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OTO BY ROLF HAGB

**ALSO IN THIS ISSUE:** 



page 8 Sugared fuel





# **Renewable energy revs up the rural economy** AURI's Center for Producer-Owned Energy marks second anniversary

### BY E. M. MORRISON

Minnesota farmers will be harvesting more green power, thanks to AURI's Center for Producer-Owned Energy.

In its first two years, CPOE helped develop ethanol, biodiesel, biomass gasification, manure digestion, community wind power and renewable energy coproducts, says Max Norris, CPOE director.

With a \$1 million USDA grant, plus privatesector matching grants, CPOE has backed two dozen ideas for turning farm products into renewable energy. Several projects have resulted in businesses expected to attract an estimated \$200 million in capital investment. And CPOE initiatives have benefited more than 8,800 Minnesota ag producers, says Lisa Gjersvik, AURI resource development manager. "Creating wealth in rural Minnesota is what it's all about," Norris says.

CPOE offers business development expertise and applied research services to commercialize innovative ideas. Minnesota has "a very active renewable energy research program at the University of Minnesota," says Wayne Hansen, AURI project director. "One of our roles is to take that basic research and put it to use." CPOE has worked with producer-owned companies at every business-development stage — from first concept to feasibility to financing. It's a unique mission, carried out in partnership with Minnesota commodity groups and ag processors who contributed cash and in-kind the first two years.

Not only do these partners contribute money, "they also help develop concepts and opportunities for renewable energy," says Denny Timmerman, AURI project director. "Our commodity groups depend on us to look at new ideas," Norris adds.

### Accomplishments

Over the last two years, the center has helped Minnesota farmers evaluate the profitability of gasifying grass seed chaff, sugar beet pulp and corn stover. It has worked with soybean growers to test biodiesel performance in all-terrain vehicles and Mississippi River towboats. And it has helped both large and small dairy farmers explore methane production.

In the liquid biofuels sector, CPOE helped launch a new corn ethanol plant in Fergus Falls, Minn., which broke ground in October 2006. And it's working with organizers of proposed ethanol plants near Erskine and Luverne. The center also worked with CornPlus Ethanol in Winnebago to boost ethanol yields by adding cheap excess sugar to the fermentation phase (see "Sweeter still," page 8).

In the coming year, CPOE will test crude glycerin and vegetable oils in industrial turbines and boilers. "There's huge interest in this research," which could open vast new markets for biodiesel coproducts, says Rose Patzer, AURI associate scientist. The center will also investigate fractionating soybean meal, another biodiesel coproduct, to improve its nutritional qualities for poultry.

### Lowering risk

These innovations could one day help farmers diversify their products and strengthen the rural economy, says Mike Sparby, AURI project director. But new ideas are often risky, and CPOE's work "helps mitigate the risk of new technology," he says.

Pilot tests - such as a biodiesel-wind cogeneration demonstration scheduled for next summer — let investors see new technology in action. "These are local projects, within driving distance," Hansen says. "You don't have to go to Europe or India to see them."

The center's feasibility research also saves producers time and money. For example, a new community wind-power handbook outlines all the steps needed to develop a profitable wind turbine. Even studies that turn thumbs down on a proposed venture, such as transporting methane made on dairy farms, are valuable learning tools, Hansen says. "You can show people the numbers and prevent them from putting money into something that's not going to work — at least not now."

### **Energy leader**

Two years after its founding, the Center for Producer-Owned Energy is the go-to place for rural Minnesota entrepreneurs who want to start renewable-energy businesses, says Butch Koehmstedt, a USDA rural development officer in Thief River Falls. "The staff has a lot of expertise and knowledge, which they can pass on to businesses looking for alternative energy resources."

Minnesota is already a renewable energy leader, Norris says. The state boasts robust ethanol and biodiesel manufacturing, expanding E85 distribution, rapidly growing wind-power capacity and strong interest in biomass power.

Norris says that the Center for Producer-Owned Energy "is part of the reason there is so much interest in Minnesota in renewable fuels. The USDA funds let us look at a broad array of ways to create renewable energy." Although the USDA grant ended in December, the center's renewable energy mission will continue, Norris says, supported by AURI, Minnesota commodity groups and other state partners.

# **Project summaries:**

### AURI CENTER FOR PRODUCER-OWNED ENERGY PROJECTS, 2004-2006



### BIODIESEL

### **Turbine power**

Identify oils that meet the performance, storage and economic requirements for turbine fuel.

### **Opportunity and idea:**

substitutes to fuel turbines.

- Large supplies of low-value, unrefined vegetable oils are available. Industry wants low-cost petroleum and natural-gas
- Partners:
- Minnesota Soybean Growers and Soybean Research
- & Promotion Council.
- Center for Diesel Research.

### Outcome:

- Biodiesel meets the performance and storage requirements for turbine fuel.
- · Partly-refined soybean oil shows promise.

### **Towboats on biodiesel**

Test biodiesel blends of 20 to 50 percent in slow-rpm towboat diesel engines

### Opportunity and idea:

· Environmentally-friendly fuels needed for river boats. • Fuel Mississippi River towboats with biodegradable biodiesel.

### Partners:

- Minnesota Soybean Growers and Soybean Research & Promotion Council
- Center for Diesel Research
- Biotransportation

### **Outcome:**

- Biodiesel blends can be used successfully with minor modifications in engines and fuel systems.
- · Fuel efficiency and emissions tests will be done in 2007.

