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Volume XXII Number 1 Spring 2007 Focus on Farming

Research magazine

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Weed specialist Mike Cowbrough is helping corn producers with new management approaches. *See page 10.*

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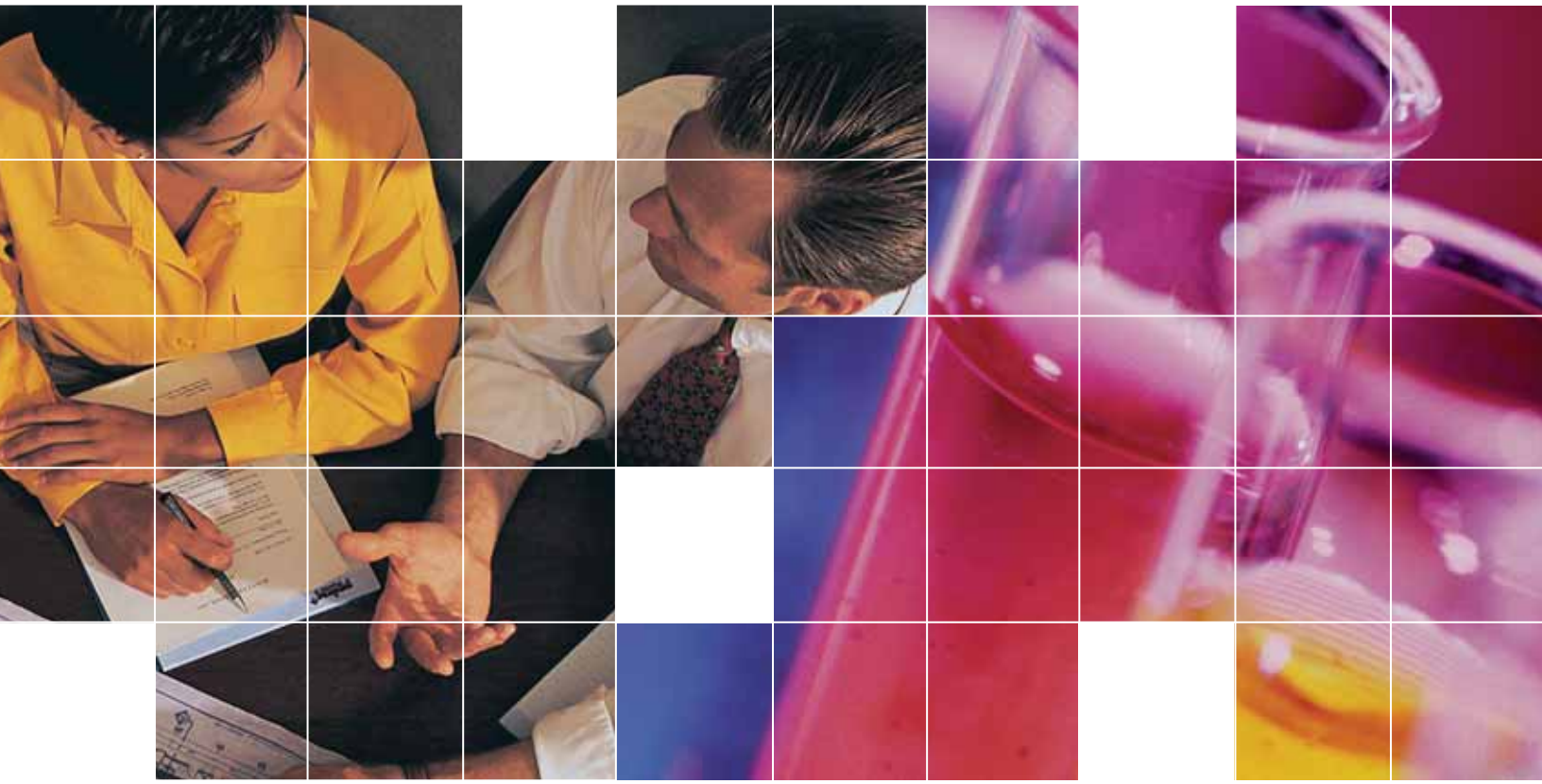

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A PUBLICATION TO PROMOTE DIALOGUE, UNDERSTANDING AND COMMUNICATION ABOUT RESEARCH ACCOMPLISHMENTS AND ACTIVITY AT THE UNIVERSITY OF GUELPH

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LET'S START HERE

Research supports those who keep us fed

Alan Wildeman

We've all seen miraculous feats of balancing performed by jugglers and acrobats. We view it as entertainment and applaud when we see an artist excel at the likes of spinning a globe on the tip of a finger. Canadians learned recently from our national census that more and more of us now live in cities. During the era when the country was founded, more than 80 per cent of Canadians lived in rural settings. This number has now fully reversed, with more than 80 per cent making their home in towns and cities, and cities now dominating virtually all growth.

The farming community is a smaller and smaller percentage of our population. But it's on the fingertips of farmers — rural Canada's jugglers and acrobats — that the increasingly weighty urban sector spins. This issue of *Research* magazine is about the work we do at the University of Guelph for those jugglers and acrobats who make it happen. This issue is about agriculture.

Brian Fray

With so many people (i.e., voters) living in cities and towns and such a large media focus on the thoughts and lifestyles of urban people, we are a country where metaphorically the head is slowly losing sight of the feet. In this issue, for example, you'll read about things that can have a much more far-reaching effect on our quality of life than a pothole on a suburban street. Controlling weeds and insects in crops, maintaining the health of livestock and keeping the land healthy underpin our standard of living and our economy.

There's a great deal of excitement these days about the new bioeconomy, the development of new crops with industrial uses and the creation of renewable fuels from agriculture and forestry. The University of Guelph indeed has many researchers focused on these opportunities. But it remains equally true that much has to happen before consumers can open a new carton of eggs, litre of milk or loaf of bread. It's a reasonable prediction that, with increased transportation costs and diversion of farmland into other uses, self-sufficiency in food production could become even more important for Ontario.

The University of Guelph has hundreds of faculty, staff and students who are committed to agriculture. These stories, written by our SPARK program participants, reflect some of their research activities and achievements. We continue to be grateful to the Ontario government, through the Ontario Ministry of Agriculture, Food and Rural Affairs, for its long-standing commitment to agricultural research and to the many farm organizations, producer groups and industries that support our efforts. We all need to be supporting the people on whose fingertips we spin. R

Alan Wildeman
Vice-President (Research)

Contributors

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SPARK 15 Years of Excellence

The University of Guelph Research magazine is written and co-ordinated by students involved in the University's Students Promoting Awareness of Research Knowledge (SPARK) program and Guelph's agricultural communications program.

UNIVERSITY of GUELPH

A First-year landscape architecture student Kate Nelischer is diving right into sustainability and environmental issues. She was exposed to agricultural issues for the first time in writing for this issue of *Research* and used her studies in urban design to relate to agriculture and natural resources. She learned how researchers are finding ways to maximize crop yields in canola. For more, see page 18.

B C SPARK co-ordinator Kim Waalderbos, left, and fourth-year agricultural science student Katie Savage are used to seeing things in black and white — the colour of Holsteins. Both come from dairy farms in different parts of the country — Kim, from Amherst, N.S., and Katie, from near Bradford, Ont. Both credit 4-H for fostering their love of animals, and in this issue, they tackle stories about dairy and liquid feed for pigs.

D Second-year veterinary student Katharine Found goes hog wild for these four-legged animals. She loves spending time on her family farm in Courtice, Ont., which features an agricultural awareness barn that's visited by thousands of schoolchildren each year. Katharine writes about environmental effects of swine operations on page 35.

E At almost 5'10", fourth-year marketing student Kate Roberts is intrigued by anything that, unlike her, is close to the ground. Whether it's miniature donkeys like Willie or mushrooms, Kate can't get enough short stuff. Check out her story on spent mushroom substrate on page 6.

F Goats such as this one named Salt are more than cute pets for fourth-year agricultural science student Patricia Dickenson. She has her own goat herd on her parents' dairy farm in Sarnia, Ont. When Patricia isn't working in the field or the barn, she's busy communicating about agricultural issues. See her story on tillage and manure practices on page 11.

G H Spilling the beans about agriculture is common for fourth-year students Alicia Roberts, drama, and Kyle Maw, agricultural business. They're both involved with Project SOY (Soybean Opportunities for Youth), a program that encourages students to find new uses for soybeans (www.projectsoy.ca). Kyle, an aspiring farmer, writes about a devastating soybean disease on page 8, and Alicia delves into plant stress from drifting herbicides on page 16.

I J Lindsay Brown, a biomedical toxicology science student, and Arthur Churchyard, an arts and sciences student, gave a leg up to these soft feathered friends and expanded their poultry knowledge for this issue. On page 33, see what Arthur learned about new feeds developed at Guelph that could improve chicken health. Lindsay, who hails from a dairy farm, broadened her animal nutrition scope with an article on broiler chicken growth. For more, see page 36.

Thank you to the College Royal and Old MacDonald's New Farm organizers for their help in arranging these photos. R

Photos by Martin Schwalbe

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Cover photo by Martin Schwalbe

Kim Waalderbos

Premium compost

Researcher finds new use for mushroom production leftovers

By Kate Roberts

Canadian mushroom growers now have a profitable option when it comes to dealing with the leftover organic substrate used to grow mushrooms.

Ron Fleming of the University of Guelph's Ridgetown Campus has found that spent mushroom substrate — manure-based material — can be fully composted and give rise to a high-quality material that can be sold at a premium.

"Composting can give mushroom growers an alternative method of dealing with this substrate while providing an additional income source," says Fleming.

On a world scale, about 13.6 million tonnes of substrate are produced each year, he says. Normally, it's disposed of, spread on farmland or sometimes sold to other farmers.

When applied to land, spent mushroom substrate improves soil structure by increasing the water- and nutrient-holding capacity and adding organic matter. It's more consistent than many other compost products because the mix recipe stays fairly constant year-round.

As a bonus, it's free from weeds and disease because it's already been partially composted and fully pasteurized before being removed from the mushroom house.

Because of the compost mix recipe needed for mushroom production, however, the finished compost has a higher salt content than other composts. This can put some limitations on how the compost can be used. In the past, the industry has dealt with the high salt content by stacking spent mushroom substrate outside for at least six months, allowing precipitation to leach out the salt. But this approach creates concerns related to Ontario's Nutrient Management Act because of the potential to contaminate surface and groundwater.

So in 2005, the Canadian Mushroom Growers' Association (CMGA) asked Fleming to find other options to deal with the substrate.

He turned to his expertise in anaerobic digestion to see if spent mushroom substrate could be used to generate methane gas. But the substrate didn't generate enough energy to be viable. In fact, the methane produced wasn't even enough to heat and run the digester.

Instead he found that a complete composting process could be used to improve the soil application qualities of spent mushroom substrate. The substrate was mixed and aerated for four weeks to create premium compost. In Ontario, selling this material in bulk garners up to $60 per tonne.

Fleming notes that the initial capital costs of the compost system are significant and include site preparation, composting structures, aeration fans, tractors and storage. But if the compost fetches a good price, the process can be economically viable, he says.

"Composting is safer for the environment and results in finished compost that has an excellent feel and appearance. Branding this as superior to other composts will be the ultimate factor in whether farmers can reap benefits."

This research was sponsored by CMGA, the Canada-Ontario Research and Development Program and the Ontario Ministry of Agriculture, Food and Rural Affairs. The substrate was provided by Rol-Land Farms.

CURIOSITY GROWING FOR GREEN ENERGY

Canadians are often influenced by European culture, in everything from fashion to food. And so it goes with anaerobic digestion — European technology is opening doors here.

Researchers at the University of Guelph's Ridgetown Campus are using European anaerobic digestion techniques to break down organic matter such as manure, which ultimately produces biogas and odorless bacteria-free material that can be applied to farmland.

The digester is an oxygen-free environment that traps heat and encourages certain gas-producing bacteria in manure to grow.

Over the course of 15 to 40 days, the bacteria in the digester break down organic material and produce a biogas made up of methane and carbon dioxide.

The methane is most valuable. It's captured and stored so it can then be used to heat the digester. It can also be directed to a generator to produce electricity or burned for heat.

To be practical, methane digesters must produce more energy as methane than the energy needed to run the system.

As this technique becomes more popular, farmer curiosity is growing and researchers are studying different formulas and new materials to see what will produce the most methane efficiently.

Stored spuds that don't darken

Cold-tolerant chipping potatoes could maintain quality in low-temperature storage

By Arthur Churchyard

If Ontario chip manufacturers could store potatoes through the winter, they wouldn't need to import as many spuds to maintain year-round chip production. But the low temperatures needed for long-term storage lead to dark brown chips that most consumers find unappetizing. Now, University of Guelph researchers say they've found an enzyme in a particular potato variety that prevents browning of chips made from cold-stored tubers.

Prof. Rickey Yada and a team of researchers in the departments of Food Science and Plant Agriculture identified the enzyme — called pyruvate decarboxylase — in a potato from North Dakota (variety ND 860-2). They say that introducing the gene for the enzyme into local chipping varieties would be a big plus for the Ontario potato industry.

"There are major benefits in being able to store potatoes at refrigeration temperatures," says Yada. "Ontario potato farmers would see increased demand, and the chip industry would gain a consistent and tasty potato variety."

Currently, chip manufacturers store potatoes at 10 to 12°C and treat them with inhibitors to prevent sprouting, a practice not favoured by consumers who prefer untreated produce. But manufacturers have to do something because using colder temperatures with existing potato varieties creates a problem called low-temperature sweetening. This results when starches in potatoes break down through a cold-induced chemical process into smaller sugar molecules. These sugars cause brown colour to appear during chip processing — except in chips made from ND 860-2.

This marked difference in chip quality led the research team to explore what characteristics made the North Dakota potato different and more cold-tolerant. They found that one enzyme in particular, pyruvate decarboxylase, helped convert the broken-down sugars in cold-stored potatoes into other molecules, reducing the browning effect.

Yada says the variety's cold tolerance can be linked to its genetic origins in South America, where it evolved in the high-altitude cold regions of the Andes Mountains. Now he and his research team hope to gain a better understanding of the enzymes responsible for the cold tolerance, so they can ultimately transfer the genes to other high-yield chipping varieties.

Others involved in this research include Prof. Alejandro Marangoni and Reena Pinhero of the Department of Food Science, Prof. Al Sullivan and Vanessa Currie of the Department of Plant Agriculture and potato breeder Robert Coffin.

Funding for this research is provided by the Canada-Ontario Research and Development Program, the Ontario Potato Growers, the Canadian Snack Food Association and the Ontario Ministry of Agriculture, Food and Rural Affairs.

