Weeds AR Wild Series, S3 Ep2. Inversions

[00:01] Intro/Outro
Arkansas Row Crops Radio: Providing up to date information and timely recommendations on row crop production in Arkansas.

[00:11] Tommy Butts
Welcome to the Weeds AR Wild podcast series as a part of Arkansas Road Crop Radio. My name is Tommy Butts, extension weed scientist for the University of Arkansas System Division of Agriculture. And thank you to everyone for joining us again for the second episode of season three here at the Weeds AR wild podcast. Today, I have the honor of working with Dr. Joe Ikley. He's an assistant professor, extension weed specialist at North Dakota State University. Joe, do you just want to say hi and maybe tell us a little bit about yourself.

[00:43] Joe Ikley
Yes, thanks for having me on, Tommy. So, again, Joe Ikley here from North Dakota State University. I've been here since December 31st of 2018. And so for me to get into this a little bit here in a minute, but my first day at work was a ground blizzard, which was a new terminology, new event to me. So prior to getting here at NDSU, I got my Ph.D. at Purdue, so spent several years in Indiana with research and then a couple of full time positions as a research specialist and an extension specialist there. But then so once I got up here to NDSU, basically here I've got extension or statewide extension responsibility for all crops except for two, sugar beet and potato. I don't have to touch those two crops. That just leaves 20 some other crops that I have to answer questions on. For specifically, though, for research, my main focus is corn, soybean and then dry edible beans. So we typically have other weed scientists that conduct research on all those other 20 or so crops that we have across the state.

[01:49] Tommy Butts
No, that's awesome. So I'm really glad that you're able to join us today. And, you know, just for some of our listeners, you might be wondering why I've got, you know, a North Dakota individual on today. Well, for a couple of reasons. One, I just wanted to make us all feel a little bit better about our current weather situation. So, Joe, do you want to just give us an update on what the weather looks like up there in North Dakota?

[02:11] Joe Ikley
Yeah, I was probably the only one you asked who has time because we're not out in the field right now doing some sort of research. So this is a recording here on the 22nd of March, and we got a fresh six inches of snow last night. And so actually saw we're at a record for March 27th for snow depth. So we've got 24 inches right now packed in. So we're still, you know, some March's we might be thinking about planting right about now, but life in the northern plains, we're currently a day, I believe, 133 in a row below 40 degrees. So since November 9th, until we're there's still nothing in the forecast. So we might make it to April of not having the day hit

40 degrees here in Fargo. So still a while before we'll be spraying and worry about some of the things we'll be talking about today. But again, that that's kind of life up here.

[03:04] Tommy Butts
Yeah, that's so that's crazy. So we were all just, you know, going through our freezing spell where we were dire cold. And it's because we, you know, broke freezing the last few days. So we had, you know, highs just above 35 or so and, you know, going down below freezing at night. And that was terrible for us. And now today, I looked at the weather a little bit ago, and we're 75 today. So we're you know, we're back living the life of luxury right now.

[03:26] Joe Ikley
That's a nice June weather you've got there. Yeah.

[03:31] Tommy Butts
Well, yeah, See, that's where the tradeoff happens, though. Then in the middle of summer, when it's, you know, 95, 100 and we're in 100% humidity, flooded rice field, you know, that's when I am missing the north because that's killer on in the middle of summer. But right now it's pretty nice, I like it. So, but anyway so just kind of speaking about weather honestly that was the topic that I really wanted to hit on today. And this is why, you know, I invited in Joe to be in on this podcast was I really wanted to hit on inversions and talking about that and how those impact our applications and things and what we need to watch out for. And Joe really has a lot of expertise on the inversion side of things, both from some of his research as well as is North Dakota is one of the leaders on kind of inversion research and things. So I wanted to have him on just to help talk about this whole process and how we can do better with our applications moving forward. So really right off the top, Joe, you know, I just wanted to turn it over and can you just give me, you know, kind of a rundown and give our listeners a rundown on, you know, what inversions are and you know, how we measure them and that kind of stuff.

[04:34] Joe Ikley
Yeah. So, you know, temperature inversions is probably one of these things that many of us didn't think about until it became part of our daily vernacular back in 2017 or so. So that that launch year of Xtend Soybeans, we started talking a lot about temperature inversions and and why it's bad to be applying pesticides during those inversions. And so that's probably the first time a lot of soybeans, I'll include cotton country too, but were exposed to that terminology at least for folks like you and I in the weed science world and and certainly those who are making ground applications.