### **Burning glycerin**

Evaluate glycerin combustion emissions to see if the fuel meets Minnesota environmental regulations. Glycerin is a coproduct of biodiesel processing.

#### **Opportunity and idea:**

- Large supplies of low-value glycerin available.
- New markets needed for expanding glycerin
- supplies. • Burn cheap glycerin in industrial boilers.

- Partners:
- Minnesota Soybean Growers and Soybean Research & Promotion Council
- Farmers Union Marketing and Processing Association

### Outcome:

Tests will be completed in 2007.

### **Biodiesel off-road**

Test the performance of B20 in ATV diesel engines.

Opportunity and idea:

#### • Minnesota-based Arctic Cat is manufacturing a diesel all-terrain vehicle (ATV) that could run on B20

#### Partners:

 Minnesota Soybean Growers and Soybean Research & Promotion Council

### Arctic Cat

- Outcome:
- B20 approved for use in Arctic Cat's diesel ATV.



### **ETHANOL**

### Speedy ethanol

Evaluate adding small amounts of beet sugar during ethanol fermentation to speed up corn-based ethanol manufacturing. Conduct three commercial-scale demonstrations with a 2 percent sugar addition.

### **Opportunity and idea:**

- Minnesota's sugar beet industry produces excess sugar, which has a low value on world markets.
- Use excess sugar to speed up corn starch fermentation in ethanol processing.

#### Partners:

- Southern Minnesota Beet Sugar Cooperative in Renville, Minn.
- CornPlus Ethanol in Winnebago, Minn.

#### Outcome:

• Average fermentation time cut by three hours. Average ethanol yield increase of 1,500 gallons per batch.

### **Expanding ethanol's reach**

Develop a 65-million-gallon corn dry mill, the first ethanol plant in northwest Minnesota. Project helped assess plant feasibility, prepare a business plan and organize an equity drive.

### **Opportunity and idea:**

- Corn production is expanding in northwest Minnesota.
- Ethanol demand is strong.
- Federal and state biofuel incentives are available.
- Help Otter Tail County-area growers plan a 65million-gallon corn ethanol plant.

#### **Partners:**

- Minnesota Corn Research & Promotion Council
- Otter Tail Ag Enterprises, LLC

#### Outcome:

- \$100 million+ ethanol plant broke ground in late
- 2006 and will begin production in early 2008. • The project attracted 877 rural Minnesota investors.

### Ethanol up north

Determine the feasibility of a 70-million-gallon corn or barley ethanol plant in Polk County, prepare a business plan and select a site

### **Opportunity and idea:**

- Corn production is expanding in northwest Minnesota.
- Ethanol demand is strong.
- Federal and state biofuel incentives are available.

### Partner:

Agassiz Energy, LLC

### Outcome:

 Initial planning and permitting finished on a corn dry mill.



### WIND POWER

### Wind plus biodiesel

Evaluate the technical and economic feasibility of supplementing wind power with electricity from a biodiesel generator.

### Continued on page 4



### **Opportunity and idea:**

- Minnesota wind-power capacity is expanding.
- Continuous, reliable wind power is needed.Federal and state wind power incentives are
- available.
- Electric companies are offering premiums for firm, renewable power.
- Supplement intermittent wind power with on-site electrical generator sets powered by biodiesel.

#### Partner:

• Minnesota Soybean Growers and Soybean Research & Promotion Council

#### Outcome:

- Feasibility study identified conditions for profitable cogeneration.
- Demonstration of cogeneration planned for 2007, in cooperation with Excel Energy.

### Wind power primer

Prepare a handbook to guide development of community wind projects, outlining organizational structures, business planning, permitting, financing and other issues.

### **Opportunity and idea:**

- Demand for Minnesota wind power is expanding.
  New state wind-power incentives are available for
- community-owned wind projects.Minnesota farmers are interested in building wind
- Minnesota farmers are interested in building wind farms.

#### Partners:

- Rural Minnesota Energy Board
- Windustry
- Southwest Minnesota Foundation
  Minnesota Corn Research & Promotion Council
- Minnesota com Research & Fi

Outcome: •Lower wind-power development costs.



### **BIOMASS GASIFICATION**

#### Chaff gas

Test grass seed chaff gasification and evaluate the economic feasibility.

#### **Opportunity and idea:**

- Seed cleaning plant is paying to dispose of grass seed chaff.
  Gasify chaff on-site to produce syngas to run the
- Gasity chaft on-site to produce syngas to run the seed plant.

PAGE 4 AURI AG INNOVATION NEWS • APR-JUN 2007

### Partner:

- Northern Excellence Co-op in Williams, Minn.

  Outcome:
- Grower co-op is seeking financing for 100-kilowatt gasification unit.
- Estimated three-year payback on \$150,000 investment.

### Corn stover to ethanol

Evaluate the economic and technical feasibility of making ethanol through gasification of corn stover and catalytic conversion.

#### **Opportunity and idea:**

- Large supplies of corn stover and other agricultural biomass are available.
- New ethanol feedstocks are needed to meet future ethanol goals.
- Convert corn stover to liquid biofuels through gasification and Fischer-Tropsch catalysis.

### Partner:

• Rural Energy Marketing, LLC in Luverne, Minn. Outcome:

 Luverne grower group is planning a biomass gasification plant to make methanol, a biofuel.

### More than ethanol

Find profitable uses for any excess syngas produced by Central Minnesota Ethanol Co-op's wood gasification unit.

### **Opportunity and idea:**

- Northern Minnesota ethanol plant is gasifying waste wood to run dryers and produce electricity.
- Plant could produce excess syngas in the future.
- Pipe excess syngas and steam to the city industrial park.

