

Industrial Hemp History and Agronomy

Good afternoon. Welcome today's webinar about the history and Agronomy for Industrial Hemp. My name is Jen Ryan and I am a Natural Resources Specialist for the Natural Resources Conservation Service's East National Technology Support Center and I will be your host.

I am pleased to now turn the webinar over to Jodie Reisner. Jodie currently serves as the Conservation Agronomist with the NRCS at the Central National Technology Support Center in Fort Worth, Texas. Over the Last Seven Years, She has Also Served in the State Conservation Agronomist Role in Missouri and Texas. Jody Received Her Bachelor of Science Degree in Biology and Environmental Science from the University of Wisconsin and Her Master of Science Degree from the University of Missouri. She Enjoys bringing many scientific disciplines together to implement conservation and regenerative agriculture across landscapes and has found working with farmers has been the most rewarding part of her career. Jodi, You May Now Begin.

Good Afternoon Everybody. We Are so Pleased You Could Join Us for Today's Webinar. This Will Be a New Crop for Farmers You Are Interacting with over the Next Following Years. Here's a Brief History. One of Things I Want You to Know Is That There Is a Specific Term for Industrial Hemp. It Means That the Plant Cannabis sativa and Any Part of Such Plant Whether or Going or Not, and It Needs to Have a Delta Nine Concentration of Not More Than 0.3 Percent on a Dry Weight Basis. Also I Want to Point out That You Can Find out More Information at the Agricultural Marketing Service at the USDA. You Can See the Website. That's the USDA Agency That Oversees All Hemp Rules.

A Little Bit about the History of Hemp. This Crop Has Been Here for a Long Time. Not in Our Country but It Started, the Origins Are in the Northern and Temperate Latitudes Where There Was Adequate Moisture and Sunlight. As You Can See by the Red Star, Eurasia and Central Asia Is Favored As the Origin. And Then It Arrived in Europe about 1500 BC and It Was Important for All of This Dealing with Naval Vessels. One of the Reasons Why We Have the Word Cannabis, It Does Come from the Word Canvas. There Is a Link There with Making Those Products for the Naval Vessels. That Was Very Important.

Also I Wanted to Share with You That There Is Different File Type Groups. There Is Narrow Leaf Hemp, Broadly Hemp and Focusing on the Fiber. It Was Estimated That 8500 Years Ago It Was First Harvested and Then the First Cultivation Was between 4000 and 6000 Years Ago.

It Has an Annual Lifecycle. Early Cultivation and Dissemination. That Means It Followed around People As They Traveled about. And Eventually It Was Domesticated As the People Traveled and They Took It with Them. The Seeds with Them.

Some More Information Here, like a Said, If You Are a Camp Follower for Humans. Dump Heaps, Manure Piles, Disturbed Soils Work That Is Where Hemp Did Well. And Some of the Desirable Traits That Humans Look for Was for Seed. They Used the Seed for Food and of Course Then They Took the Seeds with Them for the Next Generation of Plants. They Learned How to Use the Fiber for Ropes and Making Tools. And Also They Used It in Ceremonial or Medicine for Their Tribes As They Traveled around. In These Pictures, They Were Taken in Wisconsin.

Also Dispersion Happened by Wild Birds, Animals and Eventually Humans. And in the Wild Populations Provided a Seed, Fiber and Also Drugs for the Ceremonial and Medicinal. These Became Part of the People's Culture. Just like I Will Give You an Example, Just like Potatoes Are a Culture for Ireland. This Canvas Became a Culture for Many of These Tribes.

It Eventually Ended up in the New England Colonies in about 1645 and It Was Important for Rope Production. And As They Were Building Many of the Buildings That They Needed and so Forth, They Needed to Have a Source of Natural Fiber for Ropes. So Hemp Was a Perfect Fit. And Then Also George Washington and Thomas Jefferson Both Grew Hemp on Their Farms and Supported the Crop. And As the U.S. Cordage Industry Expanded, Kentucky Took the Lead in Commercial Cordage and Then It Moved onto Missouri and Illinois. And Also You Can See That Cloth Was Made. And Then in the U.S., the Hemp Production Declined for Various Reasons. Such As Competition from Other Fiber Sources, the Cotton Gin Lowered the Costs of Cotton Production. And Also the Imported Jute and a BOK of Fibers Were Also in Competition with Hemp Fibers.

And Then Eventually Concerns over Its Drug Uses Had Impacts. And the Marijuana Tax Act of 1937 Put Everything under the Control of the U.S. Treasury Department. So That the Growers Had to Be Licensed and Registered. And Then This Eventually Led to the End of Hemp Production. But Then during World War II, It Actually Had a Resurgence of Hemp Fiber Production Because We Needed It to Help in the Materials Needed in the War. So We Had a Peak in 1943-1944. And Then after the War, It Declined Because of Fiber Competition and Legal Restrictions.

And Then Actually in the 1990s, Canada and Europe, They Made Decisions to Allow Hemp Production. And Then That Also Increase the Interest in the U.S. In 1999, Nine States Pass Laws Related to Hemp Study and Research of Hemp. The U.S. Drug Enforcement Agency Slowed Progress with Regulatory Regulation. And Hemp Was a Schedule One Controlled Substance Regardless of the THC Content. And This Is What a Field of Hemp Look like. This Is a Weedy Field but It Gives You an Idea of What the Seeds Look like across the Field.