[05:08] Tommy Butts
I was just going to say and I would emphasize the ground applications, the aerial guys have known about inversions a long time because it messes with their flight patterns. So the aerial guys are really, honestly way more advanced on on all of us when it comes to inversions compared to ground guys. Now, that's not saying that we don't have aerial applications going out as inversions. So that's a different story. But they've at least, like you said, known a lot about

them a lot longer than than a lot of our ground guys. And even us as weed scientists really dealt with it.

[05:32] Joe Ikley
Yeah, and that's exactly the point I was going to make, is I think some of the aerial guys were kind of laughing probably in back then five or six years ago. So like, what's what's the new deal with this? You know, we we know about inversions. I think that's one of the reasons why appeared in NDSU, predating my time here. There's been a lot of research on inversions because similar to what you have, we have quite a bit of aerial applicators and these are things you want to see flight and to do a good job making an application. They they have to know these things. And so then it really became in the ground application world, what the heck is this temperature inversion everyone's all of a sudden now talking about as as we went there and through, let's see, 2017 to 2018 winter training season, that's when we all got exposed to it. And probably sick of the word.

[06:18] Tommy Butts
That's right, 100%.

[06:20] Joe Ikley
But but yeah. So getting back to your basic point of what is a temperature inversion and again, I'm not a trained meteorologist, I try to simplify things and that always helps me think about things. So a true meteorologist might might kill me for getting some of the technical or terminology a little bit incorrect. But again, we're here to simplify things, help explain things. That's our job here in extension. And so that the way that I think about this is in a normal atmosphere condition, the higher you go into the atmosphere, the colder the air gets. And so maybe for for folks who are seeing what's going on in California with the weather right now, you always see in the backdrops where they talk about the mountain snow and then rain down at lower elevations. Why is it snowed in the mountains and then raining at lower elevations? The higher you go, the colder it gets. So that's a pretty easy concept for us all to to really think about. But then when we think about temperature inversions, at some level in the atmosphere, we're going to have a layer of of hotter air above some colder air. And so that's the general concept. This this does occur in, I guess, nature in the atmosphere. It occurs probably somewhere in the atmosphere every day, you know, somewhere if we go from here up to outer space. And we see this, I'm sure you guys deal with freezing rain during the winter. That's, you know, probably now the temperature inversion that we're talking about, but that's hotter air over colder air. So it's whatever is falling from the sky, turns liquid, hits some cold, colder air, the ground and freezes probably. That's not the temperature inversions we're talking about with the concept of hotter air above colder air. For our purposes, it's really when we go in much closer to the ground, when we talk about temperature inversions as it relates to spray drift. And that's in the in the magnitude of of 10 to 30 feet. What the measure on weather stations, you know, 3 to 10 meters where we have at that ten meter or 30, sorry, three meter or ten meter or ten feet versus 30 feet warmer air at that level compared to at the ground level. And so really, as we've studied inversions in a lot more depth over the last five or six years in the weed science world, we typically have a temperature probe at about three feet and then one at about ten feet. And

once we have warmer air at ten feet over three feet, that's typically when we have for ground rig applications, a temperature inversion that we would have to worry about. So just the basics of having that hotter air over the colder air and the kind of where we're looking at in the atmosphere for our purposes.

[09:07] Tommy Butts
So you mentioned, you know, that these can occur basically, you know, almost every day somewhere, you know, within the atmosphere can kind of occur somewhere every day. But not, you know, when we're talking measuring between three or ten feet or, you know, let's say even for our aerial guys, since we both deal with a lot of aerial applications at ten to thirty feet, you know, is there a rough estimate, you know, how many you know, how many days out of the year or how much time that we actually have an inversion, say, for, you know, that 3 to 10 feet or in that 10 to 30 feet, how how often or how frequently does that actually occur throughout the year?

[09:39] Joe Ikley
And that's where it's really nice to know your local meteorological people or those who measure it locally, because I think it does change in different areas across the U.S. So if I think about up here in North Dakota, it's almost daily. So it's specifically in the summer and during spray season. As long as we don't have some sort of weather front coming through where the winds are blowing tremendously or, you know, very high winds throughout the night, we typically will get a temperature inversion, probably a little bit different during the winter. But again, for my purposes when I think temperature inversions, I think in the spray season and that's kind of the data that I'm accustomed with.

[10:21] Tommy Butts
That makes sense. I was going to say. So, you know, as you move south, does that tend to, you know, occur less just because we're already hotter? Does it occur more? What, is there a general trend on any of that kind of front?

