

BATTLING PESTS



With agriculture as Ohio's No. 1 industry, helping farmers, growers and producers stay efficient and productive is an important goal for researchers at The Ohio State University's Ohio Agricultural Research and Development Center. Stopping pests — diseases, insects or weeds — is one way Ohio State scientists are continually working to help Ohio farmers increase crop yields and profitability while producing safe, healthy foods and food products.

FIGHTING FUSARIUM HEAD BLIGHT IN WHEAT

Wheat growers now have an online tool to help guide fungicide application decisions to combat one of the most economically important wheat diseases in Ohio: Fusarium head blight, also called head scab.

Using the Fusarium Risk Assessment Tool available at the Fusarium Head Blight Prediction Center (wheatscab.psu.edu), growers can determine the risk for scab and decide whether to use a fungicide to control it.

This tool is important for growers, as head scab isn't scoutable for the purpose of making fungicide application decisions. By the time growers see the disease in their fields, it's too late for them to manage it with a fungicide, say Ohio State plant pathologists.

Scab causes vomitoxin contamination of the grain, making the grain unfit for human or animal consumption. More than 2 parts per million vomitoxin in the grain can cause the grain to be priced down or rejected. Therefore, just a 10 to 15 percent scab

Pierce Paul with wheat



infestation can cause more than a 50 percent crop loss.

The scab forecasting system uses temperature and relative humidity to calculate scab risk, determining whether there is a high, moderate or low risk for the disease.

More: go.osu.edu/scabtool

GAINING ON OHIO'S GIANT RAGWEED

Growers have long wanted to know what's causing the spread of a weed that's plagued corn, soybean and cotton crops for more than 30 years.

Now, thanks to Ohio State researchers who are working with a team of investigators from six universities and the U.S. Department of Agriculture's Agricultural Research Service, growers are gaining insight into how giant ragweed proliferates and how to manage it.

Giant ragweed is a fast-spreading, increasingly herbicide-resistant weed that has impacted crop fields in the east-central U.S. Corn Belt, including north of the Ohio River in Indiana and western Ohio.

The research team found that giant ragweed populations are highest in fields managed with minimum tillage, planted continuously with soybean crops, and treated with multiple herbicide applications (i.e., more than one application per growing season). They also found it is prevalent in crops near noncrop areas populated with



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giant ragweed, as well as in crop fields with large populations of seed-burying earthworms.

With this knowledge, researchers say growers can help reduce ragweed's spread by managing its presence in nearby noncrop areas, as well as by using a more diverse rotation of crop species, tillage intensity and herbicide sites of action to increase season-long control and select against herbicide-resistant biotypes.

STOPPING PALMER AMARANTH'S SPREAD

Ohio State weed scientists are working to stop the spread throughout Ohio crop fields of a glyphosate-resistant weed that has devastated many cotton and soybean fields in Southern states. In many cases, entire fields have had to be mowed down.

Palmer amaranth, also known as "pigweed on steroids," has been reported in 13 Ohio counties as of late 2015. That's a marked increase from 2012, when the weed was found in only one county in the state.

Unless farmers work diligently to stop its growth, the weed could have a devastating impact on crops. Palmer amaranth is difficult to manage because it requires multiple applications of herbicide and has to be treated when it is less than 3 inches tall. It can grow 3 inches daily, and it can release nearly one-half million seeds per plant.



Emilie Regnier with giant ragweed

Palmer amaranth entered Ohio fields through manure from local livestock fed contaminated cottonseed products from the South. The noxious weed can also be spread by water and farm equipment previously used on a contaminated field. Because of Palmer amaranth's fast growth, herbicide resistance and ability to destroy entire crops, Ohio growers have to be vigilant to prevent it from spreading statewide.

Ohio State weed researchers are helping to stop Palmer amaranth's spread by educating dealers, agronomists and farmers about its identification and management. Farmers are also being

advised to scout their fields for Palmer amaranth, and if it's found, to eradicate the weed before it goes to seed.

In addition, grain and animal producers, as well as feed and equipment dealers, are being advised to stop importing combines from Palmer amaranth-infested areas, and to stop using cotton-based feed products from these areas. Lastly, Ohio State specialists are recommending that growers use free Ohio Department of Agriculture testing of all cover crop seed for the presence of Palmer amaranth seed prior to planting.

More: u.osu.edu/osuweeds

Mark Loux with Palmer amaranth



ENVIRONMENTAL QUALITY



The environment touches us in many ways: trees in yards, crops in fields, lakes and streams, and so on. Conserving those resources — growing and nurturing them — while also supporting their use by people are goals of The Ohio State University. Ohio State works on what Teddy Roosevelt called “the great central task of leaving this land even a better land for our descendants than it is for us;” and Ohio State specialists share what they learn with the citizens, industries and institutions of Ohio.

COMPOSTABLE FOOD CONTAINERS ARE EARTH- AND BUSINESS-FRIENDLY

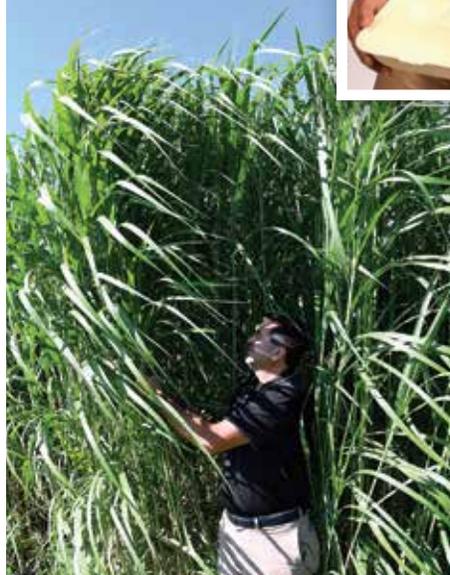
Giant miscanthus — a grass that grows as tall as LeBron James can jump — is a new crop for farmers in northeastern Ohio, a new raw material for biobased product manufacturers, and a focus of development by Ohio State.

Farmers in Ashtabula County, about 70 miles east of Cleveland, started growing giant miscanthus in 2011. There are now about 4,000 acres of the crop in the county. The harvest from the crop goes to two new Ashtabula County manufacturing facilities run by Conneaut-based Aloterra Energy. One of them uses giant miscanthus fiber to make compostable food containers. The other uses it to produce biodegradable absorbents for soaking up fluid spills, such as oil.