For the Current Information Now in the U.S., the 2018 Farm Bill Changed That. It Change the Federal Policy. And It Actually Removed Hemp As a Controlled Substance from the Controlled Substance Act. And It Looked at the Consideration of Hemp As an Agricultural Product. So It Now Allows to Submit a Plan with the States Having a Signed off Plan by the USDA. And Also to Produce Hemp in Their State, Each of the State Department of Agriculture Has To Implement This Plan. That Is Approved by the USDA. Here's a Nice Picture of a Hemp Plant. There Are Many Hemp Parts. This Is a New Crop That Would Would like You to Give Consideration on and Learn a Little Bit.

The Current Information, These Are All the States in Purple That Actually Have State Legislation so Far. There Is Only If You States That Don't. So Many of the States Then Will Be Submitting a Plan to the Agricultural Marketing Service of the USDA to Get Their Plan Approved.

And I Just Want to Make Sure You Know That the Is NRCS Policy out There. This Is Dated November 4, 2019. It Gives Guidance and Direction on Assisting Producers on Ag Operations That Are under Industrial Hemp Cultivation. So That You Are Aware It Is NRCS.

Now We Will Actually Transition to Agronomy in Hemp. I Want to Introduce Bob Pierce and He's the Interim Director of Hemp Programs for the University of Kentucky, the College of Agriculture Food and Environment. BOB Grew up on a Small Kentucky Farm Helping to Raise Corn, Soybeans and Tobacco. He Received Degrees in Agronomy from the University of Kentucky and a PhD in Chemistry from the University of Georgia. During His 25 Years As an Specialist in Kentucky, He Worked on Tobacco Transplant Production Systems, Fertility for Tobacco, Conservation and Control Programs. He Recently Studied the Application of a Tobacco Style Drone System to Hemp Production. He Screamed Potential Herbicides That Could Be Useful for Hemp Production and Conducted a Hemp Variety and Fertility Trial. We Want to Welcome Dr. Bob Pierce. Thank You.

Thank You, Judy. Good Afternoon Everyone. It's a Pleasure to Be with You This Afternoon to Discuss Some of Our Experiences with Hemp. Of Course the 2018 Farm Bill D Scheduled Him but It Was Actually a 2014 Farm Bill That Allowed States Which Would Allow the Production of Hemp or Allow the Research of Hemp to Be Eight to Begin Working on That. We Begin Working on Hemp at the University of Kentucky in 2014. And Hopefully over the Course of the Next Limits, I Will Have an Opportunity to Share with You Some of Those Experiences. One of the Things That Has Come up with Hemp As You May Have Heard People Say That It's the Plant with 1000 Uses or 5000 or 10,000. I Have Heard a Number of Different Numbers Thrown out. And Its Versatility Is One of the Things That Have so Many People Excited about the Potential for This Crop. The First Thing I Would Do Is Talk about Sort of the Three Main Uses in the Production Systems. The Main Uses Tie in with What Joe DiGiuseppe They Go Back to the Historical Uses of This Crop. The First One That Typically Comes to Mind Is Fiber. Hemp Is Known As a Vast Fiber Crop. Two Types of Fiber. The Vast Fibers Which Is the Outer Covering and You Can See That Unraveled in This Picture Here with the Long Stringy Fibers That Are There. And Then You Have the Herd Which Is the Middle of the Stock Which Is a More Pithy Type of Tissue. But It Also Has a Number of Uses Itself. Answer You Can See Some of the Potential Uses There in Terms of Bedding and Insulation and for the Bast Fiber Rope and Various Types of Text As That People Are Interested in Looking at. From an Agronomic Person Perspective with Fiber Production, of the Different Uses, Fiber Protection Has the Lowest Potential Inputs and Even If We Get Pesticides Labeled for This Crop, Probably Not Going to See Tremendous Amount of Use of Those in Fiber Production. The Main Cost Is Really Going to Be the Seed Because You're Seeding This at a Very High Density. Right Now We Are Looking at 50 or More Pounds of Seed per Acre. Live Seed per Acre. And the Seed Cost Anywhere from Two, 2526 Dollars per Pound. So If You're the High Expense for the Seed Relative to Other Types of Crops. It Has Grown at a High Intensity. You Can See in the Picture in the Upper Left There That Those Are Eight Inch Rows with A Lot of Seed Being Put out. It Can Be Mechanically Handled and Harvest Which Helps to Reduce Labor. You See the Picture There of Going

through with a Typical Type of Forage Equipment. One Thing to Realize Is That Because of the Fibers Nature of This Crop, It Is Hard on Equipment. And Any Kind of Bearings or Shafts That Can Get Wrapped around, so You Have To Be Diligent about Keeping Those Things Clean. After It Has Been Cut, It Will Lay on the Ground for a Period of A Few Weeks to Rest As They Call It and That Helps to Begin to Separate the Inner Fiber from the Inner Heart from the Outer Fiber to Help Get That Apart. And You Can See It Being Bailed after It Had a Resting Process. Most of the Economic Models and Budgets Show That the Returns for This Crop Will Be for Fiber Crop Will Be Marginal Based on Current Fiber Uses. Although We Are All Hopeful That We Will See Some Improved Uses or Different Uses That Will Come about That Will Make Hemp More in Demand. Hemp Fiber More in Demand. But Currently Pretty Marginal in Terms of Returns per Acre. Also Growers Will Have To Be Pretty Close to the Processor in Order to Make This Pay Because of the Bulkiness of the Material.