### Partner:

• Central Minnesota Ethanol Co-op in Little Falls, Minn.

### Outcome:

- Currently ethanol plant is using all its syngas.Little Falls is exploring use of other renewable
- energy resources.

### Gasifying beet pulp

Evaluate gasifying sugar beet pulp for syngas to run American Crystal Sugar's dryers.

### Opportunity and idea:

- Large supply of low-value sugar beet pulp is available.
- Sugar industry needs cheaper natural-gas substitutes.
- Gasify coproduct beet pulp on-site to make syngas for running dryers.
- Partner:American Crystal Sugar

### Outcome:

- Gasification is not economical for American Crystal Sugar.
- Dryer technology improvements identified during the study will save the grower co-op more than \$1 million per year.



### **ANAEROBIC DIGESTION**

### Moving methane

Study the feasibility of making methane on small dairy farms through anaerobic manure digestion and transporting the methane in containers to off-farm users.

### **Opportunity and idea:**

- Industry needs cheaper substitutes for natural gas.
- Small dairy farms want to add value to manure.
- Collect methane from anaerobic manure digesters on small dairy farms and sell it to off-farm users.

### Partner:Minnesota Corn Growers Research & Promotion

- Council
  Outcome:
  Over-the-road methane shipment not currently
- Over-the-road methane shipment not currently economical.
- On-farm use for methane needed for profitable manure digestion.

### Methane in the pipeline

Evaluate the economics of transporting methane from a 5,500-cow dairy farm by pipeline to Morris, Minn. industrial park

### Opportunity and idea:

- Industry needs cheaper substitutes for natural gas.
- Large dairy farms want to add value to manure.Use manure anaerobic digestion to produce large
- quantities of pipeline-quality methane for city industrial park

### Partners:

• West River Dairy of Morris, Minn.

### • City of Morris

- Outcome: • Pipeline methane transport is not currently
- economical.On-farm use for methane needed for profitable manure digestion.



### **RENEWABLE ENERGY COPRODUCTS**

### Better turkey dinner

Test ways to separate oligosaccharides from soybean meal, test fermentation traits of extracted soybean sugars, and do poultry-feeding trials on soybean-meal fraction.

### Opportunity:

- Large supplies of soybean meal are available.Ethanol industry needs new feedstocks to meet
- future ethanol goals.
- Minnesota turkey industry needs high-protein, lowcarbohydrate soybean meal feed.
- Extract certain sugars from soybean meal to make a more desirable turkey feed.
- Use the extracted sugars to make ethanol.

#### Partner: • Minnosota So

• Minnesota Soybean Growers and Soybean Research & Promotion Council

Visit our Web site at www.auri.org

#### **Desired outcome:** • More demand for Minnesota soybean meal.

# AURI energy center helps launch northern Minnesota ethanol plant

BY E. M. MORRISON

*Fergus Falls, Minn.* — In just eight days, Otter Tail Ag Enterprises, LLC raised \$42.2 million in capital and attracted 877 investors from rural Minnesota — 59 percent of them farmers.

The \$100-million-plus ethanol project, the largest private investment ever made in Otter Tail County, was developed with help from AURI's Center for Producer-Owned Energy. The ethanol plant's annual economic impact in Otter Tail County and the surrounding region will top \$110 million, says Kelly Longtin, Otter Tail Ag Enterprises CEO.

The new ethanol business is an example of how renewable energy development is helping to diversify farm income and stimulate rural economic activity, says Energy Center Director Max Norris. The Energy Center estimates that its two dozen renewable energy development projects have benefited at least 8,800 Minnesota ag producers.

The Energy Center and the Minnesota Corn Growers Research & Promotion Council provided start-up money so Otter Tail Ag could do a feasibility study, prepare a business plan and organize an equity drive. "It was a great boost to help get our company off the ground in the very beginning," Longtin says. Without some early assistance "to determine if we could go forward, it probably wouldn't have happened."

In October, Otter Tail Ag Enterprises broke ground on a 65-million-gallon corn dry mill plant being built by Harris Mechanical of Minneapolis. OTAE's venture is financed by AgStar and Midwest Minnesota Community Development Corporation, a consortium of Detroit Lakes, Minn. banks. The plant will market its ethanol through Renewable Products Marketing Group of Belle Plaine, Minn. and Commodity Specialists Company of Minneapolis will handle the plant's distillers grains.

When it begins operating in 2008, OTAE will employ about 35 workers and generate an annual payroll of at least \$1.5 million, Longtin says. The Fergus Falls business is a JOBZ participant.

OTAE, the first ethanol plant in northwestern Minnesota, will grind 20 million bushels of corn a year. "We're going to be in the market for corn every day," Longtin says, "which should enhance the basis to local farmers." ■

# PARTNERS

The Center for Producer-Owned Energy has worked with organizations and grower groups from many sectors of Minnesota agricultural production, processing and research. Some of our partners include:

Minnesota Corn Research & Promotion Council		
Minnesota Soybean Research & Promotion Council		
Minnesota Soybean Growers Association		
Center for Diesel Research		
Southern Minnesota Beet Sugar Cooperative		
American Crystal Sugar		
Biotransportation		
• Rural Energy Board		
Minnesota Soybean Processors		
• Farmers Union industries, LLC		
Minnesota Biodiesel Task Force		
University of Minnesota		
Minnesota Department of Agriculture		
Kandiyohi Agribusiness and Renewable Energy Development		
• Windustry		
- Couthwart Minnosoto Foundation		





*Researchers find it wasn't just soy diesel clogging fuel filters in late 2005* 

### BY CINDY GREEN

Don't blame it all on biodiesel.