Aloterra’s success, which has been catalyzed by the U.S. Department of Agriculture’s Biomass Crop Assistance Program, has opened the eyes of farmers and landowners about the long-term

possibilities for giant miscanthus, according to Ohio State University Extension. As part of OSU Extension’s efforts to advance the crop, educators led a tour this past winter of farmers’ plantings and Aloterra’s facilities, partly to interest potential new growers. Ohio Agricultural Research and Development Center

David Marrison with miscanthus



scientists, for their part, are studying the best ways to grow giant miscanthus in test plantings at the Ashtabula Agricultural Research Station and OSU South Centers in Piketon.

In all, Ohio State’s work supports a crop that’s green in more ways than one. Giant miscanthus grows well on marginal land, which could help farmers grow their income. It’s a perennial plant, which could save time, fuel and labor for planting. It also goes to make

marketable, biodegradable products. Aloterra officials say the company now employs 50 people – 50 new jobs made possible by giant miscanthus.

More: go.osu.edu/GrowingMiscanthus

SUPPORTING FISH AND WILDLIFE, AND \$3.6 BILLION IN RECREATION

Invasive species — species that start to spread wildly in an area where they aren’t native — have a “dramatic effect

on our natural resources, human health and economy,” the U.S. Fish and Wildlife Service says. The nonprofit National Wildlife Federation estimates invasive species’ impact on ecosystems and the U.S. economy at billions of dollars each year. In Ohio, these invaders include, to name a few, Asian carp, emerald ash borer, round goby fish, Palmer amaranth, and zebra and quagga mussels.

OARDC scientists recently studied a previously unreported aspect of such invasions: How do non-native species, such as the round goby, affect the native fish and wildlife that eat them, such as Lake Erie watersnakes or smallmouth bass? They reviewed more than 100 studies on predator-prey interactions. They found that predator populations rose by as much as 57 percent after an invasion of new prey — but only when the predators’ traditional native prey remained abundant, too.

As it turns out, eating non-native prey isn’t as good for predators as eating native prey, the scientists say. This might be because the new prey isn’t nutritious; it’s basically junk food. Or the predator might not have evolved the ability to eat it or digest it well. But in all the studies, whenever a predator’s diet was restricted to non-native prey, the predator didn’t perform as well as it did on a diet of native prey.

The scientists say they hope their new findings will help environmental agencies

identify where invasive species will have the greatest impact. A result will be more targeted, more cost-effective efforts to control the invaders, support native species and protect habitat.

A better understanding of invasive species will protect economic assets, too. In northwestern Ohio alone, bird-watching generates more than \$26 million a year in economic activity, according to a study by Ohio Sea Grant. Some 1.3 million Ohioans go fishing and spend nearly \$2 billion a year in the process, according to the American Sportfishing Association. In all, a study by the U.S. Fish and Wildlife Service says wildlife-related recreation has an economic impact on Ohio’s economy of \$3.6 billion.

More: go.osu.edu/BestPreyforWildlife

TRANSFORMING WASTE PRODUCTS INTO BIOFUEL

When a city treats its wastewater, dealing with the sludge left behind — treating, sanitizing, hauling and disposing of it — can account for up to 50 percent of a wastewater treatment facility’s operating costs. Now, instead of landfilling or otherwise wasting the sludge, many of those facilities are making biogas from it. The biogas is used to generate electricity or is turned into vehicle fuel. OARDC scientists are developing ways to make that process more efficient.

Specifically, the scientists studied a pretreatment step for the sludge: controlled-flow hydrodynamic cavitation. Their findings so far suggest this step can help break down the sludge even further and boost the production of biogas. Hydrodynamic cavitation involves passing a flowing material — in this case, sewage sludge — through a constriction at high pressures. Tiny gas- or vapor-filled cavities form in the sludge, then collapse, causing chemical and physical changes in the sludge. The changes expose even more of the sludge to anaerobic digestion.

The scientists are working on the research with Cleveland-based Arisdyne Systems Inc., which makes hydrodynamic cavitation devices based on several U.S. patents. Helping, too, are municipal wastewater

treatment plants in Lima, Wooster and Rocky River, a Cleveland suburb. Together, the team hopes to provide cities with a way to make their wastewater treatment more efficient, take pressure off landfills and produce even more eco-friendly biofuel.



WHERE HAVE ALL THE BOBWHITES GONE? REPORTING THE STATUS OF BIRDS IN OHIO

Some of America’s best-loved birds, such as the eastern meadowlark and northern bobwhite, are a lot less common anymore, their numbers having fallen by an average of 70 percent in the past 40 years. As part of efforts to understand and reverse the decline, OARDC-funded scientists helped gather and publish current, detailed, long-term data specifically on the status of Ohio’s own birds.

The result of their work is a highly praised book called *The Second Atlas of Breeding Birds in Ohio*. Written for a wide range of readers — from birdwatchers to scientists — it shows the abundance, breeding locations and trends over time of more than 100 species. Key help in compiling data for the book came from 1,000 citizen scientists who submitted more than 1 million breeding-bird records from 2006 to 2011. The data collected for the atlas offers a wealth of opportunities for biologists and land managers to explore the complex relationships between species distribution and land use. OARDC scientists are already using it to study the influence of climate change on bird distributions and to assess the possible impacts on bird species from large-scale energy development.

More: go.osu.edu/StateOfOurBirds



HEALTH AND WELLNESS



Americans spend \$3 trillion annually, or an average of more than \$9,500 per person, on health care. But a healthy lifestyle — and an environment that promotes healthy living — can significantly reduce the illnesses and frailties that eventually require medical care. In addition, research can provide insights into novel ways to fight new threats such as Zika virus and the age-old menace of cancer. The Ohio State University has the knowledge and expertise to tackle such issues.

MAKING HEALTHY CHOICES THE EASY CHOICES

More than 20 percent of U.S. teens are obese, and nearly 6 in 10 teens aren't physically fit. Other issues, including sleep deprivation, drug and alcohol use, and emotional well-being, also loom large for today's adolescents.

That's why Ohio 4-H sent a small delegation to the National Youth

Summit on Healthy Living in Washington, D.C., in 2015 and 2016. At the first summit, the team saw a "Smoothie Bike," a stationary bicycle with a blender powered by pedaling. Thanks to a private grant, the team purchased the bike to draw attention to both physical activity and nutrition. In its first year, the bike was featured at an average of three events per month statewide. More than 2,000 Ohioans who put their feet to the pedals learned it would take more than an hour of moderate biking to burn off the calories in a milkshake compared with just 15 minutes of cycling to burn off a healthy smoothie.

