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FUTURES

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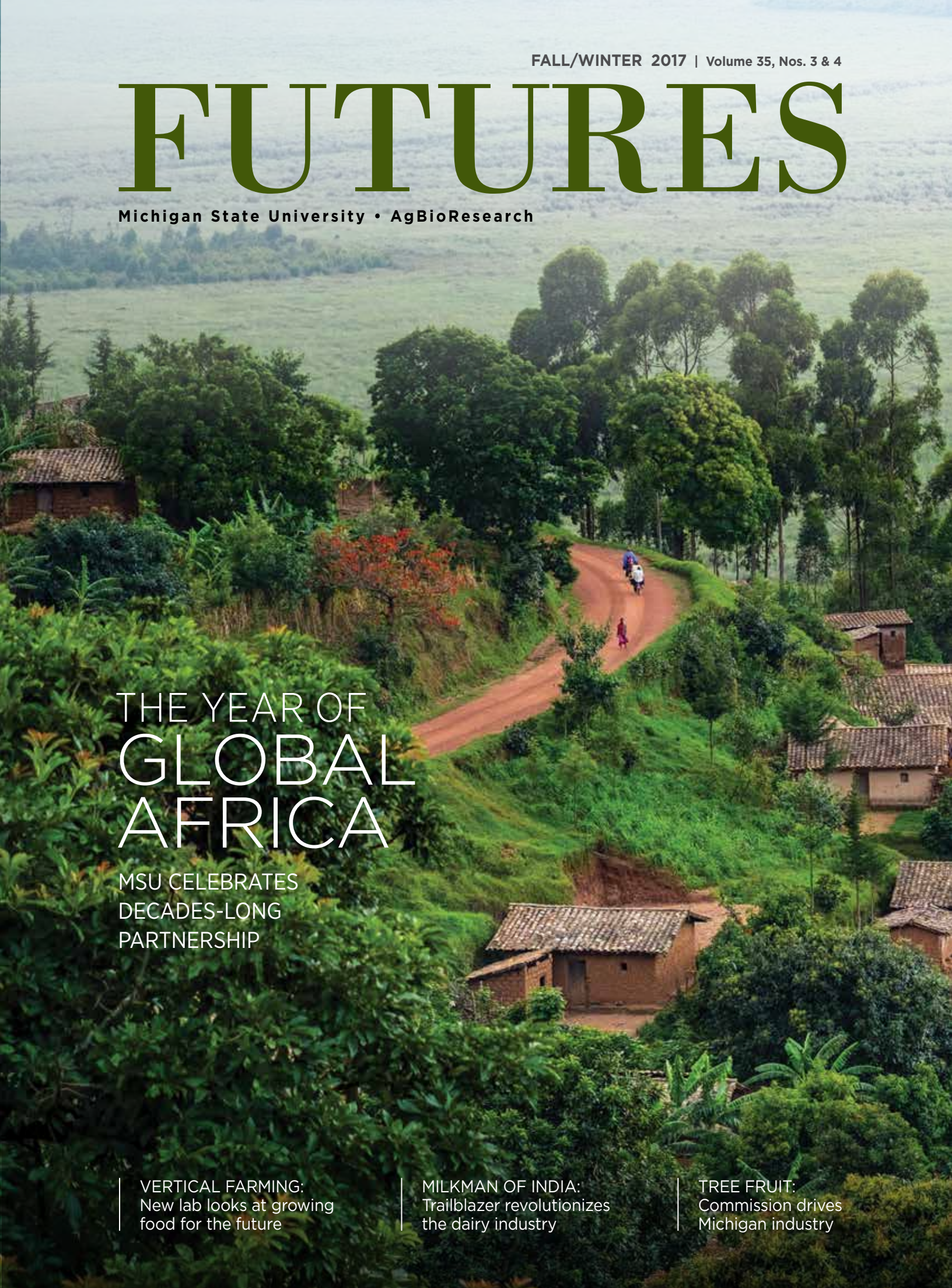

THE YEAR OF GLOBAL AFRICA

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New lab looks at growing food for the future

