University of Saskatchewan

College of **Agriculture**

Annual Research Report 2003

CULTIVATING KNOWLEDGE

Located in the heart of Canada's largest farming region, the College of Agriculture at the University of Saskatchewan is one of the country's leading centres for training and research for this foundation industry.

Five academic departments explore innovative solutions for barn, pasture, field and plate, as well as business issues like farm gate profits and the impact of government policy. About 1000 students pursue their work at the diploma, degree and post-graduate level in the Departments of Agricultural Economics, Animal and Poultry Science, Applied Microbiology and Food Science, Plant Sciences and Soil Science. About 350 research scientists, faculty and support staff provide training for the next generation of agriculture professionals, as well as tools to enhance production on the farm and in agri-business.

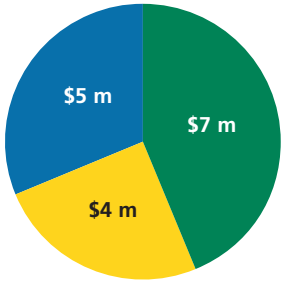
The College is also at the centre of an excellent research network that includes Agriculture and Agri-Food Canada's Saskatoon Research Centre; the National Research Council's Plant Biotechnology Institute; the National Hydrology Research Centre; POS Pilot Plant Corporation; and the Canadian Light Source, Canada's first synchrotron. The College also has strong links with various biotechnology companies just north of campus at Innovation Place Research Park.

In the following pages, you will find examples of the broad range of research undertaken by faculty in the College of Agriculture. Of course, these highlights are only a small sample of the work of some of our researchers. For a more in-depth view, please visit our Web site at www.ag.usask.ca or e-mail us at agriculture@usask.ca.

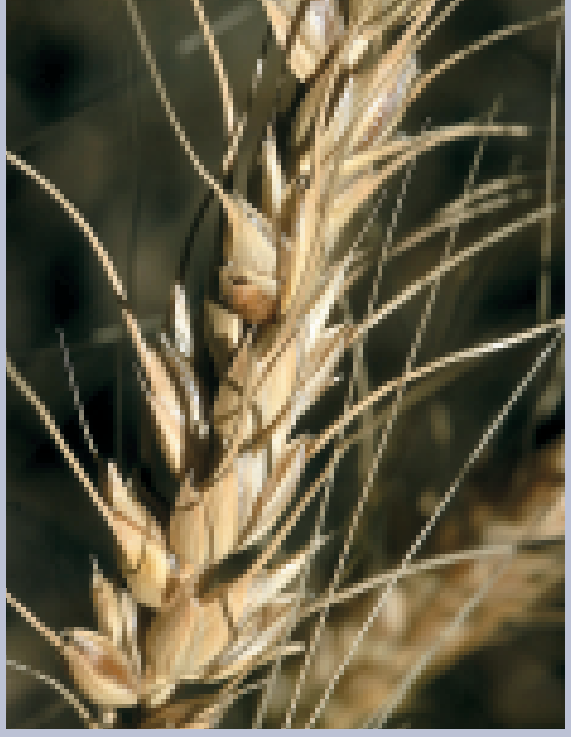
Resources for discovery

Discovery, like any other endeavor, demands dollars. The College's researchers have been particularly successful here, landing over $300,000 per faculty member — the highest level in the University and 15 per cent of the institution's total.

Funding Sources



- Saskatchewan Agriculture, Food and Rural Revitalization ***(SAFRR)***
- Natural Sciences and Engineering Research Council ***(NSERC)***
  Social Sciences and Humanitites Research Council ***(SSHRC)***
  Canada Foundation for Innovation ***(CFI)***
- Producers and Industry



COLD CEREAL

Canada's Prairies constitute one of the coldest crop production areas in the world, second only to Siberia.

It's not surprising, then, that the U of S has special expertise with winter wheat. Varieties developed by Dr. Brian Fowler and his collaborators account for 90 per cent of the Prairie crop. The program also enjoys strong support from Ducks Unlimited, who prize winter wheat as ground cover for waterfowl.

Now, backed with $9 million (part of a larger grant from Genome Canada), Fowler's group is identifying and mapping cold tolerance genes in winter wheat. This knowledge may lead to better cold tolerance in other cereals and other crops.

Cold tolerance is one of the great hurdles still facing modern plant breeding. It's not a simple matter of crossing cold tolerant plants with others. Triticale, for example, adds all of the genes of cold-tolerant rye to those of durum wheat. However, the wheat genes somehow suppress the rye genes, and triticale offers no better cold tolerance than the wheat parent.