Now, the Ohio 4-H Healthy Living program is spreading the word that young people can have a strong voice in advocating for healthy changes, not only individually but also community-wide. A November summit drew 38 teens from around the state, who

developed action plans to help make their communities healthier places.

More: go.osu.edu/healthyliv



NEW WEAPON IN FIGHT TO COMBAT MOSQUITOES

Mosquitoes that transmit dengue, malaria and Zika virus are developing resistance to traditional insecticides. Ohio State entomologists believe they've uncovered a new biological weapon in this fight: make mosquitoes unable to pee.

Female mosquitoes rely on their Malpighian tubules, which are the equivalent of kidneys, when consuming a human blood meal. They may ingest the equivalent of their own body mass in blood, so they need to immediately get rid of the excess fluid they consume. They actually urinate on their host while feeding.



The team, which includes researchers at Cornell and Vanderbilt universities, has identified a chemical that interferes with mosquitoes' "kidney" function, rendering them bloated and unable to fly, all leading to a shorter lifespan. The team hopes its ongoing research leads to next-generation mosquito-control products that will not be harmful to beneficial insects, including honeybees and other pollinators.

More: go.osu.edu/mosquitoes

ASSESSING HEALTH NEEDS OF COMMUNITIES

The Affordable Care Act requires nonprofit hospitals and health providers to conduct a community health needs assessment every three years. Ohio State University Extension can help.

Already, OSU Extension has worked with Clinton and Highland counties to gather and analyze data on local health concerns and challenges. Health assessments can reveal eye-opening trends, which is just what happened in these communities. For example, in 2016, the Highland County survey revealed that, overwhelmingly, the public's primary health concern wasn't cancer or obesity, but illegal drug use. In fact, 70 percent of respondents personally know someone who uses illegal drugs such as heroin and methamphetamine. Respondents also believe the county doesn't have adequate resources to deal with these drug abuse and mental health issues.

Similar findings in Clinton County in 2012 directly led a local nonprofit to create and fund a new position to start addressing these needs.

More: go.osu.edu/communityhealth

A NEW APPROACH TO FIGHT CANCER

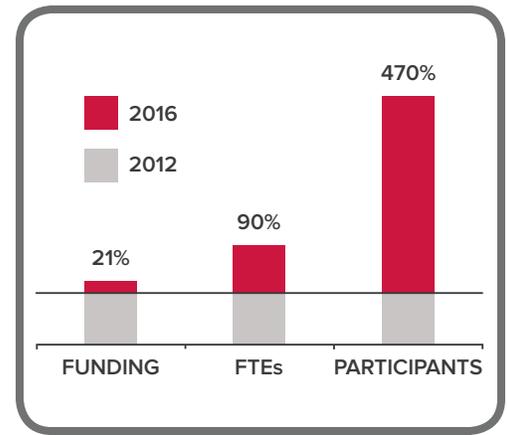
Cancer will claim an estimated half-million American lives in 2016. Consumption of fruits and vegetables, along with the antioxidants they provide, has long been known to provide some protection. But until now, scientists have not had a way to determine the relative importance of different antioxidants in controlling a cancer, or how the antioxidants might work together.

In an Ohio Agricultural Research and Development Center-led multidisciplinary study, researchers collected 75 samples of black raspberries, each representing different varieties and growing and harvest conditions, and made extracts to use in testing. Using metabolomics, an emerging technique to monitor all metabolites present in cells, the researchers identified bioactive compounds from each sample and measured how the compounds act against colon cancer cells.

As a result, the researchers were able to compile a list of compounds effective against cancer in order of importance. Together with the fruit's pigments, these compounds halted cancer cell division and, in some cases, caused cancer cell death.

This approach can be used to study the effectiveness of compounds from any type of produce against any type of cancer. Health researchers can use this information to determine how each stage of cancer development is affected by different compounds at different concentrations, and plant breeders can draw on it to develop new varieties that contain the most effective compounds.

More: go.osu.edu/BjCZ



NUTRITION EDUCATION: A LITTLE MORE GOES A LONG WAY

OSU Extension's community nutrition education programs have experienced significant gains in federal funding in the past four years, rising from \$5.7 million in 2011–12 to \$6.5 million in 2014–15. With that funding, staffing has increased from 74 full-time equivalents to 141.

But even more significant is the number of Ohioans participating in these programs, which has increased nearly fivefold in those years, from 53,539 to 251,324. That means with a 21 percent increase in funding, Extension's community nutrition programs increased staff by 90 percent and participants by 470 percent. OSU Extension has leveraged the relatively small increase in funding to help many more Ohioans hone their skills in choosing and preparing healthy foods on a budget, and becoming physically active every day.

Supporting these sessions are two new community nutrition efforts. A statewide social marketing campaign, in collaboration with several state agencies, is focusing on the importance of increasing fruit and vegetable consumption. Also, Ohio SNAP-Ed, the education program for those receiving Supplemental Nutrition Assistance Program benefits, is working with Case Western Reserve University to develop an online tool that community stakeholders can use to determine which food and/or physical activity interventions would have the greatest chance of success locally.

More: go.osu.edu/snap-ed and go.osu.edu/efnep



Black raspberries

HUNGER AND FOOD SECURITY



Hunger statistics never fail to alarm. In 2014, one in seven U.S. households was food insecure, and Ohio was even worse at one in six households. Families with children are hardest hit. Globally, authorities estimate 11 percent of the world population — nearly 800 million people — are malnourished, and they foresee mass unrest unless farmers find a way to produce 60 percent more food by 2050. Faculty at The Ohio State University tackle the issue from multiple angles by focusing on maximizing efficiencies in food production, examining how to keep food safe, and taking the lead on reducing the billions of pounds of food wasted annually.

PLANTING WITH PRECISION TO MAXIMIZE CROP YIELDS

Planting is the most critical operation of crop farming. Improperly placing seed or working a poor seedbed could cut a crop's yield potential by half.

But what if a farmer could plant just the right seed at the right rate on each patch of ground to maximize yields?

In farm fields, particularly those in central and southern Ohio, soil type can vary significantly within a matter of 50 feet. Multihybrid planters allow farmers to simultaneously plant different seeds at different rates to produce the highest yields or generate the

highest returns for their operations. In 2016, Ohio State researchers tested prescription planting protocols on approximately 600 acres across central Ohio.

On some fields, especially in northwest Ohio where soil tends to be more uniform, high-speed planters may be more beneficial. By speeding up planting by 40 to 60 percent, crops can be planted when weather narrows the planting window, as it did in spring 2016. Researchers work to help farmers determine the right equipment for their operation, whether it's high-speed, variable-rate, multihybrid or some combination of each method.