In the fall 2005, soon after a Minnesota mandate kicked in requiring a 2-percent biodiesel blend, truckers and bus drivers started complaining that the soy-based diesel was clogging fuel filters. Just before Christmas, the state lifted the mandate for 21 days, then extended the waiver another 30 days until the fuel-plugging problems could be solved.

"Quality issues were taken seriously and addressed by Minnesota biodiesel producers," says Rose Patzer, AURI associate scientist. Clogged-filter complaints subsided after producers made sure all biodiesel going on the market met quality standards, and the 2percent mandate went back into effect.

But was biodiesel the problem? "In some cases, yes, but many other things contributed," Patzer says. "We haven't seen many issues with Minnesota's biodiesel this season. And most of those were relating to higher blends or biodiesel that was produced from other states."

AURI just released findings of its two-year study of blended-fuel filter plugging. While results are not conclusive, it's likely that storage issues, water contamination, microbes and other secondary causes are as much to blame as fuel quality.

### Perfect storm

Filter clogging in late 2005 was caused by several converging circumstances. "It was a perfect storm — a coming together of bad events" Patzer says. The temperatures dropped to around zero degrees, which can cause gelling in high-percentage biodiesel blends. "Last year people were regularly using blends above the recommended levels. They are taking destiny into their own hands when they go higher than B20."

Hurricane Katrina exacerbated the problems. "Terminals ran out of fuel. When a tank is emptied, sediment settles at the bottom," for microbes to feed on.

But most of the contamination was water in fuel storage tanks. "Diesel will always be on top of the water, but if there are bugs, the interface between the fuel and water is where they'll survive," Patzer says. She explains that in both biodiesel and petrodiesel, if a thin grey line is present in the fuel tank, that indicates live microbes are present. "If the line is black, generally they're dead."

"We want to isolate and identify the microbes, then take those cultures and put them in biodiesel and see what damage they do."

### Too clean

"From my perspective, I don't think we'll ever resolve (the plugging issue) because we don't have all the pieces – but through characterizing, we can come to some conclusions."

Acting like a cleaning agent, biodiesel may remove sludge and varnish-like deposits in tanks and components, which can plug fuel filters. Chemicals will kill the bacteria but water needs to be pumped out first, and emptying and cleaning tanks can be expensive.

A 2004 U.S. Department of Energy biodiesel handling report says that using blends with 20-percent biodiesel or less minimizes problems with tank sediments, although filter plugging may be an issue in the initial weeks of B20 use. The DOE recommends always storing blends above 20 percent in clean, dry tanks as is recommended for conventional diesel.

High glycerin concentrations in biodiesel can also cause a wax coating on fuel filters. But if fuel is stored below ground where it's better insulated and warmer than above-ground storage, there may be fewer problems with glycerin.

Soy sterol glucosides are another contaminate and usually eliminated during soybean oil or biodiesel production, but it can remain in up to 3 percent of the fuel. "We need to figure out how to make sure it's eliminated," Patzer says.

### **Inconclusive tests**

When Minnesota truckers started having problems with clogged filters in October 2005, some were advised to send their filters to AURI's oils lab in Marshall for testing.

"One of the problems was, we were never able to obtain an actual diesel sample," Patzer says, so the oils lab didn't know if the trucker had used B2, B5, B20, 100-percent biodiesel or regular diesel when the gelling occurred. "We only had part of the picture."

Biodiesel may not even have been a factor. Lower-sulfur petrodiesels now on the market could be prone to contamination, as sulfur has an anti-microbial effect

"When there is a (fuel) quality issue, then we have an obvious answer – through chemical analysis. When it isn't a quality issue ... it could be water in the bottom of a tank where there could be microbial activity."

"There is no one answer — and no one cureall," Patzer says. "There are many problems, many different issues." ■



Rose Patzer, AURI associate scientist (left) and Renae Jorgenson, chemist, inspect one of the fuel filters that truckers sent to AURI in late 2005 after complaints arose that state-mandated biodiesel blends were causing filter plugging. An AURI study revealed that storage and handling problems contributed to fuel gelling.



#### BY CINDY GREEN

Biodiesel is nontoxic, biodegradable and reduces emissions of carbon monoxide, hydrocarbons and particulates. Unlike other alternative fuels, it can be used in unmodified engines, even in its pure form.

Biodiesel can be made from almost any oilseed crop, animal fat or restaurant waste grease. It is produced primarily from soybean oil in the United States and rapeseed in Europe.

The fuel is produced by plant or animal oil transesterification: oil is combined with alcohol to produce the chemical compounds esters and glycerin. Esters are used for biodiesel and glycerin is the coproduct used in dozens of products such as soaps and cosmetics.

The cost is slightly higher than regular diesel, but the federal government offers a rebate to companies blending biodiesel, making it competitive with petrodiesel

In fuel blends with 20-percent biodiesel or lower, it performs as well as conventional diesel. "This product looks like, stores like, pumps like, and burns like diesel fuel. It requires no modifications in our fueling infrastructure, no extensive training for driver or mechanics, and no major modifications to the vehicle," writes Denny Coughlin, Minneapolis Public Schools bus fleet manager, in the February 2006 issue of School Transportation News.

"The fuel tank, lines, filters and injectors will generally accept lower levels of biodiesel mixtures with no noticeable changes."