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TREE FRUIT:
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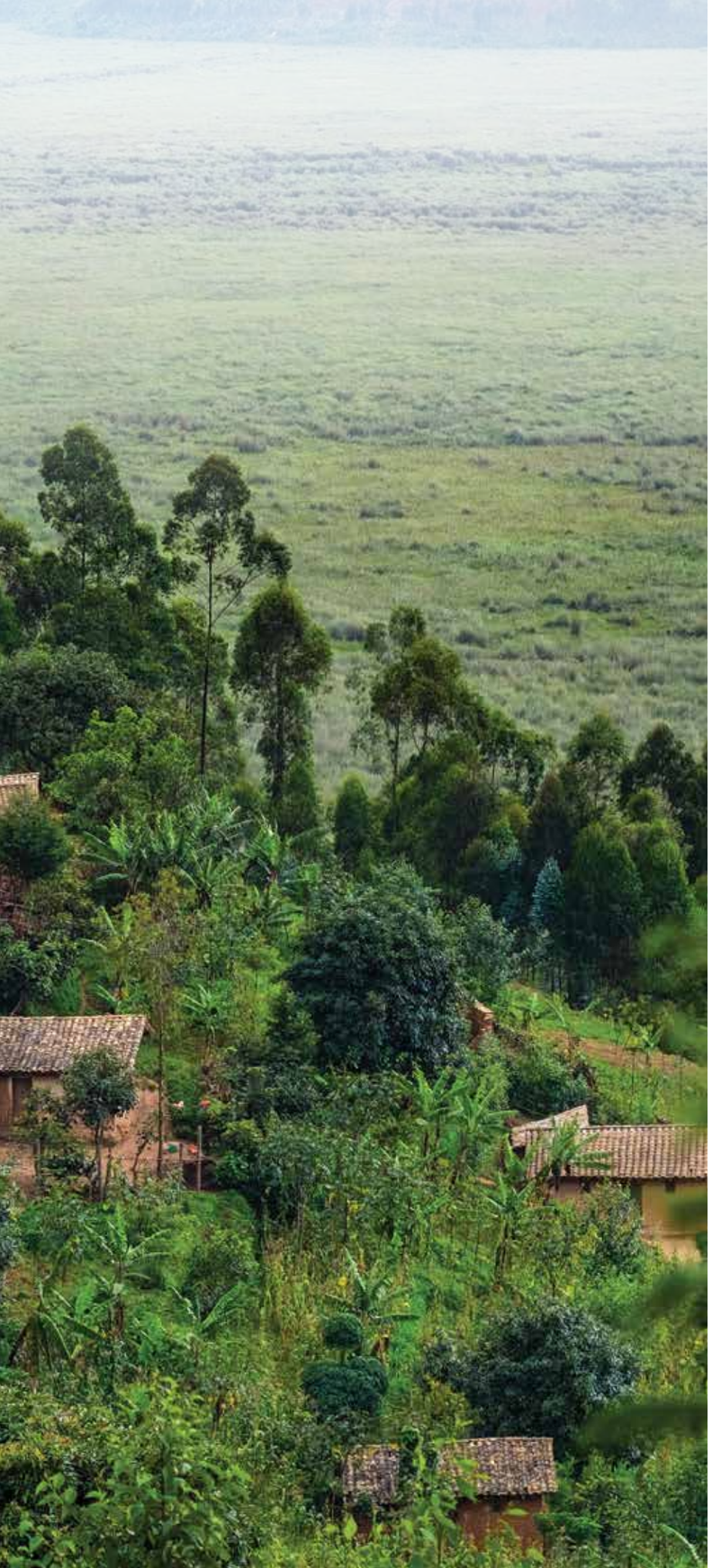

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Cover photo taken from a roadside overlook near Rushaki in northern Rwanda on a journey with MSU bean breeder Jim Kelly and his former grad student Gerardine Mukeshimana, now Minister of Agriculture and Animal Resources of Rwanda.

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BY JAMES DAU, STAFF WRITER

A whole new world:

Opening international blueberry markets through pest management research

IN 1916, THE DAUGHTER OF A NEW JERSEY CRANBERRY GROWER AND A U.S. DEPARTMENT OF AGRICULTURE (USDA) BOTANIST HARVESTED THE FIRST COMMERCIAL CROP OF HIGHBUSH BLUEBERRIES. PRIOR TO THIS, BLUEBERRIES WERE CONSIDERED IMPOSSIBLE TO DOMESTICATE AND IMPRACTICAL FOR AGRICULTURAL PRODUCTION.