More: go.osu.edu/brutuscornfield



SAVING TONS OF FOOD WASTE

Many people don't know where their next meal will come from, yet about one-third of the world's food is wasted. In the United States, consumers throw out an estimated 80 billion pounds of food annually. Yet only half are aware that food waste is a problem, and some mistakenly perceive that pitching food can be beneficial.

In a major study, Ohio State researchers found that 68 percent of Americans believe discarding food after the package date has passed reduces the chance of foodborne illness, although experts disagree. Only 58 percent understand food waste is bad

Multihybrid planter



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for the environment, but it is the most destructive type of household waste in terms of greenhouse gas emissions.

The researchers followed up their study by holding a regional conference and national webinar, bringing together authorities interested in reducing food waste. Also, with Louisiana State University, they are developing a smartphone app to better track household food waste and help consumers make changes.

More: go.osu.edu/foodwaste



BETTER TASTING PORK BRINGS HIGHER PROFITS

Ohio State animal science researchers are working to improve pork quality by investigating the underlying mechanisms that control the formation of meat quality attributes in Berkshire pigs. These animals are widely considered a superior breed for producing high-quality meat. However, because the breed produces small litters, the research goal is to understand the genetic and biochemical mechanisms responsible for improved meat quality from Berkshire pigs. Ultimately, the researchers hope to use the information gained from their studies to improve quality of all commercial pig herds.

The researchers aim to help Ohio pork producers meet the increasing demand for naturally tender, juicy, all-natural pork from global and domestic consumers. This is a significant goal for pork producers statewide, considering the Ohio pork industry generates \$542.7 million in revenue and provides 8,700 jobs. Additionally, Ohio exports \$71 million in pork, resulting in 1,700 export jobs.

Ohio State's research is expected to strengthen the position of Ohio pork and provide stability in this sector of the food industry.

FIGHTING FUNGUS THAT RAVAGES RICE, WHEAT

Rice is a staple for about half of the world's population, including many people who face dire poverty and hunger. Yet, a fungal disease, rice blast, results in the loss of 10 to 30 percent of the global crop, costing an estimated \$5 billion to \$6 billion annually. A related disease, wheat blast, has caused severe losses in South America, and is a potential threat to wheat production in the United States. Few other plant pathogens have such an impact on nutrition, livelihood, culture and economic well-being.

Developing resistant varieties is the most economically and environmentally sound approach to combat this disease, but the fungus overcomes new resistance traits relatively rapidly. What's needed is a complete understanding of how this fungus destroys rice plants.

Ohio State plant pathologists are cracking the genetic code to understand precisely how the fungus undermines a natural defense mechanism in rice plants. Ohio State's findings are now being used in rice breeding programs; and working with Kansas State University, scientists are inserting the rice plant defense gene into wheat to determine if its protective effect transfers to this other staple crop, an important Ohio commodity.

More: go.osu.edu/wang_lab and go.osu.edu/mitchell_lab



Guo-Liang Wang with rice



Luis Rodriguez-Saona with handheld spectrometer

IMPROVING FOOD TESTING FOR CONSUMER SAFETY

Food adulteration and counterfeiting cost the food production industry an estimated \$10 billion to \$15 billion a year and sometimes pose safety risks. In 2008, baby formula tainted with the chemical melamine killed six infants in China and made 300,000 babies sick. Since then, the authenticity of olive oil, honey and other foods has been questioned.

But lab tests, whether they're checks of imported foods at the dock or production-line quality testing at U.S. facilities, can be time-intensive and costly, undermining efforts to conduct widespread tests of imports or to allow processors to make swift quality control adjustments when needed.

Today, an Ohio State researcher is using portable infrared scanners to conduct tests on-site and on various foods with almost instantaneous results.

The process seems deceptively simple: A small sample of the product is scanned with a handheld spectrometer or with a scanner. Thanks to approaches the researcher has developed, chemical attributes can be analyzed in less than a minute. This measurement could eliminate the need for lab tests that traditionally take hours or days to complete.

More: go.osu.edu/infrared

JOB SKILLS AND CAREERS

As part of The Ohio State University, Ohio State University Extension works with Ohioans young and old to provide job training, workforce skills and education to help residents statewide attain new jobs, retain current jobs or prepare for professional licensing requirements. From offering 4-H leadership and job skills programs to teaching agriculture in urban centers to helping farmers and pesticide applicators meet educational requirements for new licenses or recertifications, the goal is the same: keep Ohioans working.

OHIO 4-H CAMP COUNSELORS ARE PREPARED TO WORK

What makes a good camp counselor? Strong leadership, problem-solving, and communication and teamwork skills, among others. These are just a few of the competencies that Ohio 4-H



Natalyn Landis, 4-H camp counselor

camp counselors ages 14–18 are taught through OSU Extension's Making eXtreme Counselors state workshops. They then put this training into action as counselors at 4-H camps throughout the state.

Through the training, Extension empowers teens to develop skills that prepare them for the workforce. At the same time, Extension helps shape the positive development of Ohio youths ages 8–13 who attend 4-H camps statewide.

Some 107 teens from 29 Ohio counties were trained as 4-H camp counselors last year through the program, which focuses on teaching skills they can use in the planning, programming and teaching process at their county 4-H camps. The training opportunity is open to teens in all 88 counties.

Skills taught during the training include responsibility, confidence, teamwork, public speaking, cooperation, customer service, accountability and respect for others. Ninety-two percent of participants say they are better counselors because they attended the training, while

96 percent say they have utilized skills gained from the training in their camping experience. And 97 percent of participants believe the training they received will also help them get a job.

More: go.osu.edu/campcounselor

GROWING URBAN FARMERS

OSU Extension is working to train new urban farmers.

In less than two years, the new Ohio Master Urban Farmer program has trained 180 people in Toledo and Columbus to become food and crop producers within

city limits. The program teaches participants how to produce and market food in urban areas. Participants learn how to choose a farm enterprise, how to choose a site, and how to soil-test for urban food production.

The overall goal is to provide urban dwellers who want to get into the food and crop production industry with



Anisa Ahmad, Ohio Master Urban Farmer program



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a basic understanding of how to create or expand agriculture-related business opportunities. The program also focuses on economic development, food insecurity, and environmental and community redevelopment in urban areas.

Program graduates receive free assistance to help secure the land, tools, seeds and other resources needed to start or expand a successful growing venture.

