C.G., Cliff, M.A., Thorngate, J.H., III, Marr, J.C., 2001. Evaluation of
399 yeast strains during fermentation of Riesling and Chenin blanc musts. Am. J. Enol. Vitic. 52,
400 336-344.

401 RFA, 2008. Change the Climate—fuel ethanol industry outlook 2008.
402 http://www.ethanolrfa.org/objects/pdf/outlook/RFA_Outlook_2008.pdf

403 Rooney, W.L., Blumenthal, J., Bean, B., Mullet, J.E., 2007. Designing sorghum as a dedicated
404 bioenergy feedstock. Biofuels Bioprod. Bioref. 1(2), 147-157.

405 Sluiter, A., Hames, B., Ruiz, R., Scarlata, C., Sluiter, J., Templeton, D., 2005. Determination of
406 total solids in biomass. NREL BAT Laboratory Analytical Procedure

407 Smith, G.A., Bagby, M.O., Lewellen, R.T., 1987. Evaluation of sweet sorghum for fermentable
408 sugar production potential. Crop Sci. 27, 788-793.

409 Steduto, P., Katerji, N., Puertos-Molina, H., 1997. Water-use efficiency of sweet sorghum under
410 water stress conditions: Gas-exchange investigations at leaf and canopy scales. Field Crop
411 Res. 54(3), 221-234.

412 Weitzel, T.T., Cundiff, J.S., Vaughan, D.H., 1989. Optimization of sweet sorghum processing
413 parameters. Trans. ASAE 32, 273-279.

414 Worley, J.W., Cundiff, J.S., 1991. System analysis of sweet sorghum harvest for ethanol
415 production in the Piedmont. Trans. ASAE 34(2), 539-547.

416 Wu, X., Zhao, R., Wang, D., Bean, S.R., Seib, P.A., Tuinstra, M.R., Campbell, M., O'Brien, A.,
417 2006. Effects of amylose, corn protein, and corn fiber contents on production of ethanol
418 from starch-rich media. Cereal Chem. 83(5), 569-575.

419

420 Table 1. Sugar, grain and total dry mass yields (kg/ha) of sweet sorghum M81E in Riley and

421 Doniphan Counties.

	Sugars in juice	Sugar yield	Grain yield	Total dry mass
RL103	5198.6 (60.9%)[a]	8534.3 (32.2%)[b]	1876.7 (7.08%)[b]	26498
RL206	3581.4 (53.6%)	6686.3 (32.8%)	1440.8 (7.07%)	20374
RL304	4226.3 (56.4%)	7489.3 (30.2%)	1808.9 (7.28%)	24842
RL410	4736.7 (58.7%)	8074.4 (31.4%)	872.1 (3.39%)	25750
Average	4435.7 (57.4%)	7696.0 (31.6%)	1499.6 (6.21%)	24366
DP111	6366.8 (65.7%)	9682.9 (30.2%)	2395.9 (7.48%)	32024
DP209	4974.9 (60.1%)	8283.0 (33.7%)	2710.4 (11.0%)	24568
DP304	6196.5 (59.4%)	10438.3 (34.1%)	2027.8 (6.62%)	30640
DP413	3177.8 (58.5%)	5429.9 (29.9%)	1287.2 (7.10%)	18142
Average	5179.0 (60.9%)	8458.5 (32.0%)	2105.3 (8.06%)	26344

422 [a] percentage of total sugars in the stalk.

423 [b] percentage of the total dry mass.