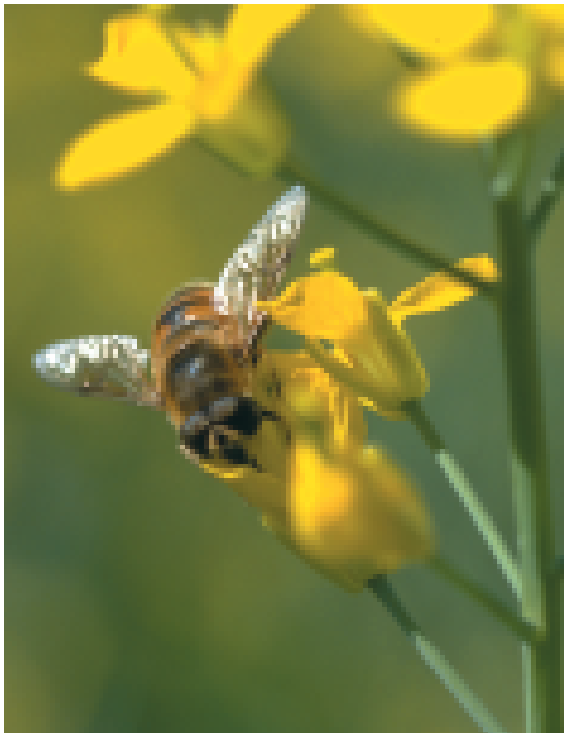
Unlocking the mysteries of cold tolerance demands expertise in many fields, from plant breeding to molecular genetics and bioinformatics. Researchers from several colleges at the university are involved, as well as other universities and research institutions across Canada, notably in Quebec and Alberta. Scientists at government institutions, such as Agriculture and Agri-Food Canada's Saskatoon Research Centre and the National Research Council's Plant Biotechnology Institute, both on the U of S campus, are also participating and share the Genome Canada funding.

Data from the project will be in the public domain, posted on a secure Web site. Ultimately, the knowledge may ease the challenge of farming some of the coldest cropland on the planet.

BETTER OATS

Oats are one of humanity's oldest crops, finding their way into everything from cosmetics to breakfast cereal and livestock feed. Most oat production in this country is in Western Canada, and in 2002, 5.9 million acres were devoted to the crop. Nearly half, or 2.6 million acres, were sown in Saskatchewan alone.

At the Crop Development Centre, Dr. Brian Rossnagel and his colleagues work to improve this ancient crop, developing varieties with excellent milling qualities, as well as agronomic traits like earlier maturity, or strong, lodging resistant stems.



One priority is breeding grain of the highest quality for human consumption. Quaker Oats, a familiar name on North American breakfast tables, has supported the program to this end for the last 28 years. Cargill is a more recent corporate partner.

Oats are also being improved for feed markets. Rossnagel's group is working with colleagues from Animal and Poultry Science to develop lines with a more digestible hull and high fat content, bringing oats up to par with barley as a feed for ruminants. This work is partially supported by a new Saskatchewan company, Super Oats Canada.

The oat program is also linked to collaborators at Agriculture and Agri-Food Canada in both Lacombe and Winnipeg. To speed the process of bringing new varieties to market, Rossnagel and his group also work with researchers in New Zealand and employ a winter nursery in that country to allow two cropping seasons per year. Another international connection is the evaluation and use of oat varieties from Wales as parents in his crossing program as a new source of genetic material.

ADDING VALUE TO CANOLA

Canola processors have always faced a problem: once the high value oil has been pressed from the seed, what is left over – 60 per cent – is sold as an undervalued feed ingredient.