The Saint Main Use Is for Grain. Another Main Use Is for Grain That We Can Talk about. A Lot of People Are Interested in Consuming Hemp Grain. It's Reported to Have Favorable Qualities in Terms of the Omega Fatty Acid Profile of the Hemp Grains. They Can Be Consumed Whole or They Can Be Hulled in the Hearts Can Be Roasted and Consumed in That Way. You Can Actually Press Seed Out Of the Oil like You Would a Soybean. It's 30% Oil, That Can Be Pressed out and Used As a Cooking Oil Just like A Lot Of Other Vegetable Oils. One of the Main Areas of Interest Is Getting Hemp into the Protein Powder Industry to Be Used in Folk Meats or Bears Other Types of Protein Substitute Types of Materials. Animal Feed Is Another Potential Mechanism or a Potential Market for Hemp Grain but Currently Animal Feeding with Hemp Is Not Permitted and Research Is Underway to Establish the Safety Protocols and the Safety Profile for the Feeding of Hemp. But Certainly If That Were to Come about, That Could Improve the Hemp Grain Market. From an Agronomic Perspective, Producing Hemp for Grain Is Similar to Producing for Fiber. Probably Going to Have Higher Inputs Here. There Would Be More Pesticide Use Once We Get Pesticides Labeled for Hemp for Grain Production Systems. But It Will Still Be Direct Seeded. Probably at a More Moderate Density. In This Particular Picture on the Left Hand Side, We Are in 16 Inch Rows Instead of Eight Inch Rows That We Were for Fiber. Without Some Weed Control Though, We Have To Do More Mechanical Weed Control with This Wider Spacing. It Can Also Be Mechanical Harvest. You See the Combine Rolling through There. Probably One Big Difference You Will All Notice Compared to Most Crops That You Are Used To Looking at, Is Running That Combine through Their. It Looks Pretty Green. Hemp Retains Wild and Seed Shadow. If We Wait for the Had to Come to Full Maturity into Dry Deck, Will Very Left to Harvest Because A Lot Of the Seeds Will Have Shattered or Been Eaten by Birds. And Attracts a Large Number of Birds. So When You Harvest That Green, You Wind up with A Lot of Grain Material in the Seed. That Will Have To Be Dried down to Keeping Moisture Very Quickly or You Will Have A Lot Of Spoilage. Also Logistic Issues with Ms. They Appeared from the Standpoint of Economics, Production for Grain Is Probably Going to Be in Moderate Return Potential. Perhaps a Bit Better Than Fiber but Not As Much As the Production of Hemp for Floral Uses. Lester in Kentucky, of the 26,000 or so Acres That We Had Planted of Hemp in Kentucky Muster, Less Than 10% Were in Fiber or Grain. The Vast Majority of It Was Being Grown for Floral Uses about 92%. This Was the Production of Cannabinoids and to See Beauty Probably Being the One You Have Heard the Most about but There Are Some Other Compounds That People Are Interested in and Extracting and Using for Health or Medicinal Purposes with This Crop. One of the Main Things to Be Aware of with This Is That It Is a Cloud over This Part of the Industry Is That FDA Still Has Not Determined Exactly What They Are Going to Do with CBD. How This Will Be Regulated in Products for Human Consumption. So This Is Something That Growers Need to Be Aware of When Getting into This.

The Production System for Floral Component Hemp Is Quite a Bit Different Than What We Talked about for the Others. It Can Be Direct Seeded and A Few People Have Done That but the Vast Majority of the Growing in the United States Has Been Using Transplanted Systems. And This Can Be Systems Similar to Vegetable Production Symptom Systems Where It Is Grown on Plastic or Similar to What We Do with Tobacco in Open Bed Systems. One of the Reasons People Go with Transplanted Systems Is That for CBD Production or Cannabinoid Production, You Want to Have an Almost All-Female Plant Population Because the Highest Concentration of Those Compounds Are Found in the Unfertilized Email Flowers so You Want to Keep the Male Plant Away so That the Females Are Not Being Pollinated. In Order to Get an All-Female Plant Publishing, a Couple Mechanisms Have Been Used. Feminized Seed Which of Those Were Last Year Running One Dollar-Two Dollars per Seat. Not or Pound, per Seat. Or Using Rooted Cuttings or Clones Which Last Year Were Running in Wherefrom Two Dollars-Eight Dollars per Plant. Those Prices Have Moderated a Little Bit This Year As the Demand This Year Is Not Quite As High but Still Fairly High Cost for This System for the Labor for Weed Control with All of That Open Ground. I Know Herbicide Is Available. The Cost of the Plants in the Cost of the Labor for Harvesting and Other Components. So the Harvest Is Still Largely in the Systems Done by Hand. Cutting Each Plant Individually and Then It Can Be

Air Dried. There Is an Example There in One of the Burly Tobacco Barns Here in Kentucky. Manually Placing the Hemp on the Drying Racks.