424

425 Table 2. Average fermentation efficiency of different juices (mean ± standard deviation)

	Frozen juice	Autoclaved juice	Concentrated juices		
			20%	25%	30%
Riley juices	94.6±1.1%	93.8±0.8%	93.3±3.0%	86.4±3.9%	72.4±7.5%
Doniphan juices	94.3±2.7%	91.6±1.1%	93.8±1.9%	89.4±3.1%	77.0±4.4%

426

427 Table 3. Residual sugars and glycerol contents in finished beers from concentrated juices

	Residual sugars (%)			Glycerol (%)		
	20%	25%	30%	20%	25%	30%
Riley juices	0.35±0.11	1.66±0.25	5.13±1.12	0.32±0.03	0.46±0.03	0.53±0.03
Doniphan juices	0.22±0.08	1.02±0.39	4.13±0.85	0.33±0.04	0.49±0.07	0.63±0.07

428
429

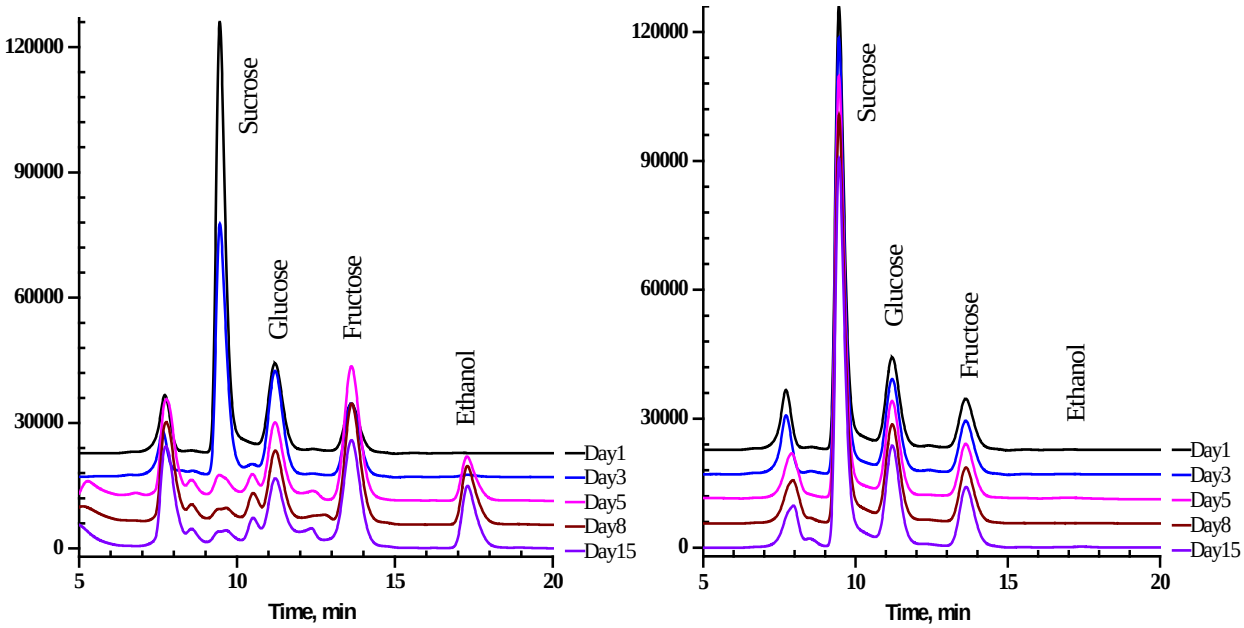


Figure 1. HPLC chromatograms show the change of sugar profile over time at room (left) and refrigerator temperature (right).