Minnesota is one of several states that has adopted American Society of Testing and Materials biodiesel quality standards. The National Biodiesel Board also offers a "seal of approval" stamp for biodiesel marketing.

While most highway vehicles use 2- to 20percent biodiesel blends, pure 100-percent biodiesel is used in environmentally sensitive areas such as wetlands and national parks because it is nontoxic and biodegrades as fast as sugar. It's also used in enclosed areas such as warehouses and mines because its flash point is nearly twice as high as petrodiesel — 300 degrees F — making it safer to store and handle. ■

# **Biodiesel green power**

# In Minnesota, by using a 2-percent biodiesel blend, we can annually:

- Reduce poisonous carbon monoxide emission by more than 800,000 pounds.
- Reduce ozone-forming hydrocarbon emissions by almost 91,000 pounds.
- Reduce hazardous diesel particulate emissions by almost 70,000 pounds.
- Reduce acid-rain-causing sulfur dioxide emissions by more than 70,000 pounds.
- Reduce harmful and cancerous polycyclic organic matter impacts to streams, wildlife and humans by more than 80 percent.
- Extend the fossil diesel supply almost four-fold for every gallon of petrodiesel

### replaced.

- Create demand for more than 15 million gallons of biodiesel.
- Use oil from more than 11 million bushels of soybeans.
- Add 1.7 to 4.2 cents to the value of a bushel of beans.
- Increase the state's gross farm income by \$4 to \$11 million, and decrease federal soybean loan payments.

Source: Minnesota Soybean web site: mnsoybean.org



# Beet sugar makes corn ethanol

# processing more efficient

### BY E. M. MORRISON

Sugar makes corn-based ethanol sweeter still.

Demonstration tests at Corn Plus in Winnebago, Minn., showed that adding 1.5 percent beet sugar to corn silage shortened fermentation time by nearly three hours and boosted ethanol yields by 1,500 gallons a batch. The research could lead to greater efficiency in corn ethanol processing. It could also inform the debate on renewable fuel policies.

AURI's Center for Producer-Owned Energy sponsored the research on behalf of the Southern Minnesota Beet Sugar Cooperative, a 570-member farmer-owned co-op based in Renville, Minn.

When the project started, SMBSC growers were looking for additional sugar markets to run their plant at full capacity. After the 2002 Farm Bill became law, the co-op's federally-supported sugar allotment dropped to 70 percent of the factory's production capacity. (Federal production controls, called allotments, shore up sugar prices. Allotments are administered through USDA nonrecourse loans, with a 22.9 cents-per-pound price guarantee. The policy discourages excess domestic supplies, while tariffs and trade agreements limit imports of cheaper foreign sugar.)

SMBSC's granulated beet-sugar capacity is 7.5 million hundredweights (cwt), but the coop could only market 5.5 million cwt at the federally-supported price. Any excess sugar has to be sold at world market prices, which are usually less than half of Midwest beetsugar prices. "It was our hope that we could find a process for using sugar that would have a return similar to domestic sugar," says John Richmond, CEO of SMBSC.

Last fall, however, SMBSC bought a California company that had a larger sugar allocation than it could fulfill. "We can use the surplus allocation here," Richmond says. "So we'll be producing at full capacity this year." The company will slice three million tons of beets grown on 120,000 acres.

Still, Minnesota farmers, who grow more than one-third of the U.S. beet crop, "would like to produce more sugar," says Dennis Timmerman, AURI project director. "They have the land and they have the processing capacity." Using sugar to enhance cornbased ethanol manufacturing "might be a way for co-ops to profitably produce sugar beyond their federal allotments," he says.

### A 'spoonful' of sugar

A series of bench-top experiments last year evaluated the effects of adding up to 5 percent refined sugar to corn mash. A 1.5 percent sugar-inclusion rate produced optimum results, improving corn-starch fermentation and yield, Timmerman says. Higher sugar inclusion rates did not produce additional efficiencies.

Three commercial-scale trials were carried out last August, September and October at Corn Plus, a 44-million-gallon corn dry mill in south central Minnesota. Corn Plus has adopted a number of cutting-edge technologies, such as combusting corn solubles in a fluidized bed reactor and pelletizing reactor ash for fertilizer.

The sugar trials were performed under Corn Plus's normal operating conditions, using 342,950-gallon fermenters with 12,000 pounds of granulated sugar added to each test batch. Each experiment included a control batch. Results were collected using high-performance liquid chromatography.

Researchers wanted to find out if sugar would inhibit corn mash's yeast activity, says Keith Kor, Corn Plus manager. In fact, "we found better yeast viability with the sugar." Sugar pushed up average ethanol yields by 1.48 percentage points compared to the controls — a 10 percent improvement. Fermentation time dropped by 2.6 hours, to an average of 40 hours — a 6 percent improvement. What's that worth to an ethanol plant?

It depends on ethanol's price, Timmerman says. At \$1.90-per-gallon ethanol, for example, the additional yield from sugar adds about 12 cents of value per pound of sugar, he says. That's three times the value of corn as a fermentable carbohydrate, Richmond notes. "But it's only about half of what's needed to encourage U.S. growers to produce sugar for ethanol."

The cost of producing sugar in North America approaches 20 cents a pound, Richmond says. So it's unlikely that domestic sugar will be used for fuel production, at least in the near term, he says.