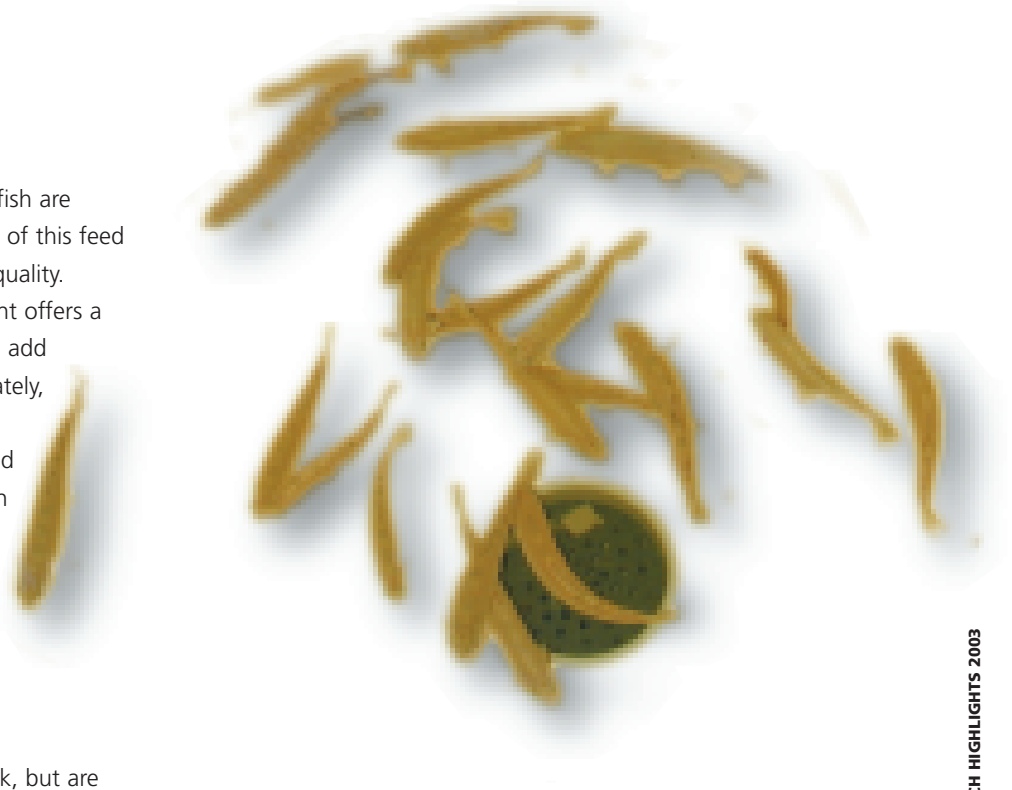
Still, the meal has some promising characteristics. It boasts the highest quality protein of any major crop plant, and it's there in quantity as well: over 30 per cent by weight. The trouble is, high fibre content and an anti-nutritional compound called phytate interfere with digestion. Even worse, phytate, used by the plant to store phosphorus, ends up in livestock manure and can pose environmental problems.

Drs. David Maenz, Henry Classen and Rex Newkirk in the Department of Animal and Poultry Science developed a process to separate canola meal into more valuable products. They founded MCN BioProducts Inc., currently based at the U of S, to capitalize on the technology and take advantage of the strong research support. The location also allows easy access to the POS Pilot Plant on campus and the BioProducts Processing Facility at Innovation Place.

The process delivers four different product streams. A sugar product provides an energy source for livestock feeds, and a high-fibre product is aimed at ruminant animals. A protein concentrate for specialized rations like calf starter is a third stream. At the top of the line is a high protein product aimed at the aquaculture market.

It is this last stream that is now getting the most attention. Since 1984, aquaculture has grown worldwide by 10 per cent every year, and is expected to soon outstrip beef cattle in food protein

production. The challenge is that farmed fish are traditionally fed with fishmeal. The supply of this feed can be unreliable and varies in price and quality. MCN BioProducts' high protein supplement offers a way to decrease reliance on fishmeal, and add value for Canadian canola farmers. Ultimately, more canola-based products could help protect farmers from fluctuations in oil and meal prices. The company expects to be in full-scale commercial production by 2005.



FEEDING THE FISH

Prairie crops feed a wide range of livestock, but are missing from one of the world's fastest growing markets: aquaculture.

To address this gap, the Prairie Aquaculture Research Facility was created in the late 1990s to look at Saskatchewan crops and their potential as fish food.

According to facility director Murray Drew, farmed fish pose much different challenges than land-based livestock. The most commonly reared species are salmonids like rainbow trout and salmon – and they are carnivorous. Because they cannot digest carbohydrates, their food must be very high in protein – up to 40 per cent. The feed must also be high in Omega-3 fatty acids.

In addressing the protein problem, the Facility has had some success with the canola protein concentrate produced by MCN BioProducts (see other article). Pea protein concentrate is also being explored, as is soy protein from out of province. Pulses like peas are steadily gaining prominence in Saskatchewan fields, and aquaculture could provide another in-province market for these crops.

With 40 per cent oil, half of which is composed of the coveted Omega-3 fatty acids, flax seed also shows promise for aquaculture. However, flax oil tends to oxidize quickly, and when extruded to form pellets, ends up as an oily mess. By mixing dehulled flax with protein concentrates, viable feed rations are being produced and tested.

Plant-derived formulations max out at about 25 per cent of the feed. If higher levels are mixed in with the regular fishmeal, the animals stop eating it. Still, with the aquaculture industry set to quadruple in the next 10 years, even a quarter of the ration represents huge potential.

WHAT'S A BISON WORTH?

Canadian farmers raise a wide range of specialty livestock, from native animals like bison, elk and deer, to more exotic species like ostrich, emu and wild boar.

The Specialty Livestock Value-Added Program, funded by the Canada-Saskatchewan Agri-Food Innovation Fund, explores the potential of these animals. This program is part of the Value-Added Processing of Meats Strategic Research Program known as the Meat Group on campus.