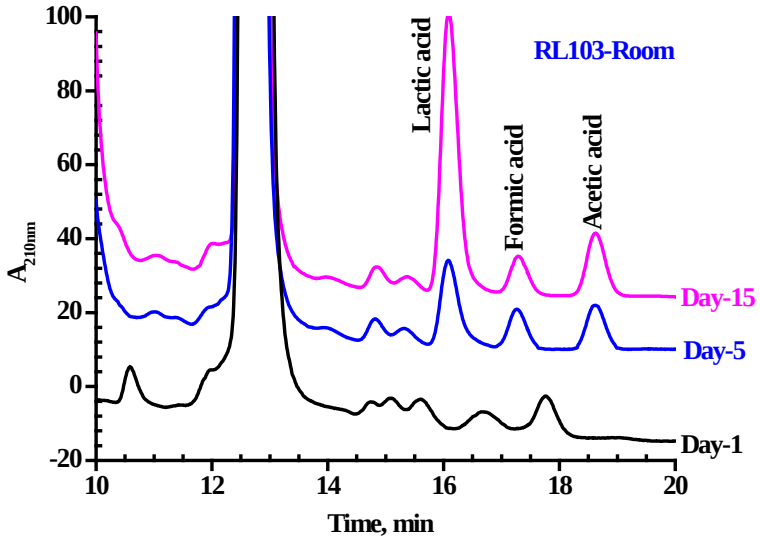


Figure 2. HPLC chromatograms showing accumulation of organic acids in sweet sorghum juice at room temperature over time.

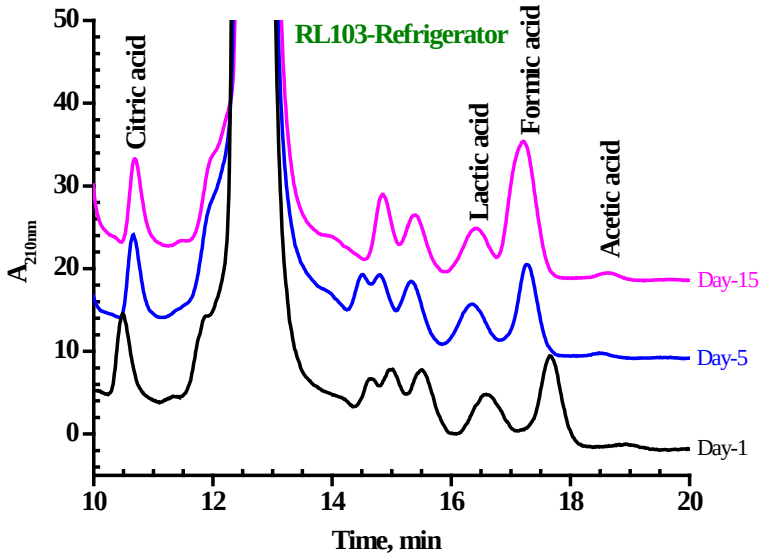


Figure 3. HPLC chromatograms of organic acids in juice stored at refrigerator temperature.