A Can Be Oven Dried. There's a Picture There of Folks Loading the Hemp into a Flu Cured Style Barn. The Best Methods, We Are Still Working out, the Best Methods to Dry the Hemp and Preserve the Compounds. We Did a Preliminary Test Where We Had Some Materials That Were Freeze-Dried and Compared to Oven and Air Dried. We Found That Particular the Oven Drying at High Temperatures Tended to Knockdown the Cannabinoid Level Significantly. Subsequent Tests Have Not Shown That so We Have To Figure out the Right Combination of Drying Temperature and Drying Time in Order to Preserve These Materials.

One of the Main Reasons That so Many People Jumped on This Bandwagon Last Year Was Because They Were Being Promised a High Return Potential.

This Charge Shows That the Beginning of 2019 of Last Year, Prices That Were Being Projected for or Offered in Context to Growers Were at the Four Dollars per Percentage Point per Pound of Material. If You Had a Pound of Flour That Had 10% CBD and It You Could Be Looking at \$40 per Pound for That Material. And Growers Were Being Told to Get 1002 Maybe 1500 Pounds of Floor Material per Acre. So When You Start Multiplying Those Numbers out, You Can See Why so Many People Got Interested in That. Throughout the Planting Season When the High Prices Were There but You Can See That Beginning around July and in through the Harvest Season, Those Prices Dropped off Considerably. A Couple of Things Going on There. People Realize How Much Material Was out There and That the Market Was Maybe Not As Big As What Had Initially Been Perceived for the End Products. And Then One Realization Finally Began to Hit Is That for All the Material That Was out There, We Did Not Have the Processing Capacity That Was Necessary to Process It. So with the Lower Prices, and Lot of Processors Backed out of Their Contracts and Unfortunately A Lot Of Growers Were Left Holding the Bag with Materials That They Either Could Not Sell or Sold at a Very Low Price Relative to What They Had Invested in It. And That Has Continued into This Year with the Cooling of This Market. A Lot Of People Went in with High Hopes Last Year and Then Reality Set in.

I Want to Briefly Mention -- What I Have Been Describing Is the System Where We Will Grow Cultivars with High Concentrations of CBD at Low Populations, Female Plants with Higher Production Costs. The Advantage of the System Is Really for the Processing Industry Because They Can Process a Small Amount of Material and Get More of the Active Ingredient That They Want Out Of That. But It Is a Higher Cost and Certainly at the Current Market Prices, They Don't Support That Model Very Well. The Other Important Factor with That Model Is That the Varieties That Are Being Grown There Are More Likely to Exceed the THC Limits in the Harvested Flower. Another Production System, and This Is What Was Being Used in Europe for the Years Prior to When Hemp Became Available to Grow in the U.S., and They Would Just Take a Common Hemp Variety That Might Produce 2-5% CBD and Grow It and Seated and Direct Seeded with Male and Female Plants at High Density and High Biomass and Practice Mechanical Harvest. There Are Harvesters out There That Can Take off the Top of the Plants and Put It in One Bin and Then May They Can Actually Cut the Lower Part of the Plant so They Could Have a Dual Harvest with the Flowers Going in One Bin and the Stems Dropping down to Be Used for Fiber Were Being Cut down for Being Fiber As Well.

This Helps to Lower the Cost of Production for the Raw Material but Then on the Processing Side, You're Looking at Having to Process Five Times As Much Material to Get the Same Amount of Active Ingredient Out Of It. So That Is One of the Reasons That the Industry Has Kind of State Away from That up to This Point. It's an Open Question As to Sort of Which of These Production Systems May Eventually Win out in Terms of the Most Economical One Overall for All Parties Involved.

So That Is Just Kind of an Introduction to Some of the Uses of Hemp and Sort of the Basic Agronomic Production System. The Next Thing I Want to Do Is to Go into Some Common Misconceptions That You May Have Heard about Growing Industry. When It First Came in, We Were Hearing All These Wonderful Things about Hemp and How Easy It Was to Grow. And Thrives on Marginal Soils. It Doesn't Take A Lot Of Care. We Don't Have To Worry about Weed and Pest or Disease Problems. It Doesn't Matter That We Don't Have Crop Protection Agents Labeled for This Because This Is a Wondrous Crop That Has Resistant to All These Things. Our Initial Experience Has Been a Little Different Than That. And What I like to Say Is You Can Grow Marginal Hemp on Mars Also. But If You Want an Equally Viable Crop Then You Have To Put It on Good Cropland Just like You Would Any Other Crop. The Other Thing That We Hear Is That It Doesn't Require Fertilizer. Again, It Will Grow That Fertilizer but in Order to Get an Economical Yield We Will Have To Grow, Add Fertilizer in Order to Get It. [Captioners Transitioning]

We are getting increases in yield. That is to be expected. The same thing with floral production. These are several different varieties. The virus 80s have a little different response. Some of them respond to the typical yield curve where we see increases up to a certain point and plateauing. Victoria, for example, plateaued very quickly. There may be some differences in terms of their nitrogen use efficiency, but all of them will

respond to nitrogen, in terms of producing more yield. The idea that we don't need fertilizer is false, but we do need to have some research to determine the optimal rates of fertilizer and all of those types of things for growing hemp.