The program is working; 45 percent of participants say they plan to start a new food-based business or enterprise, and 21 percent plan to increase their family's income based on what they've learned. Further, 84 percent say they plan to produce safe, high-quality foods. And in two years, the number of urban farms within Columbus has grown from five to 15.

The program is expanding to include Dayton and Youngstown, and a similar program is already offered in Cleveland.

More: go.osu.edu/urbanagfranklin

PESTICIDE SAFETY EDUCATION KEEPS MORE OHIOANS WORKING

Each year, OSU Extension offers training in partnership with the Ohio Department of Agriculture to pesticide applicators so they can become certified or earn recertification credits to renew their pesticide licenses. This work is done to keep the environment safe as well as Ohio homes, businesses and crops.

Extension's Ohio Pesticide Safety Education program provides training, education and outreach to pesticide applicators about the safe, effective and legal use of pesticides. The program works with farmers, businesses and public agencies to protect human health and the environment, and it serves as a critical part of job training and business growth in Ohio.

Licensed applicators need the recertification training to learn about new pesticide application alternatives



and methods, new products to control pests, and new pesticide regulations. The program focuses on the responsible use of pesticides while promoting the health of the public and the environment.

In the past year, the training included 400 new commercial pesticide applicators; 3,400 current applicators who attended commercial recertification conferences offered in five locations in Ohio; and 5,000 people who attended recertification programs for private pesticide applicators in multiple Ohio counties.

More: pested.osu.edu

ENGAGED OHIOANS, VIBRANT COMMUNITIES

Engaging Ohioans and helping build and maintain vibrant communities includes bringing economic development to areas of the state that face challenging situations such as high poverty rates and low employment rates. Ohio State University Extension empowers Ohio communities to create new businesses, bringing new jobs to residents as a result of job training, technical assistance and investment dollars to increase economic productivity.

CREATING NEW JOBS AND BUSINESSES

According to the Appalachian Regional Commission, residents in Appalachian Ohio and West Virginia experienced 8.9 and 7.2 percent unemployment, respectively, from 2011 through 2013, with a per-capita income in 2013 of \$24,855 and \$26,020, respectively, and a three-year poverty rate of 17.6 and 17.9 percent, respectively.

OSU Extension is working to increase economic productivity and job and business development in the region through its Ohio Cooperative Development Center, housed at The Ohio State University South Centers in Piketon.

During the past five years, the center has provided more than 2,900 hours of technical assistance and has provided expertise to help in the formation of

35 cooperatives and other business entities in a variety of industries. Creation of these cooperatives and businesses has resulted in an estimated 194 new and 229 retained jobs. It has also resulted in the investment of \$72,000 in seed grants.

More: southcenters.osu.edu/cooperatives

SHALE BRINGS 52,000 JOBS TO EASTERN OHIO

As shale energy development took hold in Ohio, it was unclear precisely what the impacts would be. To find out, OSU Extension worked with four regional Economic Development Administration (EDA) districts of the U.S. Department of Commerce, representing 25 counties in eastern Ohio.

The group's 2016 report analyzed trends from 2010 to 2014. The study indicated that

shale development benefited five industrial sectors the most: energy; chemicals and chemical-based products; forest and wood products; metals manufacturing; and machinery manufacturing. In fact, the metals and machinery manufacturing sectors alone accounted for a net increase of 52,000 jobs.

The analysis further showed that 90 percent of job creation in the five sectors occurred as a result of regional influences rather than national economic trends. The EDA districts are using the findings to develop strategies to diversify their economies and sustain growth.

The group is continuing to track information and help determine regional needs in areas such as workforce training and education.

POLLINATORS



We need honeybees and other pollinators for the successful growth of about one-third of U.S. food crops. But hard winters, habitat loss, unintended pesticide impacts and other environmental factors have these friends of ours under siege, both in Ohio and around the world. Protecting the state's pollinators — and in the process, securing farmers' income and food production — is among the key work being done by The Ohio State University.

HONEYBEES AND FIELD CROPS: BETTER TOGETHER

How do field crops affect honeybees? And how do honeybees affect field crops? Research by Ohio Agricultural Research and Development Center-funded scientists has found new answers and shows promising paths for more study. The scientists discovered, for instance, that foraging honeybees can pick up dust from insecticide-coated corn seeds. They can then carry the dust into their hives, where it can harm their young. Based on the new finding, the scientists have suggested ways to reduce bees' exposure to the dust, including by controlling weeds in corn before they flower so bees aren't attracted to the field; using seed planters that vent downward rather than upward to minimize the spread of the dust; and limiting the use of coated corn seeds to fields only where they're absolutely needed.

The OARDC scientists also found that nearly half of the Ohio honey they tested had soybean pollen in it, even though soybeans, as a self-pollinated crop, don't

need bees for pollination. It appears, the scientists say, that honeybees are visiting soybeans, the soybeans are contributing to honey production, and pollination by honeybees is somehow increasing soybean yields.

Looking ahead, based on the new findings, the scientists say there's good potential for joint research. It's a valuable opportunity, they say, to have two components of agriculture — field crops and beekeeping — come together to explore mutual benefits.

In all, about one-third of the food crops grown in the United States must be pollinated by honeybees or other pollinators. Those crops have a value of more than \$14 billion a year. Protecting honeybees will secure those major food sources and the billions they add to the economy.

Continuing to support Ohio's corn and soybean production will yield major benefits too. In 2015, the two crops earned \$1.9 billion and \$2.1 billion, respectively. Growing Ohio's soybean



Reed Johnson



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income by just 1 percent, for instance — if, say, honeybees could help bring that about — would mean \$21 million a year in added income for Ohio farmers.

More: go.osu.edu/BeesAndCrops

GROWING NEW HOMES FOR POLLINATORS

The land under electric transmission lines, which needs to be kept clear of trees, could soon aid bees and other pollinators, including the beleaguered monarch butterfly. A new project, called A Monarch Right-of-Way: A Pollinator Demonstration Plot, is underway at The Ohio State University at Mansfield. Its partners include experts from OARDC and OSU Extension.

The project involves growing four different plantings of native wildflowers under a FirstEnergy transmission line that crosses the campus. The end goal is threefold: give food and homes to pollinators; keep transmission lines free of tall vegetation; and further ensure safe, reliable electrical service for Ohioans.