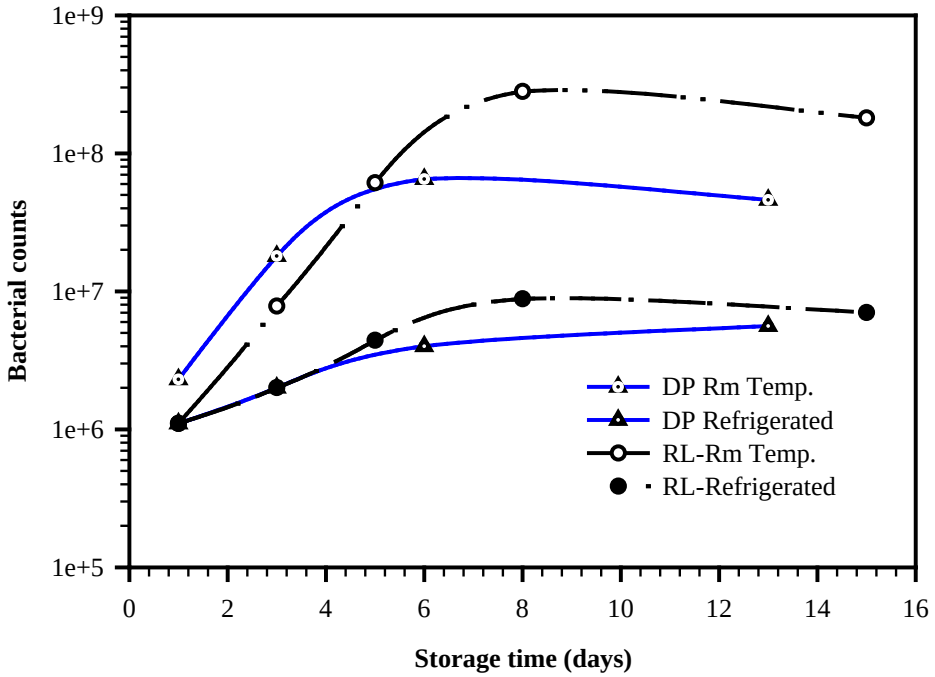
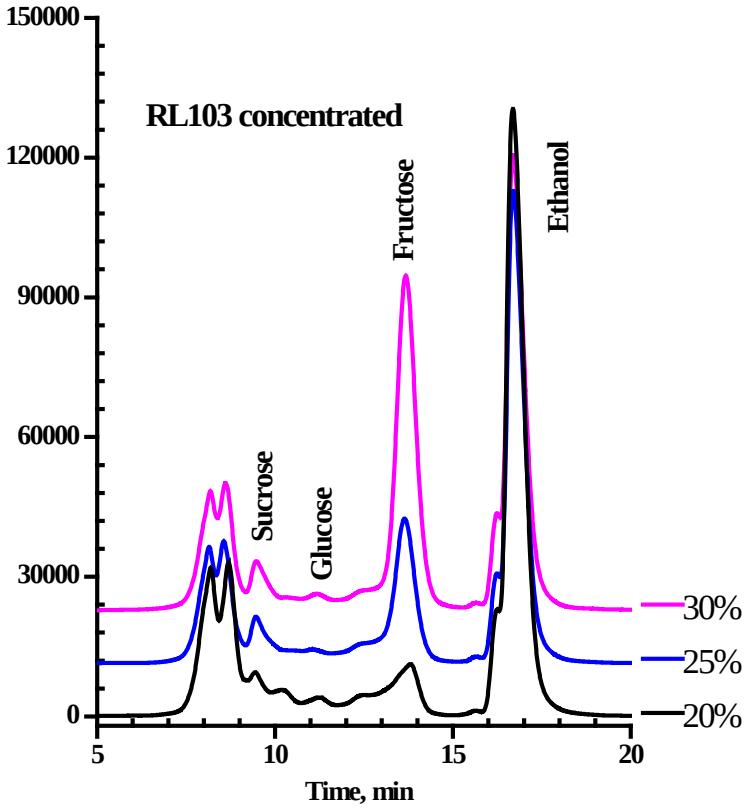


Figure 4. Average bacterial counts in Doniphan (DP) and Riley (RL) county juices during storage.



458

459

460 Figure 5. Profile of residual sugars in finished beer from concentrated juices with different sugar

461 contents.

From: Stelly_David
To: Bill Rooney
Cc: Stelly_David
Subject: Re: Call for 2009 Departmental Awards
Date: Wednesday, October 28, 2009 8:12:37 AM
Attachments:

Thanks. Here is my draft on Wayne.

DS

On Oct 27, 2009, at 11:04 PM, Bill Rooney wrote:

> I'll write for Wayne.
> Bill
>
> ---
>
> **From:** Stelly_David [mailto:stelly@tamu.edu]
> **Sent:** Friday, October 23, 2009 11:02 AM
> **To:** Smith C. Wayne; Kohel Russell; Rooney Bill; Harris Jared; Hodnett George; Saha Sukumar; Gwyn Jeff; Hanson Robert Jr.
> **Cc:** Stelly_David David M.
> **Subject:** Fwd: Call for 2009 Departmental Awards
> **Importance:** High
>
> Would you be willing (if not in conflict with other plans) to join me in nominating Mr. Wayne Raska for this award? He has been my right arm for over 25 years, longevity of which in itself an immensely important factor, as it provided great continuity. Wayne's work and work ethics are highly respected by all who know him and are familiar with his many, many contributions to our overall operations. I opted to ask for a short note from a few of you that have long-since departed my group and TAMU, but who are thus all the more aware of both his long-term dedication to our lab's work for cotton improvement and science, as well as his penchant for organization and "to get it done".
>
> David
>
> 5. Technical Staff Support: Technicians, technical assistants,
> research assistants or equivalents that do not require a M.S. degree may
> be nominated, with emphasis on their sustained contributions.

