



Healthier animals, higher profits for farmers and a new Ohio company are just some of the outcomes of OARDC virologist Daral Jackwood's vaccine and diagnostics technology.

From lab to industry

New company will allow food-animal producers to increase profits

Years of tireless research by Ohio Agricultural Research and Development Center virologist Daral Jackwood gave birth to a new technology for making vaccines and diagnostic tests to combat poultry and livestock diseases and to safeguard our food production system.

Jackwood's cutting-edge technology has led to the creation of a startup company, LARAD Inc., which is the first OARDC spinout into the university's BioHio Research Park, an agbioscience technology park based on the Wooster campus.

LARAD will commercialize the invention and has the potential to generate high-paying jobs in Ohio. It employs molecular biology methods to develop virus-like-particle (VLP) technology. VLPs can be used to make vaccines and diagnostic kits not currently available on the market, which increases the technology's commercialization potential. The technology can have a wide range of applications including viral diseases of poultry, swine, cattle, fish, horses, cats and dogs.

"These products will allow the industry to do things it hasn't been able to do before," Jackwood said.

More: go.osu.edu/UpH

"The current process for developing vaccines against infectious bursal disease virus is slow and very expensive. There is a real desire among vaccine manufacturers to be able to find an alternative. The VLP technology developed by LARAD has the opportunity to provide a much-needed answer."

— Ken Rudd, CEO, LARAD Inc.

Essentials

- LARAD will initially focus on production of VLPs for infectious bursal disease virus (IBDV), a highly contagious disease that affects poultry worldwide. Effective control of this disease is critical to the U.S., the world's largest poultry producer with an annual farm value in excess of \$20 billion.
- In Ohio, IBDV threatens an industry that supports more than 15,000 jobs and is worth close to \$700 million a year.
- LARAD's IBDV vaccine can be produced at a reduced cost compared to conventional inactivated vaccines currently used internationally. This represents a \$17 million-a-year market opportunity.
- The vaccine could also replace autogenous vaccines used by the U.S. poultry industry, a market that is currently worth \$3–4 million annually and projected to increase twofold over the next five years.



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Fred Finney of the Mount Hope Produce Auction has seen growers boost safety measures as a result of OARDC's research-based outreach and training sessions.

A comprehensive approach

OARDC's multi-disciplinary Vegetable Safety Team tackles food safety head-on

The Ohio Agricultural Research and Development Center's Vegetable Safety Research and Extension Program comprises one of the most comprehensive teams at a single institution studying the overlap of vegetable production and safety.

"We have team members from plant pathology, horticulture and crop science, natural resources, economics and nutrition," said team member Jeff LeJeune. "We work from the molecular level to a global scale. We study knowledge synthesis and transfer to understand where our outreach efforts need to go next. We investigate perceptions and awareness to determine what messages are most effective. And we do a lot of practical research on the survival and dissemination of pathogens."

Among team members' accomplishments are 30 peer-reviewed food safety-related articles in scientific journals; a statewide series of outreach meetings on good agricultural practices reaching thousands of produce growers; the training of eight new food safety-related interdisciplinary scientists; and nearly \$10 million in current and pending research contracts and grants.

More: go.osu.edu/producesafety

"Jeff LeJeune frequently sits down with a group from the Amish community and says, 'What do you need?' ... They're not reinventing the wheel. They're asking what we need, and they're doing what we need in this community."

— Fred Finney, owner,
Moreland Fruit Farm,
co-founder, Mount Hope
Produce Auction

Essentials

- Fresh produce accounts for 24 percent of U.S. foodborne illness in which both the food and contaminant are identified. That's more than any other category of food, including seafood, poultry, deli meats and eggs.
- In Ohio, the estimated annual economic burden from contaminated food ranges from \$1 billion to \$7 billion.
- The Vegetable Safety Research and Extension Program has provided data to support specific farm practices, helping shape national produce safety rules. For example, after OARDC research proved that horses don't carry *E. coli* O157:H7, federal regulators modified their position on using horses in produce fields.
- Another study in progress is examining the high-straw manure prevalent on Amish farms; it is hoped the research will help inform the new federal Food Safety Modernization Act.



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OARDC entomologist Peter Piermarini has found a new way to kill mosquitoes, which is desperately needed to protect people worldwide from deadly diseases.

Bad for mosquitoes, good for people

A new product to fight the most dangerous creature on Earth

Mosquitoes are capable of ingesting the equivalent of their body mass in blood, which means they need to immediately get rid of excess water and salt. They accomplish that by urinating on their host — while still feeding.

Ohio Agricultural Research and Development Center entomologist Peter Piermarini and his collaborators are studying the highly effective “kidney” function of mosquitoes to turn it against them: “What we are trying to do is find a way to cause ‘kidney’ failure in mosquitoes,” Piermarini said. “We have found a chemical that interferes with a mosquito’s ability to excrete urine. It also leaves mosquitoes unable to fly and severely bloated.”

