The Southern Fruitcast

Episode 15: Mating Disruptions and other Chlorpyrifos Alternatives with Dr. Doug Pfeiffer

[Intro] Thanks for tuning into the Southern Fruitcast. This podcast aims to cover the people, technology and latest developments at small fruit production in the Southeast. We are brought to you by the Southern Region Small Fruit Consortium and the University of Arkansas System Division of Agriculture.

[Cato] I'm Dr. Aaron Cato, extension specialist for Commercial Fruit and Vegetable IPM at the University of Arkansas.

[McWhirt] And I'm Dr. Amanda McWhirt, extension production specialist for fruits and vegetables, also at the University of Arkansas.

[McWhirt] All right. Welcome back to the Southern Fruitcast. Our guest today is Dr. Doug Pfeiffer. He's a professor and fruit entomologist at Virginia Tech. Doug works primarily with fruit IPM and ecological interactions in vineyard, small fruits, and orchard systems. Doug's recent research has focused on several invasive fruit insects, pests, including Spotted- wing drosophila and Spotted Lanternfly. He also works with mating disruption of lepidopteran pests such as grape root borer. Today, Doug is joining us to discuss control options for these pests, such as grape root borer, peach tree borer and a few of the other pests that he's currently working on. We're so glad to have you here with us today, Doug, on the Southern Fruitcast.

[Doug] Thank you. It's great to be here. I'm thankful for the invitation.

[Cato] Sounds good. And so let's jump right into it. And, you know, one thing that we've had a lot of questions about already this year is the recent banning of the chemical chlorpyrifos , the insecticide. Many growers have already kind of been moving away from clear chlorpyrifos, but it's been a mainstay, you know, in controlling some of these boring pests. And so, you know, with it being banned, what do you feel are the realistic options for grape growers, for grape root borer and maybe even peach grower for peach tree borer to try to manage these pest?

[Doug] Well, to answer the in the insects you ordered that you asked about in order grape root or I don't think much Lorsban was really going on for grape root borer in the first place. The pre-harvest interval was very long and it was hard to put that on in such a way to give good control and still meet the pre-harvest interval. So I don't think that's really much of an issue. It was the only insecticide that was labeled for that use. So it seems like that that would be a whole. But really mating disruption has been very effective for grape root borer. You know, we've had a reduction of more than 90% of exuviae of the pupal skins protruding from the ground using mating disruption. And it's safe and not disruptive in IPM program so that's really the way to go. Now, mating disruption works best in, you know, at least five-acre blocks and as evenly shaped as possible so that you could have a block that wasn't suitable for mating disruption. And then there might be other options, like a normal pathogenic nematodes or a groundcover management.

[Cato] Do you have any experience with that? With nematodes?

[Doug] Yes. Research has shown that a nematodes can be effective for grape root borer. For the only experience I have with it for that pest is trying to do a curative treatment, trying to inject nematodes deeper into the roots and that was not successful. So I think that, you know, to use them successfully would be a service treatment, sort of a preventative approach. And then it would be helpful to keep the ground moist with the irrigation because the nematodes are subject to desiccation.

[Cato] Yeah, I've seen some research, I think it was presented at the Southern Fruit Workers Conference where they are trying to do a little bit of almost like a drench application with a lot of water, kind of like you would do with a symbol like, you know, something like chlorpyrifos or bifenthrin. And they saw some pretty good efficacy with it.

[Doug] Yeah, that's right. And the thing is, if you look at reports of using nematodes for fruit pests, you know, there's some variability in results. But I think a lot of that could be accounted for by, you know, the nematodes drying out. You know, they need adequate moisture, but they can't tolerate standing water. So you just have to keep the soil moist, don't let it get, you know, very dry to give it a chance to survive.

[McWhirt] So, you know, for non entomologists that are listening to this podcast, can you go back and talk just a little bit more about the basics of mating disruption, you know, as far as what it is exactly and how it works kind of briefly.