Begin forwarded message:

From: "Judy Young" <j-young@tamu.edu>
Date: October 23, 2009 10:45:24 AM CDT
To: undisclosed-recipients:;
Subject: Call for 2009 Departmental Awards

** High Priority **

FROM: Mike Chandler, Chair
Departmental Awards Committee

TO: All Faculty 09; Center/Station Directors; Support Staff; Graduate Students and Undergraduate Students

DATE: 10/22/2009

SUBJECT: Call for 2009 Departmental Awards

We need to identify and prepare nomination packets for outstanding individuals in the Department of Soil and Crop Sciences. Please help assure that individuals in your group or location are aware and can help recognize others for their contributions to teaching, extension and research.

Nominating procedures and former recipients are provided in the pages that follow. The nomination is basically a two-page summary, a couple of letters of support and up to six pages on the nominees background. The 2009 nomination packet should arrive by 4 p.m. on December 3, 2009.

Please deliver packets to:

Anna Fox
Department of Soil & Crop Sciences
2474 TAMU
217 Heep
College Station, TX 77843-2474
afox@ag.tamu.edu

Please take time from your busy schedule to participate in this worth while endeavor.

AWARDS IN EXCELLENCE PROGRAM
Department of Soil and Crop Sciences, Texas A&M University System

Purpose: The Department established this Awards in Excellence program to recognize employees and others for their contributions and special efforts that enhance teaching, research, and extension activities. A committee appointed by the Department Head manages the program, reviews nominations, and selects final candidates for recognition. Award categories, nomination procedures, and other details are described below.

Categories of Awards

1. Administrative Support: Persons may be nominated who hold a position of clerical staff, account clerks, secretaries, administrative assistants, or similar duties that enhance the work and programs of teaching, extension, and/or research.

2. Research Award: This award is for faculty in research for excellence in scientific achievements and career accomplishments, with emphasis on the past three years. Considerations include innovations, collaborations, and applications.

3. Research Collaboration: This award is intended for an individual holding a Ph.D., usually post-doctoral research associate and similar position, who has provided outstanding research contributions under the direction of a permanent Faculty member.

4. Research Support: This award is for persons holding positions as research technicians, research associates, or equivalent positions that required at least a M.S. degree. Post-doctoral research associates and similar positions do not fall under this category for their contributions to the program.

5. Technical Staff Support: Technicians, technical assistants, research assistants or equivalents that do not require a M.S. degree may be nominated, with emphasis on their sustained contributions.

6. Graduate Research Award: Nominations should focus on students enrolled in a masters or doctoral program during the past calendar year, working on or off campus, and focus on research conducted at Texas A&M. The nomination may include a list of twelve (12) publications (authored or co-authored during the past five years) and may list significant presentations and awards.

7. Extension Awards: This award is for faculty excellence and accomplishments in extension education, including specialists and others, with emphasis on the past three years. Considerations include innovations, cooperation and outreach, and impacts.

8. Collaborating County Extension Agent: This award is to recognize county agents and others who have provided direct support for

Specialists in program planning, implementation activities, and/or delivery of Extension programs and may include county-based demonstration/applied research projects, enhanced communication with target audiences to deliver Extension information and resources, or other activities that enhance Extension missions and outreach - on a county, regional, or state basis.

9. Teaching Award: This award is recognize outstanding contributions of a faculty member in classroom teaching, advising, mentoring, and/or other activities toward enhancing student experiences in undergraduate or graduate teaching. The nomination may include efforts toward enriched course content, delivery, career development, and impact on students.

10. Graduate Teaching Award: This award may be granted to a graduate teaching assistant for outstanding contributions in laboratory, lecture, or non-teaching activities that enhanced student experiences in one or more courses in the Department. The nominee should have been enrolled and functioning as a graduate student during the current calendar year.