This discovery could pave the way to the development of new insecticides to fight deadly mosquito-transmitted diseases such as malaria and West Nile virus.

Piermarini’s research is funded by a \$1.4 million grant from the Foundation for the National Institutes of Health’s New Insecticides for Malaria Control program, which is supported by the Bill & Melinda Gates Foundation.

More: go.osu.edu/U8z

“Mosquitoes are becoming increasingly resistant to currently used insecticides. There is an urgent need to find new ways of killing mosquitoes to advance efforts to control diseases such as malaria and dengue, which sicken millions of people worldwide.”

— Michael Gottlieb, deputy director, Science Division, Foundation for the National Institutes of Health

Essentials

- Mosquitoes are considered the most dangerous creatures on Earth due to the many potentially fatal diseases they transmit to humans and animals.
- West Nile virus infected 33,026 people in the U.S. between 2000 and 2012, resulting in 1,542 deaths. During that same period, 857 people contracted the virus and 59 died in Ohio.
- In 2010, malaria affected an estimated 216 million globally, resulting in 655,000 deaths — most of them children younger than five.
- Dengue infects 50–100 million people around the world every year. Hundreds of thousands of them require hospitalization and tens of thousands die. The total economic impact of dengue in Asia and the Americas alone is estimated at \$1.8 billion annually.



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Turning crop biomass into green energy is at the heart of a research partnership represented by quasar's Clemens Halene, left, and OARDC's Yebo Li, right.

Energy independence that's good for the environment

OARDC expands partnership for renewable fuels

Researchers and industry partners are working together to test and expand an Ohio Agricultural Research and Development Center technology that can produce renewable fuel from organic waste and bioenergy crops. The project seeks to enhance the integrated anaerobic digestion system (*iADs*), a patent-pending technology developed by OARDC engineer Yebo Li and operated by quasar energy group, a Cleveland-based renewable energy company.

The first *iADs* was built in 2012 next to quasar's biodigester in Zanesville, Ohio. The system can produce biogas from organic materials containing up to 85 percent solids content, compared to the 14 percent solids content maximum that standard liquid biodigesters can handle.

Researchers are testing biogas production from yard waste, corn stover and giant miscanthus, a perennial warm-season grass from Asia that is garnering attention as a potential bioenergy crop.

The goal, Li said, is to develop a technology for converting all this biogas to liquid fuels, increasing energy independence, and supporting Ohio's growing renewable energy sector.

More: go.osu.edu/QCe

"This new grant builds on quasar's continuing collaboration with Dr. Yebo Li and The Ohio State University-OARDC. This project demonstrates the role academia can play in envisioning the future of the renewable energy industry."

— Clemens Halene, chief operating officer, quasar energy group

Essentials

- The biogas-to-liquid-fuel project is being funded by a \$6.5 million grant from the U.S. Department of Agriculture and the U.S. Department of Energy.
- The project involves the use of technologies that can generate energy and fuel from renewable sources. Anaerobic digestion turns manure, food waste, crops and other types of organic matter into biogas, which can then be burned to produce electricity or compressed to use as vehicle fuel. Catalytic reforming and Fischer-Tropsch synthesis can convert biogas to liquid hydrocarbon fuels so that it can be used just like gasoline.
- Thirty percent of OARDC's Wooster campus electricity now comes from this renewable resource, while several of OARDC's fleet vehicles have been converted to run on compressed natural gas.



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Water samplers at Terry McClure's McClure Farms measure how much phosphorus leaves the field and how soil and management practices affect surface and subsurface runoff.

On-Field Ohio

Rewriting Ohio's Phosphorus Risk Index to keep nutrients and water on fields

Fifth-generation farmer Terry McClure knows the importance of water quality and uses best management practices on his 3,800-acre farm to lessen the potential for agricultural runoff into Ohio waterways. He's opened his farm to Ohio Agricultural Research and Development Center researcher Elizabeth Dayton, who is in the midst of the three-year On-Field Ohio project, which seeks to revise the U.S. Department of Agriculture-Natural Resources Conservation Service Ohio Phosphorus (P) Risk Index to be more precise in predicting the risk of phosphorus moving off farm fields.

Dayton's goal in the project is to make the P Index — used by farmers and applied in all nutrient management plans — more accurate by increasing management options to reduce phosphorus runoff, and to create a Web-based tool so farmers can easily calculate and manage their phosphorus runoff.

Some management practices being evaluated include tillage, soil type, fertilizer placement, soil phosphorus content, field topography, soil infiltration rate, drainage control structures and cover crops.

