A Niagaara vineyard becomes the lab where a graduate student uses a pressure bomb to evaluate leaf water potential as part of a study on the influence of terroir on Riesling grapes in Niagara.

From the lab bench to the dining table

Ontario wine institute takes an integrated approach to improving what fills your glass

By Catherine Muir

It isn't often that the world of academia is accepting of empty wine bottles littering a professor's office, or students and teachers drinking together during class. It's equally as rare to have a distinguished university science department teaching courses about psychophysics and consumer research.

These are all commonplace at Ontario's Cool Climate Oenology and Viticulture Institute (CCOVI) though, where a scientist is just as likely to be found sipping and sniffing a glass of wine as looking down a microscope. And it's probably just as common to see a researcher using his nose for a piece of equipment as an expensive high-tech chromatography system.

Appearances can be deceiving, however. The work done at CCOVI is as meticulous and thorough as any other scientific discipline and involves research that spans the fields of biochemistry, chemistry, microbiology, genetics, cell biology, plant physiology, environmental biology, and sensory science.

Anyone thinking that working at the CCOVI just involves sitting around and drinking wine has a lot to learn, says Dr. Gary Pickering, professor and researcher at CCOVI. "A perhaps more nebulous challenge of our work is that of countering the 'soft' image that many have of what we do. 'You work for a wine institute – how hard can that be? Can I get a job there too!?' Oenology and viticulture are rigorous scientific disciplines, with a robust set of methodologies and strong linkages with many of the life sciences."

"Most 'doubters' are silenced when

they see our molecular genetics lab, visit our Gas Chromatography-Olfactometry-Mass Spectrophotometry suite, or are recruited onto one of our computerized flavour-profiling panels."

CCOVI, part of Brock University in St. Catharines, Ontario, is quite a unique place as far as scientific research goes—in its own field as well in general. The educational institute is designed to meet the growing needs of the grape, grape juice, and wine industries of cool climate regions, while serving as a research vehicle to advance knowledge and improve the processes involved with winemaking and consumption. It offers the only oenology (science of winemaking) and viticulture (science of grape growing) degree-granting program in Canada, and basically the only one in North America aside from California State University's programs in the Department of Viticulture and Enology at its Fresno campus.

Brock offers an undergraduate program leading to an Honours BSc in the discipline, as well as Masters and PhD programs in various aspects of the field. Other Canadian institutions do work on specific parts of wine research, such as molecular biology work in yeasts and vines at UBC in Vancouver, and grape-breeding research as part of plant agriculture research at U of Guelph, but CCOVI stands alone in its wine focus in Canada.

What CCOVI is most recognized for right now is its work in icewine research, says Dr. Andrew Reynolds, co-founder of the institute (now ten years old) and one of its three main researchers. The Canadian wine industry is well known around the globe for its icewines; as the largest producer in the world, Canada ships most of the sweet dessert wine to Asia. However, faux icewines sold cheaply to the Asian markets are increasingly becoming a problem for Canadian winemakers.

CCOVI's three main researchers—Dr. Reynolds, Dr. Pickering and Dr. Debbie Inglis, are collaborating on an icewine project that combines their expertise. A main part of the icewine research involves trying to sort out what's unique about Canadian icewines in terms of flavour compounds. Dr. Pickering's work is involved with this and focuses on the sensory attributes of icewine, comparing different aroma attributes and the intensity of aromas for different compounds.

Dr. Inglis' work involves looking at icewine fermentations and trying to understand some of the molecular biology related aspects of it. She is also looking at yeast strains, as "winemakers have a choice of hundreds of different yeast strains for their wines, and we wanted to get an idea of whether we could produce different icewines depending on the yeast strain used," says Reynolds.

Dr. Reynolds is spearheading another part of the project, where icewines are created with grapes picked at different times and under different conditions. "We've created a whole bunch of icewines that we've made from Vidal and from Riesling, grapes picked at different times, both before real ice wine season—it has to be minus 8 or so outside before you can pick grapes for real icewine, so before we go through these freeze/thaw cycles—and then we'll pick them a couple of times during real ice wine season in January. Once made into icewine, we found that picking them before the freeze/thaw cycles of mid-winter, in November—your product won't taste like real icewine."

Each scientist is also working on their own research outside of the icewine study. Reynolds' focus is on viticulture. "Basically we want to find out how [grape cultivation] impacts wine sensory quality, the composition of the wine, the composition of the juice that we're making the wine from and the composition of the berry samples that we're taking."