Martin Schwalbe

Food science professor Rickey Yada has found an enzyme in a particular potato variety that prevents discolouration.

Against the wind

Researchers ready Ontario's vital soybean crop for airborne Asian rust invasion

By Kyle Maw

The wind. When it comes to soybeans, there blows the problem.

Asian soybean rust, a fungal disease spread by wind-borne spores, can be devastating to a soybean field. It kills plants' leaves, leading to yield losses of up to 80 per cent.

And it's on its way to Ontario. The disease has been reported across Asia, Australia, Africa and South America. Now it's in the Midwestern United States, arriving from Colombia on the winds of hurricane Ivan in 2003.

Martin Schwalbe

Prof. Istvan Rajcan is studying which soybean varieties will resist Asian soybean rust, a devastating fungal disease on its way to Ontario.

"It's just a matter of time before the spores of the fungus make their way into Ontario," says University of Guelph soybean breeder Prof. Istvan Rajcan. "Only Michigan and Ohio are separating us now."

Luckily for Ontario growers, the spores can't survive in freezing conditions, so there's been time to prepare. Since 2004, the soybean industry and the research community have been creating what's described as an unprecedented defence plan for the disease. It includes a step-by-step plan to monitor and research the progression of soybean rust, then to inform and educate growers on how to manage the disease.

"There's never been a defence plan like this for soybeans in Ontario," says Jeanine Moyer, communications co-ordinator for the Ontario Soybean Growers. "Growers, industry, researchers and government have been working together to prepare for the day when soybean rust enters Ontario."

At Guelph, Rajcan has been studying and identifying soybean varieties that are resistant to rust, with help from the U.S. Department of Agriculture (USDA). To date, 776 resistant varieties have been identified from a gene bank of soybeans taken from many different regions around the world.

Of those, 254 varieties may be fit for Ontario conditions. Each variety has been planted into trials across Ontario. Evaluations are under way for rust resistance, and researchers are producing more seed for further evaluation, so they can understand the characteristics of each variety and how well it adapts to local climate and conditions.

"Having the ability to evaluate genetic resistance from other varieties allows us to speed up development of new varieties before the disease arrives in Ontario," says Rajcan.

Now into the third year of field trials, the researchers are selecting resistant lines, cross-breeding and incorporating resistance into new varieties. Once this is completed, information will be made available to both public and private breeders to help prevent devastation from this disease.

Other members of this project include Prof. Gary Ablett of the University of Guelph's Ridgetown Campus; Albert Tenuta, a pest-management specialist with the Ontario Ministry of Agriculture, Food and Rural Affairs in Ridgetown; Terry Anderson and Vaino Poysa of Agriculture and Agri-Food Canada (AAFC) in Harrow; Elroy Cober of AAFC in Ottawa; and Randall Nelson, curator of the USDA soybean germplasm collection in Urbana-Champaign, Ill. R

The new and improved Millennium

It makes Ontario's asparagus sector even more competitive

By Arthur Churchyard

Martin Schwalbe

Prof. David Wolyn is fine-tuning Ontario's most popular asparagus variety by breeding in increased disease resistance.

Guelph Millennium, introduced in 1996, has become one of Ontario's most popular asparagus varieties, accounting for half the province's asparagus crop. It was even named Seed of the Year in that competition's inaugural contest in 2005 (see sidebar). Now, the variety is being improved at the University of Guelph to resist rust and enhance quality, which will give growers a stronger competitive edge in world markets.

Prof. David Wolyn of the Department of Plant Agriculture is fine-tuning Guelph Millennium to contribute to what he describes as "more efficient, cost-effective and productive asparagus operations in Ontario."

Guelph Millennium is renowned for its ability to produce and sustain high yields. In comparison, several popular competitor cultivars in the United States are known to have yields that taper off as the crop cycle continues. By year six in Guelph Millennium's production, Wolyn found it produced double the number of spears of other varieties.

He is now boosting Guelph Millennium's advantages by breeding in increased resistance to disease. The improved variety will resist rust while still offering high sustained yields, he says. This will reduce pesticide treatment and help hold down crop and management costs for growers. Wolyn is also doing research to ensure that new asparagus varieties maintain high quality in hot weather.

A steady supply of asparagus and dependable quality are vital for exports, he says. A competitive marketing strategy for Ontario growers would move them into the front of the pack with Washington, Michigan and California to supply asparagus to the U.S. East Coast. A big part of winning that race lies in improving the quality of Ontario varieties, he says.

Technician Paul Banks runs the field operations for this breeding program. Prof. Maury Bredahl, chair of the Department of Food, Agricultural and Resource Economics, is also involved.

Funding for this research is provided by the Ontario Asparagus Growers' Marketing Board and the Canada-Ontario Research and Development Program.

Top seed

Seed varieties that have made an important contribution to Canadian agriculture are getting their moment in the sun, thanks to a competition called "Seed of the Year."

The competition is designed to recognize a publicly developed Canadian field crop, forage, fruit, vegetable or herb variety that has made a significant contribution to the agri-food industry. It acknowledges the many accomplishments of public plant breeders in Canada.

A committee from industry, government, academia and media judges entries. Selection is based on innovation, impact on the industry, presence throughout the value chain, sustainability and marketability.

In 2005, the competition's inaugural year, Guelph Millennium asparagus topped the entries to be named Seed of the Year. In 2006, Harovinton soybean, developed by Richard Buzzell of Agriculture and Agri-Food Canada, was named the winner at a ceremony at the Royal Agricultural Winter Fair in Toronto.

The competition was designed by the University of Guelph and SeCan with support from the Ontario Ministry of Agriculture, Food and Rural Affairs and Agriculture and Agri-Food Canada. Additional sponsorship was provided by the Ontario Asparagus Growers` Marketing Board, Ontario Bean Producers' Marketing Board, Ontario Soybean Growers and Ontario Wheat Producers' Marketing Board.

~ Kim Waalderbos

On the cover

Minding the weeds

Computer program targets easier, more effective weed management

By Katie Savage

Selecting a herbicide is never easy. Farmers must balance information from many research sources and weed management publications to get the right match that will help them optimize crop yields and maximize profits, while being mindful of the environment.

Now, University of Guelph researchers are helping to make the decision easier by compiling weed science information in one convenient program.

Mike Cowbrough, weed management lead for the Ontario Ministry of Agriculture, Food and Rural Affairs, is developing a four-step computer program based on 20 years of weed science research at Guelph. When complete, it will put that research into a useable package for crop consultants and growers.

"This program will allow growers to select the parameters that are most profitable for their production," Cowbrough says.

To generate a recommendation on the ideal herbicide to use, the program will ask users to input information such as field size, density and weed types. Then the program will factor in commodity price, potential yield, yield loss and cost of herbicide. It will also include a weed threshold that calculates what kind of damage a given number of weeds, emerging at a particular stage, will have on crop.

By using weed thresholds as part of the calculation, the program will be able to evaluate what solution will be most profitable. In some cases, the option chosen may not give the farmer the cleanest field, but it should still achieve the highest profit, Cowbrough says.

In the third step, herbicide treatments will be ranked based on their environmental impact, using an environmental quotient that considers the effect on soil, land, the applicator and the public. This will give growers a chance to make the most environmentally friendly decisions for herbicide application.

The program will list each weed species the grower specified and show what the potential yield loss is for each weed and what impact each chemical will have. The grower can click on each weed for further details, including a picture to ensure it's the weed in the grower's field. There will also be a section showing any precautions, such as pH effect and potential recropping restrictions.

The final step of the program will allow growers to select the treatment to use in their field and will give a printout with the rates and products needed. This will promote better record keeping, Cowbrough says.

The program currently being designed centres on corn. It was piloted with a focus group of producers, and the feedback is being incorporated into the program before its anticipated release to all producers later this year. It will be available via the Internet and on compact disk.

Depending on the program's success, says Cowbrough, it will be expanded beyond corn to include recommendations for wheat and soybean growers, too.

Other researchers involved in this project are Profs. François Tardif and Clarence Swanton, Department of Plant Agriculture; Profs. Peter Sikkema and Laura Van Eerd of U of G's Ridgetown Campus; Greg Stewart of the Ontario Ministry of Agriculture, Food and Rural Affairs; and Susan Weaver of Agriculture and Agri-Food Canada.

This project is supported by the Ontario Corn Producers' Association. It is also funded in part by the Canada-Ontario Research and Development Program. R

A computer program to make management decisions easier for farmers is being developed by a research team led by Mike Cowbrough.

Martin Schwalbe

When manure's on the move

How does it travel through the soil most readily? This research aims to discover the answer

By Patricia Dickenson

Research starts this spring to develop more nutrient management practices farmers can use. Prof. Kari Dunfield and colleagues in the Department of Land Resource Science are beginning a study to determine how factors such as timing of manure application and its incorporation into soil influence the flow of nutrients and the ability of pathogens to survive in the environment.

"We hope to establish a set of best-management practices for simultaneous control of pathogens and excess nutrients," says Dunfield. "These should give farmers more information that will help further protect the groundwater and soil."

Trial plots in Elora and Ridgetown, Ont., will compare differences related to soil and climate. Manure will be applied at spring and fall timings to determine which method contributes less soil and water contamination. The manure applications will be combined with various tillage practices, including no-tillage, pre-application tillage and immediate incorporation of the manure after application. A control plot with no tillage or manure inputs will be used for comparison.

The researchers want to know how the manure nutrients travel most readily — via groundwater, surface water or in-field drainpipes. They also hope to learn how long pathogens survive in soil and if they, too, can flow through water channels.

The team will monitor soil, water and plant samples that will be collected before, during and after application. The samples will help in understanding flow patterns of manure and water. They'll also be examined for the presence of contaminants such as nitrates, ammonium, phosphorus and coliforms.

Others involved in this project are Profs. Susan Glasauer, John Lauzon and Gary Parkin of the Department of Land Resource Science and Prof. Ivan O'Halloran of the University of Guelph's Ridgetown Campus.

Funding is provided by Ontario Pork. Additional support has come from the Ontario Ministry of Agriculture, Food and Rural Affairs and the Ontario Ministry of the Environment's nutrient management joint research program.

Brian Fray

THE UNFRIENDLY GIANT

Hogweed's tenacious tendencies crowd out the competition... and more

By Patricia Dickenson

François Tardif

Weed-control expert Prof. François Tardif is devising a plan to stamp out giant hogweed before it becomes a menace.

If ever a plant lived up to its name, it's giant hogweed. It was the apple of gardeners' eyes when it was introduced to North America in the early 1900s from Asia, thanks to its dramatic towering presence (it can grow up to 15 feet tall) and hardy nature. But like other well-intentioned ornamental introductions gone wrong, such as Japanese knotweed and purple loosestrife, giant hogweed has fallen from favour. It turns out the plant doesn't want to stop spreading, a message it underlines by oozing poisonous sap on its attackers, including farmers trying to get it out of their fields.

That's where Prof. François Tardif of the University of Guelph's Department of Plant Agriculture comes in. As a weed-control expert, he is building greater awareness of giant hogweed and devising a plan to stamp it out before it becomes more of a menace.

"In Canada, giant hogweed is seen mainly as an environmental problem," says Tardif, "but in Europe, it's a problem in pastures as well. That could be the case here unless we get it under control."

Clusters of giant hogweed are found primarily along roadsides, ditches, streams and trails. Its invasive nature is helping the plant broaden its territory. Its hollow stems are covered in coarse hairs, and its flower heads are large and resemble the wild carrot plant (Queen Anne's lace).

But it's anything but regal. Making skin contact with giant hogweed can lead to a painful experience for humans and light-fleshed animals because of the plant's toxic sap. When areas of skin that have been in contact with the sap are exposed to sunlight, they become highly sensitive to ultraviolet rays. If exposure is severe enough, hospitalization is required to treat the damage.

Tardif has conducted a preliminary study in a greenhouse environment to examine how well some herbicides control the plant. Now he's set to expand the project to a larger trial this summer, using giant hogweed plants growing naturally in the Waterloo region. He'll see how approaches such as herbicides, root cutting and grazing affect weed control under local conditions.

Tardif hopes the study will identify a suitable herbicide for giant hogweed control and raise awareness of the plant's presence.

Most studies of giant hogweed have been done in Europe and British Columbia, where environmental conditions are much different than in Ontario. Variables such as the average lifetime of the plant, genetic variations among plants and the effects of weather stresses such as frost can all influence control measures, Tardif says.

Support for this research has been provided by the Ontario Ministry of Agriculture, Food and Rural Affairs. R

Sugar beets that can't be beat

Researchers take a new approach to improve quality

By Lindsay Brown

Sugar beets have made a comeback in Ontario, rebounding from basically no acreage a decade ago to more than 10,000 acres today. But the quality of the overall product going to market has been hindered because sugar beets can be challenging to store, resulting in compromised sugar quantity and quality and reduced income for growers.

Two years ago, about 17 per cent of the Ontario crop was lost due to rotted beets in storage, says John Zandstra, a horticulturist at the University of Guelph's Ridgetown Campus. To help improve the final quality of sugar beets, he and Ridgetown professor Laura Van Eerd are studying factors such as growing conditions, crop maintenance, harvesting procedures and storing conditions.

"Improving the quality of sugar beet storage will allow the industry to be more profitable and will help diversify the agricultural economy," says Zandstra.

The study is being carried out at grower sites across Ontario and at the Michigan Sugar Company's piling station in Dover Centre, Ont. The research team is tracking factors from seed to processing that affect sugar beet quality.

Things they're looking at include the effect that varying nitrogen rates applied in the field have on sugar beet storage quality, and differences in storage characteristics among beet varieties.

Zandstra is also studying harvesting and piling techniques to assess the incidence of scrapes and bruises, which make sugar beets susceptible to rot when stored.

He's using an impact recording device, a small round sphere similar in shape, size and weight to the average sugar beet. The device passes through machinery and equipment as a sugar beet would. Impact data are collected, stored and later uploaded to a computer for analysis.

This technique allows Zandstra to identify areas in the harvesting and piling machinery where the beet will experience bruising and damage. He'll use this knowledge to make recommendations to help growers improve their practices.

The researchers will also monitor beet quality at the storage pile, where beets from multiple growers are dumped together into bulk piles up to six metres tall, 50 to 60 metres wide and 300 metres long. The beets are stored in these piles until they're exported to Michigan for processing. Samples will be taken from these piles throughout the storage period to monitor how sugar quality, weight and rot vary.

Zandstra says the researchers hope their findings will ultimately give growers more techniques to improve the quality of their product, reduce losses and boost their returns.

This project is funded by the Canada-Ontario Research and Development Program, the Ontario Ministry of Agriculture, Food and Rural Affairs and the Ontario Sugar Beet Growers Association.