[Doug] Sure, I'd be happy to. First of all, the way that the sexes get together naturally, the female moths release a plume of odor, of pheromones that attracts the males from distance. And the males, they don't really follow the concentration of the pheromone, but the pheromones stimulates them to fly upwind, and that tends to bring them to the source of the pheromones. The calling female. Well, with mating disruption, the pheromone is synthesized and put out and usually in hand-placed dispensers. There are some different formulations on different pests, but we'll talk about the hand place rope style dispensers. Now these are put out at, you know, 100 to 400 per acre, depending on the system. And that makes a fog of pheromones in the vineyard or orchard block. Now, this disorient the males. They're unable to find the calling females. There are several mechanisms that can work with mating disruption. And they're probably all in play in different systems or under different circumstances. One is a trail camouflage. You know, such a fog of pheromones that the males cannot pick out the natural plume of the calling females. Another is false trail following. Each dispenser is making its own plume and the males waste their time following those plumes instead of going to the calling female. Another is habituation or adaptation. And think of this as being in a room where there's a really strong smell. You walk into the room and you can smell it, but after 20 minutes or so, you can't smell it anymore. You know, the same thing can happen with these insects, you know? They just get so overwhelmed by the pheromone that they can't respond to it anymore. So there's evidence for all of those, and they're probably a multiple of those modes in play with any given insect. So that's how it works. The bottom line is the males don't reach the females, mating doesn't take place. And so there are no larvae resulting from that season's adults or that generation's adults.

[McWhirt] Yeah. That's great. Thanks so much, Doug.

[Cato] And one thing to add, we get a lot of questions. You know, when pheromones are or when mating disruption works, it's really effective and people can see it, you know, and understand it. And the question is, why don't we have this for every pest? And so the idea is that these moths primarily rely on pheromones to find each other, find opposite sexes. And so that's why what makes it so effective.

[Doug] Right. And, you know, the lepidopteran sex hormones are the best known. They've been research for the longest. There are certainly other insects that use pheromones. And this is just beginning to produce mating disruption tactics for mealybugs in vineyards, for example. You know, this is much earlier in development compared to the lepidopteran pheromones, but there are beetles that use pheromones. There are, you know, homoptera and hemiptera that use pheromones. It's just a matter of identifying it and then figuring out how to interrupt the cycle. You know, it's tougher

if the insects are all in a very tightly packed population, like in scale insects. You know, the males don't have to fly very far in the first place to find the females. But even there, you know, there's research being done, on mating disruption on scale insects. So there's certain factors that make it more difficult, but they don't always rule out the use of the approach.

[Cato] Right. And so another question I think that we'd probably need to answer is, you know, when do you start putting out these pheromone tags or the pheromone ropes or whatever.

[Doug] That you would want to put them out - I guess the same way that you would put out pheromones traps, which, you know, more people have experience with. You want to have them out before the males become active, but not really early because you don't want to waste the pheromone, you know, when the adults aren't active. So, you know, if you put them out a few days or a week before the anticipated emergence that, you know, that's preferred, you know, if you're a little bit late, you're still preventing matings. But some matings could already have taken place by the time you get it out. So aim for the appearance of the males of that species. And if growers if they're if they've been used to using pheromone traps and they'll have in their records when those insects become active, otherwise they could ask a company agent or a fruit specialist and find out when the males become active for that species in their area.

[Cato] Yeah. And that's going to vary pretty wildly, you know, up to you in Virginia, especially down into Georgia or somewhere like that.

[Doug] It will you can't use simple calendar dates for that. So, you know, just based on your experience or the experience of others, you know, place them out soon before the adults become active. And a lot of these preparations work season long. So you only have to do it, put it out at one time. So you know that that's a help.

[McWhirt] Yeah. So it's kind of following up on the logistics of how do you do it? You know, can you give some general guidelines or, you know, talk a little bit about as far as how many pheromone tags you need in a planting or estimated number per acre? And you already kind of answered that some of them may be season long, but how many do you put out there?

[Doug] For codling moth on Apple, you know, maybe 400 per acre. But on the peach borers, it's generally 150 to 250 per acre. Sometimes you'll see on the on the label, you know, one per tree. That kind of depends on the spacing of the trees. So what I do is I, you know, figure out the trees per acre and then I just do the math to figure out how

many dispensers per tree or how many trees per dispenser, you know, depending on the spacing. Maybe you put it about every tree and maybe you put them out every, you know, every three trees and skip a tree. You know, just so overall, the five acre or more block, the averages say 200 per acre, 150 to 250. Now, if the population is high, there's high pest pressure, then you should use the upper end of that range around 250 dispensers per acre. You can ease back if it is a lower population density and you can get an idea of that by previously making exuvia counts looking at to see what the average number exuvia per tree is.