CCOVI is all about cohesion—it brings many elements of science together to focus on one discipline, he says. Reynolds' "terroir" project is an excellent example of what collabora-

An undergraduate student in the viticulture research lab using distillation apparatus to concentrate grape flavour and aroma compounds for analysis.

Niagara vineyards become research and teaching laboratories for researchers and students at Brock University. Here a group of Oenology and Viticulture students receive instruction on grapevine pruning in a local vineyard.

(Above left) A graduate student pressing grapes in the research and teaching winery in Inniskillin Hall. (Top & above right) The viticulture research laboratory is equipped with the instrumentation required for the chemical analysis necessary to evaluate the results of trials conducted in Niagara vineyards.

tions between individuals in different fields of science can do. Terroir is a French term that describes the effect of the place or site where the grapes are grown on the character of the wine.

"I'm collaborating with Dr. Ralph Brown, from the engineering department at Guelph, on some remote sensing work. We do flyovers, and look at spatial correlations between mapping of vineyards done from the air with ground maps showing berry analysis, yield, and other factors affecting viticulture," says Reynolds.

Using GPS equipment to locate exact areas and identify areas that have low crop yields, for example, means that "you can look at fields that have variable yields, and perhaps be able to bring the yields up."

Reynolds reveals a lot about the philosophy of CCOVI in his statement that "we're trying to take a whole systems approach to this."

He had the idea to create a wine research institute in Canada after a trip abroad. "I had just come back from South Africa, where they have a wine research institute at Stellenbosch University, and my idea was, let's create a centre of excellence in Canada. I was interested in ways of getting an industry-sponsored institute." He thought that it would fit in B.C.'s Summerland area, but when he started making calls, he realized that Brock University had already had the same idea. "I got a call from the people at Brock. They said, we want you to come and give a seminar here, we seem to be working towards the same goal. As it turns out, this is where the institute ended up being created."

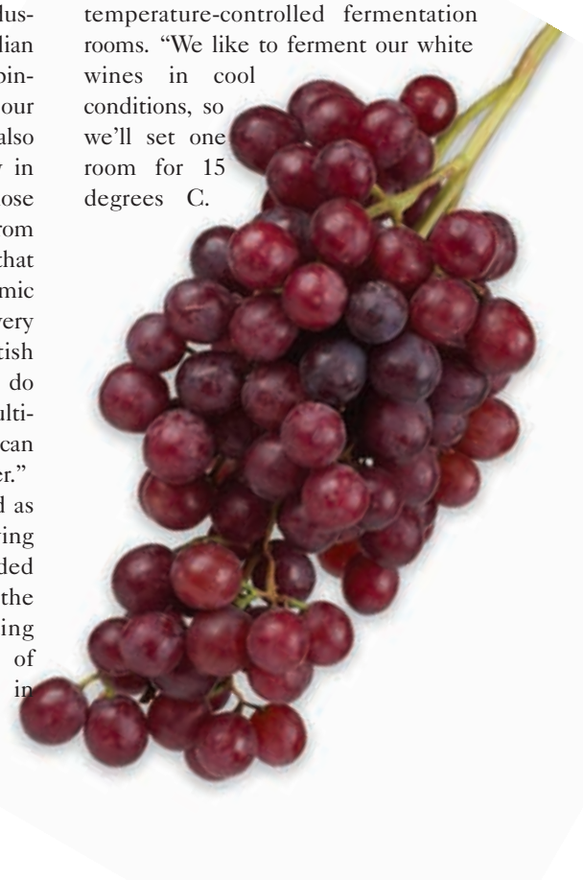
And with good reason, according to Reynolds. "The grape and wine industry is very important to the Canadian economy, mainly because of the spin-off factor. People come here to visit our wineries, they buy the wine, they also visit our restaurants, spend money in hotels, at festivals—it's one of those things that pays off several fold. From that standpoint, plus all the taxes that are generated, it's a huge economic engine to southern Ontario, and very similar to the economy of British Columbia. That behooves us to do some world-class research, because ultimately it helps our economy if we can find ways of making our wines better."

CCOVI was initially established as a partnership with many parties having an interest. Initial partners included the Wine Council of Ontario, and the Ontario Grape Growers Marketing Board, now the Grape Growers of Ontario. Since its establishment in 1996, CCOVI grew quite rapidly, and in 1999 moved to Inniskillin Hall, a facility dedicated purely to the study of wine.