Sugar beet quality can be affected by harvesting procedures and storing conditions.

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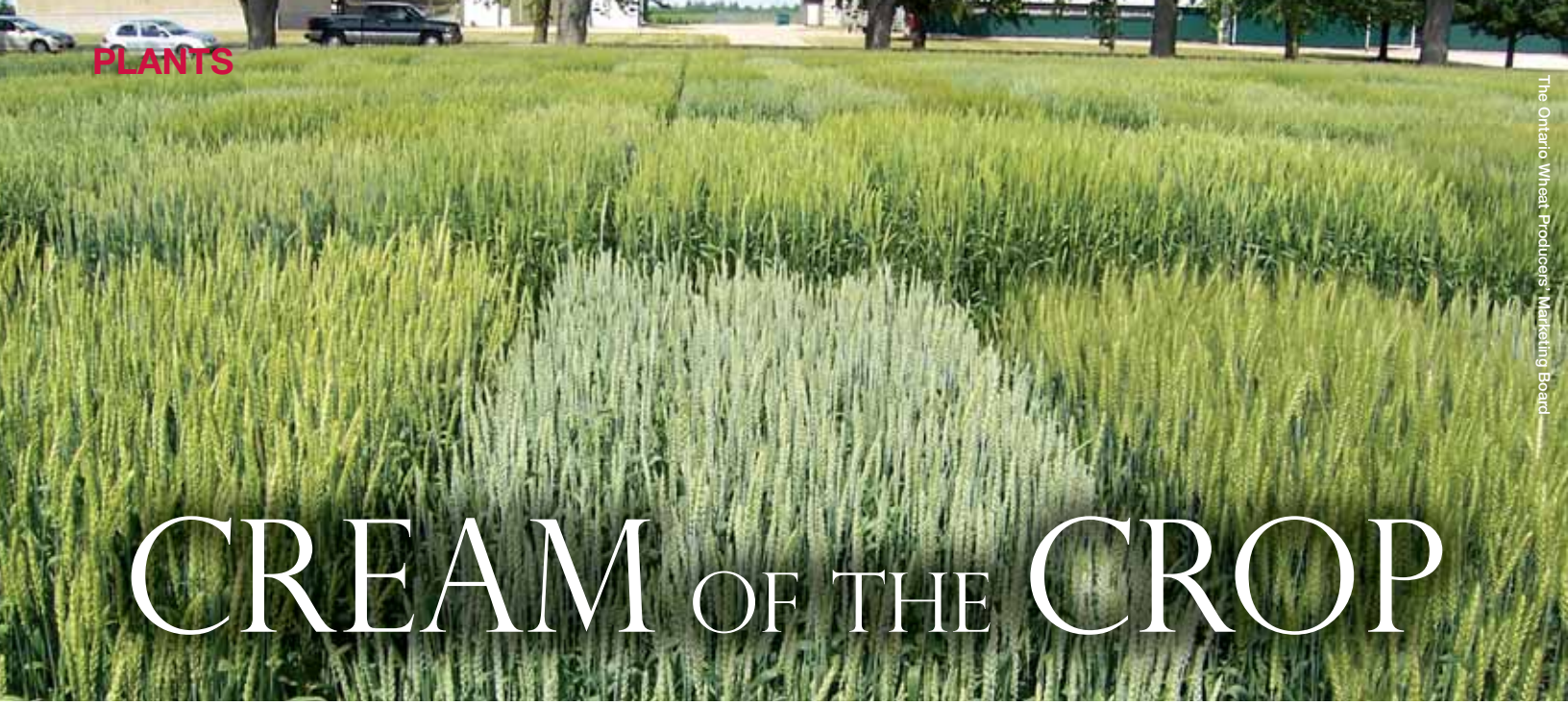


The Ontario Wheat Producers' Marketing Board

CREAM OF THE CROP

Performance trials help identify top varieties for wheat producers

By Rebecca Moore

Wheat breeding needs to keep up with changing environments to improve the hardiness, disease resistance and yields of Ontario's golden crop. To that end, researchers are working to give producers the best options for adapting varieties to suit their local growing environments.

University of Guelph plant agriculture professor Duane Falk conducts research on wheat breeding and co-ordinates the Ontario cereal performance trials. The trials are designed to test and compile data on winter wheat, spring wheat, barley and oat varieties for an annual report describing their viability in locations throughout Ontario.

Trial plots have been established at numerous sites between Harrow and Ottawa to gather information about winter wheat varieties that are — or will be — available to Ontario producers. This is the kind of information they need to keep up with the changing times, Falk says.

"The wheat performance trials are how producers figure out what's new. The seed industry is changing fast enough that there are significant improvements in breeding, which demands accurate information for producers on the success and viability of these new varieties."

The information collected on each wheat variety tested includes yield, relative yield, weight, plant height and heading date. Disease severity is also noted for most varieties. The data from the test plots across Ontario are analyzed statistically by a team of Guelph researchers that includes Falk, then are published and made available to producers.

This year, the performance trials added a new *Fusarium* index to the report information. Data on *Fusarium* head blight — the most destructive fungal wheat disease — were previously reported through separate measurements of toxin levels and symptoms. These measures were often confused and could mislead producers. To provide more accurate *Fusarium* information, Falk and his research team created an index that combines the two parameters to produce a statistically accurate and understandable index that rates a variety's susceptibility to the disease.

"Our goal for the wheat performance trials is to produce unbiased, statistically sound information that producers can use to compare varieties of wheat according to many different parameters, including the new *Fusarium* index," he says. "We're providing them with the tools they need to make the best decision for the upcoming season."

Falk says continuing change by the wheat industry is absolutely necessary in the face of a dynamic environment. He notes that only one-third of the winter wheat varieties tested in a trial remain in the study after five years — an indication that new, and better, varieties are constantly replacing old ones, which are becoming outclassed.

Wheat growers will have information about varieties best suited to Ontario, thanks to trial plots of winter wheat being studied by University of Guelph researchers.

In related wheat research at Guelph, Falk is leading an initiative to apply a system called recurrent introgressive population enrichment (RIPE) to wheat. With support from the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA), he developed RIPE about a decade ago to breed new traits more quickly into barley varieties. The system successfully introduced desirable traits considerably faster than traditional breeding techniques. He hopes that modifying the current winter wheat breeding system will produce the same results to improve characteristics such as performance, yield, milling quality and winter hardiness.

Funding for the Ontario wheat performance trials is provided by OMAFRA and the Ontario Wheat Producers' Marketing Board, with collaboration by Agriculture and Agri-Food Canada and several private breeding and seed marketing companies.

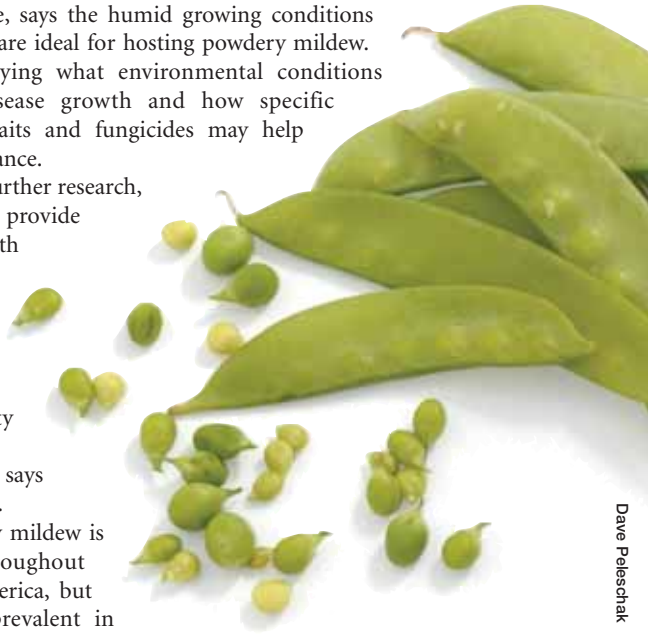
Peas without disease

Researchers aim to improve resistance to powdery mildew

By Lindsay Brown

Powdery mildew is a serious fungal disease affecting peas and other plants. It appears as a grey-coloured growth on pods and leaves, and causes crop loss and reduced yields for pea producers. Now, a Guelph researcher is studying methods to reduce or eliminate it.

Prof. Mary Ruth McDonald, Department of Plant Agriculture, says the humid growing conditions peas need are ideal for hosting powdery mildew. She's studying what environmental conditions favour disease growth and how specific cultivar traits and fungicides may help with resistance.



Dave Peleschak

"With further research, we hope to provide growers with knowledge that will allow them to produce a high-quality crop more efficiently," says McDonald.

Powdery mildew is found throughout North America, but is more prevalent in semi-arid regions, she says. In 2005, Ontario's 265 pea growers harvested 19,710 crop acres. Yield losses resulting from the disease typically affect 10 to 15 per cent of the provincial crop.

In the study, McDonald and her research team are collecting weather data to try and predict when powdery mildew will develop at their research sites at the Muck Crops Research Station in Bradford, Ont., and the Agriculture and Agri-Food Canada (AAFC) Research Station in Saskatoon, Sask. They're also testing the effectiveness of four fungicides currently on the market. In addition, they'll consider the differences in disease resistance among pea varieties.

Certain types of pea varieties are more susceptible to powdery mildew, particularly late-season fresh-market peas, which are harvested in August and September when the humid days and warm evenings favour mould growth. The spores that cause the fungus are spread through the air and, unlike other spores, germinate well in relatively high humidity.

While the research is ongoing, McDonald anticipates it will provide growers with information on resistance, will identify products that best control the disease and will differentiate among susceptible varieties.

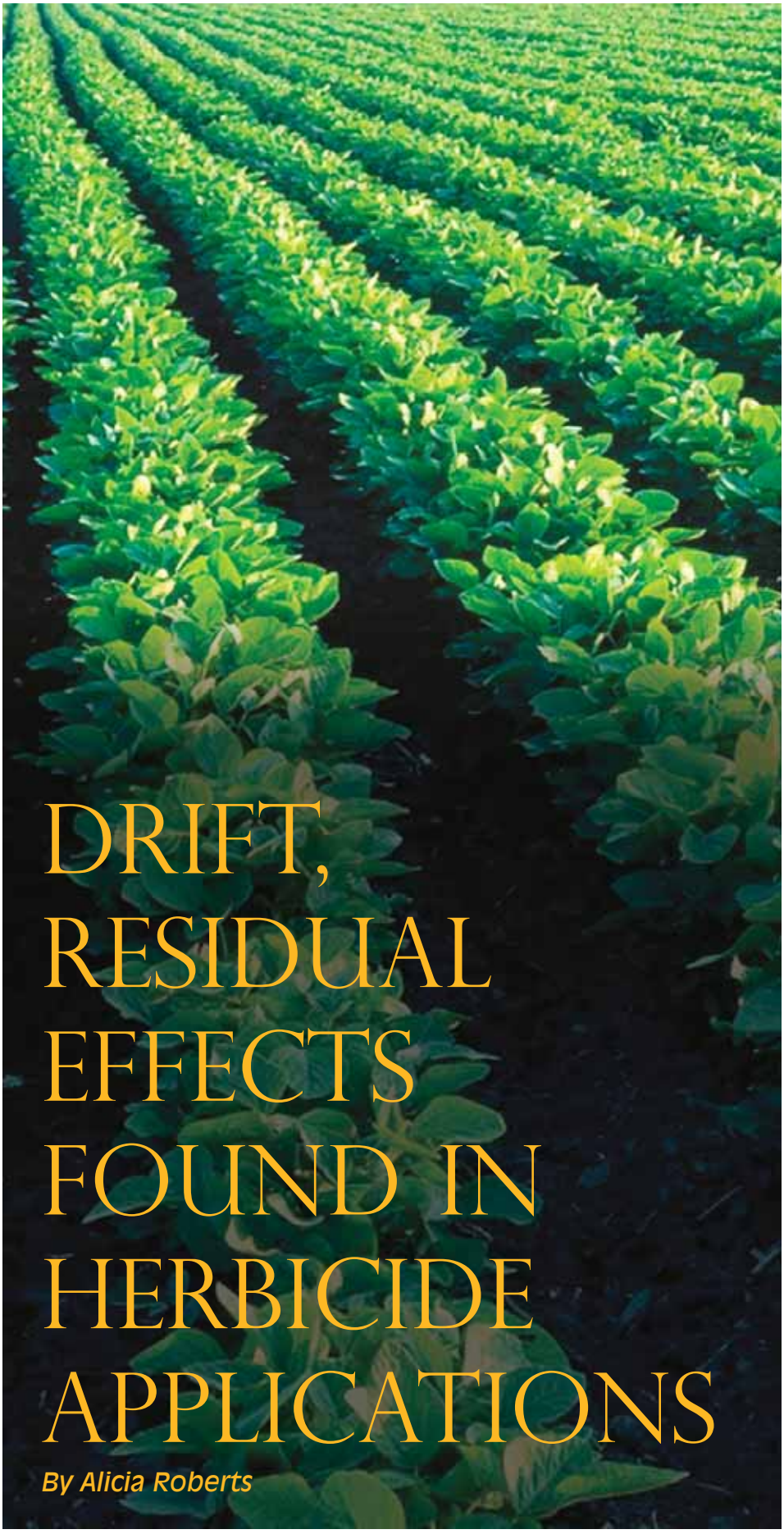
The data collected from the study will be made available to crop growers to help in selecting fungicides.

Also involved in this research are Kevin Vander Kooi of the Muck Crops Research Station, Prof. Greg Boland of the Department of Environmental Biology, Bruce Gossen of AAFC, and Mike Celetti and Elaine Roddy of the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA).

This project is funded by the Canada-Ontario Research and Development Program, the Ontario Processing Vegetable Growers, the Fresh Vegetable Growers of Ontario and OMAFRA.

Martin Schwalbe

Prof. Mary Ruth McDonald is searching for ways to prevent a serious fungal disease in peas.



DRIFT, RESIDUAL EFFECTS FOUND IN HERBICIDE APPLICATIONS

By Alicia Roberts

DuPont

Herbicides play an important role in maintaining healthy crops, but a University of Guelph researcher says application procedures must consider drift and herbicides' residual effects between various crops.

Prof. Clarence Swanton, Department of Plant Agriculture, has found that drift of corn herbicides in particular can have an impact on soybean productivity.

"Whenever we apply a chemical to the environment, it moves," he says. "We wanted to see the effects of corn herbicides on soybeans and whether in any given year it changed the yield potential of soybeans."