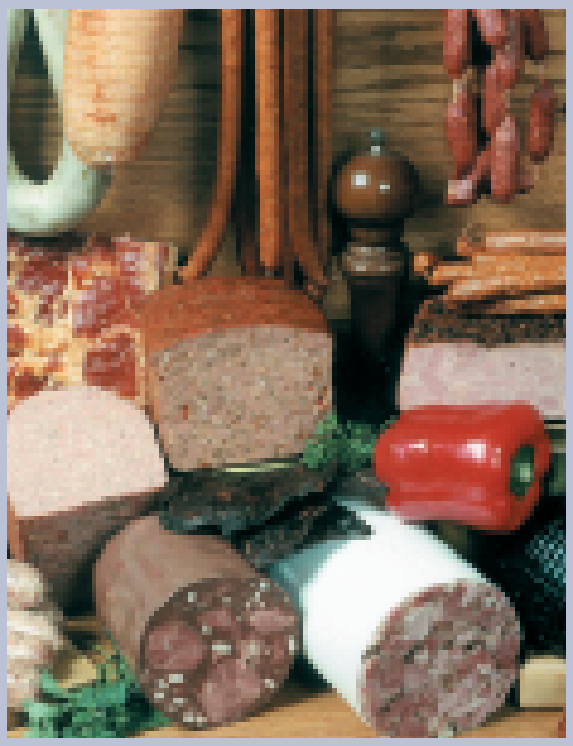
According to group head Dr. Phyllis Shand of the Department of Applied Microbiology and Food Science, much of the activity in the Specialty Livestock program centres on bison, as they show the most promise in the long term.

High-end restaurants have embraced prime cuts of bison, but cuts from the rest of the carcass have largely ended up as ground product.

The Meat Group has been working to add value here, through processes like marination to increase the moisture content of the meat for a more tender and tasty end product. Preparation is also a challenge, as cooks and chefs are unfamiliar with bison and overcook it until it is too dry. To address this, new processing techniques and formulations are developed, tested and then

evaluated in the department's commercial-scale pilot plant facilities and analytical laboratories.

Of course, for the bison industry to grow in the long run, there must be sustainable markets. The Specialized Livestock Market Research Group, led by Dr. Jill Hobbs of the Department of Agricultural Economics, looks at this question. Their research suggests consumers are willing to pay more for tenderness, reduced fat content and convenient preparation. Working closely with the Meat Group, this work was followed by consumer taste panels and consumer attitude analysis across Canada. Over 600 people participated in Saskatchewan, Alberta, British Columbia, Ontario and Quebec. This ongoing research also looks at different ways to market bison, such as emphasizing its relatively low fat content and absence of growth hormones. The work has identified a health-conscious consumer segment that may be willing to pay more for such products.



BETTER BEEF THROUGH APPLIED GENETICS

While researchers around the world work at mapping the entire genomes of livestock and companion animals, Dr. Sheila Schmutz and her colleagues are working to not only discover genes, but also use that knowledge to help producers.

In 1999 graduate student Carolyn Fitzsimmons isolated the gene in beef cattle that codes for leptin, a hormone that governs meat quality traits. Cattle with a certain form of this gene are more likely to produce the highest quality beef, with enhanced marbling and taste characteristics.

This discovery led to the launch of Quantum Genetics in 2002 by another Schmutz student, Leigh Marquess, to bring a fast, easy test for leptin to producers. Marquess has been hard at work promoting the test, even offering while-you-wait testing at Agribition in Regina, Western Canada's premier agricultural exhibition and trade show. The university continues to provide technical support and expertise as an incubator for this start-up company.

Similar work has resulted in the discovery of genes that govern coat colour. The American Angus Association had been promoting their beef based on black coat colour and this sparked an interest by other breed associations in colour as an economically important trait. A similar test for dogs, based on U of S research, is now an important service offering of an Ontario company.

More recently, an American Braunvieh producer donated an albino calf to Schmutz's program. Study on the animal allowed the genes for albinism to be isolated. A test for these genes will help producers breed this undesirable trait out of their herds. Other proprietary work is underway to identify genes associated with enhanced growth in beef cattle

WORLD-LEADING PULSES

Canada is one of the world's leading exporters of pulse crops like lentils and peas. In 2002, farmers here planted lentils on 1.48 million acres, while peas were planted on 3.2 million acres.

Many of these fields are sown with varieties developed at the Crop Development Centre. Here, Drs. Tom Warkentin, Bert Vandenberg and their colleagues work to improve yields and develop advanced plant breeding techniques like doubled haploid production. This technology, already in use in canola, allows breeders to bring new varieties to market much faster. Other advanced tools include marker-assisted selection, which uses genetic markers to identify desirable traits in plants. This allows breeders to better choose which plants have the best performance.