In 2019, we did see a lot of nutrient deficiencies, despite the fact that growers were applying fertilizer to it. When you see a situation like this, where you have a soil test that says, you know, you are generally in the adequate range for most nutrients and you have a plant analysis that comes back deficient in almost anything, that suggests you don't have necessarily a supplier problem in the soil. What that suggests to me and what we often found in these situations, we have a root problem. Hemp seems to have a propensity for girdling roots. They will actually wrap around the plant. Last year we had so many people that jumped into this business and many of these people had never produced a rooted cutting in their life. That showed in some of the quality of the plants we were getting with limited root systems. The picture on the far right shows that with good management, we can produce plants that will have an adequate root system and grow well. We just need to learn about these processes of producing these plants.

Another common misconception is that we didn't need to be concerned with weed control. Again, this really comes down to how we are growing this crop. If we are growing this crop in one of these transplanted systems or with a low rate of speed -- seed and a wide spacing, there is a lot of open ground there. We don't get canopy closure, any help from the crop, or very limited help from the crop in shading out and controlling those weeds. This was a trial we did, looking at different herbicide options, but as part of that, we had a manual weed control and check. In this transplanted system, the weeding check had significant lower yields than the manual we control treatment. That shows that we will have to do something for we control. Incidentally, we did find some herbicides that appear to have some good activity and would be safe to use on hemp, but nothing in the range of herbicides yet has been labeled for this crop. There is nothing yet that growers can use for weed control in have. In that same trial, we also had a direct seeded treatment. We were going to harvest for grain. Our grain yields were all pretty low in this place because we planted this crop rather late. If we just compare between the manual weed control treatment and the weedy check, there was no real drop off in yield there. In this case, we were able to have the crop planted densely enough, it was able to establish and was competitive with the weed. The We competition from hemp depends a lot on how you grow it and on the conditions under which it is grown.

A couple other things we have heard, you know, no insect pests, no disease problem or that hemp is resistant to these things. My colleague here at the University of Kentucky has identified no less than a dozen different diseases on hemp that has been growing here the last four or five years. Some of the main ones we have concerns with other southern blight, it showed up a lot last year. It is a soil borne disease. That is one, as we rotate back into these fields with hemp, we may continue to see it build up and continue to cause more problems over the years. A number of leaf spot diseases, the hemp leaf spot disease shown on the bottom was actually identified on hemp for the first time here in Kentucky. That has been one that under rainy and wet conditions, we will see it explode and cause a lot of problems, but most of the time, it is there. You can find it in most fields. To most, it is only in low levels. We have to identify which diseases are of most economic concern to growers and to develop management practices for that.

In terms of insects, we have seen problems in indoor systems with things like mites but we have seen core near worms and fall army warms. They came in late in the season, as the flowers were developing on these plants. Remember, for this type of production, the flowers of the economically important part. These worms would burrow in through those flowers. You can see in the picture on the right-hand side, a lot of the tops of the dead floral material is where the worms have burned through there and cut those off from their supply. That is lost yields that a grower would not be able to recover.

Those are some of the misconceptions. Now, I want to go through a few of the challenges we faced in trying to ramp up to large-scale commercial production of industrial hemp. One of the key problems we have and have continued to have now is a lack of knowledge about the cultivars in the varieties that are adapted to regional climate soil, day length is an important consideration for hemp, in terms of plowing time, and also, it is very important to consider the THC compliance. In terms of the day length, hemp is a short day crop, photosensitive. A lot of the cultivars have been developed at northern latitudes. When we try to grow them in places south of that, a lot of times they will bloom early. This is an example from 2019. This is a crop that was planted in the middle of May. By the middle of June, before we even hit the longest day of the year, it was already flowering. Even our longest days were still much shorter than the longest day at the location where this cultivar was developed. I believe Calvin, who will follow me, will have more to say about the photo period, as well.

The other major issue that we saw last year was that almost any of the cultivars that claimed to produce a high level of cannabinoids, or CBD, the pathway for CBD and THC is the same until we get right to the end of that pathway where kind of branches off. If you have a plant that produces high CBD, there is a chance it

will produce a noncompliant THC result, as well. In Kentucky, the Kentucky Department of Agriculture publishes this list of varieties. They list on their if there is a variety of concern, meaning and has at least one test above the 0.3% THC limit. In some cases, we have varieties that you can see on the chart in red that have been prohibited from being grown in Kentucky because they have repeatedly exceeded that compliance level. In 2019, we had a lot of new growers coming into the industry. We had a lot of cultivars coming in they were not familiar with and we were not familiar with. Over 40% of grower test as last year were above 0.3% THC. Under the current rules, some of those would have been allowed because of the uncertainty of the laboratory measures, but a number of them, including any of these that last year tested above 0.4% would have to be destroyed. The grower would have all of that invested to get to the end of the year and only have to destroy it.

Other challenges we faced, particularly in grain production, is trying to get our stems established from seeds. Seed quality has been an issue. Initially, we were bringing a lot of it in from overseas. The quality was quite variable. There is uneven maturity and shattering that occurs. Apparently, this seed does not score well. There is the 69% German nation we tested it in 2019. We tested the same lot again this spring and it was down to 7% germination. It had been in cold storage. You know, there is definitely some issues with seed quality and viability. It seems to be getting better. In 2019 and 2020 we have had some seeds that have come in with a lab germination in the mid to high 90s. We are definitely looking at the need to adjust our seeding rate, based on germination. Most determinations are made in terms of pounds of seed. We are looking at planting for a specific population.