Swanton designed trials to have corn and soybean herbicides drifting onto soybeans at research sites in Woodstock and Ridgetown. He found that drift caused 20 to 40 per cent of soybean injuries such as stunting, leaf burning and poor emergence. In areas where the highest drift rates occurred, soybean yields were reduced by 14 per cent. Injury to the soybean plants was further increased when soy-specific herbicides closely followed drifting corn herbicides.

Research trials reflect real production problems in Ontario

In related research, Swanton studied how soybean production is influenced by sudden changes in planting routines (for example, a situation where the soil has already been treated with corn herbicide but has been planted with soybeans instead because of weather or other restrictions).

In this study, corn herbicide was applied at established time intervals of 14, 28 and 42 days before planting soybeans. Swanton found that the longer the corn herbicide was on the ground, the less stressful it was for soybeans to grow. He says knowing the influence of time intervals could help farmers determine the optimal time to plant when in a similar situation.

"These research trials were designed to reflect real production problems that could affect Ontario farms," he says. "I hope the results can serve as a knowledge base to help guide decisions for farmers."

This research is sponsored by Agriculture and Agri-Food Canada, E.I. du Pont Canada Co., the Ontario Soybean Growers and BASF. R

Soybeans can be damaged by herbicide drift from neighbouring crops.

Talking in circles about the environment

Inclusive aboriginal approach is applied to water-quality problems

By Arthur Churchyard

Complaints about nutrient overloading and soaring bacteria counts along the Great Lakes shoreline are growing trends across Ontario. As waterfront properties get eaten up, population pressures intensify and urban encroachment becomes chronic. Water quality deteriorates for all users, and cottagers and farmers point fingers at each other. Frustration escalates, and answers are elusive.

Against this backdrop, University of Guelph researchers are working to break down misunderstandings between rural groups and to encourage land stewardship on both sides. Prof. Wayne Caldwell of the School of Environmental Design and Rural Development (SEDRD) is developing a guide based on his studies of Huron County that could be used across Ontario to prompt landowners to take responsibility for their own contributions to water-quality problems.

Part of the study involves conciliatory aboriginal-like circle talks. They put all participants on an equal footing and promote discussion because, in this configuration, everyone's voice is heard.

"This project is about each of us as landowners, thinking about the daily decisions we make that contribute to water quality," says Caldwell, who is also director of the sustainable rural communities portion of the University of Guelph-Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) agreement. "We can't simply point fingers at a group such as farmers when our own actions are part of the problem."

Cottagers are often the most vocal about water-quality problems, he says. That's why the first part of his research considers the impact of cottagers on water quality, using a septic re-inspection program. Municipalities in Huron County can volunteer to participate in the septic re-inspection, which involves an expert from the Huron County Health Unit visiting area homes to look for potential water-quality factors such as outdated septic systems and leakage. The goal is to identify potential problem areas and pinpoint what cottagers can do to prevent water pollution.

Caldwell is working with SEDRD colleague Prof. Karen Landman to produce the "Rural Landowner Stewardship Guide." It will help landowners identify approaches to environmental issues on their property, so they can reduce their contributions to water-quality problems.

The guide is based on workshops taking place this year and next. So far, more than 225 participants have provided feedback on what problems are in their area, where they think the problems are coming from and what they can do to help. News about the workshops is being spread by many local partners, including cottage associations.

Agricultural stakeholders are also taking part in the research. Meetings to enhance communication are conducted using the traditional First Nations style of circles. Caldwell says this approach has proven to be a great success so far because it ensures that everyone (cottagers and farmers) can participate in the meeting and that all views are considered equally.

Circle-style meetings are of particular interest to Guelph PhD candidate Jennifer Ball, who has seen first-hand the conflict-dissolving potential of the circles. The criminal justice system in Canada and the United States uses circles in a number of contexts, but this is believed to be the first use of the technique in the context of land-use planning. Ball has observed the success of five circle meetings between rural landowners in Huron County.

Plans for 20 more workshops and circle meetings are under way, and the meeting results will be summarized for Ontario rural planners so they can be applied across the province.

Funding for this research is provided by OMAFRA, the Ontario Ministry of Natural Resources and many local groups and private organizations, including Friends of the Bayfield River.

Alison Stieglitz

See no weevil

Canola researchers want to bag a bothersome bug and boost production

By Kate Nelischer

Along with the new millennium came an unwanted visitor: the cabbage seedpod weevil, which appeared in Ontario canola fields after spreading from Western Canada. This insect takes its toll on canola, both by eating the seeds of the plant and by making it more susceptible to brown seed, a condition caused by hot, dry weather. Guelph researchers are investigating how a registered insecticide can help reduce brown seed by controlling the insect population.

Prof. Hugh Earl of the Department of Plant Agriculture is collaborating with other researchers from Guelph and the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) to investigate the best timing of insecticide use to achieve maximum plant benefits. They've found that using a pyrethroid insecticide that's registered for use on canola not only protects yields by controlling insects but also greatly improves the quality of harvested canola.

"This is a two-part issue," says Earl. "We're dealing with insects that eat the canola seeds, as well as the harmful effects hot, dry weather can have on the seeds."

First, the weevil. It punctures the pods of the canola, laying its eggs directly inside. The larvae consume the seeds (the valuable part of the plant), reducing the crop's yield.

Then there's brown seed. It results when the canola seed matures in hot, dry weather. Fats in the seed oil break down and become rancid. This causes the yellow interior of the seed to turn brown, reducing the crop's value.

"The 2005 growing season was a sort of perfect storm for Ontario canola," says Earl. "Hot and dry conditions led to significant brown seed levels, and weevil populations were also very high."

While testing the insecticide against the weevil that year, the researchers found crop yields were increasing as they expected. But when they then looked at seed quality, they were surprised to find the insecticide treatment had also significantly reduced the brown seed problem.

Earl says it's unlikely that the insecticide affects brown seed directly. Instead, it could be that cutting down the insect population is helping to reduce overall stress on the plant, so the net effects of heat stress are lessened, he says. The insecticide also seems to reduce the localized injury where the larvae grow inside the pods.

Canola Council of Canada

The cabbage seedpod weevil: taking a toll on Ontario canola.

This finding has led the researchers to refine recommendations for the insecticide's use, so it provides ideal protection from weevils and reduces brown seed.

Also involved in this project are Profs. Mark Sears and Rebecca Hallett of the Department of Environmental Biology and Tracey Baute of OMAFRA.

This study is supported by the Ontario Canola Growers Association, the Agricultural Adaptation Council through the CanAdapt program, BASF Canada Ltd., Bayer Inc., DuPont Canada Inc. and Syngenta Crop Protection Canada Inc.

Oil from the soil

Building opportunities with biodiesel for Ontario farmers and processors

By Kyle Maw

Biodiesel is processed fuel made from biological sources, most often vegetable and animal fats, which are readily available. By keeping pace with technological advances, Ontario biodiesel production is beginning to flourish. Now, University of Guelph researchers are working to position soybeans as an attractive and economical source of biodiesel. They're trying to modify soybeans to produce oil that blends better than current biodiesel sources.

Profs. Gary Ablett and Istvan Rajcan and graduate student Golsa Saket of the Department of Plant Agriculture say using soybeans as a biodiesel source could provide economic advantages for both farmers and fuel processors, provided the soybean varieties selected for this application are bred to have a favourable combination of oil quality and quantity. The oil is what's needed to produce biodiesel.

"We're looking to create higher value for farmers and companies producing biodiesel by making soybeans more attractive as a raw commodity," says Ablett.

In the past, varieties were developed for protein content rather than high oil. These varieties have many uses because of their health benefits. Pushing for higher oil content means a trade-off for lower protein.

Typical soybean varieties have an oil content of 18 to 20 per cent. But the researchers hope to push this up to 23 to 25 per cent. This is considered a significant increase and is as high as they will aim. Otherwise, yield potential will be sacrificed.

To increase soybean oil content, the research team is breeding and then screening large numbers of soybeans to select only those that have high oil content, compared with their parental lines. Those varieties are then used for further breeding and are tested for other agronomic traits such as plant height and time to maturity.

This study began in 2005, and Ablett says it will take several years before some of the varieties they're developing will be available to farmers, but they could eventually develop into an identity-preserved market that garners premiums for growers. This program exemplifies why long-term research approaches are needed for activities such as new-variety development. Introducing a new variety into the sector can take eight to 10 years.

This project is funded by the Canada-Ontario Research and Development Program, the Ontario Soybean Growers and the Ontario Ministry of Agriculture, Food and Rural Affairs.

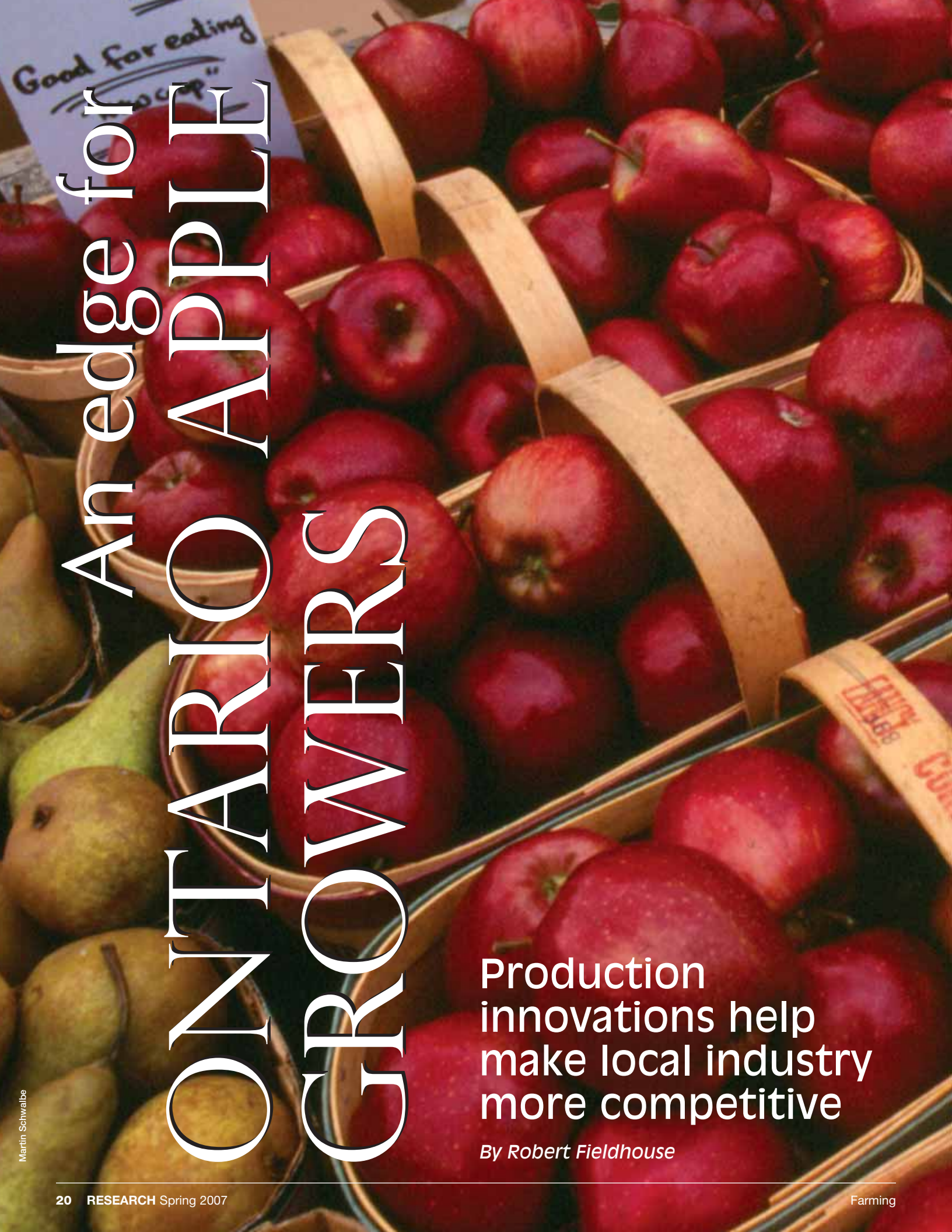
Soybeans may soon be a source for making biodiesel.

DuPont

An edge for ONTARIO APPLE GROWERS

Production innovations help make local industry more competitive

By Robert Fieldhouse



Martin Schwalbe

Innovative apple production strategies being developed at the University of Guelph are strengthening the Ontario apple industry and growers' orchards alike.

Prof. John Cline, Department of Plant Agriculture, operates a research project that spans five to 10 hectares at the University's Simcoe campus. His goal is to boost the province's $80-million apple industry, which faces increasingly intense international competition.

Cline has developed several strategies to improve production, enhance fruit quality and decrease costs of production by providing growers with greater control in manipulating the natural physiology of the tree (fruiting, flowering and tree growth).

"Research and innovation are going to help the industry survive and compete," he says. "Our overall goal is to help Ontario apple growers produce high-quality fruit in an economically sustainable way to help them compete globally."

The research areas Cline is exploring include new growth-controlling compounds called bioregulators, and optimized rootstock and cultivar combinations.

Bioregulators can have profound effects on apple tree physiology and are an effective, inexpensive and safe way for growers to influence production, he says. They're made to mimic natural compounds found in apple trees to influence traits such as growth, flowering, ripening, yield and apple quality.

"Plant bioregulator work is continually changing, offering new apple production opportunities for growers," says Cline. "They're very specific compounds that play a specific role in the plant."

He has recently studied the effects of a new bioregulator called prohexadione calcium (Apogee). It reduces vegetative growth by inhibiting the synthesis of what's called gibberellic acid, a naturally occurring plant hormone that, among many roles, stimulates vegetative growth. Cline says growers can use Apogee to improve fruit quality, reduce shoot growth (and ultimately pruning) and, in some instances, reduce injury caused by fire blight, a devastating bacterial disease.

Exerting chemical control over apple tree physiology is just one way to improve production. Cline is also investigating the benefits of improved rootstocks (the tree's root portion that is grafted with a genetically different cultivar in the nursery).

He's currently overseeing the final development of a series of seven apple rootstocks that have been researched at the Vineland station since the 1960s. Three Vineland rootstocks have already been commercialized, and he is evaluating the others for their commercial potential.

Rootstocks have a huge influence on a tree's performance, says Cline. They're what make it large or small, productive or unproductive, and resistant or susceptible to disease, water stress and cold winter temperatures.

He's especially interested in size-controlling rootstocks because dwarf trees are generally more productive per hectare than their full-size counterparts are. The Vineland rootstocks are as productive as other commercially available size-controlling rootstocks, but what makes them unique is their ability to withstand cold winters and resist fire blight.

"We're pretty excited about grower interest in this series of apple rootstocks and what it might do for the apple industry," says Cline.

