Julie Urban:

Research is really important because, by definition, it's the only way to get new knowledge. There's so much that isn't yet known that it's just a cool time to be in science.

Speaker 1:

Well, I think at the end of the day what really gets us out of bed in the morning is just a curiosity. Trying to understand things we didn't understand the day before.

Beth Bamford:

Welcome to Reach, the podcast that tells the stories of researchers, their studies, and how their work impacts you and the world you live in. I'm Beth Bamford.

Cole Collin:

And I'm Cole Collin. Today we're going to tell you about the spotted lanternfly. More specifically the research being done at Penn State about the spotted lanternfly.

We are located in central Pennsylvania about three hours away from the quarantine zone of the spotted lanternfly, so we don't hear a whole lot about it.

Beth Bamford:

The first time I heard about the spotted lanternfly was in a news article warning travelers from the quarantine zone to inspect their vehicles before traveling outside of the quarantine zone and I thought to myself, "how on earth are they going to control this insect?" And also, "how much of an impact could one little bug have?"

Cole Collin:

After we learned what a big issue the spotted lanternfly was, we decided to dedicate an entire episode to the spotted lanternfly.

Beth Bamford:

We sat down with Dr. Julie Urban from the Department of Entomology to understand more about the spotted lanternfly.

Julie Urban:

My name is Dr. Julie Urban. I'm a research associate professor in the Department of Entomology at Penn State and I'm an evolutionary biologist who studies plant hoppers and their coevolution with bacterial and fungal symbionts.

Beth Bamford:

What made you interested in becoming an evolutionary biologist?

Julie Urban:

Basically it's a second career for me. My first PhD was in human factor psychology, so I studied military team performance and was a faculty member in psychology and got interested in thinking about, well, psychology is a study of behavior, thinking about behavior as anything else that evolves. So I decided to

go back to school, retrain. I was interested in evolutionary biology and I thought I wanted to study birds. I did volunteer work at the New York state museum. At that point, my husband's position took us to Albany, New York, and I knew I wanted to do something with DNA and so I volunteered in a lab at the museum that worked on DNA and that scientist actually studied plant hoppers and their associated hoppers and I had never voluntarily touched an insect in my life until that point.

And then I learned what plant hoppers were. They're really cool looking. They have unusual body forms. They've coevolved with multiple bacterial and fungal symbionts. They use substrate born vibrations, so they sing, they shoot wax out their rear ends. They're a really cool insect group and not much studied. And so I just fell in love and said that's what I want to do for my life. Lanternflies are primarily... It's a family of plant hopper. There's about 500 species. They're mostly tropical. This particular species, like hormo delicatula is one that occurs in Asia. So its native range is China and into Vietnam and Japan. And basically what's unusual about lanternflies compared to other plant hoppers and most other sap feeding insects, is that typically these insects should lay their eggs where their offspring can feed. Lanternflies, apparently never read the literature.

And not just our spotted lanternfly, but it's typical of other members of this family to lay their egg cases on essentially anything. And so from where it first appeared in Berks County, what we pretty much have determined is that this insect laid its eggs on either a pallet or on a shipment of rock and just was transported. Their egg cases look like mud. They're really difficult to detect. And so we think that it got here through transport in the egg case stage on a stone shipment.

Beth Bamford:

And how was it first detected?

Julie Urban:

It was actually kind of interesting. It was first detected, Pennsylvania Department of Agriculture has the details here so I don't remember if it was exactly a game warden, but it was a person who saw these insects and recognized that something looked unusual, that these seemed out of place.

And they called Pennsylvania Department of Agriculture who sent a survey crew out. And in fact, two colleagues of mine who had studied under a plant hopper expert for their master's degree, in fact, happened to be the two gentleman who came out on the survey crew. What a coincidence. And so they immediately recognized what this was. They immediately recognized it by species. Also, spotted lanternfly was an invasive in South Korea beginning in 2004, and so there was somewhat of a literature where we knew that this thing was a pest to grapes, in particular. And so everybody kind of had a little bit of an alert in the back of their minds so that when they saw this, they knew this was something we needed to really act on.

