

My name is Eric Anderson. I'm a field crops educator with Michigan State University Extension. I am housed in St Joseph County, and I cover field crops in the south central, southwest portion of the state. So my portion of today is talking about an overview of industrial hemp production. Obviously it's a new crop for Michigan, it's a new crop for MSU. It's based on a bulletin that a number of us on campus produced. There's a handful of specialists and then a few educators. And that is called Industrial Hemp Production in Michigan. A few of us put together the presentation based on that. So if you want a more in-depth treatment of some of the topics that I'll be touching on today, certainly feel free to visit that. It's a free downloadable PDF.

So this is what I'll be talking about today. It's a brief history of hemp in North America. I'll talk a little bit about the relevant laws and regulations that we're working with here in Michigan, go on to then talk about varieties, types of hemp, uses and markets, agronomy, and I will touch on a number of issues, and then I'll save all the irrigation-type questions for our other presenters. And then I'll just end briefly with a couple of considerations about the economics.

Before I start anything, though, this is a good time to talk about what we're talking about today, because when you hear people talking about cannabis or hemp, all sorts of different things come to mind for different people. So what is industrial hemp? So marijuana and industrial hemp, it's all the same species. It's *Cannabis sativa*. The only difference between those two plants is how much of this THC, this delta nine tetrahydrocannabinol, I'll just abbreviate as THC. So by law if that cannabis plant has less than or .3% or below THC, then we call it industrial hemp. And if it's above that, even if it's .4%, we'll call it marijuana, even though typically marijuana, the THC levels are somewhere between 10 and 20% or higher. So there's a great disparity, but by law, that's the difference between the two. There are different types of *Cannabis sativa* and they look different. But telling difference between marijuana and industrial hemp is problematic even for folks who've been working with it for a while, which is why some of the laws and all the regulations, what some people think of as fuss or red tape that we're having to deal with, it's because law enforcement are still having to work with both of these types of plants. It's all the same species. It's an annual plant. Obviously we're planting it each year. The height, it really depends on the type you're going to be growing, and we'll talk about that in a bit. It's tap-rooted. It's photoperiod sensitive. In other words, in order for floral initiation to begin, it's based on day length, and I'll talk a little bit about that as well. It's wind pollinated which is a huge issue that I'll talk about. Plants are indeterminate, in other words seeds are being produced all throughout that flowering period, and that has something to do, if you're producing the seed, and again I'll come back and talk about that. So everything that we're going to talk about today is just about industrial hemp. So if you've got questions about, because we get questions coming in, people asking about marijuana, different laws, what can and we can't do with marijuana, we won't be addressing that at all today.

So brief history, just really brief and know that it's been around for a long time. You probably see, even dates before this. We've got documentation that our Founding Fathers grew industrial hemp for paper production, for rope, for canvas, all those things and we'll talk about some of that later on today. We peaked with our hemp acreage right around the mid to late 1800s and the states where most of it was grown, as you can imagine, are further south at Kentucky, Tennessee, Missouri, Illinois.

Moving into the 1900s, industrial hemp sort of got lumped together with marijuana and so some of the concerns that people had with that psychoactive portion of marijuana had an impact on what we could and couldn't do with industrial hemp. And so you see that by 1937, this marijuana and again that H

spelling, you've probably seen that before. A lot times that'll show up in legal documents, it's marijuana. So essentially what happened was people started to look at both types of crops as being the same. That had a bit of a pause right around World War Two when we needed more hemp for obvious purposes, for war, for paracord, for clothing for soldiers, that sort of thing. But then the Federal Controlled Substances Act officially made all types of cannabis federally illegal.

Fast forwarding then almost to the 2000s, Canada decided to legalize industrial hemp. And so they've actually been working with this crop for almost a couple decades now. Some of the laws that we've had here in the US in the past 20 years, 15 to 20 years, in 2012 a number of states were legalizing all forms of cannabis or various forms. The 2014 Farm Bill is probably the most relevant for us today and I'll talk a little bit more about that. In the interim between then and 2018, a number of states legalized industrial hemp at the state level. And then in 2018, the Farm Bill, 2018 Farm Bill just last December made it available for all states to legally commercially produce industrial hemp sort of. And I'll talk about what our situation is right now.