[Cato] So I just - to talk a little bit about the biology of the pest. So say you employ this tactic, do you expect to get that 90% suppression of the pupal skins, exuvia within a year? Or, you know, what? What's the outlook on some kind of this?

[Doug] It should work right away. You know, in our trials we – well, first of all, for researchers one way of. As the first line of information to find out if it's working is you put conventional pheromone traps out in the fruit planting – the orchard or the vineyard. And if the mating disruption is working, then you should be able to find no males in the traps just like they can't find the calling female. They shouldn't be able to find the pheromone trap. So that's the first line of defense. So, you know, in our experience and in most cases, we're catching no males in the traps. So that's a good clue that we're disrupting the ability of the males to find the females. And that happens right away. As soon as the dispensers are out, you see that. And when we were doing mating disruption for lesser Peachtree Bore, we didn't have the dispensers in time for the first generation of the first year, but we placed them in time for the second generation. And we had 100% trap shutdown in the borer block in the in the where we had the dispensers. And then the following year we had, you know, subsequent generations. We got no males in the in the treated block. And so for those three disrupted generations, we had equally low numbers of exuvia per tree compared relative to the lorsban because it was lower than the mechanical control block. So it's actually more effective than chlorpyrifos. And the reduction happened in the first post disruption generation. So the effect can be rapid. Yeah, it kind of depends on the on the pest. So codling moth Apple is a tougher one to disrupt. So, you know, you may have to work it down to the low levels over time. But for oriental fruit moth was the borers and peach that happened very fast. Now, one thing to remember, it's not going to do anything about any larvae either in the tree already. You know, it's not toxic and certainly doesn't get the larvae in in the wood. So if you have a damaging population, well, there's nothing you can really do about that. But then there was nothing you could do about that using insecticides either. You know, you just have to wait for them to come out and

address the future generations. With in general, with mating disruption systems. If it's a very high population, you may have to use insecticides in the beginning to help bring the population down. You know, that wasn't our experience in the peach borers or oriental fruit moth, but it does seem to help with codling moth. You know, when we first did codling moth disruption in apples. I, I first hoped that mating disruption would take over for all the codling moth control. So from I had the grower spray through petal fall and from first cover on just relied on mating disruption. Well, it was variable, the results were variable. And so from then on I, I recommended using insecticide for first cover to help bring the population down and then try to rely on mating disruption after that. So it depends on the crop and the pest did to some degree, but the chances of success for the peach borers is very high, know it's a very effective system and it was very effective for grape root borer as well.

[Cato] And so kind of in the same vein for a grape root borer and peach and greater peachy borer, we know we have growers that have it and some that don't. It seems like it can be pretty spotty. And so, you know, is there some kind of threshold that you all kind of looked into for, you know, initial pheromone trap catches when you start using a mating description or just kind of if you're getting them and you're seeing damage, you should be using it.

[Doug] Well. That's also a tricky question because with mating disruption, it works best at low to moderate populations. And so, you know, I think it's a if it's a pest that you're likely to have, then you should start doing it preventatively before you reach a threshold population. You know, it's a the question comes up whether or not these are insecticides and they're not an insecticide the way we are used to thinking about that. So we don't wait for a threshold to occur before we start using it. You want to be in advance of the population. As far as EPA goes, these are insecticides. You know, if you use pheromones in a monitoring trap, it doesn't need EPA or a label. It's not an insecticide. But the way FIFRA (federal insecticide, fungicide, and rodenticide act) defines insecticide, it's anything that kills pests or mitigates their damage. And so even though it's not killing anything, these are considered insecticides. And before we could recommend them, we had to wait for them to have an EPA label. But so that they are insecticides in that sense. But, you know, they really work best preventatively. And so, you know, you wouldn't wait for a threshold. And in general, mating disruption works best at low to moderate populations because there are fewer females calling and fewer males to find them. The chances of a failure are higher if it's a very high population. So if you have a very high population, you should just watch it. And you know, you may have to supplement with insecticides. You know, at first.

[McWhirt] You know, those numbers, though, that you're quoting as far as how efficacious this is, are really exciting. And, you know, I probably for a lot of growers, they're now thinking, okay, this is something that I can use that's going to work, but how much is it going to cost me? Do you have any ideas on, you know, generalities of cost per acre for some of these things?