“Encouraging the growth of these special plants in transmission line corridors is an idea gaining momentum in the utility industry,” says Steven A. Strah, president of FirstEnergy Utilities, a partner on the project. “We expect the outcome of the experiment to produce positive, environmentally friendly results that can be used in the 14,000 miles of transmission rights-of-way that FirstEnergy maintains.”

In Ohio alone, electric companies must maintain about 7,000 miles of high-voltage transmission lines. In the United States overall, about 200,000 miles are maintained.

Meanwhile, pollinator populations in the United States and around the world are declining. Of note, numbers of the beloved monarch butterfly have plummeted by 90 percent, partly due to the loss of milkweed in fields and along field edges.



Monarch butterfly

It's the only plant on which the butterflies lay their eggs, and the only one on which their larvae feed. That's why the Mansfield plantings had to include species of milkweed.

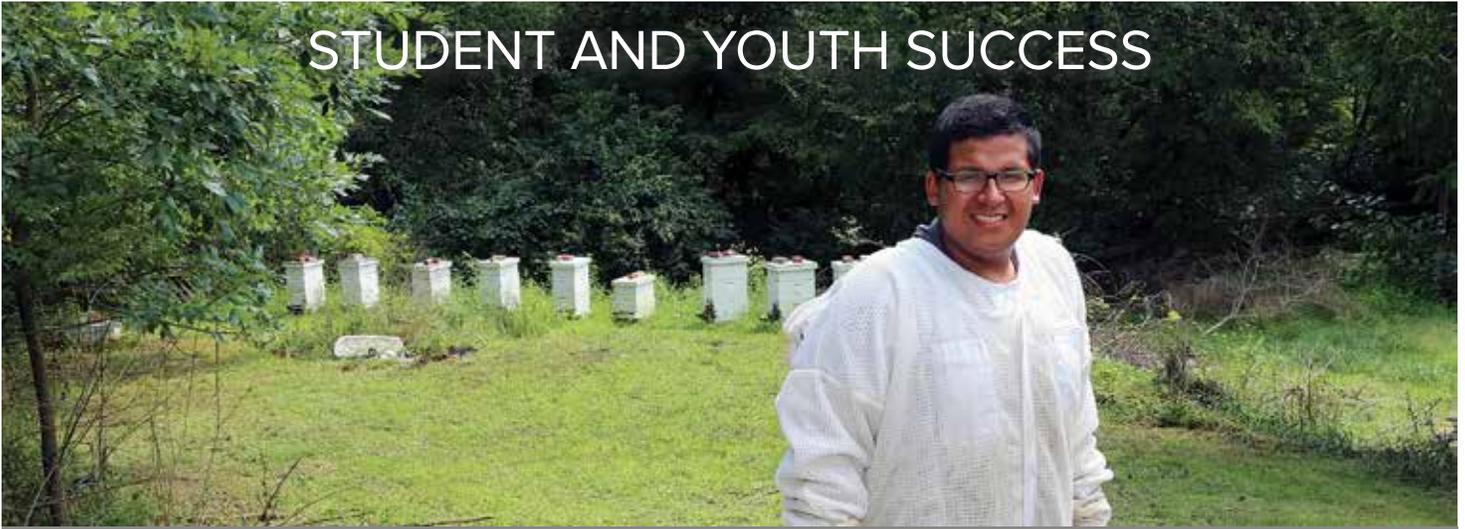
Project partners also include the national Pollinator Partnership, Ohio Prairie Nursery, Arnold's Landscaping, Davey Tree, and the Utility Arborists Association.

More: go.osu.edu/PollinatorsUnderPowerLines



Brian White, Ohio State Mansfield (middle left), with First Energy colleagues Rebecca Spach, Patrick Failor and Kate Bloss (left to right)

STUDENT AND YOUTH SUCCESS



Hands-on learning was at the center of A.B. Graham's first boys' and girls' agricultural club in Springfield, Ohio, in 1902. Youngsters planted seeds in experimental plots, tested the soil, and identified weeds and insects. They studied scientific theory and presented findings to their peers. Today, nearly 290,000 young Ohioans participate in 4-H clubs; camps; and school-enrichment, after-school, and special-interest programs. All are provided with ample opportunities for experiential learning. At the same time, by addressing real-world challenges, The Ohio State University's College of Food, Agricultural, and Environmental Sciences prepares students to successfully progress into worthwhile careers.

EXPERIENTIAL LEARNING: A 4-H SUCCESS STORY

When Jacob Shuman was in elementary school, he sometimes tore his homework into pieces in meltdowns of frustration. Adopted as an infant from Guatemala, it took years for Jacob's fetal alcohol syndrome to be diagnosed, which explained his unusual learning disabilities: He could add, but not subtract; multiply, but not divide. He'd understand a concept one day and forget it the next.

For a short time, he enjoyed participating in Cub Scouts with his dad and his brothers. But his mom felt left out and enrolled Jacob, then 6, in Ross County 4-H. It was a fateful move.

Soon, the three boys and parents were involved in one club as a family. Jacob took various projects: meteorology, insects and goats. He became a club officer, requiring him to practice public speaking. The hands-on learning and boost in confidence he experienced in 4-H helped him do better in school. At 13, he took the 4-H beekeeping

project. In four years, one hive grew to 14, housing hundreds of thousands of honeybees.

Along the way, Jacob created TEACH B's: Teens Educating Adults and Children about Honey Bees, in which he gives demonstrations not only about the importance of honeybees, but also about eating plenty of the fruits and vegetables they pollinate and adopting other healthy



Jacob Shuman

living habits. He speaks at schools, libraries and anywhere he can. So far, he has reached more than 500 people.

For that outreach effort, Jacob, now 17, was awarded the national 2016 Youth in Action Award in agriculture and animal sciences, and a \$5,000 scholarship from the National 4-H Council. At Jacob's request, an additional \$5,000 award that went to the Ross County 4-H program will be used to fund scholarships for 4-H members interested in taking up beekeeping, which requires a significant investment for hives, bees and equipment.

Jacob plans to use his scholarship to attend The Ohio State University Agricultural Technical Institute in Wooster to study under bee researcher Reed Johnson, and then continue his education on the Columbus campus for a degree in entomology and Extension. Several companies have already expressed interest in offering Jacob summer internships as he pursues his education.

More: go.osu.edu/shuman2016



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INNOVATION LAB LIGHTS A SPARK

It's not quite Silicon Valley, but for rural Hardin County (population 31,641), it comes close.

A large portion of the Hardin County Extension office is now the Spark Lab Innovation Center. Inspired by the "Maker Movement," the lab is designed to spark creativity, innovation and hands-on learning in young people and local entrepreneurs.