Relevant laws and regulations. Some of that based on those farm bills. So the 2014 Farm Bill opened up the window to do research in the Farm Bill language that year. They decided that individual departments of Ag for the states and then also institutions of higher education were able to begin doing research. And so as far back as 2014, 2015, a lot of research has been done and that is all the way from germ plasm, so from seed all the way out to the marketing aspect of it. Here in Michigan in 2014 we had a couple of state laws come up. And then in 2018, those of us who are in Michigan, you know that the Prop One Bill where all forms of cannabis were legalized and then following right up with these you see on the screen for industrial hemp research. 2018 Farm Bill basically opened it up so that everyone can grow however currently we're still operating under the 2014 Farm Bill.

So here's why that is. The USDA is the agency that is tasked with overseeing all things related to industrial hemp. They have yet to come up with the regulatory framework that all the states then will need to follow with regards to how to grow it, how to monitor it, keeping that THC level below .3%. And so since all the states are waiting on the USDA, then essentially we're back before December, 2018. We're back under the 2014 Farm Bill. And so all states, even the ones that have been working with it for a number of years, are still working under that research protocol. Now here in Michigan, we didn't have a research protocol because no one had, including MSU, no one had gained permission, approval from the DEA at the time to do any work with it. And so our Michigan Department of Ag, MDARD, they didn't have statewide regulatory framework as well. So that was just put into play this past spring. Now this last bullet here, I'll probably talk a little bit more about that later but the question remains and really it remains on a nationwide level as to what to do with the spread, some people call it the contamination of pollen between types of cannabis, industrial hemp or marijuana.

The pollen contamination issue that I hear talked about is that it's a huge issue. It is male plants and some of this I'll get into in a bit, marijuana and industrial hemp for the most part, you're only wanting to produce female plants, particularly if you are growing marijuana and hemp for CBD. And again, I'll talk about that in a bit. But if you are growing for seed or for fiber, you are growing male plants. And so that male pollen that's produced can then travel and pollinate the female plants. I've seen all kinds of numbers all over the board as far as how far out that pollen will spread. It will definitely spread hundreds of feet. That's really common with all of our real crops. These pollinators will take that as far as a few miles. This study that you're seeing the picture of in the lower left-hand corner, there was

research done, some folks over in Spain. They were looking at how far marijuana that was being grown in northern Morocco, how far that would travel. And so they had some pollen traps set up and they were seeing it show up as far as 90 or more miles away. And so people understandably have, they're very concerned about it. In the lower right-hand corner you'll see that the seed certifier, AOSCA, they have set up guidelines by which you have to separate different types of hemp depending on if you're growing for seed. And so those numbers that you're seeing down there are relatively small. The number that I come across most often is a safe starting point to isolate different types of hemp is about 10 miles. That obviously is an issue if you have some neighbors who are also looking to grow. Here in Michigan, the Department of AG, MDARD has a list of all registrants. However the information at this point anyway is not being made public.

This is a screenshot from the Colorado's Department of Ag, they have obviously been working with industrial hemp much longer than we have. They have their registrants publicly available on their website. You can go in, you can look at who registered. You can look at, I believe there are phone numbers on there. I didn't see an address. But that may be something that our Michigan Department of Ag comes up with at some point.

One suggestion that I've heard about this issue of pollen contamination is to set up appellations, similar to what happens with wine grapes. You have these different regions and so for example on this picture on the right-hand side, you can see well in this area right here, those grapes, those are from let's say the Mount Veeder. And so for that type of wine, you can't try to sell it with that particular name unless you're growing it in that area. So perhaps there may be a time where for example southwest Michigan, or maybe on a county basis, those folks, they would have to be growing a certain type of hemp. In a different part of Michigan, maybe they would be open to planting a different type. So all that to say that pollen contamination or pollen spread from one type of cannabis to another is going to be something that we're going to have to work on moving forward.

So MDARD for this year, they have a process by which anyone can register for these research proposals. Initially they made that available and started accepting applications, I believe it was right around April, April 18th or so. Two different types of registrants that you could have. Initially this was all done via what they called registration events. It was really nice. It was streamlined and you walked out of there the same day and you had your temporary license in hand. Now they don't have an online version but they do have a mail-in version.