A relative newcomer to the Prairies, chickpea, poses special problems. The crop is susceptible to ascochyta blight, a fungal disease that is also the bane of lentils.

The CDC has the only Canadian chickpea breeding program, started in the mid-90s with material produced by collaborators in Washington State.

The Canada Foundation for Innovation provides funding for this program. CDC researchers have worked with plant breeding centres in the U.S., Australia, Turkey and Syria to identify varieties with blight resistance. So far, success has been limited, although the newest strains are rated as "fair" in resistance, which is a great improvement from the "poor" or worse ratings of older varieties. Warkentin explains the resistance genes may simply be missing from the chickpea genome, and they may have to explore wild plant relatives to eventually nail down this trait. The program is also looking at developing varieties that mature faster to better fit the short Canadian growing season.

RECIPES FOR SUCCESS

A new food product can be a simple matter of changing one thing - giving it a little nudge, and making it our own.

For example, how about using roasted chickpeas instead of nuts in a fudge bar, or golden flax instead of peanuts in a brittle candy? It would make these products safe for people with nut allergies, and perhaps open a new market.

Prototypes of both of these confectionery items are just two examples of the innovative ideas being explored at the College's product development facility.

Under the direction of Dr. Bob Tyler and Gerald Henriksen in the Department of Applied Microbiology and Food Science, the facility is used to help develop products from Saskatchewan crops that can be made here and marketed widely. One recent customer is Pulse Wise Foods of Shaunavon, launched by a farm couple to exploit the value of the lentils they grow. The company developed a low-fat, meat-free lentil lasagna that tastes great and delivers high protein. The U of S worked with the inventors and the Saskatchewan Food Industry Development

Centre, also on campus. The product is now being test marketed in Shaunavon and in Saskatoon Co-op grocery stores.

Supported in part by the Food Processing Initiative (which is funded by an endowment from the Canada-Saskatchewan Agri-Food Innovation Fund), the product development facility boasts a full chemistry lab, plus a kitchen and a pilot plant. Equipment, from stoves and refrigerators to a freeze dryer and clamshell griddle, are of commercial quality so that real-world conditions can be accurately simulated. Access is limited with a card key system, and little is said about projects on the go, to protect the interests of the clients.

A BLOSSOMING PRAIRIE INDUSTRY

On a secluded 22-acre orchard just off the university campus, Dr. Bob Bors and his colleagues are developing fruits that may be unique to the market, and offer farmers another market to tap.

Sour cherry, nearly abandoned by most commercial orchards, has been developed into breeding lines with great taste, extreme hardiness and ease of harvesting. Carmine Jewel, a U of S variety, can be eaten fresh or pressed into a juice with a bright, vibrant red colour.

The program –northernmost on the continent – also produces excellent apples. These cultivars offer exceptional flavour and crispness, and are resistant to common diseases. Raspberry, strawberry, plums, pears and apricots are under development.

Despite the cold, the Prairie climate offers real advantages. Hot days and cool nights boost sugar production, and hot, dry conditions suppress pests.

Underpinning the success of the program are over 120 producers, mostly in Saskatchewan, but also in five other provinces as well as the Yukon and Alaska. A close partnership with the Saskatchewan Fruit Growers Association is a cornerstone of both the domestic and native fruit programs, providing an immense boost to the efforts of research staff. For example, in 2002, the university planted 1,500 cherry seedlings for evaluation. Growers planted 30,000 seeds into seedling flats, with most of the resulting seedlings destined for their own land.

Close industry partnerships, as well as support from Saskatchewan Agriculture, Food and Rural Revitalization, are also foundation blocks of the Native Fruit Development Program. The program, headed by Dr. Richard St.-Pierre, works closely with producers, and carries out its research on grower land.

Much of the work is with one of the most familiar native fruits: the saskatoon berry. Over the last 20 years this bush has been planted in orchards across the Prairies, and has grown from a strictly cottage concern to a nascent commercial industry.

Just because they are native doesn't mean saskatoons get a free ride. They are susceptible to fungal diseases, and, like other fruit trees, will underperform in a drought year without irrigation. Disease and pest resistance are top priorities.

While saskatoons are the most advanced, the program

is also looking at another native fruit, the chokecherry. Long used locally in cottage wine making, jams and jellies, this fruit offers superior, concentrated flavour that gives it great processing potential.

FARMING TREES

In a province that is more than half covered by forest, growing more trees as a crop might seem like a non-starter. However, according to Dr. Ken Van Rees, the project makes perfect sense. There is an increased wood demand from the limited provincial forest by lumber and pulp mills, and there are some farmers on the forest edge that could use an alternative crop for their marginal lands.