Today, just over a century after that first crop made it from the farm to the dinner table, over 1.2 billion pounds of blueberries are produced worldwide every year, with more than half originating in the United States. Their future is bright with the U.S. Highbush Blueberry Council (USHBC) estimating that North American blueberry production will increase by 25 percent by 2019.

As a major producer of blueberries in the nation, Michigan has opportunities to expand businesses through overseas export markets. Tapping into those is not as simple as boxing up blueberries and loading them onto a ship bound for France or Hong Kong, however. Several obstacles stand between Michigan growers and the lucrative markets of Europe and Asia, chief among them a fly less than a third of an inch long.

The blueberry maggot fly has been a major pest of blueberry growers since the birth of the industry. Female flies lay 25-100 eggs inside individual blueberries, where the larvae hatch and devour the fruit as they grow over approximately a three-week period. Larvae drop into the soil, pupate and wait through the winter, emerging as adult flies in the next season.

AN OBSTACLE TO TRADE

First reported in 1914 and native to the major blueberry-growing regions of eastern North America, the blueberry maggot fly is common throughout Michigan, but a combination of natural parasite species and integrated pest management practices allow growers to effectively control it and prevent the damage it can cause.

It is not present in most overseas markets, however, nor are there any natural defenses against it. This has made it a quarantine pest, with some trading partners not accepting blueberries from Michigan because of the potential risk it poses. This is a problem Michigan State University (MSU) AgBioResearch entomologist Rufus Isaacs is aiming to solve.

"Growers in the United States have a lot of ways of effectively managing the blueberry maggot fly," said Isaacs, professor in the MSU Department of Entomology and MSU Extension specialist. "But trading partners such as China and Australia do not have this pest, nor a strategy developed to control it. They are highly concerned about preventing its entry, so we also need strategies that can guarantee any stray blueberry maggot that survives to harvest is eliminated before the fruit are shipped."

To this end, the USHBC approached Isaacs to assemble a team of researchers to develop strategies to eliminate blueberry maggot from the fruit after harvest to meet the import standards of potential trade partners. With funding from the USDA Trade Assistance for Specialty Crops program and in collaboration with scientists from the USDA Agricultural Research Service in California, they proposed to test three different post-harvest techniques to purge blueberries of the blueberry maggot and ensure the pest does not spread beyond its native range.

The team elected to test a variety of methods to provide growers with multiple options, as well as to make sure that both small and large growers had methods they could feasibly implement into their operations.

Philip Fanning, postdoctoral researcher in Isaacs's lab, manages much of the day-to-day operations of the project team.

"At MSU, we're working on helping blueberry growers take advantage of the increasing global demand for their crop," Fanning said. "That means looking at practices that small growers can implement now, as well as investigating new technological approaches for growers with the resources to invest in them."

Testing these methods would be impossible without the cooperation of Michigan's blueberry growers. Growers have provided large volumes of their clean fruit while others have allowed access to abandoned fields that provide a source of infested fruit, which Fanning collects and delivers to the team as valuable test subjects.

"This is very much an industry-led project," Fanning said. "They recognize the value of eliminating this pest and opening export markets, and are working with us to help improve the marketing of blueberries."

Top Left and above
A blueberry maggot fly perches atop a ripe blueberry. Female flies lay as many as 100 eggs inside a single blueberry, where they hatch and consume the fruit as they develop.

Top Right
While native to the eastern United States and Canada, many overseas trading partners do not have blueberry maggots, nor the means to combat them. In order to ensure the pest does not spread abroad, Isaac's team is exploring multiple strategies to eliminate them from Michigan blueberries after harvest.

A THREE-PRONGED STRATEGY

One method already in common use in fruit agriculture, both for pest control and for extending the life of fruit, is cold storage. In this, harvested fruit is placed in specialized low-temperature chambers for a period of about two to three weeks. During this time, the activity of pests is slowed dramatically, reducing development, consumption and eventually leading to their deaths. In the case of some pests, such as the Queensland fruit fly, this method alone is enough to eliminate them entirely.

"Cold storage has a lot of potential for helping us eliminate blueberry maggots, and it has the added benefit of being relatively easy for growers to implement regardless of the scale of their operation," Fanning said. "Our current tests are already showing success at the small, experimental level. We have to see what that looks like when we take it to a commercial scale, but so far it's promising."