Among other technologies, the lab is home to a 3-D printer (the county's first), a handful of drones, GPS units, LEGO robotics kits, a smart board, a laser cutter, a video conferencing seminar room, iPads, and a video production lab with an HD video camera, a green screen and a computer with Final Cut software for video production work.

The space is possible thanks to a \$49,000 innovation grant from eXtension, a nationwide Cooperative Extension System organization, and a \$23,000 Columbus Foundation grant. Broad community support from a property tax levy provides a secure base, allowing staff to pursue such additional funding.

By hosting regular sessions such as Tech Tuesdays and Workshop Wednesdays, and special programming via projects ranging from sewing and art to robotics and rocketry, the space has hosted nearly 1,000 young people and adults in its first year of operation.

More: go.osu.edu/hardinspark

OHIO 4-H PETPALS: ENHANCING HEALTH THROUGH HUMAN-ANIMAL CONNECTIONS

Residents in senior facilities often feel lonely and cut off from the world. Meaningful interaction with young people and pets can provide stress relief, comfort and companionship.

That's where 4-H PetPALS comes in. The Ohio 4-H PetPALS program — People and Animals Linking Successfully — was developed in the late 1990s to teach 4-H members the skills needed to interact with residents of health care facilities,

particularly nursing homes and assisted living, and prepare their pets for such visits. It has since expanded to include visits to schools, hospice programs and colleges during finals. In 2015–16, 181 4-H members, with the oversight of trained adult volunteers, brought pets to visit an estimated 5,500 Ohioans in 35 counties.

Besides learning how to socialize and train their pets, 4-H members undergo sensitivity training to learn more about seniors and people with disabilities. Ohio State research shows that 4-H PetPALS participants are more empathic and compassionate toward seniors and have a keener sense of understanding, respect and appreciation for them. Ohio's 4-H

PetPALS participants can earn an American Kennel Club Therapy Dog title, the only 4-H project in the nation so recognized.

Even more, the program provides therapeutic relief from stress and loneliness to Ohioans of all ages.

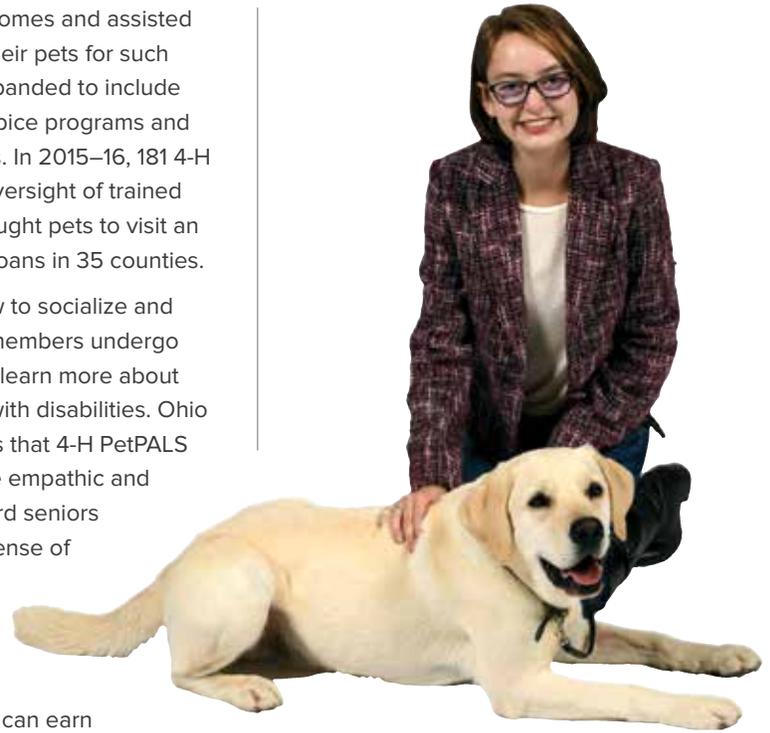
More: go.osu.edu/petpals

OUR GRADUATES GET HIRED

With growing demand for skilled professionals in food safety and security, water quality, the global food market, and sustainability and environmental issues, the College of Food, Agricultural, and Environmental Sciences positions its graduates for success.

In a survey from the 2014–15 academic year, 92 percent of graduates reported either having a job or being enrolled in an advanced degree program within six months of graduation.

Of those graduates, 74.4 percent reported accepting positions in Ohio. The remaining graduates accepted

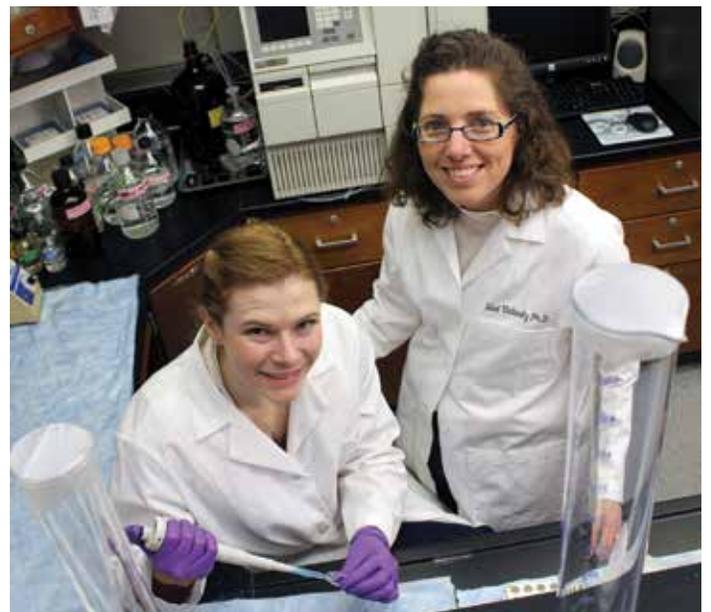


Emma Newell and Quincy

positions in 30 other states and six international locations. The overall average starting salary: \$42,184.

Graduates of the college's Agricultural Technical Institute also report success, with 97 percent either employed or transferred to a four-year, degree-granting institution within six months of graduation. Of those employed, 90 percent found jobs in Ohio, with an average starting salary of \$30,986 at 57 companies and organizations.

More: go.osu.edu/cfaesgraduates



Amber Simmons, graduate student (left), with Yael Vodovotz, professor (right)

WATER QUALITY



Experts say soluble phosphorus runoff from farms is one of several contributors to the harmful algal blooms plaguing Lake Erie and other bodies of water in recent years. Researchers at The Ohio State University are working to solve this problem and improve Ohio's water quality by helping farmers continue to achieve high levels of productivity while reducing input usage and cost. The key is to keep more fertilizer in the soil where crops can use it and to apply only what is needed for growing crops.