Enter the hybrid poplar. Backed by nearly a million dollars in NSERC strategic funding, Dr. Van Rees is working with several government and private forest industry organizations as well as local landowners, to evaluate the trees' potential. While native poplars take 60 to 80 years to mature, the hybrids can be harvested in 15 to 20 years. This may not be attractive to farmers approaching retirement, but could be a lucrative investment for younger producers.

While poplars grow abundantly in Saskatchewan, and have been cultivated widely as shelterbelts, little is

known about their agronomics. Van Rees and his colleagues are looking at how the trees react to nitrogen fertilizer and how best to handle weed control. The work will also determine how well plantation trees sequester carbon from the atmosphere, an important consideration in light of Canada's ratification of the Kyoto Protocol.

A CLOSE LOOK AT BARLEY

Barley, of course, makes excellent beer. It also is a high quality feed for livestock. The trouble is, varieties that ferment nicely in the brewery don't perform as well in the natural fermenter of a cow's belly.

Standard chemical analysis shows little difference between feed and malting barley. With SR-FTIR, a technique using infrared synchrotron light, Drs. Peiqiang Yu and John McKinnon and their colleagues have found that the two are indeed dissimilar, which may help explain the difference in how ruminants digest them.

In this case, the synchrotron is used much like a microscope, allowing the researcher to look at the fine structure of the endosperm of the barley grain, down to a resolution of three to 10 billionths of an inch. At this scale, protein and starch distribution can be looked at directly — and the synchrotron allows this to be done without damaging the sample.

The synchrotron research in the Department of Animal and Poultry Science is closely aligned with the Crop Development Centre (CDC), which supplied material for testing. In turn, results can be used by CDC researchers in their breeding programs to produce varieties more closely aligned with the needs of livestock.

Typically, grain fed to livestock is that which has not made the grade for human consumption, but according to McKinnon, this is changing. Using knowledge of how the grains are composed, varieties can be tailored to the needs of ruminants like cattle, and single-stomach animals like pigs and poultry. This promises better livestock performance and, perhaps, price premiums for grain producers.

The synchrotron work is also an initial foray into assessing the potential of this tool in agricultural research. The barley study was done at the Aladdin synchrotron at the University of Wisconsin-Madison. However, the expertise developed will be directly applicable to work with the Canadian Light Source synchrotron, scheduled to come online in 2004 on the University of Saskatchewan campus.

BREWING GREEN ENERGY

Ethanol, an alcohol, provides the kick in beer, wine and hard liquors. It's also a clean alternative fuel that is gaining

importance in the marketplace. A multibillion-dollar industry is based, essentially, on this product of biotechnology from a single celled organism: yeast.

Keeping yeast happy is the mission of Dr. Mike Ingledew. In the mid-1980s, Ingledew and his group developed a technology they called Very High Gravity Fermentation (VHG). It allowed production of higher concentrations of alcohol than was possible in industry, using regular yeast and a special nutrition protocol. Today, every major brewery in the world uses the high-sugar technique to produce more beer with existing equipment and labour.

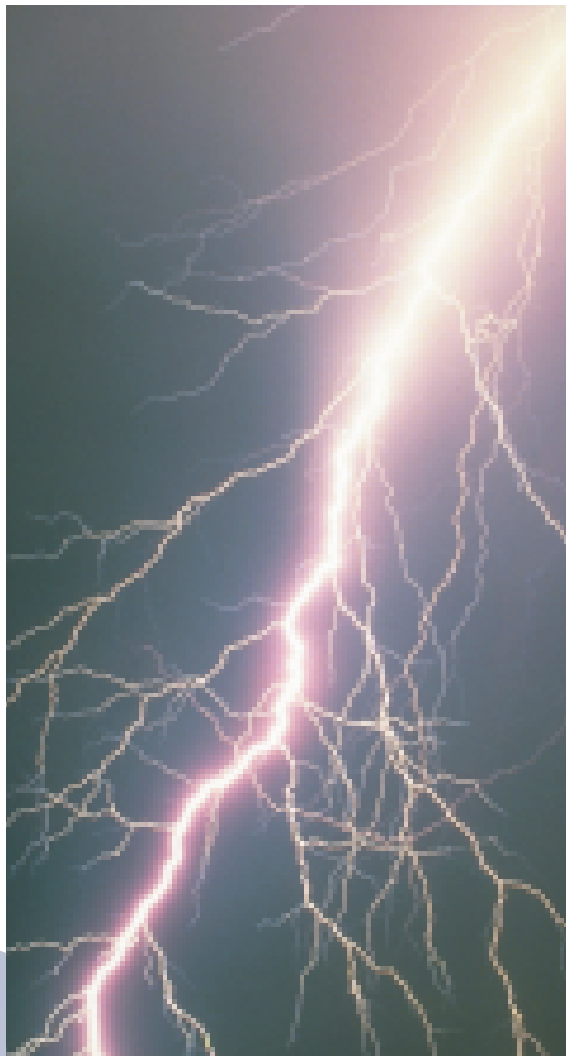
Ingledew's program backed by longstanding support from NSERC, is now focusing on the fuel alcohol industry. In the lab, Ingledew and his colleagues have produced grain mashes with over 38 per cent carbohydrate to make 23.8 per cent alcohol. In production facilities in the U. S., this has translated into 18 per cent alcohol solutions. Prior to this, the best alcohol plants could achieve was 12 per cent. This offers a 150 per cent increase in productivity, with no extra capital investment. Alcohol costs are lowered, making ethanol an easier sell for use as a fuel extender, an octane enhancer, or as an additive to help gasoline burn cleaner. Also, seeing ethanol is viewed as carbon dioxide neutral, the world benefits from fewer greenhouse gas emissions. At the same time, ethanol reduces toxic emissions from gasoline by 10 per cent or more.