In an hour 2019 variety trial, we adjusted for seed germination. We also counted our seeds so we knew the seed size. We knew how much live seed we were putting out. Still, even some of our best cultivars only have between 50% and 60% emergence in establishment of the live seed we put out. As an agronomist, I look at this, this is an unacceptable situation in the long-term. We can't have it continuing to put out twice as much seed is what we need to establish. That is something we deathly have to work on, in terms of the viability and the vigor of the seed.

There are certainly some management aspects of seeding we need to get a better handle on. We have generally been recommending a shallow planting Depth. Some of that information comes from places like Canada where they have been growing hemp for a longer period of time. The shallow Depth was being recommended for faster emergence, better We competition but at that shallow Depth, it is subjected to those conditions at the soil surface drying out very rapidly. Also, birds love to follow our planter with that shallow planting. There is a lot of bird predation of seed. We are looking at bigger planting Depth to improve our consistency of establishment. Hemp is also very susceptible to soil questing. It it emerges like soybeans. We get heavy rain that tend to go over the surface. The plant has a hard time breaking through the surface, as you can see for the pictures here. We are looking at some indication of that, as well. We are looking at mitigation, as well.

I figured I needed to throw in a little something about no till. This is something I would like to see us develop further, as well. This is a crop we were putting in on one of our research farms into wheat stubble. On the right-hand side of this picture, there is corn landed on the right. There is an area where it overlaps. The wheat was killed down much earlier than the bulk of the area. This is that same area a few weeks later. The bulk of the area sees some of the typical problems I see with our stand establishment all the time, that is uneven establishment, areas of good establishment and areas of poor establishment. If you look over to the right, next to the corner over there, there is a strip, it is about a half a drill pass ride, where the germination was more consistent, it is thicker and the plants were bigger, I will show you another picture of that up close. It is right up next to the corn where the growth was much better.

Following up on that, this year they did trials with cover crop management, where we took a wheat crop, burned it down early and left it standing, burned it down late, left it standing, did a removal of the crop material, a crimper roller was burned down and a crimper roller with no burn down and conventional treatment. It was amazing the growth that we got, the growth improvement we got from the early burned down. This is all planted at the same time. We got a 30% thicker stand and better height. I am confident there are some things we can do to improve our management of planting, but it will take us a while to work out some of these details.

I have already talked about some of these other challenges, light transplant production and fertility management, little bit on post harvest. The last thing I will talk about in terms of challenges are the limited pesticide registrations we have. Right now, the options are the 20 5B root, which are the ingredients that are relatively safe. These are typically natural compounds. For the most part, they are marginally effective against most tests. Those are available for hemp producers to use. There are 10 products that were approved by EPA for section 3 federal labels. This happened not quite a year ago. They registered these products. Again, they are mostly based on natural products, five of them were based on neem oil. Three our biological

fungicides and one is an appellation and one is based on fatty acids. It is still based on chemistry. We don't have a lot of data on the efficacy with some of the common pests we see in hemp but we hope this opens the door for additional pesticide approvals. Here in Kentucky we have been pretty fortunate to get a couple of 24C labels, as well. We have one for a product, which, if the earworms come back again this year, at least we've got something that we can recommend to growers that we feel could have some activity on those types of pests. Still, most of the 24C activity has been on relatively soft chemistry. As I mentioned earlier, Noel besides no herbicides today have been viable. Besides being valuable to growers, it is important to know what is labeled in your region. A lot of the time the state Department of Agriculture can provide that information. Another factor we have to consider is that the process or tolerance for pesticides, even when we do get some of these labeled, for the medicinal uses, we feel like they are not Kenner want pesticide residues in that. A lot of extractors are concerned because the residues can actually concentrate during the extraction process. We have concerns from that, in terms of labeling. We have also seen concerns in residues carryover from previous cropping systems. Whatever was grown the previous year.

Growing hemp is a risky business. Growers need to be aware of that going in. We have only just begun to work on this crop again after 50 years of nobody doing anything with it. There is a lot to be learned, in terms of production risk. There is also a lot of market risk. We have had processors coming in and out of this business for the last several years. Some of them were not around very long. You know, growers need to, you know, when they are talking with these folks, do they have a business plan? Do they have stability? Do they know what they are doing? A lot of times, you know, when you take a hard look at that, the answer is no. There is also the risk that, depending on how the FDA ultimately decides to rule on the status of CBD and whether or not that can be put into supplements or those types of things, or if it will be regulated more heavily, that will impact the market. The grower can grow the crop and have a test that goes above the limit and have to destroy the whole crop. As we have seen, market saturation is an issue. The bottom line is, my advice to growers as caution, caution. Look at this thing. Don't get drawn in by promises of big money. Sure you research the process and know what you are getting paid for. Know what you're getting yourself into. My bottom line is to growers, don't spend any more on this crop because you can afford to lose because of the risk that is involved with it. I appreciate your attention this afternoon. I will be around for the question-and-answer session a bit later. I guess I will turn it back over to you.

Thank you so much. We appreciate all of your advice. [Indiscernible - low volume] our next guest grows numerous crops during droughts. He grew up on a farm in eastern Kansas. He received his training in Agronomy at Texas A&M and the University of Minnesota. [Indiscernible - low volume] as an alternative crop, his duties include serving as the statewide agronomist specialist for hemp and some flowers. Thank you for joining us today.

I have on my screen, I believe I click share my screen. Is that what we remember?

Yeah. There you go.