I won't go through these steps in great detail but you'll download all this information. If you want to just grow the crop, in other words, you don't want to harvest. You don't plan on selling it. You're not going to make any money off of it. You're really just growing it for the information for this year, that is called a grower and it's a \$100 registration fee. If you want to do anything else with it, if you want to sell it, if you want to have somebody else come and harvest it, you would have this \$1,350 fee. And I've had a few conversations with folks at MDARD and what you're seeing on the screen, that is what it is. So if you've heard something else from someone else that you don't have to register or if someone else is coming out to your property and doing the harvesting, what you're seeing on the screen, that is what MDARD expects to happen for 2019. I've had folks ask about 2020 and moving forward. We don't have any guidance at this point. I'm told that what we're having this year is essentially what will be in place as far as registrations for next year but we'll just have to see how that plays out.

All of the paperwork, you will fill all of that out. You'll mail it all in and then you'll wait. I have heard folks talking about somewhere in the two-to-four week timeframe. As of June 7th, MDARD said that they had roughly 600 people licensed. Of course they don't give out any names or anything but these are the numbers that they gave out. And that's at 615 different growing locations with over 25,000 acres. If we're anything like other states, like I think it was North Carolina that I heard they had X-number of people that had registered but only a portion of those actually go ahead and grow for various reasons.

We'll move on to talk about varieties.

There are three general types of hemp that you can grow and it really has a lot to do with what the end product is. You could be growing it for fiber, for the seed or for the what we're calling here non-seed oils and extracts. And I'm just going to call those CBD as a generic term. So all the cannabinoids aside from THC, all those cannabinoids, that would be a third type. And those pictures on the bottom, each give you a general idea of what we're looking at. And I'll go into each of these in detail.

The hemp varieties that we're currently working with, the germplasm is mostly from Europe or at some point in the past was from Europe. Hemp is originally from south Asia, east Asia, from China and that general area but most of the varieties we're working with were bred in Europe. There are three types. There's dioecious, monoecious and female-predominant dioecious. What does that mean? Dioecious means it's like humans. We've got males and we've got females. Monoecious would be more like a corn plant. So one plant has both the male and female reproductive parts on the same plant. There are some forms of hemp that are monoecious that are being used commercially. But for the most part, most industrial hemp is dioecious. So you've got males and you've got females and that's a big deal and we'll come back and talk about that. All these different characteristics about industrial hemp that you could look at, whether it's fiber quality or CBD content, has everything to do with the variety that you're growing, what that was bred for. You do have cultivars that are dual purpose. In other words for example you could harvest the seed off the top and then come back in and harvest the fiber, so a dual-purpose crop. Currently, and those varieties are widely available currently. The trend is toward focusing on just one, making that plant do a really good job at one thing. But all types are available.

I already mentioned that they're photoperiod sensitive. So we just came across our summer solstice so now our day lengths are slowly getting shorter and that's what triggers floral initiation. So somewhere four to five weeks from now we'll expect to see floral initiation and that's where some of these types of hemp where you're relying on flowers for the most part, that's where that'll come into play. Obviously you're going to want to find cultivars that are adapted to your latitude, to your number of growing days and then also to the temperature regime. In Canada for example that'd probably the closest for those folks who are in Ontario, that would probably be the closest to us. They actually have a list of what they call certified seed. In other words, they have gone through and they tested those and they have historically all stayed below .3% THC. And so those are the only ones that they have available. In the US we currently don't have a national registry or a national certification. There are some states that have tried to do that with the different types. We'll just have to see what Michigan does moving forward.

As you are going on to find out, and again we're getting towards the end of our planting season this year, but for those of you who are looking at next year and you're wondering well, where do I source seed from, just know that when you go online and you're looking in all these websites, there's a difference between what I'm calling seed breeders and seed producers. So anyone can grow hemp and it will pollinate and you can collect the seed from that and then sell it to anybody. But if you want good

quality seed, obviously you would have to find a company or a grower who's done a good job with their breeding program and they've bred it for a particular purpose. They've bred it to keep that THC low. And so just to give you an example of some of the names out there, depending on the type of hemp that you're growing, these are just some examples. You can tell, for those of you who are farmers, you're probably used to seeing like DK 1742 and that's just the name of the seed. They're a little bit more colorful with industrial hemp. Anyway, that just gives you an idea.