Inniskillin Hall encompasses two floors with many labs devoted to oenology and viticulture. Reynolds describes what a visual tour through the facility would be like: Downstairs is home to one large lab that is mainly for biotech and molecular biology-related activities, as well as a pilot winery where experimental batches of wine are made. Another lab is devoted primarily to the chemical analysis of grapes and wines. A flavour and aroma lab was also set up three years ago.

"Up on the second floor, we've got our sensory evaluation facility, with 14 individual tasting booths, each one with its own computer and a central computer where aroma attributes and other factors of wine or grapes can be compiled. A lot of sensory data can be gathered very quickly using this system," Reynolds says.

The second floor also houses a fermentation room – once all the grapes are pressed and crushed and prepared downstairs, they are run upstairs on an elevator and into one of four different temperature-controlled fermentation rooms. "We like to ferment our white wines in cool conditions, so we'll set one room for 15 degrees C.



Dr. Andy Reynolds with a class at the Horticulture Research Station at Vineland.

We have another room that we do our reds in that we set at a higher temperature, around 25 degrees. We've got another cold room where we remove all the tartaric acid from and stabilize the wines. The fourth room is both a lab and a classroom," he says.

Reynolds' own viticulture lab is mostly used for analysis of berries, juice and wine composition. "We've got things like an HPLC, for doing things such as organic acids and anthocyanins and phenolics. We've also got a fancy titration ensemble in there, and a couple of cold rooms," he says.

Each lab at the institute requires its own particular set of lab equipment. The flavour and aroma lab holds a gas chromatograph and an attached Gerstel thermo-desorption system that allows for analyzing different aroma compounds in wine. Sounding a bit like something that might be found in Willy Wonka's candy factory, an olfactometer allows a scientist to smell individual compounds and characterize them in terms of scent and intensity. The institute is also planning to purchase a $60,000 mass spectrometer to upgrade the aroma-flavour lab for its icewine research, since samples are currently being sent to a local winery for identification of compounds.

One of the institute's most interesting pieces of equipment bridges the gap between laboratory and vineyard. The wine scan, based on infra-red technology, uses standard-measured sugar concentrations and matching spectral fingerprints of a number of grape samples to make a data set for comparison. When you take a spectral fingerprint from an unknown sample, the machine will give you an accurate sugar concentration, quickly and easily. "You can take this thing that looks like a gun and point it at a fruit and quickly get an analysis of that specific fruit," boasts Reynolds.

His viticulture lab also contains new equipment. The lab is equipped with "an HPLC for separating out organic acids, anthocyanins and phenolics, and includes a fancy titration ensemble."

Pickering feels that for his sensory studies "the most unique equipment used is probably the sensory evaluation lab itself, where panelists and subjects assess the wine and other stimuli." Reducing the influence of potential biases as much as possible is accomplished using features such as individual partitions between each subject (stops discussion/distracting noises), close control of temperature and humidity (keeps sample presentation constant), high-end lighting (including the ability to mask certain wine hues), positive pressure, high-flow air circulation (removes odors quickly before they can accumulate), dentist-style spittoons, and computerized data collection systems within each booth, he says.

With all the equipment and labour-intensive research involved in oenology and viticulture, CCOVI has to be innovative in its quest for funding. The money to support the research has come from many sources, says Reynolds, including the wine council of Ontario, the grape growers of Ontario, and NSERC. He is hoping that some of the funding for his current terroir research will come out of his collaborations with other scientists. "Dr. Ralph Brown and myself and some members of the geography and earth science departments are writing a grant for collaborative remote sensing work. I hope some of the money will come from Ontario's Centres of Excellence and some of the granting agencies that are interested in remote sensing applications in precision agriculture."

Working in a field that involves so many different disciplines, variables, and factors can lead to many difficulties. Managing simple logistics can be a complicated procedure, says Reynolds. Trying to juggle his time as a professor in the fall, when he has to teach two courses, and the harvesting work that he and his graduate students have to do all over the Niagara peninsula can lead to time management problems. The summer can get a tricky as well, with soil moisture and transpiration measurements to be taken, irrigation trials to be run, and berry analyzing to be done.

"The diversity of research that we conduct certainly creates challenges," says Pickering. "Our work at CCOVI involves such a range of scientific disciplines and technologies, that, for instance, it is not uncommon to see a professor or research student finishing off a GC or HPLC-run one minute, and the next minute they are facilitating a sensory evaluation panel in an adjacent lab. The challenges come in part from maintaining the wide range of skill-sets, personnel and equipment needed to meet our mandate of holistic research." LB