Okay. Let's have this come over here.

Just a reminder for participants, if you have any questions, please put them in the chat box. We will get to them after this presentation. Thank you.

Jennifer, my PowerPoint is showing okay?

It is still loading. It should just take a second.

Okay. Anyway, for folks here, I looked through the list of names and I would really like to know where everybody is from. I recognize a couple of names, one of them I just met through email from New Mexico. I had a question for Morgan [Indiscernible] and I enjoyed that discussion. I look forward to helping share our information there. Jennifer, tell me when you have my presentation full screen and I will go through that.

Okay. It doesn't seem to be loading. We can load the PDF that you sent. Give me a minute.

Karite. I certainly appreciate the information. The advantage Dr. Pierce has over people like myself, he has been working with hemp about five years. I, like probably most of you, are pretty new to hemp. I started the learning process just over a year ago. I made some trips to Colorado and New Mexico last fall, the late summer and fall, revisited some of the same field so I could see what they looked like at different times of the year. I saw Harvest. In Texas, this is the first year of crop production with hemp. Texas did not take advantage of the provisions in the 2014 Farm Bill, like Kentucky or Colorado did. Legislatively, the hemp regulations were approved in Texas in the spring, late spring of 2019. We started to prepare for the 2020 crop. The disadvantage that a lot of first time growers have this year is the license application did not become available until mid-March. We knew that would put us behind in terms of what we thought would be hitting the optimum planting dates, especially in Texas. We are trying to keep track of some of the different issues there. Much of what I am learning is certainly an affirmation of what Dr. Pierce has shared. There are other things we see in Texas, I think maybe it is a little bit part of the mindset, maybe of the more established farmers, those thinking about hemp, possibly on a larger scale. I will talk about some of the perspectives in

Texas that we see, in terms on how to grow hemp. There are a lot of different ways to grow hemp. There will be those individuals that say to grow hemp you have to start from transplants or you have to have, for example, this is what I heard in the meeting, you have to use surface irrigation underneath the plastic sheet. Okay, that is a comment more for a semiarid region like a portion of the Great Plains, maybe most of the Great Plains. That would be done differently in Kentucky. Do we have pictures yet again?

Yes, we do.

We have someone from Massachusetts on.

Excellent.

I would like to be on Cape Cod next week, but we are not able to travel very far this year because of the virus. Anyway, as I am learning my way through hemp, when we talked to our growers, for many of you here, I think these will be the things that we saw in a lot of our many workshops. A lot of the people that attended the workshops that we had, that we had 19 of them, at most, we never had more than 40% of the attendees that were actually farmers. In some cases, as many as 80% of attendees were not farm people. They had some land. They wanted to grow. They were interested. [Indiscernible - low volume] maybe they heard about the high prices. Our approach, not knowing that I was in a position to talk to people yet without the experience from walking out on a field and watching the plants grow is to talk about aspects, questions to explain some things and anticipate with hemp would be like wherever we were, as we visited with folks across Texas or whatever reason we were in to help them think through. A lot of that came down to really, what is your goal? What is your objective? For most of those people that we visited with, it tended to be something in the order of a half-acre to maybe two or 3 acres. We had a few people that were like, we are going to grow 50 acres for CBD. A part of me wanted to say, no of your not. You don't realize how much effort it will take to grow even 2 acres. One of the things we see in West Texas, when I started here in 1999, we were on the cusp with a lot of wine grape vineyards being installed. They were half-acre, 1 acre, 2 acres. We got into the mid to thousands, a lot of those vineyards had been abandoned. I think the growers, I think the owners just realized it was too much work. It was not worth it. I think we may find that some folks encounter that with hemp. Because of the low prices this year, I think as many as one fourth of the people in Texas who applied for and received a license have actually not grown anything. I would say probably, Bob, many years as many as half of the folks say they will tinker it out and grow a little bit so they can learn about it.

We talked about CBD, the hemp hearts over here. I went to a farmers market in Montrose, Colorado, you can purchase your CBD products with the peaches and the late-season green beans. They had the certificate of analysis right on the table. When I see a consumer looking at a product I'd like to see a QR code on side of the bottle. That will give a little more confidence in what they are buying. Remember, the CBD products are not regulated. No one is checking them to make sure they have the advertised level in milligrams of CBD or whatever else that might be in there. One of the first mistakes that I made when I wrote about hemp last year, I talked about hemp oil, CBD oil, as if it were crushed from the seed. If somebody said I was in India, they would have been right early on. There is a distinction. The CBD oil, other cabinet adenoids like CBG or CBN, those are compounds that are extracted from the plant and reconstituted and a carrier oil, like coconut oil, or maybe hemp seed oil or something else. That is your CBD oil. That is in contrast like soybean oil or something crushed out like sunflower oil. There is an example of the hemp seed oil product in the upper right-hand corner. Here is the reality check that stumped a lot of growers in the U. S., including folks that have grown a couple years.