As you're going online, just know that it's going to be something similar to what I think of as shopping on Amazon. So you're looking for how many likes, how many stars, how have people rated that particular company. Obviously the more years that that company's been in business the better. If you can get certified seed, all the better. They should be able to show you a sheet, a certification and I'll show you one of those in a minute. If you're looking to import from overseas, that is possible. I've talked with USDA APHIS and with folks at MDARD. If you're importing seed from let's say Canada, you need a final sanitary certificate definitely. But really in the end, at this point anyway, it's really buyer beware. Just like you could go on to Amazon and see a product that was rated at 4-1/2 stars by 2,000 people, that doesn't mean that all of those ratings were valid. So there are some unsavory folks out there who are trying to make money and you have to do due diligence in sourcing those out.

Move on to the uses and the different markets that are available for the different types of hemp.

You'll see numbers all over the board as far as what you can do with hemp. I've seen this number thrown around. I've seen 50,000. So there's a lot of different things that you can do with hemp depending on what part of the plant you're looking to extract. All these are just kind of subcategories of these three main types.

This screen, obviously you don't have time to read it all, but this just gives you a sense as to how versatile the plant is. You can harvest, for example here, you can harvest the branches, leaves, primarily for CBD extraction. You could look at a couple of different types of fibers, which I'll talk about in a minute. So it really just has to do with how much processing, what type of processing you want to do and what markets are available to you.

We'll start with the fiber portion. There are two different types, general types of fiber in the stem. And you can see from this picture here, the outer portion, these are called the bast fibers. Those are the longer ones, higher quality. If you hear people making paper or rope or canvas, clothing, that sort of thing, that's all coming from the bast fibers. The inside, the core part, it's a hollow stem but the core part, those are the hurds or sometimes you'll hear them referred to as shivs. Those are lower quality. Oftentimes it's used for animal bedding, although other uses have been made.

For example here's one that's called Hempcrete. You can make different types of building construction materials, particle board, that sort of thing. And then I just came across this a couple weeks ago, Levi decided, well maybe we can make some money looking at replacing a certain portion of the cotton fibers with hemp fibers. And I'm sure they would market it as they're hemp jeans or something along that line. We'll switch to the seed portion.

The seed, obviously you could resell it and other people could plant that out just like you would do with soybean. You can also use it for human consumption. You've probably seen like in the lower right-hand corner either ground or whole. You can then also crush the oil similar to what you would do with

soybean. And then you would have both the oil itself and have, I'll call it cake product or all of the non-oil portion of the seed. Just for your information, the seed, if you were to crush the seed, get the oil from that, there's no CBD in that. So if you want CBD, that particular chemical or those suite of chemicals, you'd be harvesting a different part of the plant.

CBD is the one that you hear most about. This has the biggest dollar signs associated with it. It's definitely the most popular type of industrial hemp to grow. And we'll talk a little bit more about that later. But again, CBD stands for cannabidiol. There are different types of CBD. We won't get into that today. Probably some of the products that maybe some of you have been using or taking are listed here. Skin creams, tinctures, different types of oils at different dosages. I sat in on a talk about a month ago that a pharmacist gave. They are recommending CBD for a number of different things.

There's one particular product which has actually been approved for actually curing or solving in this case, it's a couple different types of epilepsy. And that's actually a big deal. So the FDA, they are the ones, I said that the USDA was overseeing all things industrial hemp, but the FDA has been tasked with overseeing all things CBD. And part of the reason for that is because this particular drug here, Epidiolex, was actually approved by the FDA. You can see at the bottom here that came with quite a price tag, but that's the reason why they are I guess I'll say touchy about using CBD in other types of products because it has already been licensed, it's already been approved for use as a prescription drug.