Recently, he and technician Debbie Norton found a better cultivar-rootstock match for a new apple variety called Honeycrisp by using a Vineland rootstock. This variety — originally developed in Minnesota but well-suited to Ontario's climate — receives good reviews and is fetching high prices for growers. By matching it with a Vineland rootstock, Cline has cemented its place as one of the most marketable apple varieties available to growers.

Although his research plays a significant role, grower input is vital in such success stories, he says.

"Interacting with growers is very beneficial because you learn an enormous amount from them. Having the opportunity to interact with apple growers in the province is a privilege."

Also involved in this work is master's student Zia Ullah of the Department of Plant Agriculture. Other collaborators include Prof. John Zandstra of the University of Guelph's Ridgetown Campus, research scientist Charlie Embree of Agriculture and Agri-Food Canada and several scientists operating under the NC-140 Regional Research Project at U.S. land-grant agricultural universities.

This research is sponsored by the Ontario Apple Growers and the Ontario Ministry of Agriculture, Food and Rural Affairs. R

Ontario apples are being grown with innovative production technologies to give them a competitive edge in global markets.

Irrigation and the Internet

Wise water use by agricultural operations is increasingly important in the face of heightened public concern about the environment. Now, new electronic technology being developed by University of Guelph plant agriculture professor John Cline may help farmers do their part to conserve water – and prevent crop losses.

He's developing a web-based, site-specific irrigation scheduling system. The technology uses soil sensors and local weather data delivered via the Internet to determine when to irrigate orchards, typically by drip irrigation.

There isn't one solution that will work for everyone in the province, says Cline, but this technology will give growers information relevant to their location and soil type. They could realize a significant benefit because many orchards are large, intensive operations with production costs approaching $10,000 per hectare annually. Irrigation represents insurance against extreme weather effects, including droughts, he says.

"Irrigation is often overlooked because people think we have enough rainfall. And on average, we probably do, but nothing is ever average anymore."

Reducing greenhouse gas on Ontario farms

By Kate Nelischer

Farming is responsible for eight per cent of Canada's greenhouse gas emissions. That's a small amount compared with other industries, but every bit of mitigation helps the environment.

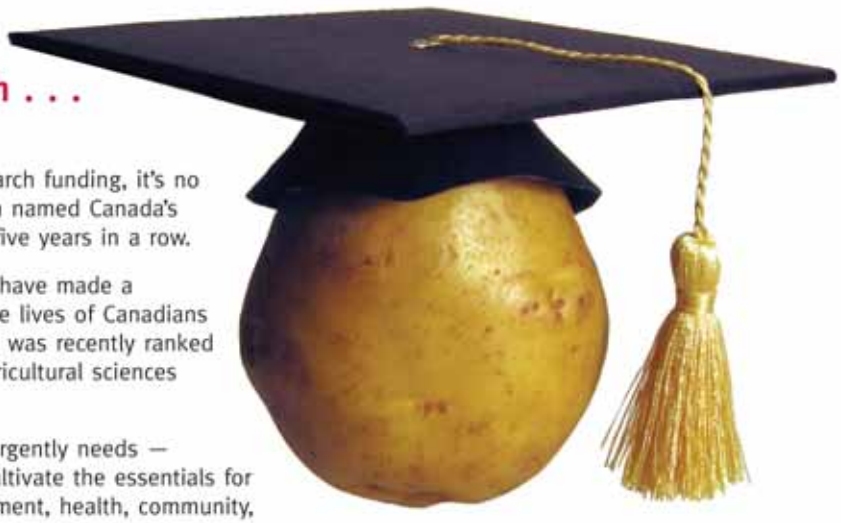
University of Guelph researchers have made progress in studies designed to reduce greenhouse gas. Among their latest findings:

- Strip tillage systems are the most economically viable choice for farmers and the most environmentally friendly method of soil tilling.
- Using zone-till toolbars when tilling medium-textured soil can actually eliminate the need for side-dress nitrogen application and decrease farmers' fuel consumption.
- Cover crops, drip irrigation systems and fertigation can increase crop yield and help reduce the amount of nitrogen left in the soil after harvest.
- By identifying and implementing the least expensive use of fertilizer nitrogen, farmers can put into place a production practice that leads to the highest reduction of greenhouse gas emissions.

For more information about on-farm greenhouse gas mitigation strategies, visit the Ontario Soil and Crop Improvement Association website at www.ontariosoilcrop.org or call 1-800-265-9751.

Harvesting soybeans.

DuPont



The University of Guelph: The foundation for agri-food research in Ontario

By Kate Roberts

It was the mid-1990s and the agri-food sector was at a crossroads. Chronically low commodity prices, biotechnology, food safety, animal welfare and urban sprawl were among the growing pressures challenging the sector. The Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) wanted to know farmers' priorities and embarked on a province-wide fact-finding mission. The overwhelming response? Invest in research, farmers said.

Research pays dividends, and farmers have traditionally turned to the Ontario Agricultural College (OAC), the Ontario Veterinary College (OVC) and the University of Guelph for leadership and advice. It all began in the 1800s when the Ontario economy was even more dependent on farming than it is today. This led the provincial government to develop an agricultural school in 1874, as a branch of government to research methods that could improve farming practices and find new and more efficient ways of producing food. In 1964, the OAC and OVC officially became integrated into a new entity called the University of Guelph, and the tradition continues today. Through an enhanced partnership with OMAFRA, the agri-food sector is served through support of advanced agri-food research at the University, which includes the regional campuses and network of research stations across the province.

"We're more than a coalition of researchers," says Rob McLaughlin, associate vice-president (research), agri-food and partnerships. "We're focused on industry needs."

Farmers rely on U of G research. For example, farmers needed a way to grow corn and soybeans in the cooler, short-seasoned Canadian climate to compete with other exporting countries. Guelph researchers adapted technology to breed crops with these characteristics, ultimately leading to wider markets that created new opportunities for farmers. Now, with technology opening bioproduct opportunities such as ethanol, Ontario farmers need new varieties that are focused on more than food.

U of G is the leading university in an Ontario initiative called BioCar, a $6-million project with the universities of Toronto, Waterloo and Windsor to improve the development and the delivery capacity of biomaterials in the automotive industry. Guelph is at the forefront of this program, working with the genetics of certain crops to extract desirable biomaterials such as starches, oils and feedstocks.

In the early 1940s, Henry Ford tried to build a biocar with soybeans in an attempt to save money. Today the story's different, with BioCar being created to ease pressure on the environment, while opening up new markets for farmers.

Health and the environment have emerged as the priorities of Canadians. Guelph researchers have long shared those priorities and, in partnership with OMAFRA and the agri-food sector, continue to pursue research developments that promote a sustainable future.

Guelph's agri-food cluster, showing the University of Guelph (top) and one Stone Road (Ontario Ministry of Agriculture, Food and Rural Affairs, centre).

University of Gueph Real Estate Division

Farming innovations at

All stories by Patricia Dickenson

Researchers at the University of Guelph have worked for decades to develop and enhance the plants and animals that are important to Ontario farmers and consumers. The examples on these pages are a snapshot of some of their accomplishments.

Direct-harvest white beans

Tall plants and more erect branches made white bean varieties OAC Thunder and OAC Laser ideal for direct harvesting. The lanky traits meant bean pods weren't lying as low and could be easily picked by direct combining, giving growers more harvest options and higher yields. Developed by former Guelph professor Tom Michaels and technician Tom Smith of the Department of Plant Agriculture, both OAC Thunder and OAC Laser resisted white mould and grew well in wide- and narrow-row growth systems, giving farmers more field management options. OAC Thunder continues to be a popular variety among bean growers. The traits from these two varieties are still incorporated in current variety development.

A golden start

The famous Yukon Gold potato traces its beginnings to the University of Guelph potato-breeding program, which started in 1946. The variety was the first marketable potato developed by potato breeder Gary Johnston and his research team, and it was the first with a distinct yellow-fleshed colour and nutty flavour. Created by crossing a white-fleshed North American potato with a wild yellow-fleshed South American variety, Yukon Gold met the yellow-fleshed potato demands of European immigrants. Rich in vitamins A and C and potassium, it was readily accepted by chefs for the diversity of preparations it offered. Yukon Gold grew in popularity around the world and was on the table at a White House state dinner given in 1997 by President Bill Clinton for China's president, Jiang Zemin.

Malt like no other

OAC 21 barley revolutionized the barley industry. It was first released in 1910, thanks to the guiding hand of legendary plant scientist Charles Zavitz, who selected it from the Russian Mandscheuri barley line. OAC 21 quickly dominated barley production in Ontario, making up 98 per cent of acreage in the 1920s. High yields and quick climate adaptation helped the variety expand into Western Canada. OAC 21 was found to have exceptional malting qualities and was the desired beer-making variety for more than 50 years in Canada. Most Canadian barley varieties today trace their roots to OAC 21. Its parental influence can also be tracked in the United States, Scandinavia and South America.

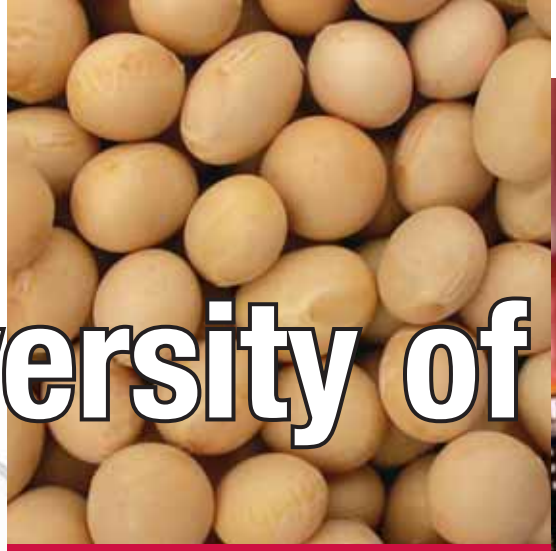
Shipping fever control

Shipping fever is a common cattle illness that results from exposure to cold, viral infections and stress. University of Guelph researchers have developed a vaccine called Presponse that fights the bacteria that can cause shipping fever pneumonia. A single dose of the vaccine is enough to protect cattle against *Mannheimia haemolytica* and *Pasteurella multocida*. Farmers can choose to give an additional booster vaccination to animals facing greater stress. Presponse is one of the University of Guelph's most successful licensing agreements and has stood the test of time, being on the market for 15 years.

A seed with added punch

It seems too good to be true: one seed yielding up to 400 plants. But plant researchers have made that leap with legume plants by using a one-step technique that plants seeds in a nutrient medium enriched with growth hormones so the induced seed can produce multiple plantlets. Legumes such as peas, beans, chickpeas and lentils typically don't propagate well. This special process, developed through a University of Guelph breeding program, means varieties can be mass propagated to reach market sooner. That's great news for health-conscious consumers who crave legumes because they're a great protein source. A diet balanced with a range of legumes containing health-enhancing properties can prevent or reduce many health conditions, including certain cancers and diabetes.

the University of Guelph



Peach processing extended

Peaches used for processing now last longer than the two-week season that used to restrain growers and processors alike. Varieties such as Virgil, Vinegold and Vulcan developed by Neil Miles at the Vineland Research Station have extended the harvesting season by up to two weeks, depending on the variety. The longer-season peaches have improved disease resistance and higher yields. They also boast fewer split pits and less red flesh, which is important for quality processing. These improvements have given processors a longer period to spread harvesting and processing.

Pigs with less stress

Hogs suffering from a genetic condition called porcine stress syndrome (PSS) have poorer-quality meat and higher risk of sudden death. Guelph scientists have developed a way to search for the PSS gene, making it easier to identify stress-susceptible animals. The test allows farmers and vets to select for animals without the PSS gene, so they can reduce the condition's prevalence in the herd. Reduced PSS means less-stressed animals, improved animal welfare and a more consistent meat product.

Beans that can't be beat

OAC soybeans, including Bayfield, Erin and Millennium varieties, have topped the production charts for years. The three high-yielding varieties, all from the same family line, were developed by Prof. Jack Tanner and Bruce Luzzi of the Department of Plant Agriculture. OAC Bayfield, released in 1993, was listed as the top soybean in Ontario for 10 years, buoyed by its resistance to white mould and its strong rooting abilities. It was finally pushed from its top spot by a newer variety called OAC Erin. Erin is a faster-maturing variety than Bayfield and has a yellow hilum, which makes it favourable for food production use. OAC Millennium, the newest of the family trio, also matures early and has higher yields than Bayfield. Millennium is the first Guelph-developed soybean variety to have its marketing rights sold. PRO Seeds of Canada can now distribute the variety.

A cherry that tops all

More than 30 years of cherry-breeding research at the University of Guelph has culminated in the creation of a variety that tops them all: the Tehranivee cherry. Named for its developer, Gus Tehrani, it has large mahogany-coloured flat-round fruit that has extremely sweet juice. The cherry is known to be high-yielding with moderate resistance to insects and disease. Tehranivee is not prone to rain-induced splitting, which saves growers money by reducing losses. The trees are self-fertile but can use pollen from other varieties to reproduce, making it versatile for fruit production.

A rainbow of peanuts

Uniquely coloured peanuts with skins ranging from white to pale green and red, and nuts striped black, red and white, have been produced by the University of Guelph peanut-breeding program. One variety, OAC Garroy, has become the most widely grown peanut in Ontario. The sweet red-skinned nut is high-yielding and matures earlier than U.S. varieties. OAC Garroy also produces up to four nuts per shell.