CLIMATE CHANGE ON THE FARM

On the farm, responding to the Kyoto protocol gets complicated. Minimum till farming is good, as it leaves carbon in the soil, but fertilizing can be bad, as it releases the greenhouse gas nitrous oxide. Turning the land over to livestock pasture fixes this problem, but the animals emit methane, another greenhouse gas.

So what's the best strategy to produce food while protecting the environment? According to agricultural economist Dr. Richard Gray, we simply don't know enough to say. Gray and his colleagues worked on policy alternatives surrounding Kyoto, looking at what technologies and practices should be promoted. Their conclusion: there are simply too many gaps in the science right now. To get the answers, a multidisciplinary approach will be needed, one that will look at biology, soil science, economics and even social issues raised by farming technologies and management practices.

Funding is beginning to be earmarked for this type of research, through agencies like BIOCAP Canada Foundation and NSERC. The U of S is in an excellent position to do this work, through such initiatives as the Centre for Studies in Agriculture, Law and Environment (CSALE). With the majority of Canada's farmland located on the Prairies, discovering the economic implications of Kyoto for the Western economy is essential.



WHERE SCIENCE AND SOCIAL ISSUES COLLIDE

The products of agricultural biotechnology have enjoyed an unprecedented rate of adoption in a handful of countries, mostly in North America, but have been shunned elsewhere, particularly in the European Union.

According to agricultural economist Dr. Peter Phillips, this parallels the arguments for and against the technology. On the one hand, Canadian, American, Argentinean and Chinese farmers have embraced the technology, enjoying lower herbicide needs and easier management. Even when this hasn't translated into higher profits at the farm gate, farmers need fewer hours in the field, time that can be spent elsewhere. In North America, where farmers often have off-farm responsibilities, this has made the crops attractive. However, in Europe, consumers have been spooked by food safety crises like mad cow disease and are suspicious of the new technology. Few genetically modified crops can be legally cultivated there, and approvals of new varieties have been halted by a de facto ban.

Although the science behind biotechnology is sound and has proven safe in North America, the stone wall of opposition in Europe illustrates there is much more to the issue than science. To address this, the GELS program was launched to study the ethical, environmental, legal and social issues surrounding genomics research and development. It is supported in part by Genome Canada, a funding and information agency created to carve out a place for this country in the international world of genomics.

Phillips is one of a group of Prairie researchers working on GELS. Saskatoon has a lot invested in biotechnology, and is among a score of centres around the world to develop a technology cluster based on the life sciences. In some specialized areas such as canola, the city ranks near the top in the world.

However, social and economic issues could still scuttle this technology. If customers refuse to buy it, companies will not develop it, no matter the quality of the science. In the end, it may be these issues that determine the fate of agricultural biotechnology.