HIGHER YIELDS, LESS FERTILIZER, IMPROVED WATER QUALITY

Since September 2014, Ohio State University Extension has trained more than 12,600 Ohio farmers on best practices to apply fertilizer for optimum crop yield, reduce the risk of nutrient runoff and improve water quality throughout the state.

Known as Fertilizer Applicator Certification Training (FACT), this program allows farmers and commercial fertilizer applicators to meet the educational requirements of Ohio's agricultural fertilization law, which requires those who apply fertilizer to more than 50 acres to become certified by September 30, 2017.

FACT was developed by College of Food, Agricultural, and Environmental Sciences researchers and educators and is offered in partnership with the Ohio Department of Agriculture. The training provides research-based tactics to keep nutrients in the field and available to crops while increasing stewardship of nearby and downstream water resources.

According to 2015 U.S. Department of Agriculture statistics, the average Ohio farm is 188 acres. Using this figure, the 12,600 farmers trained so far by FACT represent more than 2.3 million acres of farmland impacted.

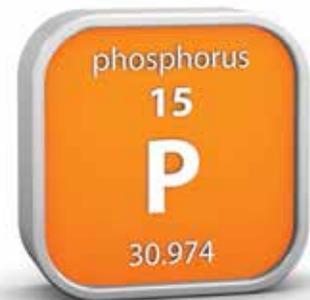
FACT helps farmers and applicators better understand the issue of water pollution and see the connections between production practices and environmental stewardship.

More: nutrienteducation.osu.edu

PHOSPHORUS LEVELS ARE DECREASING IN OHIO SOIL

Agricultural soil phosphorus levels held steady or trended downward in at least 80 percent of Ohio counties from 1993 through 2015, according to Ohio State researchers.

The findings, which are based on data from more than 2 million phosphorus soil tests from 1993 to 2015, represent good news for Ohioans concerned about protecting surface water quality while maintaining agricultural production. Soil



phosphorus levels are strongly related to the concentration of phosphorus in runoff water; less phosphorus in the soil should result in reduced phosphorus runoff risk.

Phosphorus soil testing is an important tool farmers use to determine if phosphorus fertilizer is needed for crop growth; and if so, how much. In Ohio, crop-specific phosphorus fertilizer recommendations come from the Tri-State Fertility Guidelines.

Farmers are being asked to avoid applying phosphorus fertilizer beyond crop needs. Maintaining soil phosphorus levels within the appropriate agronomic range minimizes phosphorus runoff risk, while providing sufficient crop nutrition.



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In 2015, the median soil phosphorus level was within the appropriate agronomic range in 87 of 88 Ohio counties, assuming nutrition needs for a typical Ohio crop rotation.

Ohio State researchers are also working to evaluate and revise the Ohio Phosphorus Risk Index so it accurately reflects runoff risk of phosphorus. The index is a U.S. Department of Agriculture Natural Resources Conservation Service tool used by farmers to assess their risk of phosphorus moving off farm fields. The revisions include adding more management options into the index to reduce runoff risk with a goal of broad implementation of revised and more specific phosphorus recommendations to improve Ohio water quality.

FIELD TO FAUCET: PARTNERSHIPS TO RID OHIO WATERS OF HARMFUL ALGAL BLOOMS

In the two years since a harmful algal bloom shut down the drinking water for two days in Toledo, Ohio, 23 research projects aimed at ensuring safe drinking water while keeping Ohio farms productive and profitable are now up and running thanks to the ongoing Field to Faucet water quality program. The program was created in September 2014 after harmful algal blooms

created the water quality crisis in Lake Erie that suspended access to clean, safe water to the northern Ohio city of Toledo.

Field to Faucet involves researchers from multiple Ohio State colleges, other regional universities, and several agricultural organizations and government agencies. A full listing of partner schools and organizations can be found at **field2faucet.osu.edu**. Ongoing projects include a one-stop shop for farmland data, new field sensors to quickly scan for multiple algal toxins in water and food, a new app to help farmers manage farm nutrients, research to rid livestock manure of phosphorus and nitrogen, and the use of unmanned aerial vehicles (drones) to provide real-time concentrations of microcystin in Lake Erie's waters. Microcystin is a toxin made by certain harmful algal blooms.

More: **field2faucet.osu.edu**

ARE FISH SAFE TO EAT DURING ALGAL BLOOMS?

Harmful algal blooms can produce toxic microcystin, and severe blooms in Lake Erie have caused worries that sport fish might be contaminated.

To see if that is the case, Ohio Agricultural Research and Development Center-funded scientists tested microcystin concentrations in three Lake Erie fish — walleye, yellow perch and white perch — collected in

summer 2013. They found significant differences among them, but say none of the samples posed a health risk to people who follow state guidelines for safe fish consumption.

But there are caveats. The study used safe-eating thresholds for healthy adults; children and the immune-compromised might be susceptible to lower doses. There's also evidence that microcystin accumulates in white perch and walleye, and that levels in white perch vary with bloom conditions.

For those reasons, the scientists strongly recommend that, during algal blooms, microcystin should be monitored not just in water but also in fish. They say the monitoring would lead to a better understanding of the microcystin levels and their risks. Benefits would also include protection for Ohio's \$2 billion-a-year sport fishing industry and the 1.3 million Ohioans who fish and eat what they catch.

A NEW, FAST, CHEAPER TEST FOR ALGAL BLOOM TOXIN

Harmful algal blooms are a growing health and environmental concern, not just in Ohio but also around the world, partly because some of the blooms produce toxic microcystin. Unsafe microcystin levels in western Lake Erie, for instance, were behind the two-day shutdown of Toledo's drinking water supply in 2014. A new test developed by OARDC-funded scientists detects microcystin in water samples quickly and at a low cost.

Based on technology called enzyme-linked immunosorbent assay, or ELISA, the new test is simple to use, fast — less than 3 hours from preparing the test kit to detection — and more than 10 times less expensive than the current ELISA test — less than \$1 per sample instead of \$10. The scientists say their new test can be used on a wide variety of samples, from drinking water sources to bloom samples to municipal water treatment plants and more. An end result will be better protection of people's health, including the 3 million Ohioans (and 11 million people total) who rely on Lake Erie for their drinking water.

Lake Erie algal bloom