### **Demand squeeze**

But the equation could change in the coming decades, Kor says, if rising demand for ethanol squeezes corn supplies. "There's good potential for making ethanol from sugar if the economics work out," says Kor, who used to manage a small Iowa ethanol plant that converted scrap sugar to ethanol. "It depends on the price of sugar. During times when the U.S. sugar industry struggles to get rid of excess product, there might be an opportunity." And as the ethanol industry expands, he adds, sugar could supplement corn feedstocks, helping the country meet ambitious renewable fuel goals.

As the country formulates renewable-fuel policy, Richmond adds, there could be future "encouragements to use sugar for ethanol, especially at times when the U.S. has more sugar than it can consume, or if the government wants to encourage the importation of sugar from Third World countries, to help their economies."

### Average Performance Results, Adding 1.5% Sugar to Corn Mash Fermentation

Results	Control	With Sugar
Ethanol Yield v/v	14.50%	15.98%
Fermentation time	42.93 hrs	40.33 hrs
Residual Sugar	1.95	.94

Source: Center for Producer-Owned Energy trials 8-21-06; 9-21-06; 10-18-06 at Corn Plus.

# BUILDING BESSIE A BETTER BED

# AURI AND UNIVERSITY RESEARCHERS ARE INVESTIGATING VARIOUS AG RESIDUES THAT COULD BE USED FOR LIVESTOCK BEDDING

#### BY DAN LEMKE

*St. Paul, Minn.* — Minnesota is home to more than 5,000 dairy farms, and most have fewer than 100 cows. Many of these herds are housed in older facilities that are often less efficient than larger, more modern dairies — a competitive disadvantage. That's one of the reasons Minnesota is losing about two dairies a day.

Finding an economically-viable way to modernize could help these small operations survive. A new, innovative cow-housing system with lower construction costs, reduced labor inputs and improved cow comfort could help solve some manure-management issues that small farms face.

Compost-bedded-pack dairy barns are open facilities with bedding, typically sawdust, which is several feet deep. Cows lounge on the thick pack that farmers till or stir several times a day. Microbial activity causes the manure and bedding to compost, creating warmth for the cow and stabilizing the manure. It also reduces pathogens and is good for cows' health.

But rising fuel prices have increased the cost of transporting sawdust and wood shavings commonly used in compost barns. Tight wood-product supplies also impact availability.

Since wood is only one source of bedding, AURI and the University of Minnesota investigated other locally-available products to find an alternative. "Farmers have used straws and corn stalks for bedding for many years," says Al Doering, who heads AURI's coproduct lab in Waseca. "We wanted to see if there were ag products out there that could work for compost barns."

Researchers at the U of M St. Paul campus tested 11 different media for chemical, physical and microbiological characteristics that would indicate they could be used for bedding. They tested beet pulp, corn cobs, corn stover, elm chips, flax straw, pine bark, pine chips, soybean hulls, soybean straw, wheat straw and wheat-straw screenings. They evaluated the various products for pH, waterholding capacity, carbon to nitrogen ratios, phosphorous, bulk density and free air space, which is needed to support microbial activity.

For various reasons, many of the products tested were not suitable for composted pack barns.

"We know a lot more than we did two years ago, but we still don't have all the answers," says lead researcher Tom Halbach of the U of M soil, water and climate department.

Halbach says there were significant differences between many of the products tested, and not all were suited for compost barns. For example, corn stalks absorbed water, but once the cell wall was ruptured, water was released, leading to a wet mess. Soybean hulls and beet pulp didn't work either. Only one product looks to be viable, Hallbach says.

"Corn cobs worked because they're light

and airy, are low in carbon and are easy to handle," Hallbach says. "But the difficulty with corn cobs is it's difficult to find a supply ... we'd likely have to modify (corn) harvest techniques."

Flax and soybean straw showed potential, but would have to be blended with sawdust or small wood chips.

"We're on the right track," Halbach says. "We had some options and found out that some didn't work."

"Because of the growing interest in compost

barns and the demand for bedding material, this really provides an excellent opportunity to utilize ag fibers and coproducts," Doering says. "Not everything we looked at worked; it helps to narrow down other alternative sources that could be available to dairies."

Four different media are undergoing more tests at the West Central Research and Outreach Center in Morris, Minn. including sawdust, a blend of sawdust and small wood chips, corn cobs and soybean straw. ■



# **Elsewhere in ag innovations**

BY DAN LEMKE CARTOONS © UNCLE HYGGLY

Editor's note: As a service to our readers, we provide news from around the globe on new uses for agricultural products. Please note that ARS is the research arm of the USDA.

### **Shrimp bandages**

The U.S. Army has discovered that a shrimp extract is the best way to stop extreme bleeding. Medical personnel have started purchasing bandages made from chitosan, an extract from the exoskeletons of Icelandic shrimp. Chitosan is a mucoadhesive that gets very sticky when wet. Army researchers found the dressings had a 97 percent success rate for external hemorrhage control in combat operations. Although they are edible, the bandages do not taste like seafood and will not trigger reactions in people allergic to shellfish.

From: Fishupdate.com, February 2, 2007



### Wine for the heart

One of Great Britain's largest supermarket chains is cashing in on healthy eating and drinking trends by launching a new heart-healthy wine. Red Heart, marketed by Sainsbury's, has an antioxidant level 32 percent higher than most other red wines. The antioxidants come from the skin and seeds



of special grape varieties used to make Red Heart.

From: Foodnavigator.com, December 12, 2006

### **Metal-eating plants**

ARS researchers are successfully using alpine pennycress plants to remove cadmium and other heavy metals from contaminated soil. With a phytoextraction process, pennycress and other metal-accumulating plants can reduce metal concentrations to safe levels in three to 10 years — at a fraction of the cost of other remediation practices.