So Pennsylvania Department of Agriculture notified the USDA and then they brought in a group of scientists from around the world, mostly from the US, to come in and to consult on how this should be treated. And so they found spotted lanternfly September 22nd, 2014, and they called that technical working group I think by October. So they reacted immediately to get input on what do we know about this insect and what's the best way to manage it.

Beth Bamford:

So why did they react so quickly?

Julie Urban:

Because based on what this insect did in Korea, in South Korea, it's a pretty voracious sap feeder. And so it feeds very heavily on sap and we have some videos that you can see that online and because these insects are depleting grapes, in particular, but they'll feed on as many as 70 different species of plants and trees. So that's kind of unusual for an insect that's a sap feeder to feed so broadly on everything and deplete a plant of its resources that that right there is really potentially damaging. But it also induces damage secondarily through what's called sooty mold. So these insects feed on so much sap, which means that they excrete a lot of sugary liquid. We call that excrement honeydew because it sounds a lot better than anything else. And so that honeydew is a substrate for sooty mold growth.

And so in Korea, the main way that lanternfly actually impacted grapes was that that sooty mold blackens the surface of the grape leaves and would block photosynthesis. So not only are these insects depleting the plant of their carbohydrate, that they've produced in photosynthesis, but they're also blocking further photosynthesis. And so lanternflies still are an outbreak problem in grapes in Korea. But also they cause damage in stone fruit as well. We believe it came from China and in the US it's only found in 14 counties of Southeastern Pennsylvania, one county in Delaware, a few counties in Maryland and New Jersey, but all in a contiguous area. And then in about a 16 square mile area around Winchester, Virginia. I have a PhD student, Erica Smyres, who began actually working on lanternfly before I got here with now our retired grape entomologist, Mike Saunders.

And so she was doing work in the area that's now quarantined for spotted lanternfly looking at spotted lanternfly impacts on grape. This was two summers ago, we had been collecting insects and making observations in an orchard out of the quarantine zone. And this was an orchard that was part grapes and part apple. And in the previous years, lanternfly had never occurred on the apple whatsoever. And so that year we saw lanternfly in larger numbers and my student took videos of lanternfly in very heavy numbers feeding on grapes in that vineyard and in other vineyards. And she recorded that. And then one day they moved onto the apple trees en mass. And so at that point, she took videos, which are now posted to the Penn State website, but they've kind of gotten around. And at that point, it became pretty obvious to the general public and to other folks within the USDA that populations were higher than we expected.

And moving on to apples is a really potential economic threat. And so I think that's when that kicked off a lot of additional attention and political attention to lanternfly and then kicked off some other research projects really aimed at trying to manage lanternfly. And so last year with funding from Penn State, from USDA, and from Pennsylvania Department of Association, we had just a list of, okay these are research studies that we need to do to test insecticides and determine how these insects are impacting plants because we need solutions now.

It is just a completely different beast among sap feeders. It's a different beast among plant hoppers. And so Dean Rausch in the College of Agriculture has referred to this as potentially the most threatening invasive insect since the gypsy moth. It was introduced 150 years ago. And so it really does have that potential or hopefully we can control it in time. But that certainly...

Hopefully we can control it in time, but that's certainly what we're afraid of.

PART 1 OF 3 ENDS [00:10:04]

Beth Bamford:

So you indicated that there's a lot of research being done right now.

Julie Urban:

With this work we're looking for, we're essentially trying to look for using insecticides and these other control methods to buy us time to do the research to get to longterm sustainable solutions that don't require dependence on those types of chemicals.

We're actually trying to organize among the researchers because that's really important so that we don't, you know, research dollars are limited and so we need to make sure that we're not doing the same things.

Beth Bamford:

Where do these researchers come from?

Julie Urban:

So from really all around the country, USDA scientists, and from a variety of universities. But there's an umbrella grant proposal that I'm leading that's called a Specialty Crops Research Initiative and it's a USDA NIFFA funded project. And so I'm, I'm leading that project right now. We're writing the proposal and that has seven other colleagues at Penn State who are on that grant doing a variety of different research projects and extension projects. But also on that grant, we have USDA scientists as partners and the major land grants of the Northeast, University of Maryland, Virginia Tech, University of Delaware, University of Rhode Island, Rutgers, Cornell, Temple. So basically the whole Northeast and we're trying to band together.