[Doug] I guess, to take what I'm about to say with a grain of salt, because, you know, for the borers, it seems to me it was around, you know, $45 or $50 an acre for the for the dispensers. And so you're codling moth that was higher. That was a little bit more than $100 per acre for the dispensers. Again, you know, I would check with your supplier because, you know, prices are always subject to negotiation. And also with the inflation that we've had lately, you know, and I don't know what the if the supply chain has disrupted the dispensers at all. But keep in mind, for the peach borers, that's one time of year and you don't have to spray for them thereafter. It's not disruptive, so you don't have to worry about flaring natural enemies. It's safer for applicators. So there is benefit to all of those. Though there is a labor cost, you know, you can put these on. Once you get the technique down, you can go almost at walking speed. You know, don't you have to slow down a little bit with the tree. But they go on very quickly and you develop a pattern and you can get them on. You know, a couple of people treating a five-acre block doesn't take all that long. And again, it's once a year instead of having to spray for them. And yet remember that with the borer sprays, if it's done right, that's a two-person job anyway. So you know, you're doing handgun one person by the tractor, one, to aim the gun. So that's a special spray that's just going on for borers. It's you know, it's relatively hazardous because the applicator is in very close proximity to the spray. And so, you know, I think it's really in terms of the cost, it's worthwhile not only for the control of the insect, but the minimizing risk to farm workers and, you know, beneficial species in the orchard.

[Cato] Yeah. I think, you know, we've had discussions with some of the growers here in Arkansas that talk about how much they have to do to suit up and carefully even put out that chlorpyrifos application when they do it in their peaches. And so, you know, it's not, -

[Doug] - you know, one thing about the risk. You know, I said that these are nontoxic and they generally are. Some of them are eye irritants. And so if you're doing this, the label recommends using wearing gloves. And I support that because, you know, if you get it on your hands or you touch your eye, it's just going to sting for a while. You know, it's not dangerous, but you're smart for a little while if you if you get it in there. But it's so I, you know, definitely wear gloves.

[Cato] Yeah. It's hot part of the year. So people are always wiping around their eyes. And so just kind of, you know, you talked a little bit about where you can find them. Is there any online sources that all kind of lean on for these kinds of pheromones?

[Doug] I'm sorry. Say that again.

[Cato] Any online sources that growers can maybe look for?

[Doug] My source has always been Pacific Bio Control. They are online and you can have them shipped. Unfortunately, the person the technical rep and sales rep that I've used for years is just retired last year and so I don't have a contact person but go to the website for Pacific Bio Control and you can get information there. Otherwise you could talk with your normal pesticide dealer and see if they can get them.

[Cato] Okay. Yeah. I didn't know if, like, there's like the Great Lakes IPM or people like that sold it or.

[Doug] They have pheromone traps. I didn't see the rope dispensers there, but maybe I was just missing them. But, you know, they're a very good one. Stop shopping for quite a few of our IBM supplies.

[Cato] Okay, and when you've bought them in the past, is this the kind of thing that you need to get on top of buying it early? Can growers stockpile them? So maybe if they're going to plan on using it for three years, can you stock – buy a bunch of and then store them?

[Doug] The rule of thumb I use is, you know, you store for a year in refrigeration that should always be refrigerated just to stabilize them, keep them from volatilizing. But, you know, I wouldn't worry about keeping them in refrigeration for an additional year. I'd be cautious about going, you know, three years or so. So but again, talk with a tech rep and see if they have any new information on that.

[McWhirt] So, you know, this is all really great information. But if this is not an option for someone, for whatever reason, are there any alternatives to the pheromone tags?

[Doug] Yeah, that depends. Obviously, the most effective insecticides for the borers are gone, though. We had a chlorpyrifos and endosulfan earlier. They're both gone. for a lesser peach tree borer. You may see recommendations for pyrethroids at the time the adults are flying in that first generation and that can be effective as well. Pyrethroids, you know, we try to minimize that in the short term because they're so toxic to natural enemies. So you know that that could be avoided if you're trying to do rely on biological control. But that's the main chemical alternative and for lesser Peachtree Bore.