From: USDA-ARS, January 23, 2007

### **Yogurt drinking binge**

Drinkable yogurt is the world's fastest growing food and beverage product according to ACNielsen market research. Researchers credit its healthy attributes, good taste, handy packaging and portability for the consumption surge. Yogurt beverages also adapt well to added functional ingredients such as omega-3, phytosterols and probiotics.

Researchers tested 45 markets. China led with a 49 percent annual growth in yogurt beverage consumption. Markets in Greece, Romania, Finland and Italy grew more than 40 percent, but growth was down by 5 percent in the United States.

From: Foodnavigator.com, January 26, 2007

### Where does our corn go?

While Minnesota's ethanol industry is increasing demand for corn, the majority of the state's crop is still exported — as raw corn, not fuel.

According to the Minnesota Corn Growers Association, the average corn crop from 2002 to 2006 was about 1.09 billion bushels per year. During that time, 153 million bushels — about 14 percent — was processed into ethanol, 23 percent was fed to Minnesota livestock, and about 7 percent was processed in Minnesota for other uses. The remaining 56 percent, roughly 610 million bushels, was shipped out of state.

From: Corn Talk, January 2007

# Mushrooms battle fowl sickness

A major parasitic disease afflicting poultry may have met its match in the mushroom. ARS researchers at the Animal Parasitic Diseases Laboratory in Maryland have developed a technique for controlling coccidiosis, which costs the world's poultry industry billions annually. The technique introduces mushroom proteins to birds via injection or drinking water. The proteins spur a protective reaction against the disease in the bird's gut. Coccidiosis is caused by parasites that infect the intestinal tract and are transmitted between birds through infected feces.

From: USDA-ARS, December 8, 2006



# **AURI Ag Innovation Quiz**

- 1. What does the presence of a thin grey line in a diesel storage tank mean?
  - a. Fuel is aging
  - b. Too much glycerin
  - c. Live microbes are present
- What percentage of added sugar was found to optimally boost corn ethanol production?

   a. 70%
   b. 1.5%
   c. 11%
- 3. About how many farmers have been impacted by Center for Producer Owned Energy projects so far? a. 500
  - b. 8,800
  - c. 1,250

- 4. What agricultural product shows the most promise as a bedding source for compost barns?
  - a. corn cobs
  - b. corn stover
    - corn meal
- How many new board members have joined AURI in 2007?

   a. 5
   b. 1
- How many bushels of corn will the new Otter Tail Ag Enterprises plant consume?
   a. 20 million bushels per year
   b. 1 million bushels per day
  - b. 1 million bushels per day c. 362 thousand bushels per
    - year
  - year

c. 3

- What is the biggest carcass quality concern with hogs fed a diet high in DDGS?
  - fed a diet high in DDGS? a. Odd color
  - b. Tastes like chicken
  - c. Soft belly fat
- What is the flash point for biodiesel?

   a. 212 degrees F
  - b. 300 degrees F
  - c. 98.6 degrees F



AUSWERS: 1) c; 2) b; 4) a; 5) c; 6) a; 7) c; 8) b

### AURI EXECUTIVE DIRECTOR'S COLUMN

# Sustaining rural wealth

### BY TERESA SPAETH

We live value-added agriculture at AURI. Whether it's a new shelf-stable meat product or biodegradable corn-stalk hog mat, or energy powered by crop residue, our goal is to help develop products that bring more money to the people who grow or process them.

While value-added agriculture is our method, we are really pursuing sustained rural wealth. Recognizing and developing emerging opportunities creates positive rural economic activity — where it is needed and where it creates a ripple effect.

Producer-owned cooperatives show us how this works successfully. Local investors, who take the risk, share the rewards of profitable ventures. An ethanol cooperative may have hundreds of members scattered around the region. So profits are spread around and used to support businesses, schools and communities around the area.

It's not just cooperatives that benefit rural communities. Successful businesses mean jobs and economic activity, and profitable farmers invest in their local communities. That's why AURI offers unique services to businesses and entrepreneurs with valueadded ideas.

However, while nearly every opportunity shows some promise in the beginning, further investigation and analysis may reveal that it's not a good investment. Shining the light on challenges, as well as opportunities, can prevent money from being thrown at unwise ventures and retain rural wealth.

Whether it is developing ways to create wealth or retain it, AURI's goal is to

keep Minnesota agriculture - and the communities that depend on it innovative and strong.

### **About AG INNOVATION NEWS**

Dan Lemke, communications director Cindy Green, managing editor Rolf Hagberg, photography Design by pounce.com

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Spaeth.

### **AURI Board welcomes three new members**

#### BY DAN LEMKE

Three agricultural leaders were named to AURI's board of directors in January. The new members include:

State Senator Jim Vickerman, chair of the Senate Agriculture and Veterans Budget and Policy Committee, is in his seventh term in the Minnesota Legislature. He also farms near Tracy, Minn. Vickerman replaces the late Senator Dallas Sams as the Senate representative on AURI's board.

State Representative Al Juhnke, in his sixth term, chairs the House Agriculture, **Rural Economies and Veterans Affairs** Finance Committee. Juhnke, a real estate appraiser, replaces Greg Davids as the House representative on AURI's board.

Veteran board member Ed Ellison recently retired after serving almost 14 years on AURI's board. His seat, representing agri-business, has been filled by Roger Chamberlain, a senior lending officer at AgriBank in St. Paul. ■



Vickerman.



Juhnke.