More: agcrops.osu.edu/

"If you might be part of the problem, you should want to be part of the solution. While we don't know what's causing the issue, agriculture needs to understand what we can do to change it. If we are losing nutrients from our fields, we need to make changes so our farms benefit."

— Terry McClure, owner of McClure Farms, Paulding County

Essentials

- Phosphorus is often implicated in the degradation of Ohio fresh surface water and a contributor to harmful algal blooms.
- Reducing agricultural runoff into Ohio waterways by helping farmers make proper application of nitrogen and phosphorus benefits farmers by reducing costs and protecting water and soil quality.
- The P Index is an integral part of nutrient management plans for both manure and commercial fertilizer application.
- Monitoring equipment has been installed on 24 fields in the Scioto, Grand Lake St. Marys and Western Lake Erie Basin watersheds, the latter of which are the two most problematic watersheds in heavy agricultural areas. Data collection is underway.



Kent Wamsley of The Nature Conservancy wades in a two-stage ditch. The new design has double benefits, he says. It saves farmers money while cleaning the water.

Two-stage ditch a win-win for farmers, environment

Research literally holds water

Drainage ditches are often a must to grow crops in Ohio. But conventional ditches can have drawbacks. They cost farmers money to maintain. Sediment deposits can restrict their flow, and sometimes their banks erode or collapse. And they carry farm nutrients and eroded soil downstream into rivers and lakes.

But today there's a better way to dig a ditch, thanks to Ohio Agricultural Research and Development Center scientists. Research by Andy Ward and colleagues has led to the innovative "two-stage" ditch design, which benefits not just farms but water quality.

The two-stage ditch, when compared to conventional ditches, drains water better, reduces flooding, reduces erosion, helps take nitrogen and phosphorus out of the water, and needs little maintenance.

According to Kent Wamsley, project manager of The Nature Conservancy's Wabash River Initiative, which urges farmers to use the design, "These benefits translate to cost savings and increased yields for the farmer and to cleaner water for all of us."

More: go.osu.edu/twostageditch

"Research is paramount to provide the worth, function and relevance of a conservation practice in our ever-changing environment. The work that Andy Ward and other partners have done on two-stage ditches is the backbone and foundation of the effort."

— Kent Wamsley, project manager, Wabash River Initiative, The Nature Conservancy

Essentials

- The new design has a small main channel at the bottom of the ditch (stage one) and raised, grass-covered "benches" along both sides of the channel (stage two).
- Two-stage ditches can take 50–2,000 pounds of farm nitrogen runoff out of the water per mile per year, depending on several factors including their age. (They work better as they get older). Nitrogen in farm runoff is the main cause of "dead zones" in lakes and in the Gulf of Mexico.
- Two-stage ditches can remove phosphorus from drainage water, Ward said, but further research is needed to determine exactly how much.
- Ohio has nine two-stage ditches, Indiana has 43, and there are others elsewhere in the U.S., Canada and Europe. To date, farmers and agencies have installed 40–50 miles of ditches employing the improved design.



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Vince Messerly of the Ohio Wetlands Foundation stands at the Schiermeier Olentangy River Wetland Research Park, where research aims to boost water quality in Ohio, Lake Erie and beyond.

“Ecosystem restoration will play a large role as we try to reverse the declines in the nation’s water quality. The Olentangy River Wetland Research Park will play a crucial role in the development of predictable, repeatable habitat restoration models that can be implemented across the landscape.”

— Vince Messerly,
professional engineer and
president, Ohio Wetlands
Foundation

Improving Ohio’s water quality

Wetlands — and this one especially — offer keys to cleaner water

Cleaner water for Ohioans could spring from 52 acres in Columbus. The Ohio State University’s Wilma H. Schiermeier Olentangy River Wetland Research Park, supported in part by the Ohio Agricultural Research and Development Center, conducts globally known, locally relevant research on wetlands and how to protect, build and use them to improve water quality.

Recognized as a Wetland of International Importance, the park “is uniquely positioned to more broadly address problems related to water supply and quality in Ohio and beyond,” said Ron Hendrick, former director of Ohio State’s School of Environment and Natural Resources (SENR), and now senior associate dean of the College of Food, Agricultural, and Environmental Sciences. The park is part of SENR, and those problems cited by Hendrick include nutrient runoff and the toxic, costly algal blooms the runoff might cause — as in Lake Erie, for example.

“Wetlands provide ecosystem services that protect both our soil and water,” said research partner Kurt Keljo of the Franklin Soil and Water Conservation District. “Research at the park provides insight into these services while raising the visibility of wetlands and their contributions to people’s well-being.”