Entomopathogenic nematodes have been shown to be quite effective, at least as effective as chemical control for a Peachtree borer which is living down by the ground line. And I've seen studies both curative and preventative use of nematodes for Peachtree borer. So that is a good option and that would not depend on the block size or the shape of the block, the way mating disruption does. There was another study I saw for a lesser Peachtree borer, which was promising but not commercial yet. You know, the nematodes would have to be applied in some type of protective matrix to keep them from drying out and dying up on the tree. The trees since, you know, those are Peachtree borers up on the scaffold limbs of the tree.

[Cato] Mm hmm. And I guess that kind of goes back to conventional versus organic production. You know, there's no good pyrethrin, you know. But it seems like it'd be a lot of applications of pyrethrin trying to get a –

[Doug] Well, that's right. And in some cases, you know, well, actually, several of the purposes we're talking about now is kind of where organic and conventional meet, you know, because your mating disruption is generally approved in organic systems. And it's the way to go for, you know, even non-organic growers. So some of our tools cross the boundaries and the same would be true for endo pathogenic nematodes. Now regarding certification for organic, it's always a good idea to talk with your certifier to see what's applied because I've seen differences of opinion among certifiers were mating disruption is acceptable and even use of pheromone traps is accessible. So always talk about it ahead of time with your certifier if you're going for organic certification.

[Cato] Well, yeah, I don't I don't know if there's going to be any organics. There are too many successful organic peaches or grapes in Arkansas without at least pheromone traps or mating disruption. You know, we already don't have a two to a minimum of an environment –

[Doug] I know it's you know, organic growers more than anybody are relying on biological information. And that's the first line of information for the activity of some of these pests.

[Cato] Right. Well, I think we've run the gambit on. Lesser Peachtree borer, Greater Peachtree borer, and there are other borer. So another you know, insect pest that I saw that you worked some with at least spotted lanternfly. And you know, we don't have it here in Arkansas yet. I know there are some indications of whether or not it will move across the states or whatnot. Could you tell us a little bit more about what y'all are dealing with currently in Virginia with Spotted Lanternfly?

[Doug] Yeah. We're still in the early stages in Virginia. Spotted Lanternfly is a plant hopper that was introduced from China into Pennsylvania in 2014. Each year thereafter, there was steady growth expansion of its range. We found it in Northern Virginia in January 2018. And so since we found egg masses and adults and dead adults, we knew that it had to be here at least as far back as 2017. So it's been expanding. Right now, it's the most intense population is our three county area in northern Virginia. Those three counties are under quarantine, set up by VDACS, Virginia, Department of Agriculture and Consumer Services. But it's present in about 15 counties in an independent city. Now, in Virginia, it's most common in the lower or northern Shenandoah Valley. In the northern Piedmont. We have infested counties in the Upper Shenandoah Valley and in the Central Piedmont - more limited infestations. And we have even some small infestations in the city of Lynchburg and in Carroll County, which is on the North Carolina line. So it seems to be following avenues of transportation, rail beds, interstate highway. It's a known hitchhiker – both the adults in the nymphs and they lay eggs on vehicles. And so there's a real risk of human assisted transportation, and we're seeing that. But railroad beds. Not only will the insects hitchhike on trains, but the rail beds tend to be lined to a good extent with the tree of heaven, which is a preferred host tree. So it's ideal for export of spotted lantern flies in a couple of ways and we're seeing that play out. So it's spreading. Last year we have the first lanternfly at a commercial vineyard and this year we had lanternfly in four vineyards. So following the pattern in Pennsylvania and New Jersey, a year or two after the first occurrence, it kind of just exploded in very high numbers in a vineyard. And so we're expecting that this coming year we may see started to see some economic impact of a spotted lanternfly. Now, lanternfly feeds on more than 70 different host plants. The host range is widest in the young nymphs. As the nymphs age, the host range constricts and the last instar and the adults in particular go heavily towards tree of Heaven and grapevines. Grape is by far the most vulnerable crop for spotted lanternfly. In Pennsylvania, there was a tripling of insecticide use. Once spotted Lanternfly hit their vineyards and they still had dramatic reductions in yield. Some vineyard blocks had vines killed either outright by the feeding of the lanternfly or a reduction in cold hardiness for the winter. So it's potentially an extremely dangerous pest for vineyards. There's still research going on to look at the impact on small fruit crops, orchards, hops, for example. But we know the grape is very vulnerable. So that's where that stands now. In addition to following the spread, we're doing work using endo pathogenic fungi and other potential oversights. And so in the egg stage for eight months of the year, you know, that seems like it would be a good approach. So we're looking at efficacy of ovicides applied in the early in the overwintering period versus late in the overwintering period. And people in