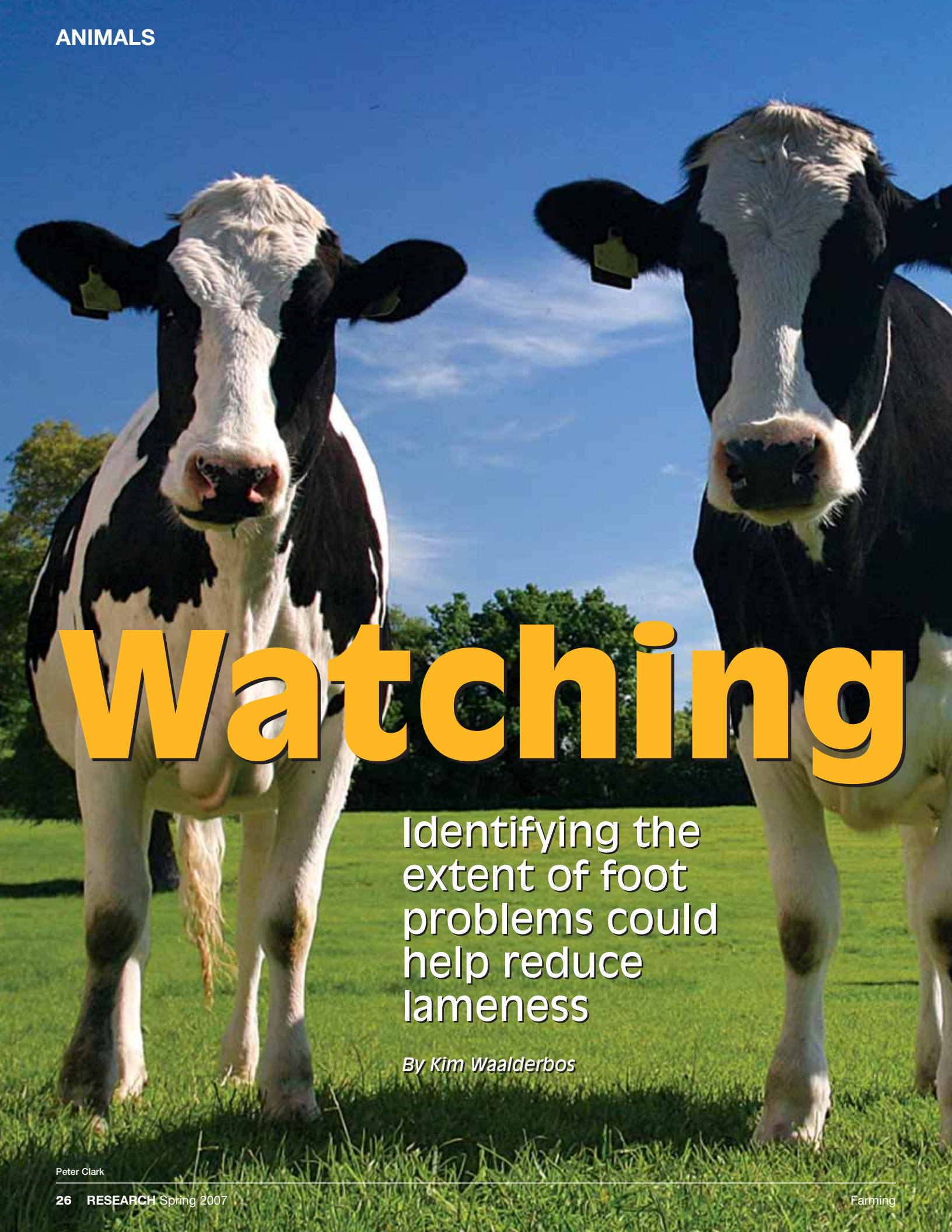
Currants that fight back

Black currants grow in limited numbers in Canadian woodlots because two fungal diseases, powdery mildew and grey mould, devastate the fruit. But two cultivars, Ben Alder and Ben Sarek, were developed by Guelph plant scientists Prof. Adam Dale and Sam Wong to resist the conditions. The berry varieties are early-ripening and high-yielding with large fruit. Ben Alder has excellent juice quality, and Ben Sarek is resistant to rust, another fungal disease. Because of the large European market for currants and limited growth of the berries in the United States, these varieties have given Ontario growers a strong competitive advantage.

An eye on enhanced milk

Cow's milk has been given an added boost from an omega-3 fatty acid called docosahexaenoic acid (DHA), offering consumers even more health benefits. Animal scientists Brian McBride and Tom Wright and nutritional scientist Bruce Holub of the University of Guelph developed a way to feed fish oil, naturally DHA-rich, to cattle so it would enrich the milk. DHA is an essential nutrient that contributes to optimal development of the brain, eye and nervous system. In Ontario, DHA milk has been launched commercially with great success by Neilson under the "Dairy-Oh!" brand. In Quebec, it's being marketed as "Oh! Lait."

Photography by
Christine Balderas, Olivia Brown, Dave Peleschak, Alicia Roberts and Kyle Rodriguez



Watching

Identifying the extent of foot problems could help reduce lameness

By Kim Waalderbos

Peter Clark

their step

Lameness in Ontario dairy herds may be more common than suspected, say University of Guelph researchers. They've found that, on average, 28 per cent of cows are lame in free-stall herds. This finding underlines how lameness affects pocketbooks and public perception.

Profs. Kerry Lissemore and David Kelton and graduate student Gerard Cramer of the Department of Population Medicine looked into the prevalence and effects of lameness on Ontario dairy farms. They're using their findings to identify simple, effective tools that can be used to improve hoof health.

Current research suggests that lameness costs producers about $300 per case, based on risk of culling, reproduction and milk production losses. Cramer says serious problems carry over when animals stop showing heat signs and spend less time eating and walking because of sore feet. At this stage, the visible signs of lameness look bad to farm visitors or observers and ultimately to consumers, he says.

"Lameness problems are underestimated and deserve attention. It's important to have ways to recognize lameness earlier so serious foot problems can be prevented."

In their study, more than 14,000 cows on 200 herds were followed for 15 months. Information collected from hoof trimmers was assessed and compared with locomotion scores from a smaller group of herds. Cramer assigned locomotion scores on a scale of one to four (one being a normal gait and four being visible lameness and uneven weight distribution).

The research team found that infectious hoof diseases were the most prominent in all herds. In particular, 14 per cent of cows had digital dermatitis (strawberry foot), and eight per cent had heel horn erosion lesions. Non-infectious diseases accounted for fewer cases of hoof lameness, with the most common being sole ulcers in six per cent of animals.

The study also found a higher incidence of digital dermatitis lesions in free-stall herds, which Cramer says may be due to the fact that the animals are sharing their walking environment for longer periods with other herd mates.

The causes of lameness can be varied, he says. That means a combination of tools must be used to reduce the likelihood of hoof problems.

"Caring for feet is much like caring for udders. The key is to keep them clean, dry, regularly disinfected and trimmed."

Other researchers involved in this study include Prof. Ken Leslie of the Department of Population Medicine and Cornell University professor Charles Guard.

Funding for this project has been provided by Dairy Farmers of Ontario, the Natural Sciences and Engineering Research Council, the American Association of Bovine Practitioners, the Ontario Ministry of Agriculture, Food and Rural Affairs and the Hoof Trimmers Association, Inc.

Foot care for cows

- Hoof trim cows at least twice each lactation and more often in problem herds.
- Use a footbath frequently. Ensure that it's cleaned regularly (about every 200 cows) to reduce hoof problems.
- Use ample clean bedding. Animals with less than one inch of material are at greater risk for non-infectious diseases.
- Try locomotion scoring. Watch how animals walk on soft surfaces, then compare their strides across the barn floor. Consider how the animals' feet match up and determine if they are shortening their stride or distributing weight unevenly. Identify problem cows earlier and have them examined in a specific treatment spot.
- Incorporate good record-keeping practices into herd management to help track progress. Ask the hoof trimmer to record findings, particularly infectious versus non-infectious cases.

SOUP FOR PIGS: THE LINE BEGINS TO FORM

Researchers say liquid feed systems are good alternatives for Ontario farmers

By Katie Savage

Liquid feeding systems are being adopted by swine operations throughout North America and already have a foothold with 20 per cent of market pigs raised in Ontario. Are they really better? Is this "soup for pigs" superior to traditional dry feed?

University of Guelph researchers are assessing how the new system is suited to Ontario farm conditions. Prof. Kees de Lange, Department of Animal and Poultry Science, has a four-year research program under way to compare feeding pigs liquid diets versus conventional dry diets. He says liquid feeding may be more versatile, economical and healthier than conventional dry feeding systems.

"Liquid feeding systems are being increasingly adopted on Ontario swine farms," says de Lange. "They could help lower feed costs for pig producers and use co-products from the food and biofuels industries that would otherwise go to waste and become environmental hazards."

Liquid feeding started in Europe and is widely used in Germany, Denmark, the Netherlands and the United Kingdom. But it's only now catching the interest of North American producers. It uses a computerized program to mix liquids such as milk and water with dry feed components. The liquid feed is then distributed via pipes that pour the mix into feed troughs for the pigs.

In his study, de Lange is finding that feeding a liquid diet reduces feed costs because farmers can use a wider range of ingredients than can be used in conventional feeding programs requiring dry feeds. Co-products from ethanol and starch production, such as corn distillers solubles and corn steep water, can fit well in liquid feed formulations.

De Lange says liquid diets also help generate a healthier gut environment in pigs and reduce the prevalence of *Salmonella*. He's studying how microbes can be added to partially ferment the liquid feed and further enhance its nutritive value. He says microbes that can degrade toxins would be particularly helpful during years when mycotoxins (damaging fungal toxins) in corn crops are elevated.

Because liquid feeding systems are highly mechanized and computer-controlled, de Lange cautions that farmers need to be technically savvy to deal with potential system breakdowns. He notes, however, that technical assistance is becoming more widely available as more Ontario farms adopt the feeding system. He adds that although a large initial investment is required for the computer and distribution system, it starts to pay back after about three years.

Other members of the Department of Animal and Poultry Science involved in this project are Profs. Ira Mandell and Tina Widowski, researcher Stewart Niven, technician Julia Zhu and graduate students Daniel Columbus, Jay Squire and Drew Woods. Other collaborators are Prof. Robert Friendship, Department of Population Medicine, and Joshua Gong of Agriculture and Agri-Food Canada.

Funding is provided by Ontario Pork, the Natural Sciences and Engineering Research Council, the Ontario Ministry of Agriculture, Food and Rural Affairs and numerous industrial partners, which are listed on the website of the Swine Liquid Feeders Association (www.slfa.ca).

Brian Fray

From bad to worse

BVD is one tough customer, and now its effects look broader than ever

By Lindsay Brown

OFAC Animal Agriculture Photo Library

A serious virus may be making cattle susceptible to another infection that causes pneumonia.

Bovine viral diarrhea (BVD) is a serious disease in cattle that's difficult to treat, taking a toll on infected animals' milk production, fertility and immune system. But a University of Guelph pathobiologist says the virus may have farther-reaching effects, making cattle more susceptible to a bacterial infection that causes pneumonia.

Prof. Jeff Caswell, Department of Pathobiology, says the BVD virus may reduce the lung's ability to defend itself.

"There is evidence that BVD predisposes cattle to bacterial infection," he says, "and this viral infection is a major contributor to shipping fever."

Shipping fever is a common illness in feedlot cattle that results from exposure to cold, viral infections and stress. An estimated eight to 20 per cent of cattle get it, and Caswell hopes a better understanding of BVD will help in identifying ways of reducing further susceptibility.

BVD is difficult to study because 70 to 90 per cent of infections occur without any clinical symptoms. The virus is contracted orally in most cases and infects cells throughout the body, including those in the trachea and other parts of the respiratory tract. It's shed through bodily secretions such as mucus and feces and transmitted to other animals.

Caswell is leading a team of researchers who are examining tracheal cells obtained from beef animals. They introduce half the cells to the BVD virus and leave the other half as a control group. Then they introduce a bacterium to compare the defence response of the two cell groups.

Previous research has found that the cells lining the airways and lungs of cattle have important antimicrobial abilities. They produce special proteins called, ß-defensins and lactoferrin that defend against bacterial infections. By observing their response in his current study, Caswell has found that the BVD virus impairs the cells' ability to ward off infection by blocking production of the proteins.

Ultimately, a better understanding of how BVD predisposes cattle to shipping fever pneumonia and other bacterial infections may lead to improved methods of identifying animals at risk, he says. It may also direct genetic improvements to select for animals with higher disease resistance and encourage ways to stimulate more, ß-defensins that can defend against illness.

This research was funded by the Beef Cattle Research Council, the Canadian Cattlemen's Association, the Ontario Ministry of Agriculture, Food and Rural Affairs and the Natural Sciences and Engineering Research Council.

Other members of the Department of Pathobiology involved in this research are Prof. Darren Wood, research technician Mary-Ellen Clark and graduate students Muthafar Al-Haddawi and Gordon Mitchell. R

Scrapie detection to the rescue

Researchers develop new device to quickly identify degenerative disease

By Christine Eisler

Detecting scrapie and other related degenerative diseases could soon be easier, thanks to a sensor developed by University of Guelph researchers.

Profs. Gordon Hayward and Warren Stiver of the School of Engineering have created a device that can detect protein particles called prions, which are thought to be at the root of degenerative diseases such as scrapie.

"Our goal is to develop a quick and inexpensive way to detect the prions that cause these deadly diseases," says Stiver. "We hope everyone from meat inspectors to veterinarians will have access to it."

Scrapie is a fatal degenerative disease affecting the central nervous system of sheep. It is traditionally detected by euthanizing suspected animals and submitting brain material for laboratory testing.

But the Guelph team's device, called an acoustic prion sensor, uses quartz crystals to detect when prion proteins abnormally miss-fold in samples taken from the environment, nerve tissue or bodily fluids. The sensor can be used on live animals and provides results in about two hours.

The researchers say the instrument's speed and accuracy mean that infected animals can be more easily pinpointed, reducing the need to dispose of entire herds to eradicate the disease. They also say it could be used for other degenerative diseases in the same family as scrapie, such as bovine spongiform encephalopathy (BSE) in cattle, chronic wasting disease in elk and deer and Creutzfeldt-Jakob disease in humans.

With further development of the sensor, Hayward and Stiver hope to see this technology used routinely for exports to eliminate the need for border closures. This could prevent drastic export losses such as those seen in the 2002 BSE crisis. The initial detection of an infected cow in Alberta cost the Canadian economy $6.3 billion before a U.S. ban on Canadian beef imports was lifted in 2005.

"We have proven the principle," says Hayward. "We intend to expand the evidence and answer important questions to support the development of a commercial device."

The Guelph team worked with researchers at the National Reference Laboratory of the Canadian Food Inspection Agency in Ottawa to develop the sensor. Financial support was provided by the Natural Sciences and Engineering Research Council, the Canadian Institutes of Health Research and the national Network of Centres of Excellence through a PrioNet Canada grant.

Detecting degenerative diseases such as scrapie in sheep could soon be easier with a Guelph-developed sensor.

Flavia Bottazzini

Cattle and carbs

Boosting enzyme helps get the most nutrients from the diet

By Lindsay Brown

Grains such as corn make up to 90 per cent of the diet of cattle in feedlots, where the animals go to gain optimum weight before processing. Cattle need an enzyme called amylase to digest the high concentrations of carbohydrates (starches) in grains. Amylase is secreted by the pancreas, but not in sufficient amounts for feedlot cattle, so the secretion levels need a boost.

University of Guelph animal science professor Kendall Swanson is working on influencing how the pancreas grows and how it produces and secretes amylase. His goal is to develop feeding strategies that will promote amylase expression and, in turn, improve digestion.

"By devising nutrient feeding plans that increase amylase secretion, we can make cattle be more efficient in digesting starch," says Swanson.