And one of those partners is the Northeast IPM that's focused at Cornell. But that's kind of the regional integrated pest management voice, you know, in the country. And so we have them involved because we want a set of research projects that are integrated and streamlined to give us solutions. And we want short term solutions in terms of insecticides, but also part of this are longer term biological control agents research projects. So looking at natural enemies of lantern flies. So looking at parasitoids, which are wasps that lay their eggs in the eggs or the nymphs of other insects. We have USDA scientists involved with that. And we also have folks, Ann Hayek is a researcher at Cornell who looks at what we call entomopathogenic fungi. So entomopathogens like are pathogens of insects. So there's certain fungi that prey upon insects and those are can be good natural control agents.

Beth Bamford:

Once you do all this research and you have some strategies, what do you do with that information?

Julie Urban:

So there, it takes a long time. And so that's kind of part of the problem with it. Why, you know what, hopefully once we do it, we apply it and this thing goes away, right? But if you think about potentially the parasitoids, so with the issue of trying to use a wasp that lays its eggs in the egg cases of lantern fly and deploy that, the reason you don't see outbreaks of lantern fly in China is because it's co-evolved with its own natural enemies that keep it from getting out of control. And so work that colleagues, Kim Homer in particular, who's a USDA scientist, he and his colleagues went to China to look for native parasitoids there and they actually brought back two. He has a quarantine lab in Newark, Delaware. This is what they do as their expertise.

And so they need to, they have those, those two species in quarantine. They've been studying the biology to make sure the timing of the emergence coincides with the timing of lantern fly. You also need to make sure that if you're going to release this critter here, it's not going to take out our native insects. And so we have collaborators at University of Delaware who are rearing plant hoppers to test and make

sure there's a specificity. So generally it takes about 10 years to be able to have that kind of control strategy in place. And so it kind of, I guess the short answer to my question is, man, I don't know. Once we have the solutions, we just use them and we're done. But there's, it's kind of a long tunnel to get to that point.

And you don't want to put all of your eggs in one basket. You know, we need to try multiple things, you know, for those longterm solutions. So I hope, I hope any of these will work. But again, I don't know what happens at that point.

Beth Bamford:

Can you tell us a little bit about where you're at in this study? Are you close to making recommendations or having conclusions to it?

Julie Urban:

We have recommendations for insecticides that are, so basically we have data that formed the basis of the recommendations that are out in the different Penn State extension fact sheets for lantern fly. We have a study that's looking at trying to determine more precisely the impacts of spotted lantern fly feeding damage on grapes. And so in that particular study we have three year old grapevines that we were, that we planted in the ground at Manatawny Vineyard. And that's in Douglasville, Pennsylvania, which is within the quarantine area.

My lab planted these three year old vines in the ground. I have a PhD student, Erica Smyres, who built PVC and mesh enclosures around each and every plant. And we wanted to let those get established a bit. And so last year she took 20 of those plants and introduced either no lantern fly for a control or low, medium, and high levels of lantern fly, you know, two, six, 10 insects per vine and allowed them to feed. And then she and Michaela Centenary, who's a faculty member here who's a viticulturalist, took different samples of plant tissue and whatnot to determine physiologically what does that level of feeding doing to the plants.

Michaela, she's going to use instruments called dendrometers, essentially things you can hook up to the grapevine, and I'm not a plant physiologist here, but basically you can monitor changes to the phloem and xylem. So basically to the sap flow in the plant. And so we want to hook those up on the plant and see how the plant is responding when the lantern fly is feeding upon it. So I'm pretty excited about that.

And then working with another scientist here, Dr. Simperna Sitar, who studies what's called EPG, uses EPG recordings. So basically you can study the electrical signal emitted if you've run a, run a slight current through these insects, you can monitor their feeding behavior such that you can see differences in the waveform that tell you when the insect is walking, when it's tasting, when it's inserting its proboscis into the plant tissue, if it's feeding on phloem or if it's feeding on xylem. So phloem if you think about plants photosynthesize phloem, is the fluid that has the products of that photosynthesis in it. Those are the sugars. the xylem is like the upcoming water that's coming into the plant. So what we want to do ideally is hookup this EPG monitoring machine and the dendrometers so you can record exactly where the insect is tapping into different tissues in the plant and then see how the plant's responding. So I'm super excited about that.