This is old data and I have looked for more recent data coming out of the EU or other markets, but at least gives you a general sense as to what some of these different products, what kind of market share they've enjoyed. On the upper left-hand corner, these are those basts, those higher quality fibers and for the most part it's going into pulp and paper. Upper right-hand corner, those are the lower quality, the inner, the hurds. And for the most part you'll see that between animal bedding and horse bedding, it's the lion's share of what it's being used for. And then down below the hemp seed and primarily it's used for feed. In other words on animal feed and then also for food. And if you include the oil in there. Now the only thing that's not showing on here is CBD production. But obviously that is not necessarily how the US markets are going to develop, but it gives you a sense as to what's been happening with the EU markets.

Now let's move on to a little bit of an agronomic perspective.

How do you grow this? Is it something that can be grown in Michigan? We get that question a lot. The answer is yes, it can be grown in Michigan. In fact, it's grown much further north and so there are different varieties that are adapted to different growing conditions. It prefers I'll say a normal corn and soybean environment, around 80 degrees. It can be planted earlier and can handle slightly colder conditions than corn and soybean, but it's pretty similar. It prefers about 10 to 13 inches of rainfall or irrigation in season.

I get this question a lot: what kind of soil does hemp grow best in? It has a wide range of soils that'll do well in. What it doesn't enjoy is being saturated. And so if you have soils that are prone to water logging, poorly drained soils, heavy clay soils, especially in a year like this, it probably won't do as well. If you've got let's say a loamy soil or it's well-drained, well tiled, it'll do just fine.

Site preparation, some of that'll have to do with the type that you're growing. And I'll talk about that in a minute. But in general, your planting window is going to be something similar to what it will be for corn

and soybean. Maybe you can start to plant just a little bit earlier with regards to soil temperatures. Again, we usually shoot for about 50 degrees for corn and soybean production. So it's about the same. Tillage, for those of you who would look to do no till, if you've got a way to manage residue and you've already got a way let's say with surface cultivation, of dealing with weeds then no till make work for you. CBD, producing hemp for CBD production, they'll often use a plastic mulch, different types of irrigation.

For planting, if you're planting for fiber or grain, you can use probably something that a farmer would typically already have, a planter or a drill, something right around 3/8 of an inch deep or so. For fiber you're probably planting something around 50 pounds of seed per acre. And for grain, maybe about 25 to 35 pounds. Those are the numbers that we've heard the most. Row spacing, you're going to want as tight of a row spacing as you can get, maybe 7-1/2 inches if you're growing for fiber. because really what you want is you don't need floral production, you don't need a lot of leaves. You're looking for a lot of stem production, a lot of stem elongation. Whereas for grain production you want seed heads to form. So you're going to have a little bit more space. And so you could still plant in tighter rows like that but you might want to space it out just a little bit more and that's why the seeding rate is a little bit lower as well.

For those who are looking to grow hemp for CBD, I think it's just a very different production system, at least the way it has traditionally been grown. Instead of let's say a million plants per acre, you're looking at more like 2,500 plants per acre. The spacing probably has a lot to do with the equipment that you have. I've seen row spacing of like five feet between rows sometimes common, but again that probably has more to do with the equipment that you have. As far as square feet per plant, I've seen numbers all over the board. On the next slide I'll show you some folks who were planting on a five-foot by five-foot, in other five foot between rows, five foot between plants within a row. And that would be 25 square feet. I've seen that number all the way down to let's say 10, 11, 12 square feet per plant. For CBD production you only want female plants. So that means that you have to either grow out all the seed that you get from your source and then go on a rogue out, take out all your male plants before they start to produce pollen right at that floral initiation. Or you can plant what they call feminized seed, in other words all those or almost all of those seeds should be producing a female plant. You should still go out and rogue out all your males. Or what's most commonly done on a commercial scale anyway is to produce clones. So you have female plants and then you would asexually produce clones. And so all of your transplants then would then be female. I already mentioned this pollination isolation. Again, I've seen numbers as low as three miles separation. So you want to be that far away from a field that you know is going to be producing male hemp or you could have pollen spread.

A couple different farmers in Illinois planted on five foot by five foot spacing. That gives you something like 2,500 plants per acre. This, there's two I guess distinct types of CBD hemp. It's either tall or short. The taller ones will grow fairly thin, maybe a narrower base at the bottom. And then ones like this, which almost look more like a Christmas tree, they'll definitely spread out, so be more of a bush type.