11. Undergraduate Student Support: This award is intended to recognize an undergraduate student who significantly contributed to teaching, research or extension programs above and beyond usual employment expectations.

12. Special Service/Recognition Award: This award recognizes outstanding support by an individual and/or organization for teaching, research, and/or extension programs of the Department. The nomination should summarize contributions and impacts, with emphasis on the past five years. The award may be presented at a time or place to more fully recognize the contributions.

Eligibility

1. Any Soil and Crop Sciences faculty or staff may submit nominations for any category. Student groups may nominate one faculty member for an award.

2. Any Soil and Crop Sciences faculty, staff, or student is eligible to receive awards, subject to these constraints:

a. Members of the Departmental Awards Committee are not eligible to receive an award.

b. Previous recipients of a Departmental, Association of Former Students, or Agriculture Program award are not eligible for an award in the same category in this program but may be nominated in a different category.

c. Previous nominees are eligible but must be re-nominated if not

successful. If a candidate is nominated for more than one category, an award may be in only one category.

d. All nominees must have been associated with the Department for at least three years, except for nominees for Graduate, Undergraduate, and Research Collaboration Awards, who must be affiliated with the Department at least in the calender year of nomination.

Nomination and submission procedures:

Nominations should first clearly identify the award category.
Nomination packets must include:

1. A two-page double-spaced statement summarizing significant accomplishments, achievements, and/or evidence of impacts, with emphasis on recent years and conclude with the nominator's name and date.

2. Up to two letters (one page each) supporting the nomination.

3. A copy of significant portions (up to six pages) from the nominee's annual achievement report, resume, or comparable information.

Submission and selection

1. Seven (7) complete collated packets should be prepared with each copy placed in a folder labeled with the award category and the nominee's name.
Packets should be received by 4 PM on December 3, 2009 in the Departmental office.

2. The Departmental Awards Committee will evaluate and select award recipients.
All decisions by the Committee will be final and subject to acceptance by the Head.
Awards will presented at a Departmental meeting or other event for recognition.
A list of former Departmental Award recipients is presented below.
Questions may be directed to the Awards Chairman or the Departmental Office.

Past Recipients - SOIL AND CROP SCIENCES DEPARTMENTAL AWARDS
(if no location is indicated, the recipient was at College Station)

1. Administrative Support: Debbie Sutherland, Janet Case, Missy Vajdak, Cindy King, Betty Yezak, Jolene K. Hampton, Sherry Higgenbotham, Glenda Kurten, Mary Cooper, Lubbock, Janis Williamson, Overton, Lynette Huval, Tami Hons, Gloria Conrad, Thelma M. Barrett, Lubbock, Tina Nuche, Ginger Franks, Janell McCullough, Martha Hyde, Lubbock, Gladys Beasley, Helen Butler, Carol Rhodes, Joan Cowart, Judy Young, Li Zhang, Kevin Moore

2. Research Faculty: Frank, Hons, C. Wayne Smith, Ralph Waniska, Gerald Evers - Overton, Kevin McInnes, Richard Loeppert, F. Monty Rouquette, Jr. - Overton, Olin Smith, Seeichi Miyamoto - El Paso, Charles Simpson- Stephenville, W.R. Ocumpaugh - Beeville, Arthur Onken,-Lubbock, Vincent A. Haby- Overton, Larry Wilding, Lloyd Hossner, Charles Wendt -Lubbock, Kirk Brown, Darrell Rosenow - Lubbock, Keith McCree, Floyd Fenn - El Paso, Allen Wiese- Amarillo, Cleve Gerard - Vernon, Kenneth Porter- Amarillo, Ethan Holt, Gerald Smith-Overton, Bill Rooney