ORGANIC QUESTIONS

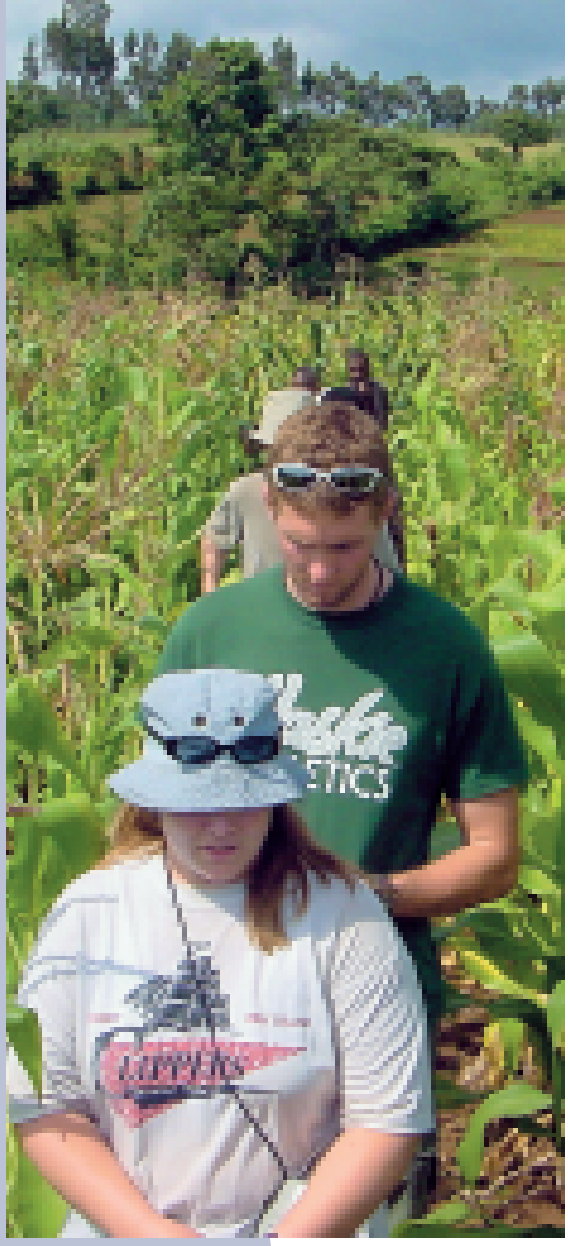
In Saskatchewan, in the 1999-2000 year, organic farming grew 64 per cent, giving this province more organic producers than anywhere in Canada. Two per cent of the province's farmers fall in this group, representing a market in excess of $30 million annually.

Despite lower yields and more intensive management, organic farming can be more profitable than conventional farming, as organic commodities can command more than double the price of conventional products.

The Saskatchewan Organic On-Farm Research Project, backed by funding from Saskatchewan Agriculture, Food and Rural Revitalization, was launched to examine the special challenges faced by organic farmers. Dr. Steve Shirtliffe of the Department of Plant Science and Dr. Diane Knight with the Department of Soil Science lead the project. The first phase, completed in 2002, included a survey of 64 organic farms representing every soil zone in the province. Data on soil nutrients, weed populations and management history were collected to get a good picture of the status of the industry in the province.

Next, the researchers are addressing specific challenges and tools for organic farmers. One problem is phosphorus, an essential plant mineral that is depleted with each crop. Unlike nitrogen, which can be supplied by green manure crops like legumes, phosphorus must be applied to the soil from an external source like manures or phosphorus-containing minerals. Rock phosphate is one such mineral that is permitted in organic farming, but making it available to the plants is an issue. Research will test the effectiveness of buckwheat and fungi-based products in liberating the phosphorus so crop plants can use it.

The project will also look at heritage varieties of crop plants to test their performance under low-nutrient, high weed pressure organic conditions. Weed control using competitive plants and water management will also be scrutinized, as well as manure handling and application needs.



HELPING FARMERS TO HELP THEMSELVES IN ETHIOPIA

Ethiopia is a land rich in opportunity but poor in development. Its 65 million people are overwhelmingly rural, closely tied to the land and vagaries of weather for their survival. Eradicating poverty, and fostering sustainable, equitable development are major goals — and major challenges.

Yet, according to Dr. Ahmet R. Mermut in the Department of Soil Science, the country has the potential to grow more food than it needs. It is blessed with mild temperatures, good soils, and plentiful water. The trouble is, the water and the fields

don't exist in the same place. A well-distributed irrigation system connected to rivers would free the country from the ravages of drought and make it extremely viable.

In a place where money and resources are virtually nonexistent, it is still possible to apply knowledge. Dr. Mermut, his colleagues and his students offer programs like LISA, the Low-Input Sustainable Agriculture program. One LISA initiative looked at leaving crop residues on the fields to conserve moisture and increase soil fertility. In areas where soils are acid, local sources of lime were identified, so farmers could apply it to their fields to help their crops absorb nutrients. Four Ethiopian students came to the U of S to complete their Master of Science degrees, and U of S undergrads traveled to Ethiopia to enrich their training. LISA, funded by the Canadian International Development Agency (CIDA), ran for six years and will be concluded at the end of 2003.

Mermut is currently pitching CIDA on a project to help local farmers to work together. Currently, they sell their produce to local brokers, who then sell the food in cities like Addis Ababa for a much higher price. Cooperatives would allow the farmers to market collectively, and keep more of the profits for themselves.

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