Pennsylvania have been doing all kinds of research as well since they've been bearing the brunt at first for this insect. So it'll be a major research focus for us, for the –

[Cato] Lucky to have Pennsylvania State being so small fruit and horticulture focus throughout there at that near the epicenter. And, you know, you know, we're here much further, I guess, south and west of y'all. And, you know, there's a lot of people directly south of you that are really wondering, you know, where to how far do we think this is going to go? And, you know, there's been two conflicting models that I've seen, one that says the southeast is better for spotted lanternfly and then a newer one that said they don't like the heat so much. So what do you all think is the reality?

[Doug] Well, that's sort of the big question right now. You know, so, yeah, there was one map that was published a year a little bit more ago that showing that the most intense based on weather and our understandings of the requirements of the insect. So far, the most intense area is southern New England, down through Virginia, North Carolina to the Carolinas and west in a bend. It's medium suitability. And then the Gulf Coast states are your lower suitability, probably, probably because of the heat. But you have to remember that, you know, this find in Pennsylvania was the first time it had ever been recorded outside of Asia. And so we don't know what the ultimate range will be or how the insect can adapt and become suited for additional conditions. So we're all waiting to see that. But right now, I think it will be in a you know, in Virginia, certainly it's still in the red zone. The most problematic. It'll be less of an issue, but probably still an issue on grapes in the middle zone. And we'll just have to wait and see in the Gulf Coast, the Gulf tier of states.

[Cato] I know we spent all summer looking for Tree of Heaven as we drove around. And it's absolutely everywhere in Arkansas. And I'm sure it's the same in a lot of the other states in the Southeast. But, you know, our Department of Ag kind of, you know, came at us with the same questions like how do we even look for and, so, find Tree of Heaven near railroad sites or, you know, just railroads, I mean, it seems like that's going to be the way it gets here if it does. But just, -

[Doug] - you know, if you have tree of heavens and then look on various trees and rocks and things like that near the stand of Tree of Heaven, they don't limit their opposition to Tree of Heaven. And so they'll lay their eggs on inanimate objects, which could be a mode of transportation as well. And another tool that we have is trying to eliminate Tree of Heaven. You know, part of the eradication program or the slow the spread program is a trap tree approach. The property to remove Tree of Heaven of small trees under six inches DBH and leave some of the larger trees and then treat those trees

with dinotefuran. And so then when the adults return to those Tree of Heaven in the fall, they pick up the pesticide and die. And that does kill a lot of lantern flies. Well, there's an important caution. If you're trying to remove a Tree of Heaven from your property, don't just cut it down because it sprouts profusely from stumps and roots. And in a couple of vineyards where I've seen the growers simply cut down the trees, they end up with a thick stand of young, vigorous, growing Tree of Heaven. It has to be followed with the herbicide.

[Cato] Yeah, Arkansas just went through and did a lot of widening of the area near our interstates. And so we now have a lot of thick stands of Tree of Heaven lining our interstates.

[Doug] Right. Right. So, yeah, it's it helps in a very short term, but it ends up being counterproductive.

[McWhirt] Well, Doug, I really appreciate you joining us today on the Southern Fruit Cast. I know I learned a lot. And we appreciate you coming on and sharing your expertise with us.

[Doug] Well, thanks and I look forward to talking with you later.

[Cato] Yeah. See you, Doug.

[Music]

[Outro-Cato] Thanks for tuning into the Southern Fruitcast. Our episodes are hosted by Pod Bean and also can be accessed on the University of Arkansas Extension website at uaex.uada.edu/southernfruitcast . Here you can see all of our episodes and provide us feedback to [help shape future episodes of this podcast.

[Outro-Mcwhirt] We'd again like to thank the Southern Region Small Fruit Consortium for funding this podcast. The consortium provides a large library of production and integrated pest management resources at smallfruits.org . We'll be back again soon with more updates on t Southeast small fruit industry and interviews with researchers, specialists, and farmers from across the country.