To boost amylase production and efficiency, he is studying how diets with differing protein and energy concentrations influence pancreatic tissue growth in beef cattle. He's also working to understand how nutrition affects the receptors on the pancreas that are responsible for triggering amylase production and secretion.

Swanson is conducting the study at the Elora Beef Research Station. He's using tissue samples from the digestive tracts of animals raised there to pinpoint specific mechanisms that are responsible for pancreatic regulation and enzyme expression in cattle.

Also involved in this study are research assistants Simone Holligan and Heba Salim, post-doctoral researcher Nyree Kelly and graduate student Yajing Wang, all of the Department of Animal and Poultry Science.

The research is sponsored by the Natural Sciences and Engineering Research Council, the Ontario Cattlemen's Association and the Ontario Ministry of Agriculture, Food and Rural Affairs. R

Feedlot cattle don't produce enough enzymes to make the best use of their diet.

OFAC Animal Agriculture Photo Library

The meat of the matter

Animal scientists hit on genetic link behind beef tenderness

By Arthur Churchyard

Beef tenderness can have a big impact on consumer satisfaction. In fact, it's consistently rated as the most important factor in store-bought beef purchases. Predicting tenderness isn't easy, but University of Guelph researchers have discovered a genetic link that will help make it possible.

Using specialized analytical equipment and a decade of data from the Elora Beef Research Station, a team led by Prof. Stephen Miller of the Department of Animal and Poultry Science is working to pinpoint the part of a beef animal's genetic makeup that influences meat tenderness. Miller says this finding could lead to new testing methods to better determine tenderness and improve the final product consumers buy on store shelves.

"The end result of our work will be a test producers can use to help guarantee that beef is more tender," he says. "Using that test, we can focus our cattle genetics to develop clear advantages in meat quality."

The snippet of genetic information the researchers worked with is a single nucleotide polymorphism (SNP). An SNP is a tiny difference among genes that produces differences in meat quality, such as tenderness.

In this case, the researchers found their SNP could be linked to the protein calpastatin, which works against natural tenderizing agents to keep meat tough. They believe an easy-to-administer genetic test can be developed to look specifically for the presence of this SNP using a simple tissue sample, such as a hair follicle. Such a test could help build better breeding programs, using animals with higher predicted tenderness.

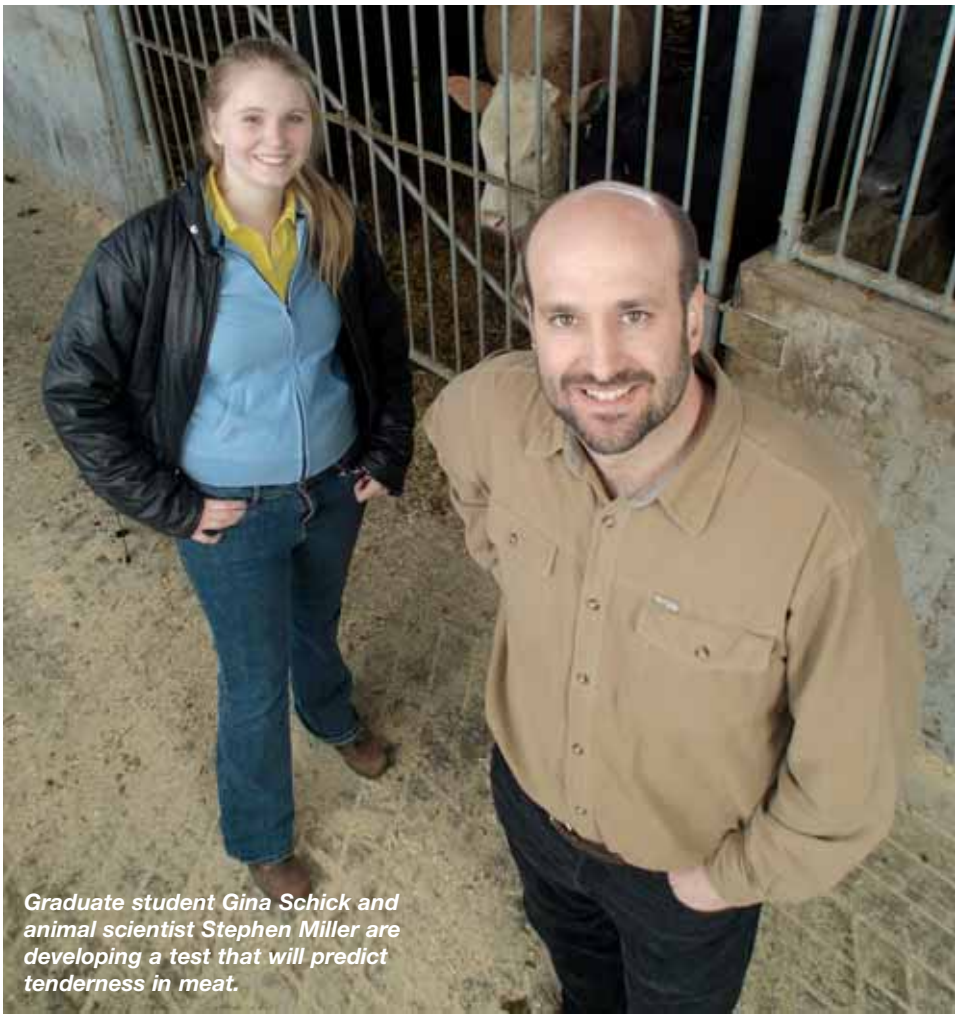
Miller and his colleagues are using this finding along with advanced breeding strategies to build a herd selected for meat tenderness. Each year, semen from the best 24 bulls is collected, analyzed and stored for future breeding. These bulls are then culled and dissected, with the weights of fat, bone and lean muscle meticulously recorded.

Shear force measurements, which assess the effort required to cut through a steak, are recorded. For example, meat requiring a shear force greater than 5.7 kilograms would be considered tough. Bulls from the Guelph breeding program have produced beef with a shear force as low as three kg. The top bulls identified during this further analysis are then used in future herd breeding.

Miller expects that in the next few years there will be as many as 10 new genetic tests developed for meat tenderness. In fact, one test called Igenity is already on the market. This progress will be due, in part, to the Bovine Genome Project, an international effort to sequence the bovine genome, which has already identified more than 100,000 SNPs. Figuring out which SNPs are related to more tender meat will be key to breeding better beef, he says.

Miller will continue his research with the SNP linked to calpastatin, working with Profs. Ira Mandell and Jim Wilton and other University of Guelph colleagues. Miller will reconfirm his findings using another unrelated set of animals.

Funding for this research has been provided by the Ontario Cattlemen's Association, the Beef Cattle Research Council, the Ontario Ministry of Agriculture, Food, and Rural Affairs, the Agricultural Adaptation Council's CanAdapt program, the Canada Foundation for Innovation, Ontario Innovation Trust and Agriculture and Agri-Food Canada.



Martin Schwalbe

Graduate student Gina Schick and animal scientist Stephen Miller are developing a test that will predict tenderness in meat.

IF YOU CAN'T BEAT IT, ADSORB IT

Special fibres for broiler breeders can prevent intestinal damage from mouldy feed

By Arthur Churchyard

Fusarium mould has been growing rampantly in the heat of recent summers, widely infecting grain crops. As the mould becomes more prevalent, it inevitably produces more mycotoxins (poisons), resulting in higher toxin levels in the grains being fed to chickens. That causes intestinal damage and reproductive problems in the birds.

Now, researchers at the University of Guelph say a natural fibre found in yeast can be used to remove mycotoxins consumed by broiler chickens, preventing health problems.

Prof. Trevor Smith and graduate student Mojtaba Yegani of the Department of Animal and Poultry Science have spent the last two years studying the effects of this fibre, called polymeric glucomannan mycotoxin adsorbent (GMA), which can be included in broiler diets in tiny amounts.

"It's often difficult to find *Fusarium*-free grain," says Smith. "So if mycotoxins have to be in broiler diets, it's crucial to also include something in the feed that can prevent damage from mycotoxins by adsorbing them."

GMA is found in the inner cell wall of yeasts and is obtained after culturing, separating and drying yeast cells. It doesn't affect the nutritional value of feed because only two kilograms are needed per tonne of grain to be effective against *Fusarium*.

GMA is a large indigestible molecule that passes harmlessly through chicken intestines. The molecule has branches with electrically charged ends that can attract particles of the opposite electrical charge. In a chicken's digestive juices, mycotoxins become charged and stick to GMA like magnets. The chicken can then excrete the mycotoxins in feces.

Without GMA, the mycotoxins would enter the bird's bloodstream. The researchers observed that broiler breeder chickens laid fewer eggs after eating mycotoxins. Those eggs also had thinner shells, causing them to lose moisture more rapidly in the incubator.

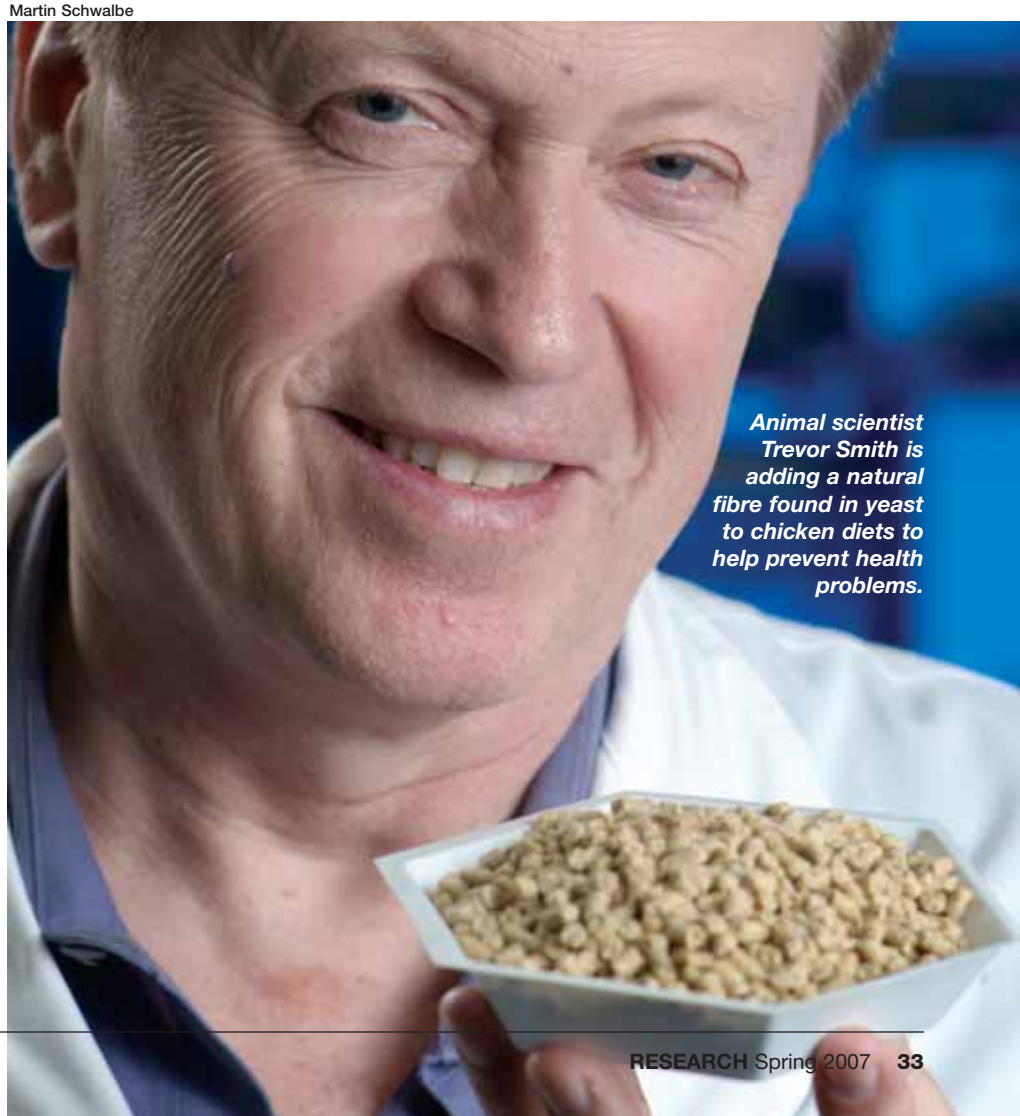
As a result, nearly five times as many chicken embryos died when broiler breeders were fed *Fusarium* grain without GMA.

Chickens consuming *Fusarium*-infected feed also had lowered immunity, leaving them more vulnerable to disease and less responsive to vaccines.

Smith says feed additives derived from yeast are gaining popularity as an alternative to growth-promoting antibiotics, which are banned in the European Union and under scrutiny in Canada. He says GMA is also an economically viable alternative for poultry farmers who want to prevent mycotoxin damage because such a small amount is needed in the diet to improve broiler health.

The team carried out its research at the Arkell Poultry Research Centre with individually housed hens and roosters. Funding was provided by the Ontario Ministry of Agriculture, Food and Rural Affairs and Alltech Inc.

Martin Schwalbe



Animal scientist Trevor Smith is adding a natural fibre found in yeast to chicken diets to help prevent health problems.

More than they can chew

Researchers find cows can do with less phosphorus

By Kim Waalderbos

OFAC Animal Agriculture Photo Library

The phosphorus contributions from forages in dairy diets may be underestimated, say University of Guelph researchers. They believe phosphorus supplements can be cut back in diets, saving producers money while protecting the environment and maintaining cow health.

Prof. Brian McBride and research associate Nicholas Odongo of the Department of Animal and Poultry Science say dairy diets have traditionally overfed phosphorus and should be reformulated to meet minimum requirements set by the National Research Council (NRC).

"In the past, when animals weren't receiving enough phosphorus from forages to meet minimum requirement levels, supplementation could help," says Odongo. "But now, most animals do not have an imbalance and consume enough phosphorus from forages to meet their requirements. There is no longer any benefit to excessive supplementation."

The researchers say it's important to have soil and forage analyses done as a starting point to see what phosphorus content cows are already receiving before reformulating their diet. "Measure it to manage it," says McBride.

In their study, 60 cows at the University of Guelph's Kemptville Campus (average yield 40 kilograms of milk per day) were fed diets formulated with two different phosphorus levels: 0.42 per cent of dry matter (DM) and the NRC-recommended level of 0.32-per-cent DM. The cows were fed a typical Ontario total mixed ration of corn silage, haylage, hay and corn. Feed analyses showed that phosphorus from the forages was sufficient to meet the 0.32-per-cent phosphorus diet; with supplementation, 0.42 per cent was achieved.