And then my work, I'm looking at the bacterial endosymbiance of these insects and so they have organs that are made of bacteria, which some insects do, but plant hoppers are the only animals on the planet known to have a separate organ for each different species of bacterium they've co-evolved with. Most plant hoppers have two different bacterial species that they've co-evolved with. Lantern flies have a third, I'm describing that. And so we're looking to see what that does and see if we can interrupt the

transmission of those bacteria to the eggs. They have to pass them onto their offspring via egg. And if we can interrupt that transmission, that would be a really highly specific way to target lantern flies. So it's more basic research. But that's the stuff that the other main thrust of what I'm working on in my lab.

Beth Bamford:

So do you sleep ever?

Julie Urban:

No.

Beth Bamford:

It sounds like you are working on so many different things and so many different angles to either contain or solve the problem.

Julie Urban:

There's a big team of folks and that's been, I mean this has been really overwhelming and strange, but at the same time the group of folks at Penn State and then at USDA and whatnot who are working on this, are really dynamic. And what's been fun, especially at Penn State is, you know, I have two PhD students, I have a technician, I have, you know, working with Dr. Sitar and working with Charlie Masons and other post doc. There's all these young hungry scientists. Heather Leach is our spotted lantern fly extension associate. And she does a lot of extension work, but she's really integral in the research. And so it's been really neat to see. And what I've been trying to encourage are these early career scientists to like carve out their own piece and really run with it. And so that's been, it's been that enthusiasm that we see that really I think keeps the rest of us going. And so that's been super cool.

Beth Bamford:

Yeah. It sounds like, just based on this conversation, it sounds like you're probably pretty good at cultivating that passion within the people you work with.

Julie Urban:

It's just fun. I think we're just having, we're having fun. If you can stick wires on bugs, you know, and, and get electrical potentials through them and it's just kind of cool stuff.

In Southeastern Pennsylvania, the area where lantern fly occurs and it occurs pretty patchily, it's not, you know, in heavy infestation throughout this quarantine zone. But the quarantine zone is an area of now 14 counties where lantern fly has been detected and in some cases occurs in really high numbers. And so because the insects can easily be transported if they fly into your car or if they lay-

Be transported if they fly into your car or if they lay their eggs on your vehicle or whatnot. They're at high risk for long distance transport. And so because of that, and because Pennsylvania Department of Agriculture recognized that immediately, and USDA, they instituted a quarantine zone in order to basically regulate the movement of goods through and in and out of that zone to try to limit the spread of this insect.

PART 2 OF 3 ENDS [00:20:04]

Beth Bamford:

Has that been successful?

Julie Urban:

Well, the fact that... I mean the insect has spread somewhat, but given the potential for such long distance transport, it could have shown up in California, and Oregon, and whatnot, and it hasn't. And so if you look at, since 2014 when it was first detected and kind of step back here, to be at the numbers we were seeing in 2014, we expect that it had gotten here probably at least two years prior to that. And so the fact that this insect that can spread so easily through long distance transport, is still contained to this pretty localized area of Southeastern Pennsylvania I think is a good testament to the effectiveness of how USDA and PDA have tried to contain it.

There is a second established population in Winchester, Virginia, that was first detected in December, 2017. And that has spread somewhat. But again, we just have those two particular sites where there are known established populations of lantern fly. How this insect is regulated is a big challenge. Basically, there is a permit that businesses and even us at Penn State, working and moving through that area are required to get. And you get a hang tag after you go through a training, a training on how to restrict movement of spotted lantern fly. PDA has offered some of those trainings in person and then since Penn State has developed an online training module for it. I know that when certain commodities, for example, Christmas trees have been transported out of state, that New York has been concerned and wants to make sure that before those trees would cross the border in that particular case, that they've been inspected and are compliant and have no lantern fly.