The second technique the team is exploring attempts to use the laws of physics to gain an advantage over the pests. By storing blueberries in hypobaric chambers, which can reduce the pressure inside to about 2 percent of typical air pressure, the team hopes to increase the efficacy of fumigant gases capable of killing any unwanted infestation.

Under reduced pressure conditions, introduced gases expand faster and penetrate deeper into stored fruit by the simple virtue of there being significantly fewer other molecules in their way.

Randy Beaudry, professor in the MSU Department of Horticulture, has been studying low-pressure storage technology for the last two years, working with a diverse group of crops including spinach, strawberries and roses. His team demonstrated it was not a viable solution to the needs of those growers, but sees potential for it in the case of blueberries.

"These low-pressure systems have been in use in horticulture for some time, as a way of extending the storage life of plants, so this equipment already exists for growers at a commercial scale," Beaudry explained. "What we're looking at is seeing if we can adapt it to help us eliminate pests, to find new uses for old technology."

For the last six months, Beaudry's team has been testing different concentrations of sulfur dioxide. Team members plan to test one gas per year for the duration of the project. While each of the compounds Beaudry is testing degrades rapidly, leaving little risk of health effects, the team will also evaluate their safety for human consumption.

While Beaudry's team has not yet brought blueberry maggot infestations down to an acceptable level for international trade, he remains cautiously optimistic about the technology's potential.

"GROWERS, PROCESSORS AND MARKETERS ARE VERY INTERESTED IN THE PROSPECT OF EXPANDING THEIR MARKETS BY OBTAINING NEW TOOLS TO FIGHT COMMON PESTS LIKE BLUEBERRY MAGGOT," ISAACS SAID. **"THIS PROJECT IS A DIRECT RESPONSE TO AN INDUSTRY NEED, AND THAT'S WHAT WE TRY TO DO HERE AT MSU."**

"So far, we've done preliminary tests and killed a lot of insects," Beaudry said. "You have to kill 99.999 percent of them to make the fruit safe for export, and we're not there yet. We've been testing very heavily infested fruit, and it may be that we see more positive results on fruit with more natural pest levels, the kind you'd see in the field."

The third and final technique the team is exploring, under the purview of MSU food safety engineer Sanghyup Jeong, uses irradiation technology to kill blueberry maggots. Irradiation is an increasingly common practice for removing insect pests, disease-causing bacteria and other microorganisms from fruit, vegetables and meats without having an impact on their nutritional value.

Jeong, assistant professor in the MSU Department of Biosystems and Agricultural Engineering, is partnering with a Michigan-based company developing irradiation technology for food safety systems. Through this partner, Jeong has access to a pilot-scale facility capable of treating blueberry batches at near-commercial levels.

Lab technician Olivia Horton and MSU Department of Entomology Professor Rufus Isaacs examine blueberry clusters for pests in a pollination experiment.

"We're using X-ray radiation, which is less energy-intensive than other forms of the technology and, therefore, more cost effective for growers," Jeong said. "It makes it available to more than just large-scale growers; it allows us to help more people."

In previous research, Jeong and a team of food safety researchers demonstrated the efficacy of irradiation technology against critical bacterial pathogens such as *E. coli* and *Salmonella.* Now, he is trying to scale that up to more complex organisms, including the blueberry maggot.

LOOKING AHEAD

While the blueberry maggot fly project is only in the first of its three-year run, the team is already seeing progress.

"We're definitely seeing we can significantly reduce the blueberry maggot through some of these techniques," Fanning said. "From this year's work so far, it looks like we can have a program similar to the ones we use in other exported fruit like grapes. Elimination of the maggot should be possible by the end of this project."

Going into the next two years, the team will be taking their early experiments and scaling them up to the commercial level, to ensure that their findings remain practical for growers in the field. Research priorities will also focus on ensuring these techniques will maintain fruit quality, in order to ensure consumers continue to enjoy the fresh blueberries that are quickly becoming a staple in supermarkets year-round.

Success will mean providing the more than 600 Michigan blueberry growers with new opportunities to grow their businesses and send Michigan blueberries around the globe.

"Growers, processors and marketers are very interested in the prospect of expanding their markets by obtaining new tools to fight common pests like blueberry maggot," Isaacs said. "This project is a direct response to an industry need, and that's what we try to do here at MSU." ▯