[10:33] Joe Ikley
Yeah, for the things that I've seen, when we go like from North Dakota further south within the Great Plains, I don't think it changes that much. So we're we're dealing with a lot of flat geography, which probably will lead to us being pretty similar from north to south, even though we have a range of temperatures throughout the day. I think it's when you get into more hilly environments or get a lot more trees involved, other terrain features that could change. And again, that's where I'm I'm not too versed in different areas of the U.S., but at least within the Great Plains, it does seem to be almost daily, despite the fact that Kansas might be 100 degrees every day and we might be 80 to 90.

[11:13] Tommy Butts
Yeah, well, that I mean that like the geography you're describing makes a lot of sense for us in Arkansas, too, because, you know, a lot of our our arable land is very flat. You know, we're Delta, Delta soil type land. But then we also have a formation called Crowley's Ridge that goes up kind

of eastern part of our state. And it's kind of like a, it's like a plateau almost. And then it drops off and you go into the river valley right next to it, you know, over there like Mississippi, Crittenden, Poinsett, and Craighead counties kind of thing. And that's where a lot of our, you know, initial troubles, you know, with inversions, whether it was, you know, 2,4-D, dicamba, you know, any of these things really kind of happen over there and it kind of fits with what you're saying because it's this low lying area. You've got this plateau and then all of a sudden it just kind of drops off and it's super flat, right? And you're just right into the river valley. And so it kind of fits that that terrain of Arkansas is kind of matching with what you're seeing with North Dakota. So that's just really interesting.

[12:04] Joe Ikley
Yeah. And you're probably not helped by having that that higher environment that drops off because the other thing that, you know, how do we get cold air towards the ground. And another thing that we can all kind of easily imagine is cold air is denser than hot air. And so if you have areas where cold air can roll off of some terrain feature, then you can certainly get cold air pooling down in different areas. And so you might have, you know, cold air coming off that plateau and then flooding into that flat area. So we certainly see this if we do have low spots and fields or if we're near a body of water, particularly rivers, you can usually see this cold air drainage. So if you have temperature probes out there, you can certainly measure it. If you have pesticide drift sprayed into a temperature inversion, which I know we'll get into more of that here in a minute, we can kind of follow the low lying areas oftentimes for symptomology as that cold air drainage will bring whatever air particles along with it into these lower areas as that dense air is trying to go to an even lower area.

[13:04] Tommy Butts
No, that's that's really that's really great information to have to help explain kind of what's where that stuff is and what's going on. So I'm glad glad you were able to share that and kind of tie it together with with what our geography looks like. That's awesome. So we talked about, you know, measuring, you know, kind of the different heights for our our applications where it's important to measure those temperature things, you know, and just kind of what an inversion is. But you want to just hit on a little bit, too, then, you know, again, rolling more into the applications like we're talking about, why is it so important that we actually, you know, know where these inversions are? How often they're occurring, that kind of stuff? Why is it important to to to know and talk about these in more detail?

[13:41] Joe Ikley
Yeah. And so the other probably very important part I haven't mentioned yet, when we think about temperature inversions, again as it relates to to ground applications of pesticides is there's also they're also usually associated with a very stable air mass. And so it's like I mentioned, if we have a strong front coming through or the winds are blowing all night, we won't have an inversion set in most of the time. And the way to think about that is we have in high wind conditions, the air is very turbulent. There's a lot of tumbling and mixing of the air. So it's very hard for that warmer air to settle in and kind of lock in the colder air below it. If you have this these stable air masses and there's not a whole lot of turbulence and other things that

that's when this area, it's just very stagnant, as if you're close to the river. You probably know about those stagnant evenings where it's just oppressive almost, no air movement and that becomes a problem for pesticides, too. So we can think of that stagnant air and just how it doesn't feel good to us. But when there's not a lot of movement, then we'll typically, that's when we have small driftable fines of spray particles can stay suspended in that stable air as well. And so there's a whole lot of good information out there about how long it takes for a drop of a certain size to, for instance, fall from ten feet down to the ground. And some of our drifts will find might on a more typical time might be 10, 20, 30 minutes, depending on the size of that droplet. When the stable atmosphere conditions within that temperature inversion, it may take even longer. But let's just say 30 minutes, we'll just use that just do some simple math here. And so if you have a typical droplet that takes 2 seconds to fall, a large droplet takes 2 seconds from the nozzle to hit the target and a ten mile per hour wind, you can kind of calculate out how far that's going to go. If we think about this from that inversion standpoint, a small droplet that takes 30 minutes to hit the ground. If you have a one or two mile per hour winds, that is not dead calm during these inversions, we often have some amount of wind. We can have that suspended droplet for 30 minutes, likely a lot longer, to be honest with some of these droplets. So they can move miles, in these inversions because it's it's remained stable, elevated in the that ten feet or so above the ground and with some sort of wind, you can just kind of calculate it out a three mile per hour wind, which is typical. We can have that during an inversion half hour. If it takes a drop to fall, do the math and we can move some droplets, miles versus in an over windier condition with larger droplets. Yeah, we can certainly move product a half mile for doing things really wrong. But with these inversions, those fine droplets just take so long to hit the ground. That's when we're talking some very long distance movement of particles.