This is my endeavor into planting CBD hemp this year. I went through the same process that a number of you have already gone through and I got registered. I am only registered as a grower this year, so I'm really just looking for information. So I sourced seed and plantlets and you can see in this back row here, I've got a few different things going on. I've got plantlets and they were right around eight to 10 inches tall at the time of planting. I just planted them this past weekend. Here on this side I was planting on two-foot spacing and that was one variable. And the other I did three-foot spacing. I tried a couple

different kinds of substrate, plastic versus like a landscape mulch which I don't see people using on a commercial scale, but I just wanted to try it. And I'll probably have another variable that I throw in. So just to get a sense as to some of the information that might be generated through the ag pilot program this year.

Soil fertility, had lots of calls come already this year about what kinds of fertilizer to use at what rates. The recommendation that we've seen used most often for the fiber and grain, excuse me, the phosphorus and the potassium, fairly similar to what you could expect for winter wheat. And so if you take your soil sample and send it into the lab, at least right now anyway, depending on where the lab is located, they won't have recommendations based on industrial hemp. So you'll need to use a proxy crop. And so winter wheat would be a good proxy. With regards to nitrogen, the number I've seen most often, here I've got 110 pounds per acre. 120 pounds is the one that we've been using for the most part. I have heard from the main researcher down in Kentucky that he, I don't know that he's ready to recommend it but he suggested that maybe lowering the nitrogen for hemp grown for fiber to 50 pounds had something to do with stem elongation, not wanting thin-walled cells on those. I don't know that anyone's recommending that at that point, so I would probably stick with 110, somewhere between 100 and 120 pounds of nitrogen per acre.

For the next few slides I'll talk a bit about pest management. And if you just want to fast forward and scroll down to the bottom of this slide, that's really what we're dealing with. There are no pesticides in the US that are labeled for use in industrial hemp. So for weed management, you want to start clean and that's why for CBD production anyway, a lot of times you'll see them using plastic to aid with the weed control. I've had people ask can you spray a particular herbicide between the rows of plastic for CBD production and the answer is no. If the crop is not listed on the label then it's not on the label and it's illegal. So that's the short answer for weeds.

For insects, also nothing labeled. Our field crop entomologist, she says that there are a number of different insects that may use hemp as a source of food. But since we haven't been growing a lot of it yet in Michigan, there's probably not going to be an initial, I'll say epidemic-size problem with it, although that could come along as we have more acreage. I heard a presentation by the entomologist in Colorado and he had many, many different types of insects that they have seen feeding on the plants, but he only mentioned a few of them that were actually problematic. So we'll have to see how that plays out in Michigan. But again, no insecticides are labeled. There are couple of products that are like a garlic oil or I've seen rosemary oil. That may have some usefulness that say that they're labeled for hemp but no, I'll say normal registrations for insecticides.

And then again, the same thing with diseases. So there's no fungicides labeled. White mold may be an issue. So if you are, let's say you want to rotate in and you've got corn, soybean and you want to maybe put hemp in every other rotation, if you've had white mold problems on a given field, that may be a problem for hemp production as well.

For harvesting, if you're harvesting for fiber, you could use an implement similar to what you would use for hay. You will cut it down, leave it lay in the field for a certain amount of time, what they call retting which is similar to rotting, which is essentially what's happening. Microbes are starting to break down the fibers, trying to loosen that bond between those inner and outer fibers. That's one way to do it. There are also what are called decorticating machines which essentially mechanically do that separation as well. You're looking to, if you're going to leave it in the field, you're looking to harvest at about 15% or

lower. If you're looking to bale it and then store it for a period of time, there's been some question, particularly in a year like this. We have questions about well what could we actually get that dried down to in a wetter climate like we do, compared with if you were growing out further west let's say, in parts of Oregon and Washington, much drier areas. So there's some question about how low we could get that number in our fall.

Grain harvest, again there is a potential to have a dual purpose. And this video that you're seeing, that's what they're doing. So they've got a typical combine with a small-grain head. They've got it raised up as high as it'll go. Although I've seen some equipment that is specifically designed so you can raise it up even higher. So they're coming through and they're harvesting the seed. They're leaving the fiber and then they'll come back or they have the potential of coming back through and harvesting that. The seed only, as I said it's indeterminate. So only about 3/4 of the seed at harvest time are going to be mature, going to be ripe. You're probably going to be harvesting somewhere in that 22 to 30, so not too dissimilar to what you would typically harvest corn and soybean at, maybe a little bit higher. And then again, you'll dry that down.