3. Research Collaboration: Hyeon-Se Lee, Hamid Shahandeh, Sung Hun Park, Nurul Islam-Faridi, Scott Finlayson, Sam Yang

4. Research Support: Margaret J. (Peggy) Parsons, William H. (Pete) Higgins - Stephenville, Mark H. Hall, Brent A. Bessler, Yoakum, G. Norman White, Stephen Ward, Overton, Charles Woodfin -Lubbock, Doug Nesmith- Lubbock, Cassandra McDonough, Allen Leonard - Overton, Indre J. Pemberton - Overton, Sam Sifers, James V. Davis - Overton, M.J. Florence - Overton, L. Richard Drees, Wallace Menn, Jim Thomas, Mary Ketchersid, Chantel Scheuring, John Everitt - Lubbock, Randy Bow-Stephenville

5. Technical Staff Support: Todd Carpenter, Vince Saladino, Annette Fincher, Joel Kerby -Overton, Frank Fojt, Michael R. Baring, Leon Synatschk, Vicki Gergeni, Kathy Schmitt, Henry Cobb- Lubbock, Jim Crowder, Overton, Lyndon Schoenhals - Lubbock, Curtis Gilbert - Overton, Gene Bolton, Bobby Bredthauer, Dennis Pietsch, K.C. Donnelly, Robert McGee- Weslaco, Gary Peterson- Amarillo,Wayne Chenault- Amarillo, Gary Nimr - Overton, Dawn Deno, Delroy Collins

6. Graduate Student Research: Jason Krutz, Lu Tian, Ronnie Schnell, Abdul Mohammed

7. Extension Faculty: Brent Bean- Amarillo, Todd Baughman -Vernon, Randy Boman - Lubbock, Mark McFarland, C.S., Robert Lemon -C.S., Paul Baumann - CS, Travis Miller- C.S. Billy Warrick -San Angelo, Charles Stichler - Uvalde, George Alston -Stephenville, Willis Gaas -C.S., Steve Livingston- C.S., .Ed. Colburn - C.S., William Knoop- Dallas, Billy L.

Harris- C.S, John Bremer- C.C., Neal Pratt- C.S., Dave Weaver- C.S., James Supak -Lubbock, Kenneth Lindsey- Ft. Stockton, Robert Metzer- C.S., Frank Petr- Amarillo, A.C. Novasad- C.S., Jim McAfee-Dallas, Tony Provin - C.S., Gaylon Morgan - C.S.

8. Collaborating County Agent: Ron Leps, Gary Bomar-Abilene

9. Teaching Faculty: Richard White, Scott Senseman, Tom Cothren, Ralph Waniska, Mike Chandler, Kirk Brown, Wallace Menn, Harry Cralle, Mark Hussey, Tom Hallmark, Frank Hons, Don Vietor, David Zuberer, Murray Milford, Morris Merkle, J. F. Mills, Sam Feagley, Christine Morgan, Terry Gentry

10. Graduate Teaching: Robyn McGilloway, Cecilia Gerngross, Faith Ann Heinsch, Trent Hale, Thomas Brooks, Curtis Wiltze, Michelle Finlayson, Linn White, Travis Waiser, Brad Westmoreland, Sara Lancaster

11. Undergraduate Student Support: Travis Waiser,Ashley Fowler, (Gigi) Alicia Mauer, Kristen Kurten, Courtney Swyden, Morgan Arnett, Katrina Hutchinson, Scott Stanislav

12. Special Services/ Recognition Award: Doug Jost - Monsanto, Jim Faubion -Club Corp,
Norman Rozeff -Rio Grande Valley Sugar Growers, Inc., Billy Turner, Texas Turfgrass Association, Mike Wright and Andy Pontz - KBTX, Ernest Rivers -C.S. ,Texas Wheat Producers Board, Lamesa Cotton Growers Association, Carl Cox - TFFC, Texas Producers Peanut Board, USGA Green Section, Turfgrass Producers of Texas, Craig Potts - Assistant Athletic Field Manger at Texas A&M University

AgriLIFE RESEARCH
Texas A&M System

TEXAS A&M UNIVERSITY

COLLEGE OF AGRICULTURE
AND LIFE SCIENCES
Department of Soil and Crop Sciences

October 26, 2009

TO: Awards Committee – Department of Soil & Crop Sciences

FR: David Stelly, Professor

RE: Nomination of Dwaine A. Raska for Technical Staff Support

I have led the Cotton Cytogenetics / Wide-cross Introgression Project for 25 years, during most of which Dwaine ("Wayne") A. Raska has been the project's "right arm". Wayne was an hourly student worker when I assumed a faculty position in 1983. A few years later, he completed his B.Sc. and I was able to hire him as a replacement for my pre-existing technician, who departed for Cornell University with her husband. He has proven himself to be an indispensable part of this project and served with distinction for many years as our project's technical guru and research assistant.