[16:42] Tommy Butts
Yeah, and that's that's an excellent point to make, because I know, like you said, we can do some things really wrong and have a physical drift event, you know, go pretty far. But but the events where you have it, where it travel, I mean, miles upon miles, it's almost always where somehow it got dropped into an inversion and it just hung there and went where it went, you know, and it just stayed in the air forever. So, yeah, that's that's that's an important note to make on just how far some of that can travel. I mean, because it's kind of it's really as long as that temperature inversion holds, those droplets are going to sit there. They ain't going to drop out until that inversion breaks. And so trying, you know, I mean, that's you know, that could be, you know, like you said, maybe 30 minutes, it could be hours on end that it's just hung there, so that that really can affect distance traveled in a hurry.

[17:27] Joe Ikley
But yeah and some of the some of the longer distance drift events I've had to work with up here, it's usually something like paraquat sprayed during an inversion for various reasons. And that's when I'm talking miles. Yeah. And so and that's also a very obvious symptomology. So it's somewhat easy to track. Then when the symptoms run out, you kind of realize that's okay. That's when the drift event ended. But I've seen paraquat do an inversion kind of funnel through an opening in some trees and they expand back out. And so it's pretty unpredictable,

too, of where these droplets are going to go if they're if they're hanging up in that atmosphere during an inversion. And that's that sort of becomes a lot more difficult to even predict drift okay. If the wind's blowing high during one direction, do something's wrong. We kind of know where we're drifting. Not always is easy to predict during an inversion.

[18:21] Tommy Butts
Yeah, I've actually said that a lot. That, like, if I was talking to applicators, I'd almost rather err on the side that I'm a little bit windier versus less wind and potentially an inversion because at least like you just said, when it's windier. Well, you know, right where everything's going, I mean, you can track it, you can try and do some stuff to manage it, whatever. If you you know, if you drop into an inversion, you really don't know where that stuff's going to go because there's that slight one, two, three mile an hour wind can just kind of swirl, change directions. Like you said, it can, you know, narrow in and then span back out. I mean, it just you don't know where it's going. And so I've always said that it's almost a little bit better to err on the higher side, more than it is the lower side because of that unknown potential.

[18:59] Joe Ikley
It's at least more predictable. I mean, so, you know, we never want to drift it. If I'm just thinking from an efficacy standpoint because that's less product hitting the weeds we want to kill. But, you know, if I'm if I'm spraying into my own crop and the wind blowing towards my own crop, it I don't care. That's a little bit more predictable. But if I'm, you know, surrounded by some other neighbors and that wind can shift very rapidly and these low wind events during inversions and just becomes a lot less predictable where there's particles are going to end up.

[19:29] Tommy Butts
Yeah, no, that's awesome info. Just couple of questions because I get these questions a lot. So I just kind of wanted to throw them your way too. So, you know, if we have an inversion, let's say 10 to 15 to 20 feet, right? Let's say it's, it's a little bit higher of an inversion and we drop in with the ground rig, so we're technically underneath that inversion. Does that inversion impact our ground application at all?

[19:52] Joe Ikley
It still would. So, you know, that's generally still low enough in the atmosphere where we're going to have these these stable environmental conditions, we're going to have you know, we're still going to have that unpredictable wind. And one things that we can usually measure up here and we'll again talk about this a little bit more and like we talked about, the Mesonet that we have up here is that it often might depend on the strength of that inversion. And again, this is where I'm I'm not going to get the things correct meteorologically. But, you know, when we have a temperature probe at three feet and then ten feet or even 30 feet, since we're talking a little bit higher, you know, if we have a half a degree Fahrenheit difference, okay, so half a degree Fahrenheit, hotter at 30 feet than three feet, we can say there's an inversion. Is it is it a very stable air mass? Is it kind of a stronger inversion? No, because we can often up here measure maybe as high as ten degree difference. I know I've seen that on our on our towers before. And so that's going to be a kind of a very stable air mass and where we can have some

issues there. So even if we're talking about 15 to 20 feet, you know, it's not that the typical area we're concerned with, but we still have a more stable air mass and we'll have a higher chance of having issues because of a drift events. First, with these inversion type of things we talked about compared to just drifting downwind, normal middle part of the day type of event.