And so, basically, by showing that businesses have gone through these steps to monitor and restrict movement of lantern fly, then that is something that makes surrounding states comfortable to still receive our goods. Because this has really huge trade implications. Beginning May 1st, the Pennsylvania police are going to work with PDA to begin to enforce the quarantine, the permitting. And so we'll see, potentially, trucks being pulled over and whatnot to be inspected for any evidence of lantern fly.

Beth Bamford:

When I think about trying to contain a pest and how small it is, it just seems fascinating that through all of these different methods that you're able to have strategies that really do reduce the chances of it spreading.

Julie Urban:

This insect because it feeds on so many things and it can lay its eggs anywhere and the egg cases are pretty cryptic. It's presented a huge challenge. So for example, I was attending a meeting, a couple of years ago at the Pennsylvania Department of Agriculture and there are a number of folks in the state who produce beehives for pollination services and ship them around the country. And so up until lantern fly, my understanding is that about 10% of those beehives would be inspected by the state to make sure that they didn't have mites and the bees were in good health. And with lantern fly, there's a recognition, "Oh no, we need to inspect 100% of any beehives leaving the state." Because if you have a lantern fly egg case on the bottom of some beehive that gets shipped out to an almond orchard in California, that's basically a Trojan horse.

And so this has just... You wouldn't think of it. There's so many ways this insect can move and so many businesses and commodities that have to be on alert for it. It's just remarkable. And that's why the economic impact of this thing is potentially so huge.

Beth Bamford:

You talked a little bit about insecticides and that was one way to kill lantern flies. Are there other ways to kill them?

Julie Urban:

Yes, which is great. So, basically these insects live one generation per year. And so how you kill them depends upon where you are in the calendar year. And so they lay their eggs in October and November, and those eggs are just dormant until they hatch in early May. And so at that time, what we've asked folks to do and what PDA and USDA have asked us to do is to scrape these egg masses.

So basically lantern flies will lay their eggs in a series of vertical rows that then get covered with mud. So they look like a mud, like smear, but you can see these seed-like dots in vertical rows and there's about 30 to 60 eggs in an egg case. And so USDA has little scraper cards. You scrape them into hand sanitizer or ethanol in a baggy and get rid of them. You want to make sure... The eggs are like hard seeds and you want to make sure that you kill them. So just disrupting the egg mass isn't enough to do it. And that's a pretty long window of time in terms of the calendar year from October, November to May. Certainly scraping egg masses is what anyone can do.

But part of the problem and part of the potential frustration is that these insects will lay their egg cases way out of reach. And so one of the things that we've been working on very recently is to do egg mass counts to try to estimate population size. And I mean we were out there Wednesday and so when you have an area that's really heavily infested with lantern fly, you can get hundreds of egg cases on one particular tree. And so scraping egg cases alone is just not, as the only means of control, isn't feasible. And we want to at least recognize that, because if you tell people, "Oh no, we're going to fix this by scraping egg cases." Anybody who sees that, they're going to think you're daft, you know? So this insect's a challenge.

Beth Bamford:

What is the one thing that we should remember after listening to this interview?

Julie Urban:

I would say keep your eyes open because this insect, because it tends to feed on so many different plants, if it's going to show up in an area, it's most likely to show up in kind of edgy, crummy habitat. It's not going to necessarily just show up on your prize grapes in your garden first. And so if you want to nip it in the bud, keep an eye out for little black insects that if you poke him in the rear and they hop, that's best way to tell what they are. They're fantastic jumpers. They have these really cool gears. It's just an impressive jumping ability to where it's almost difficult to see them move once they've disappeared. So if you see something that you wonder if it's a lantern fly, poke it and if it pops, it's what it is.

But keep an eye out in areas that are not your prize gardens, these edgy areas. And certainly if you're in an area like Center County and whatnot, that's not in the quarantine zone, report it. You'd report it to PDA or USDA, but we're all part of the same communication team. So call any of the numbers and the communication, the information will get communicated and a survey team can be sent out to see because we just need to know where it's moving.

Speaker 2:

Thank you for listening to Reach and a special thanks to Dr Julie Urban.

Cole Collin:

And don't forget, all the episodes of Reach can be found on our website. Please consider making a contribution to WPSU so that we can bring you content like this. Visit wpsu.org/donate. Thanks.

PART 3 OF 3 ENDS [00:29:03]