The project and the Department have benefited immensely from Wayne's numerous contributions, many far beyond the call of duty, including exceptionally hard work – sometimes over 100 hours per week at crunch times (no bull!). Moreover, Wayne has time and time again found ways to get things done economically. His work ethics have multiplied the benefits of his education, intelligence, organization and diverse handyman skills. His proficiency allows the project to grow large populations in greenhouses (15,000 – 20,000 sq ft / year-round), space-transplanted nursery (2.5 acres) and direct-seeded cotton fields (5-10 acres), work-crew management (5-10 student workers year round), and to make very large numbers of cytogenetic preparations and cytological analyses for cotton cytogenetic stock development (*Gossypium hirsutum* L.) and chromosome substitution (3 alien species), and many additional ad hoc projects. Our project is well recognized for its forte, cotton cytogenetics, throughout the world cotton research community – and Wayne's contributions there have been intrinsic to our success.

His "one-man-army" work ethics, abilities, meticulous attention to planning and detail and ability to operate many facets of the project independently have been a huge benefit to the project, and contributed greatly to our lab's reputation world-wide in the cotton genetics, genomics and breeding research communities. He has routinely interfaced excellently with Farms Services, the the local USDA cotton Germplasm and Plant Pathology groups, and also with the USDA groups at Mississippi State and Stoneville; as well as many others on an ad hoc basis. So, he has impacted not only internal operations, but also external ones.

Dr. David Stelly
Dept. Soil & Crop Sciences, TAMU
Heep Center, 370 Olsen Blvd.
College Station, Texas 77843-2474 USA
http://soilcrop.tamu.edu

E: stelly@tamu.edu
T: (979) 845-2745
F: (979) 845-0456 (Dept. Office)
Dept. URL:

The longevity of his role in this project (>25 years) has been an immensely important factor, as it has provided great continuity and ever-increasing proficiency and efficiency. Wayne's work and work ethics are highly respected by all who know him and are familiar with his many, many contributions at our workplace. I know that there have been several instances where Wayne could have taken positions offered to him by colleagues here and elsewhere, and probably there were others that I do not know about, but he remained very faithful to our project, too. SCSC has benefited from his deep commitment.

Wayne has long taken a personal pride in our lab and department. There have been many, many instances where Wayne took the initiative to build or modify or fix items in our buildings (#955, 961, 963, 965) and equipment, and devise operation-smoothing and -economizing gadgets or procedures. A few simple examples include repairing equipment and rebuilding our roller gins, lightweight construction of lab items, building a bridge across the constantly flooded ditch between buildings 965 and 955 (we use both), building soil bins, building sidewalks, renovating/fixing greenhouses #961 and #963, and just last week, welding a bike rack. His contributions extend to aesthetics and social matters, too – for example, he has for years planted, replaced and kept up ornamentals in front of New Beasley Lab, which arguably has the best looking greenery of all buildings along Agronomy Rd., the grounds around most of which are poorly landscaped. On a number of occasions, he has provided decorations and time for SCSC Departmental functions. In our lab, he works directly with numerous hourly workers, and has on numerous occasions taken the lead in organizing lab socials that help keep up morale and work efforts.

Wayne Raska's long-term dedication and contributions to our lab, the cotton program and SCSC warrant recognition. I request your support in having the Department recognize Wayne at this time for his contributions --- their longevity, their multi-dimensionality, consistency, and high quality. They reflect exceptional high degrees of competence and commitment.