[21:26] Tommy Butts
I really like the politician answer there that you gave. It depends. You know. But no, it's I mean, that's a it's it's a great answer, right? I mean, like you said, it depends on the strength of that inversion. It depends on just kind of what level it is. And, you know, if you are spraying below it, it's probably maybe you're maybe a little bit safer per se, you know, but it's like you said, you're still real stable. There's still a chance that some of those fines are going to get hung up somewhere. And, you know, it's not 100% safe, let's just say that. So, yeah, no, that's that's that's good. The other question I get a lot, you know, asked a lot too is if we're talking, you know, so we took what we really talked about there a lot on the the inversion side was having particles hung up. I get asked a lot on the volatility side of things is if if you know, product volatilizes up into an inversion, what happens then? So do you want to just, you know, take that a little bit and explain, you know, any potential there?

[22:20] Joe Ikley
Yeah. And so this is of course a lot more difficult thing to measure. Just, you know, we have to have something that can volatilize to even measure it. I know probably University of Missouri has more data than about anyone on actually detecting volatile product during an inversion and not having their data on hand. I believe it's, you know, something to the effect of I'll be conservative here one and a half to two times they were measuring Dicamba, the amount of Dicamba they could detect let's see it when they sprayed prior to inversion at night and then had sensors out there to detect or basically draw in the air and then analyze them later. That basically because of volatile Dicamba, they were able to collect that in that inversion. And so it's that's one data point that I'm aware of is some of the work that they did in Missouri. But it. . .

[23:17] Tommy Butts
I was just saying it just kind of makes sense, right? Because like if we're talking about that ceiling right, as much as I mean, that's what I kind of always refer to an inversion as ceiling, It's like, well, if you have this gas, you know, coming off, well, it hits a ceiling and it just it can't go anywhere. So it's trapped. And so, like you said, if you're detecting or trying to detect it, well, there's it's just there's a much more bigger mass there because it's not diluting out. And so you can detect it more. If it's going to move anywhere that concentration isn't breaking down, spreading out as much as it would normally, it's going to, again, be more concentrated kind of dose because it's trapped basically. It's like you've just trapped gas in a jar.

[23:50] Joe Ikley
Yeah. And and then a good way to visualize this is we've certainly done this for demonstration purposes is like using a smoke bomb or you've got to have. So where I grew up, we have plenty of rednecks and we've got to have at least a few down there too, that we love burning tires right. And so it's so get a nice, nice black smoke going. I've had plenty of times seen kind of a

tire fire and and you'll see that smoke rise and it's usually, you know, higher than what we're talking about here where I see this happen. But that smoke kind of rises till it hits a certain point and then just goes laterally, you know, for a while. And so it's kind of another way to visualize it if, you know, that's that smoke. So, you know, not quite herbicide volatile particles here, but a way to visualize, there's these things that can rise, gases get trapped, and they're not going above that layer so they're going sideways and if we're at a lower inversion event like we talk about for herbicide drift, there's the chance it's going to have foliage out there somewhere that intercepts those particles that are trapped there. So smoke whether it's a smoke bomb or a fire is a good way to visualize kind of what's going on with some of these lighter particles, like a volatile herbicide compound.

[25:13] Tommy Butts
Yeah, no, that's awesome, that's a that's a really good analogy or example to look at when you're trying to figure some of that out. And I mean, you know, we have pilots that try and smoke a little bit and do some of that too, to see if where that smoke is going. It gives them a little bit of wind direction, but it also can detect an inversion form if they're having some troubles on that front. So it makes a lot of sense. So just I mean, you know, the next logical step then is once we kind of understand, you know, these inversions a little bit what's going on, you know, the next logical step is, okay, well, what can we do to either avoid inversions or what's some best application practices, you know, or what what are some tools and this may be a good spot where you can talk about the Mesonet that like you mentioned or NDAWN, you know, what are some tools that we can use to help us, you know, better work around these inversions. So, you know, I guess that's a that's a big loaded question. But, you know, what's your you know, what's your typical recommendation for trying to to to be able to successfully work around inversions.