For CBD production, this is one type of a production system that you'll hear a lot about. You'll harvest the entire plant at the peak flowering time. So typically if you're producing for CBD you're going to be doing testing on the tissue, not just to make sure that your THC levels remain below .3 but also to identify when your CBD levels are the highest so that you can go in and get the most value out of the crop. So you'll harvest and you'll need to dry that down before molds begin to grow. That could be done in something as simple as hanging it upside down, similar to what they do with tobacco, as long as there's good air flow. That could take anywhere from three days to a week. Obviously if you are doing it on a more commercial scale and you have access to drying equipment, say propane dryers, that would speed things up.

I'm going to end with a really brief talk about the economics and most of this information is coming from, it's a bit dated, but it's coming from a study that they did down in University of Kentucky. So some of this may be outdated and may not be terribly pertinent. But it at least gives you some place to start with.

This gives you an idea on a scale of what are these different types, these different products. Where are they being used? What kind of market share might they enjoy? Here you can see the personal care products, the biggest slice, and again that would be all those creams and things like that. Industrial applications, food. And then they do have, on the right-hand side here, hemp for CBD production. So again, this is historically, this is 2016 data, this is historically what's happened. And so the question is, moving forward now that we've got nationwide legalization coming up for 2020, what are the markets going to do?

One analysis that they did in Kentucky was looking at how much money would I make on an acre compared to what I could expect to make if I were in a normal corn and soybean rotation on an average year? And so they've got it broken up by how productive that particular field might be. And then here we're looking at for fiber only. So I'm not harvesting anything except the fiber. And you can see that that negative dollar sign means that you're losing money. In other words, that's not, at least in this analysis, was not a feasible production system, to just harvest the fiber. If it was dual purpose and you're looking at harvesting, like you saw in that video, the seed and then the fiber, those came a little bit closer to

what you would typically see with corn and soybean. And then seed only, that was higher still. What's not in this one is what everyone's talking about and that's for CBD production.

So this is a slide that I just got from, it was a webinar that the main researcher down in Kentucky, he had come up and given, or I think it was actually a webinar. He had given a presentation for some folks in Wisconsin. And so I pulled that slide from that. So Dave Williams says that these are some of the numbers he's been working with. But even during that presentation, some folks raised their hand and say wait a second, where did you get this number and that number? I've seen really different numbers. It's kind of the wild west out there as far as some of the numbers, the market, especially out west. So anyway, this just gives you a sense for 2017, again this was in Kentucky, the number of growers that were growing a specific kind and this percentage by the way is pretty similar across the board. I've heard those for all the different presentations, the different states. That 90-plus percent of those who are registering to grow in these research, these ag pilot-type programs, almost all of them are doing for the purpose of producing CBD. This gives you an idea of the acreage planted to that, the harvested acreage, and then this number down at the bottom. So this number here for fiber, that number, he said that was kind of, I think he used the term artisan. So it's a higher quality bast fiber. If you were to, this was what Dave Williams said, if you're looking more on a general scale, maybe a little bit lower quality product, somewhere in the seven to eight cents range is what he had seen per pound. Now this number over here, \$7.20, this is per pound. This is for the biomass and someone questioned him about that. I've seen numbers a lot bigger than that so I am just going to throw this up here. I'm not saying that this is what it is either. But I have heard other people tell me that well, the markets this year are somewhere between three and \$4 per percent CBD per pound. So I just threw some numbers together. So if I have one pound of biomass per plant, which is pretty close, let's say that that particular variety was producing 10% CBD by mass, and I could, if I were able to get \$3 per percent, that would mean that each plant is producing about \$30 worth of value. So then if you start to do the math, if you say well, I'm going to plant 2,000 plants per acre, these are the numbers that people are seeing those potential gross revenues. And that's why the interest is so high in CBD hemp at this point. Of course that doesn't take into account all the seed or the clone costs or the land or fertilizer, any of that, labor costs, are going to be substantial. But this would be supposedly a potential gross amount of income.