More: go.osu.edu/olentangywetland

Essentials

- Research studies at the Olentangy River Wetland Research Park focus on water resources, aquatic ecosystems and aquatic production.
- One study made possible by the park is looking at how land cover and land use affect food webs and contaminants in water, specifically as the water moves from rural to urban areas.
- Another new study is measuring how rivers, wetlands and their ecosystems respond to the removal of dams, which is done in some cases to benefit water quality and fish and wildlife.
- A new study backed by an OARDC equipment grant is improving ways to restore Lake Erie coastal wetlands, which help clean and filter the lake’s water.
- Based on its research achievements, the park was named a Wetland of International Importance (as defined by the Ramsar Convention on Wetlands) in 2008. The U.S. has just 19 such wetlands.



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Fish Farmers of Ohio Association's Tom Machamer nets yellow perch. A century of research on livestock and crops has paid off, he says. Now, aquaculture is ripe for similar improvement.

Growing Ohio's fish farms

Getting more fresh, local seafood takes research

Tom Machamer recently broke ground on a new 4,000-square-foot, 40,000-gallon, zero-discharge fish-farming facility. As owner of Wooster's Cedar Lane Farms, where he raises bass, perch and bluegill, Machamer sees a bright future for Ohio aquaculture, is willing to invest in it, and counts on the Ohio Agricultural Research and Development Center to help keep the industry growing.

Today, that industry generates nearly \$50 million a year for Ohio's economy, and OARDC's Ohio Center for Aquaculture Research and Development works to further advance it. The center's studies improve the genetics, nutrition and production of Ohio's farmed fish — and the profitability and success of the state's 140-plus fish farms.

"The research that will have the biggest impact on any aquaculture species will revolve around genetics and nutrition," said OARDC aquaculturist Laura Tiu. "Improving the genetics and nutritional efficiency of any cultured species is the key to lowering production costs, and that, in turn, will increase demand for the product."

More: southcenters.osu.edu/aqua/

"Aquaculture, relatively, is still in its infancy. There's quite a market that Ohio can tap into. But we need research support from OARDC to do it. Without it, we could be wandering for years."

— Tom Machamer,
president, Fish Farmers
of Ohio Association

Essentials

- Experimental yellow perch bred by OARDC scientists grow 30 percent faster than unimproved perch. They reach market size in 12–13 months instead of 18, need less feed, and could boost a farm's output and profits.
- OARDC scientists are studying Ohio soybean meal as a sustainable alternative to ocean fish meal for yellow perch food. Fish meal costs nearly four times more than soybean meal, and its cost has gone up nearly 75 percent in the past decade due to falling ocean fish stocks.
- Feed costs make up half to three-quarters of a fish farm's total production costs. Less-expensive, soybean-based perch feed would increase profits.
- The U.S. imports 91 percent of its seafood, creating a \$10-billion-a-year seafood deficit. Ramped up Ohio seafood production would help cut this deficit.



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Ohio Agricultural Research and Development Center

As the research arm of The Ohio State University's College of Food, Agricultural, and Environmental Sciences (CFAES), the Ohio Agricultural Research and Development Center (OARDC) employs nearly 650 scientists and staff members throughout the state.

Its Wooster campus is the largest agbioscience research facility in the United States, and OARDC scientists work closely with researchers in Ohio State's Colleges of Education and Human Ecology, Medicine, Public Health, Veterinary Medicine, Biological Sciences and Engineering.

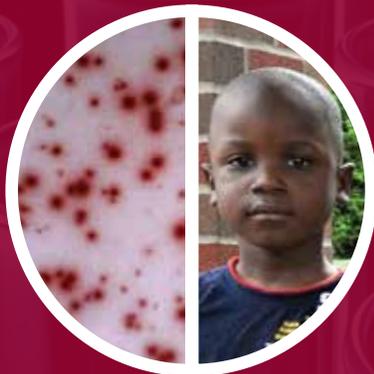
At any given time, OARDC researchers are engaged in more than 400 research projects. Primary focus is in three signature areas:

- Advanced Bioenergy and Biobased Products
- Environmental Quality and Sustainability
- Food Security, Production and Human Health

The Ohio General Assembly established OARDC as the Ohio Agricultural Experiment Station in 1882. It is supported by a line-item appropriation from the Ohio General Assembly, competitive grants, gifts, contracts, federal grants and other sources. OARDC uses these funds to provide direct research support and economic development for Ohio's annual \$100+ billion agbioscience industry. OARDC is not funded by student tuition or any other general funds of The Ohio State University.

OARDC: A Leader in Agbioscience

ag·bi·o·sci·ence (ăg'bi'ō-sī'ens) *n.* the integration of scientific disciplines to address critical needs of food security, safety and health; environmental sustainability; and biobased energy, fuel and products



Food Security, Production,
and Human Health



Environmental Quality
and Sustainability



Advanced Bioenergy
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