[26:06] Joe Ikley
Yeah. So we'll start with the general rule of thumb and then we'll talk about some free tools and then some fancier ones. And so now we've gotten with our end on Mesonet towers here, we have enough years of data that it's a pretty safe bet for us to say, at least here on the Great Plains, once we get to about 3 hours before sunset, the risk of an inversion setting in increases dramatically. And then once we get to about one hour after sunrise, that's when these inversions start lifting. So that that's for us, a general rule of thumb, that may vary by geography for you, it might be closer to 2 hours before sunset without having data. I don't really know. But just an example there that it could vary by geography and and basically the new iterations of our of our Dicamba labels would have have adapted that into label language. So that's the reason there's a prohibition of applying 2 hours before sunset until one hour after sunrise is that's the general rule of thumb of when an inversion will set in, persist throughout the night and then lift the next morning. So there's the general rule of thumb. Then when we talk about some ways to measure or detect them, so the free things are what we all have been given, whether it's sight or or hearing, a couple of different ways where we can detect them with using those senses and so if you have gravel roads and you see a car tearing down the gravel road and that dust tends to hang up in the atmosphere for a while, that's that's one of those things where there could be an inversion setting in or already in place. Already talked about smoke and

using that for one of your site clues. Hearing, so whether you're near train tracks, an airport, just a busy highway if you really pay attention. I started to after we talked more about inversions in 2017 and 2018. You'll notice you can hear those things more often towards the evening and morning hours. And really what that is, is a lot of times it's the sound waves bouncing off that inversion layer and carrying farther horizontally.

[28:17] Tommy Butts
I've never thought about that before. That's that's really cool. I didn't you know, it makes total sense. Just never even thought about it.

[28:24] Joe Ikley
Yeah. And it's that's why, you know, in the evenings if you hear a train horn and you're a mile from the train tracks, you don't often hear it. It's probably that those sound waves bouncing off the inversion layer and the traveling more horizontally. Here, here on NDSU's campus were about, oh, a half mile from the airport. Depending on which way the planes are taking off. Might be a mile for jumbo jets to take off. And a lot of times during the day and then even some mornings we don't really hear it. But there are some mornings where that sound is deafening and that's usually when we can tell we have a pretty strong inversion in place because those sound waves are coming at us horizontally and this makes it louder and that sound carries for longer. There's another sense that you can use if things are just louder that that typically aren't. That could be another clue that inversions are setting in or have set in. So that that's kind of the free stuff that we can use. So some of those clues that we can pay attention to. We'll see a lot more of these handheld devices coming out now. So I know a couple like Spot on has basically a temperature gauge on the end of stick. We can wave it down at ground level for 30 seconds and then wave it up in the air. And that's basically collecting temperature at two different heights. So that was kind of developed to help us detect inversions. There are apps on our phones. Their reliability is it's going to vary. It's been several years since I've tested the app, since they probably put in a lot of work on software and improvement algorithms. So hopefully they're a little bit improved. But the thing to remember there is that's a lot of those are often a prediction of an inversion. And now pesticide labels are saying you must measure for an inversion, essentially. So I guess keep that in mind that these apps can be good, they can have flaws, but they're they're generally free, the ones I've tested. So there's a couple of kind of lower tech tools. We all have a phone, so that's why people like the apps. But then there are some more expensive weather stations and so there's some that you can purchase commercially, anywhere from a couple hundred dollars to several grand, depending on other features on these weather towers. So some folks like to have those. Or as you mentioned, what we have up here is a publicly available Mesonet of several weather towers throughout the state that are always kind of on collecting data and recording this. Several other states do have these as well. Some have full blown Mesonets, some just have towers on research stations. And we happen to live close to one of the stations. great, because that's a pretty good indicator for you and those locations, if you have one as well. So that's off the top of my head, kind of a up of range there of different tools and devices that we can use to measure inversions.

[31:13] Tommy Butts

Yeah, No, that's awesome. And so I just wanted to emphasize to for our listeners down here in the Mid-South, you know, I don't think as far as I remember that Arkansas or Mississippi or even Louisiana really has our own, you know, Mesonets or capability, like systems across the states to do that. I do know Oklahoma has one, though, that they've kind of implemented along along the lines of what y'all have up there in North Dakota. And so that might be something at least that that we can take a glance at. And maybe it gives us kind of a rough idea. At least that's a neighbor close by, you know, and maybe give us, you know, some sort of idea, like you mentioned, with geography, right. Okay. Well, it looks like one setting in every night you know, 2 hours before dusk or one hour before dusk or something like that. And maybe it at least gives us a little bit better idea. So so definitely, you know, if any of our listeners check out the NDAWN systems up there in North Dakota to get an idea, but also maybe try and check out Oklahoma one too just as a as a good fit more for our southern geography to see what that's looking like as well. Any other tips or recommendations for for avoiding inversions or even any just general application recommendations you wanted to give for this year before we wrapped up Joe?