# **Minnesota loses rural champion**

State Senate Dallas Sams, former AURI board member, died on March 5 at age 54 from brain cancer. He served on AURI's board for almost 13 years, through 2006.

"We are deeply saddened. He was a great friend and supporter of AURI," says Teresa Spaeth, AURI executive director. "Many people will miss Dallas — a champion of agriculture, rural economic development and the environment."

A DFLer from Staples, Minn., Sams served the Minnesota Senate for 16 years and chaired the agriculture and environment committee. After losing his reelection bid last fall, he was appointed to a position with the Minnesota Department of Agriculture.

Sams was known for his leadership on rural and environmental issues, including increasing ethanol consumption, making farming more attractive to young people, gaining better mental health coverage for farmers, and he proposed a constitutional amendment that would dedicate a portion of a sales-tax increase for conservation and the outdoors. He was also a dairy farmer, agriculture management teacher, pilot and pianist.

Sams was treated for a brain tumor in 2005 and doctors found another malignant tumor last summer. He died at St. Joseph's Hospital in St. Paul. Sams is survived by his wife, Mary Beth, and five children.



Sams.



to strengthen rural Minnesota's economy, AURI helps businesses respond to market opportunities with new and value-added uses for agricultural goods. The



Institute builds working partnerships with business innovators, agricultural groups and researchers, and provides technical support to clients conducting new product research and development.

AURI programs are available to legallyorganized businesses or cooperatives with projects that have the potential to create new uses or new markets for Minnesota agricultural commodities. AURI assistance is designed for the early stages of a product's life cycle, while an element of feasibility is yet to be determined.

#### Project proposals are evaluated on the following criteria:

- Innovation/uniqueness
- Market viability
  Use of Minnesota commodities
- Number of farmer-producers impacted
- Amount of value added from further
- processing
- Economic impact Cost savings

### Programs are designed to assist with:

- Identifying emerging value-added opportunities Developing innovative commodity-based products
- Developing production processes for feasible products
- Promoting products developed with AURI technical assistance
- Providing resources to bring new products and processes to the marketplace

#### Assistance may include:

- Access to AURI's scientific and business staff
- Access to laboratory and pilot plant facilities
- Product development and feasibility testing Process evaluation and improvement
- Technology transfer and applied research
- Business needs evaluation
- Links to available resources
- Potential for grant funds to qualifying applicants

AURI provides resources proportionate to the project's impact. Smaller-impact projects may be eligible for technical assistance only, while projects with industry-wide impact may be eligible for financial assistance.

#### **AURI Facilities**

- AURI operates several laboratories: Coproducts Utilization Laboratory
- and Pilot Plant, Waseca
- Fats and Oils Laboratory, Marshall
- Meat Laboratory, Marshall

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### BY DAN LEMKE

*Waseca, Minn.* — High oil prices are fueling more than the development of alternative energy sources. As the demand for alternatives like ethanol rises, so does the price of corn, prompting livestock farmers to search for more economical feed sources.

Distiller's dried grains, the solid leftovers from ethanol fermentation, could be the solution for both pork producers and the state's growing renewable-energy industry. New hog trials show a diet with DDGS doesn't affect pork

quality; it just yields softer bacon.

Minnesota's ethanol industry is among the nation's most vibrant, with more than 620 million gallons of annual capacity and more plants being planned and constructed. Supplies of DDGS are also growing — an estimated 30 million metric tons will be produced in North America by 2010.

While the coproduct is widely used in cattle diets, poultry rations and some swine diets, new swine-feeding research may lead to more DDGS used in almost all facets of hog feeding.

AURI-supported feeding trials on growto-finish hogs were recently conducted at the University of Minnesota West Central Research and Outreach Center

in Morris and a private herd in

southern Minnesota. Four hog groups with the same genetics were fed four different diets: one contained no distiller's grains, while others contained 10, 20 or 30 percent DDGS. Analysis showed the four groups performed at nearly identical levels, regardless of their diet.

Belly fat, where bacon is derived, was the only major difference, says Sam Baidoo, U of M swine nutrition professor "On those fed the DDGS, it was not as firm." Baidoo says that is primarily an aesthetic issue for consumers. The soft bellies are used in other meat products.

Other performance factors such as carcass leanness, rate of weight gain and back fat were nearly identical among the varied diets. On all cuts except bacon, consumers would be hard pressed to tell the difference. AURI sensoryevaluation tests with trained panelists did not discern differences between pork loins from hogs fed diets with distiller's grain or corn.

"On lean cuts of meat like chops, there was no difference in taste," says Clint Gehrke, AURI meat scientist. "The difference is in the fat. Even in cooked bacon there was no difference, but the uncooked bacon was less firm."

Feeding trials underway at the Southern Research and Outreach Center in Waseca will determine if removing DDGS from hog diets two weeks before market impacts belly fat firmness. If results are positive, Baidoo says they may test even higher rates of DDGS in grow-to-finish diets, "depending on the price of DDGS."

For Minnesota's 5,000 hog farmers who feed more than 15 million market swine a year, using DDGS in hog diets may be an alternative that offers a huge potential market for Minnesota-produced DDGS. But Minnesota Pork Board Executive Director Dave Preisler cautions that it's not a silver bullet.

"It's encouraging to have the feeding trial information, but the cost of DDGS has gone up along with the price of corn. Most producers' preference is still to use corn and soybean meal, but depending on the cost, they are interested in other alternatives. The number one thing for distillers is whether or not it will be cost effective." ■

Researchers find an ethanol byproduct can enhance hog diets