The research team then measured the animals' DM and phosphorus intakes; milk yield, fat and protein contents; milk, fecal and blood phosphorus contents; and associated health and reproductive factors. They found the only significant difference between the two diets was reduced fecal phosphorus outputs from feeding the lower-phosphorus diet.

McBride says these results show that producers can safely readjust dietary phosphorus levels to meet the NRC requirements — considered the gold standard in diet formulations. In doing so, they will save money by buying less supplemental phosphorus, an expensive nutrient, and will help the environment by reducing nutrient loading, he says.

Prof. Jim Fisher of Guelph's Kemptville Campus calculates that cutting dietary phosphorus from 0.50 per cent (the standard level most farms currently use) to 0.36 per cent would save eight cents per cow per day in feed costs. That's $29.20 per cow per year or $2,920 per year for a 100-cow herd. And that's without trying to put a price on the environmental benefits of less phosphorus pollution.

In addition, because most Ontario soils are laden with phosphorus, extra chemical fertilizers aren't needed to balance the now-reduced fecal phosphorus fertilizer contributions, says Fisher.

Others involved in this research include Profs. Paul Sharpe and Dennis McKnight and technician Albert Koekkoek, all of the Kemptville Campus. This work is sponsored by Dairy Farmers of Ontario.

Cows get more phosphorus from forages in their diet than originally thought, say Guelph animal scientists.

ENVIRONMENTAL EFFECTS KEPT IN CHECK ON FARMS

By Katharine Found

Environmental activists have long criticized pharmaceutical use by hog farmers and veterinarians in treating swine disease, saying pharmaceuticals are being overused and errantly contaminating the environment. But new research from the University of Guelph has shown that environmental contamination from antibiotics does not pose appreciable risks to soil and aquatic organisms.

Prof. Paul Sibley of the Department of Environmental Biology and Prof. Keith Solomon of the Centre for Toxicology have wrapped up six years of research examining the use of pharmaceuticals in the Canadian hog and cattle industry. They've determined that the pharmaceuticals represent negligible environmental risk if used as instructed.

"It's good news for producers, veterinarians and pharmaceutical companies," says Sibley. "We've found evidence that suggests there's little risk to soil and aquatic biota from using pharmaceutical products, so there's little need to be concerned."

Pharmaceuticals first raised concerns when they were detected in the environment more than a decade ago. It was thought they could cause contamination through simple routine practices such as manure spreading. Animals administered antibiotics excreted them through feces or urine, which was then applied to land and could cause damage to soil systems or migrate into nearby waterways.

But was this true? To find out, the research team simulated real-life scenarios in the laboratory and field to study pharmaceutical toxicity. They applied pharmaceuticals directly to soil and water to simulate field exposure. This direct exposure would be similar to an actual worst-case scenario, making it a good test of potential risks, says Sibley. In toxicity, safety (or risk) is often measured as the difference between what is found in the environment and what the pharmaceutical's toxicity is known to be, he says.

University of Guelph

Pharmaceuticals used by hog farmers and veterinarians represent negligible environmental risk if used as instructed, Guelph researchers have found.

In most experiments, he found that the toxicity effects of pharmaceuticals were in the milligram- to gram-per-litre range. That was significantly higher than the nanogram- to microgram-per-litre range typically detected in soil and water for pharmaceuticals.

Sibley says the long duration of some of the studies helped to accurately assess changes in contamination levels and toxicity over time, ultimately leading to a stronger conclusion that supports environmental safety.

"It's comforting to know that levels of antibiotics in the environment don't seem to be posing a problem. We've tested aquatic, vertebrate, fish and soil communities, and the evidence clearly indicates little cause for concern."

He says there's been a strong push by consumers and activists over the last decade to reduce pharmaceutical use on pig farms. Programs such as the Canadian Quality Assurance are helping to inform farmers about proper protocols and how to manage the antibiotics given on the farm. The program also helps with traceability should contamination occur.

This study has found that farmers can be reassured that their practices are helping them be safe stewards of the land, says Sibley.

"I hope this research still encourages pharmaceutical companies, veterinarians and producers to be more efficient with their antibiotic treatments but, at the same time, eases any thoughts of potential negative environmental effects."

This research was funded by the Canadian Pork Council through the Livestock Environmental Initiative, the Canadian Cattlemen's Association and the Canadian Network of Toxicology Centres.

Feeding the ideal bird

It's ready for market at 32 or 33 days, but that's too soon

By Lindsay Brown

OFAC Animal Agriculture Photo Library

Growth rates are important to poultry producers. They strive to have their broiler chickens reach market weight quickly and efficiently. But a too-short growth period can result in the birds having an immature skeleton and reduced bone development. That's a problem for processing.

University of Guelph professor Steve Leeson, chair of the Department of Animal and Poultry Science, has found that the optimal market age is 33 to 35 days. But he predicts that, with advances in genetics and health, chickens will reach the targeted market weight of 1.75 kilograms (for use in the fast-food industry) a full week earlier by 2012, which means in as little as 26 days.

So Leeson and his research team are trying to slow growth rates down — not to the 40 days it took just 15 years ago for a chicken to develop, but to something closer to the optimal number he's found.

"We're looking at factors that help maintain the growth period at a rate that best favours the development of broilers," he says.

To this end, he's working out various diets for the chickens. Initially, he adjusted the concentration of their feed by diluting it 10 per cent, hoping to slow growth by reducing nutrient intake. This approach proved unsuccessful because the chickens consumed 10 per cent more feed to offset the dilution.

"Chickens are very smart birds, and we've not been able to fool them with more dilute diets," says Leeson. "It's as though the birds know their own nutrient requirements and consume the appropriate amount of feed to meet this goal."

So they took another approach and changed the texture of the feed, which garnered a better response. The typical pelleted feed chickens eat encourages fast growth because it can be consumed quickly and easily, he says. Grinding the pellets to a mash made the feed slightly less palatable, so it took the chickens longer to eat and ultimately slowed growth rates.

The focus is now on determining an ideal time to start changing the feed texture to slow down the growth rate.

This research was funded by the Poultry Industry Council. Also involved in this project are staff at the Arkell Poultry Research Farm, research assistant Linda Caston and graduate student Julie Steele of the Department of Animal and Poultry Science. R

Diets are being developed for chickens that promote optimal weight gain and bone development.

Limiting corn use

Research finds mycotoxins are magnified in distilling process for ethanol

By Katie Savage

As ethanol production ramps up to meet demands for alternative fuels, greater volumes of byproducts such as distillers grains (fermentation leftovers) are being produced. One way to make use of distillers grains has been to incorporate them into animal feeds, but University of Guelph researchers say this is challenging when mycotoxins (toxins produced by fungi in the grain) are elevated, as they were in the 2006 crop.

Prof. Art Schaafsma, director of Guelph's Ridgetown Campus, has been studying the effect of commercial distillation on mycotoxin levels in distillers grains. He's finding that mycotoxins in the corn used for ethanol production are stable in the distilling process and get magnified about 2.5 times in the dried byproducts. So if a shipment of corn has one part per million before distilling — an amount not normally a problem for most livestock — the resulting distillers grains will have up to 2.5 parts per million. And that may be a problem.

"Safety is an issue when you're looking at feeding distillers grains because everything that was in the corn in the first place is now intensified," Schaafsma says.

The magnification ratio of the toxins following distilling is important to understand to help mitigate the impact on animal feeds, he says. There are two main mycotoxins that cause problems when fed to livestock: deoxynivalenol (also known as vomitoxin or DON) and zearalenone. Both are produced by *Fusarium* fungi. Livestock are sensitive to both toxins in their feed, but to varying degrees. Cattle can consume up to 10 parts per million of DON in their feed before performance issues become a problem; swine are sensitive to as little as 0.5 parts per million.

Swine will refuse to eat at levels as low as one part per million of DON. They may also have compromised immune systems at levels as low as 0.5 parts per million, potentially increasing their susceptibility to common herd diseases. Reproduction in sows can be affected by levels as low as 0.5 parts per million of zearalenone because of its estrogenic (female reproductive hormone) properties.

Mycotoxins are a concern almost every year, although the problems are typically localized depending on the weather. In 2006, the growing season had prolonged warm and wet conditions during flowering, resulting in significant mycotoxin challenges to corn users in southwestern Ontario.

Schaafsma says a combined management approach is necessary to deal with high toxin levels. Growers can adjust their practices to minimize the effect of toxins on their crop (see sidebar). This, in turn, will reduce toxins in distillers grains, so the byproduct can be used more safely as animal feed.

Also involved in this project are Carleton University chemistry professor David Miller and Rudolf Krska of the Centre for Analytical Chemistry in Austria.

The research was done with Romer Labs in Chatham, Ont.; Diagnostix in Mississauga, Ont.; and Neogen and R-Biopharm in Michigan. Funding has been provided by the Canadian Food Inspection Agency. R

Minimizing crop mycotoxins: What growers can do

- Plant early so crops mature sooner.
- Choose hybrids that mature on time.
- Consider hybrid susceptibility when choosing varieties to plant.
- Clean grains when they're harvested.
- Dry corn quickly.

Duncan Walker

Flocking to animals' defence

Feeding helpful bacteria boosts chicken immunity

By Arthur Churchyard

Martin Schwalbe

Many bacteria can be a health hazard to consumers, but University of Guelph researchers say helpful bacteria called probiotics can be fed to chickens to reduce illness-causing bacteria — boosting chicken immunity and consumer health.

Prof. Shayan Sharif, Department of Pathobiology, and a team of collaborators are studying the effect of probiotics on chickens' intestinal linings to see how the bacteria interact with *Salmonella* and how overall animal health is influenced.

By having a clearer understanding of these functions, Sharif hopes to promote probiotics as a health-management tool for chicken producers.

"Once we understand how probiotics reduce *Salmonella*, the impact will go beyond academic achievement to become a valuable tool in the industry," he says. "Producers will have a way to prevent illness in chickens, and the risk of food poisoning from poultry products will fall."

The research team is trying to understand how probiotics control *Salmonella* and to quantify the impact of *Salmonella* reduction in the animal's intestine, where bacteria usually reside.

Sharif also wants to know if probiotics create a heightened immune response in poultry. He suggests that helpful bacteria might send a cue to the chicken's health defences, spurring action against harmful bacteria. Physical evidence of this could be seen in the blood and gut secretion samples being analyzed at the Ontario Veterinary College.

Special chicken feeds containing probiotics are already available in Canada, but they're marketed as feed supplements, not feed with medicinal value. To make medicinal claims, makers of probiotic feeds would need to get approval from the Canadian Food Inspection Agency, says Sharif.

This research is funded by the Poultry Industry Council, the Saskatchewan Chicken Industry Development Fund, the Natural Sciences and Engineering Research Council/Agriculture and Agri-Food Canada Partnerships Program and the Ontario Ministry of Agriculture, Food and Rural Affairs.

Pathobiologist Shayan Sharif is studying how feeding probiotics to chickens may reduce* Salmonella *infections, resulting in healthier birds and safer food for consumers.

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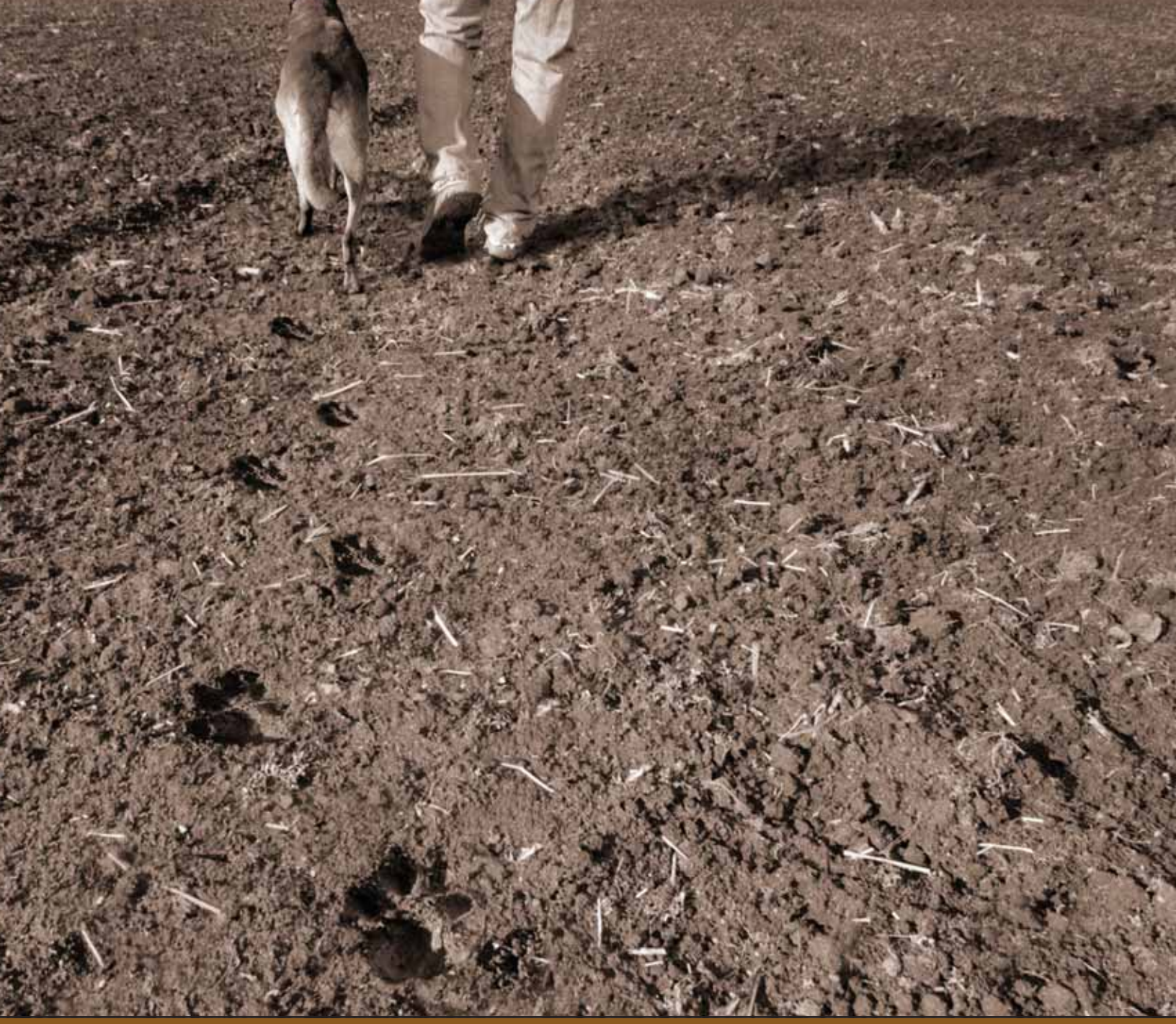

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