[32:22] Joe Ikley
Uh, well, so I just this last thing I should I should talk a little bit about NDAWN since I've referenced them, it just let, kind of let folks know what what we've been talking about and why we referenced it. And so it's NDAWN the North Dakota Agricultural Weather Network. And so this is this is a Mesonet that was really started in 1989 up here. It was originally just installed on research stations at NDSU, but it has been expanding. The real expansion has really been about the last decade. And so just going off the website, this number is constantly changing, but we're currently at 155 stations across North Dakota. We do have some in northwest Minnesota and some in eastern Montana. And I think I think that number is going to increase at least by 20 more, if not even more in the coming years. So but the general goal of our Mesonet is for most weather conditions, they feel pretty comfortable. If you have a station that the 20 mile radius around that station is covered and so the goal is to kind of have these stations fill all the gaps across across the state that the obvious ones differ. Around rainfall and versions can differ based on topography, etc., but generally we were trying to get coverage overlap on a 20 mile radius around these towers is really the goal and that's why we have that many and we are getting more and they're kind of a publicly funded thing. What's nice for for our farmers up here is that we also have an app associated with it. So we have a website you can look at real time weather data. Most stations have a camera now. So if you're listening in Arkansas and want to see snow, you can go and go to the NDAWN website and just pick a tower cam. You're going to see some snow. But so that that's kind of nice there on the websites. But we have this app and we do have, it can send you alert alerts when an inversion sets in. So I actually personally silenced it because it kind of got annoying for for me when I'm not trying to get a lot of acreage sprayed and I have to measure weather data anyways, but it is a nice tool for those. If you know your closest, your closest tower, we can basically get a notification that inversions sit in near that tower. So that's kind of another alert that we can use that's probably time to stop spraying in the evening. So I did want to talk just a little bit more about that one tool or resource that everyone can find effective. So again, that that NDAWN is as a tool more for us up here. But we do have a publication by people more versed in this than me as far as the science behind inversions and some historical perspective. So within our in NDSU numbering system, our

document is called AE1705 and the publication is Air Temperature Inversions. And so this is about a 20 page extension bulletin, but it really gets into all the things you want to, if you want to just learn about inversions. It's a pretty easy 20 pages to read and has plenty of graphics in there really getting into what these are, how they're set up, other, you know, other ways to visibly or audibly detect inversions. Anything you really think of is within that publication. So I think that's a good resource for anyone. It's free. So you can download a PDF. Probably the easiest way, we have hard copies somewhere, but most people, if you want to download a PDF, a free resource for anyone to use that will certainly tell more about inversions.

[36:03] Tommy Butts
No, and that's an excellent resource. I think I've read that one before and I actually want to say that we may use that publication for like our county pesticide applicator trainings, I think, or at least I think I had it, I had handed to me for like the, you know, the commercial applicator training. Maybe it's part of the commercial process. But yeah, that's a really great pub that that deep dives into the, you know, inversions and everything but makes it real, breaks it really down so everybody can understand it. And it is a great little pub. And again, for, you know, for our, for all of our Mid-South listeners and stuff, you know, check out the NDAWN system and just take a look at what it's like. You know, check out the Oklahoma system and, you know, moving forward, if that's something that we really, you know, that we really need to see across the Mid-South to Mississippi, Louisiana, Arkansas, you know, that's something that we really probably, you know, could could lobby or figure out, you know, funding sources or figure out something where maybe we really need to start establishing that as well, just because, you know, it's a big deal for a lot of different pesticides and and especially with the amount of aerial applications we have in the Mid-South too, you know, understanding that whole process a little bit better for from all of our standpoints would would really benefit us all. So I I'm glad that you were able to come on today, Joe, and just kind of give us an explanation of all of that so we could get some of this information out. Just kind of clear up some questions right, and some confusion. So it's been a lot of really great info today. Any other last minute tips or anything that you've got for us?

[37:27] Joe Ikley
Nah I think, you know, hopefully folks have if they needed to learn about inversions or had some questions, hopefully we will fill in some of those gaps. Like I said hopefully some of those audible and visual clues can can help folks, too, along the way. And the ultimate goal for us is we want to make sure our herbicide applications are hitting their intended target. And this is just another way where we can have some off target movement that, again, as I mentioned, for our ground rigs. We really didn't think about this a whole lot until the last five or six years. And so the more awareness we raise certainly helps us keep our application on target, which for me means we kill more weeds that way. So that's what I'm all about.

[38:09] Tommy Butts
That's right. That's always a plus, right? You killing kochia and us killing pigweed or barnyardgrass. So that's important. So and I do just want to reemphasize there too, with with everything we talked about and everything we highlighted, you know, as far as avoiding

inversions and trying to do better there, I mean, it really comes down to just monitoring and making a decision of spray or don't spray. You know, there is not a you know, I talk a lot about nozzles and a lot about, you know, spray volumes and different application practices and technologies and everything else. But at the end of the day, when it comes down to inversions, really, most of that is is pretty unhelpful for any of this. It comes down to the monitoring the weather, understanding the temperature and making a spray or no spray decision. And that's what it boils down to. So with that, just I did want to hit on a few outreach things from both of our sides. So, you know, one, as always with with us here in Arkansas, make sure to check out our Web page for any new updated information (www.uaex.uada.edu/weeds), all that kind of fun stuff. If you haven't yet, make sure to pick up the MP44 Recommended Chemicals for Weed and Brush Control publication. You can get that at your county extension office or download it free from online. If you haven't signed up for our text service, please do that. You text weeds to 501-300-8883 and you can get updates right on your phone for different things. And then as always, you know we're always open, you know, whether it's, you know, Jason Norsworthy, Tom Barber or myself, we're we're always open for questions. Feel free to give us a call, you know, give us a text, anything else. And we'd love to help you out. Joe, on your front, you know, do you want to mention your your Twitter to watch out for website or anything along those lines?

[39:45] Joe Ikley
Yeah. Yes, I'm I'm on Twitter and semi-active. More active during the growing season maybe than the off season. But @NDSUweeds would be my my my tag name, whatever we call it on Twitter. So social media, that's basically only, the only one that I'm active on. We've got a couple of websites. Most of them are really North Dakota focused for weed control research or outreach things. But I always just Google NDSU weed science and that that brings it to the to the page that I'm looking for. So again, we do have some resources there, but we're kind of going through a website overhaul. So there might be some broken links, but we yeah, for our localized research, we keep that live. So don't know how, you know, how useful will be to anyone for for you down there. As far as our links it will typically have for more now regional or national type of of helpful information but that'll be the website. And then yeah, Twitter is where you find me pretty active during the summer at least.

[40:46] Tommy Butts
No, that's awesome. I always think it's fun just to see what's going around the country though, and learn, you know, tips and tricks from from other people. So you never know what you'll pick up on from someone somewhere else across the country. So, you know, give Joe a follow or check out his, you know, the website every now and something because he's a he's got he's got really cool things up there that they're doing as well. So go ahead, Joe.

[41:07] Joe Ikley
The last one I should plug I almost forgot about this one. So I'm part of a podcast as well. We've had you on as a host, so we call that the War against Weeds. So another WAW podcast, if if you like this one, same same kind of three letter there, that's a podcast with myself and other weed science colleagues from Kansas State, Missouri and Ohio State. And so we're, we're, we're probably more in the off season. You're pretty focused during the growing season. We're

basically fall and spring focused and just several episodes around all things weed science. So I probably should plug that as well.

[41:42] Tommy Butts
Yeah, no, definitely. It is good podcast to check out too. And like you said, it's kind of nice because we have ours during the growing season and you're, you know, more in the off season. So it kind of works out that we balance each other out there. So it's kind of nice. So but yeah definitely check out that as well if you're listening. So with that, I just wanted to say thank you, Joe, for joining us. I appreciate all the insights you gave us and everything there. And as always, I wanted to thank our listeners for tuning in and the continued support from our, you know, all our funding sources as well. Because without all you know from both Joe and our perspective, without any of the funding that we receive, we can't do research, we can't do these extension events. I mean, that's it's important for all of those different activities for us to complete a lot of that. So with that, just wanted to say thank you all around. Any last minute things from you, Joe?

[42:27] Joe Ikley
Just send some heat my way.

[42:30] Tommy Butts
We'll try, you just keep that snow and freezing up there, though. We don't want that down here. So you keep that up there. We're trying to plant.

[42:37] Joe Ikley
We are too, but we're a little behind.

[42:42] Tommy Butts
So with that, thanks again, Joe, and thanks to all our listeners and thanks for joining us for this episode of The Weeds AR Wild podcast series on Arkansas Row Crops Radio.

[42:52] Intro/Outro
Arkansas Row Crops Radio is a production of the University of Arkansas System Division of Agriculture. For more information, please contact your local county extension agent or visit uaex.uada.edu.