As Dr. Pierce mentioned, with a similar graphic, we saw these prices in the range of \$4.00 per each. A year ago at this time, we still saw some of those prices in the mid-\$3.00 range, maybe \$4.00. By the time we got to January 2020, those prices were down to about \$0.70 and have stayed there. Here is some of the explanation. In 2018, we had about 78,000 acres of hemp harvested in the U. S. Most of that was for CBD. In 2019, Root 130,000 acres. I think a lot of that hemp is sitting on processed in warehouses. There wasn't the need for much crop in 2020. That is the head when growers and would be growers are facing. We realize, a plus you have a very specialized situation and you have some extreme level of efficiency, any profitability on CBD hemp looks like it would be very difficult to achieve in 2020. I think a reflection of that is a licensed acres. That is different from how many actually get planted, much less how many actually get harvested. The licensed takers in the U. S., in spite of states like Texas coming on, is down 9% for what it was a year ago. The first things to remember that I like to share with folks, this promises of profit that just don't seem to materialize. Yes, it is possible there were people making \$40,000 and \$50,000 off of 1 acre. When too many people hear about that, you have a lot of post coming out of the woodwork to say they want a piece of that pie. They want that kind of revenue. This year, in Texas, I am sure this could be the case in many other states, buyers are very scarce. I would say most of the hemp that is being grown in Texas this year is not under contract. That is something we recommend you do not do. There is still a lot of misinformation, a lot

of claims that cannot be supported. There is seed that is not what it claims to be. It doesn't germinate. People say, we will be building a CBD processing plant in Lovett, Houston or wherever. Maybe four people said they were going to build the CBD processing plant around Lubbock. None of them got any further than just the talk. Those are concerns there. [Indiscernible - Multiple Speakers]

Did you say next slide and Jennifer will be more on cue for your. Just say that if she will advance whenever you would like hurt to.

That will be fine. Are you looking at the slides I have on my screen or does she have the PDF?

I have a PDF. The slide is some first things to remember is what we are currently on.

Okay. Next slide. I was advancing my slides on the PowerPoint. I'm glad you told me that. Thank you. Next slide. Try Combs. These are the little wormlike structures that are laden with the Kadabra annoyed. Which you have there, those of the most important parts of the plant. You do have small levels of CBD, for example. You will notice some spackling on the leaves in the background. Those are Leser. It is even possible to have very light levels of CBD in male plants, on occasion, possibly 1%. Next slide.

As mentioned, for the hemp plant, we have the photosensitivity as a dominant factor. Next slide. Let me get off of my PowerPoint. Okay. I apologize for that. Okay. The hemp varieties are photo period sensitive. That means the plant is responding, possibly to simply the absolute number of hours of light or changes in the hours of light. In the case of hemp, it is the dark period, the increasing length of the dark period in the fall. That is the typical understanding. That would trigger the plant to go into photo period sensitivity. When that occurs, you begin to see the plant that will go into reproductive growth. There are some surprises for us. What you see here, this is June 2020, a farmer on the Texas Gulf Coast. He planted 500 acres. That is a little bit much to chew off for your first year. Three different varieties, he planted early May. These are great variety. They became worthless. Other things he ran into, heavy clay soil, flat ground, it doesn't drain very well and hot temperatures where the seed is at, you see 103 degrees. It is even hotter on the surface of the soil. He had a train wreck. He lost about 97% of his acres because of the flooding and then the rest of the problem here. These plants, this was for a grain crop. Basically, they're going into reproductive growth. That is very little economic you're coming from this wants. What I would like to emphasize to all of our participants, there are many different ways to grow hemp.

You have seed or you are planting stock. There is what we call straight run seed. It produces a mix of male and female flowers. When you have those in the same field, you get ready pollination of the female, which would curtail the levels of CBD or other, value annoyed you would like to reach. What I see, the mindset of the producers I have interacted with, we do expect a little bit of toughness from what we plant here in the state. I think there will be a push for more direct planting or direct seeding and expectation of higher quality seed. I think with part of that, with prices where they are at, we have to lower costs. There is an interest on large-scale ag in Texas and really, in the western portion of the Great Plains. For large-scale operations at a looking at straight run seed that produces both of male and female plants, no effort to remove the males. Yes, CBD is lower but there might be an economic model that might be favorable. It was discussed about CBD content and drying material. Yes, it is true. How many have I heard, I will go for high% CBD. Part of me wants to say, no you're not. Then you will have a hot crop. That is something you have to learn more about. Indoor production could have several crops a year. I think you will have to focus on some type of niche market that has very high value. Planting patterns, possibly the spacing like you see here on the middle right. That is the typical 5' x 5' planting. That was actually planted mechanically. They fill in the spots where they don't get a plant.

We see some folks using planters. We have transplanting equipment. There is irrigation. The first meeting I sent in June 24 last year here I set in on our hemp meeting, the farmer said he was from Colorado. He didn't say it in a good way. He said the only way to grow hemp, of course, he is from a drier region, was to use the plastic sheeting, probably for weed control with a surface drip line underneath. I looked around the room and I thought, the farmers that are in here that I see, how do they irrigate in the southern High Plains? They have pivots. They are going to figure out how to do this with pivots. I think that is something I see affirmed for the.

Harvest methods, here, we have a poor crop that get hit by a freeze. Here is another case where it is irrigated with the plastic sheeting for the drip line. This particular model is a large stairwell scale model. The bales go to a drawing floor. Here's another case where we have direct cut. This particular farmer removes the seed with his combine. There is a conveyor in the back that goes into a modified plowing wagon and then that dry material is bailed. There is a lot of different ways to grow hemp. It depends on the scale and objective. Heavy metal accumulation used for reclamation. Sometimes it is used. They accumulate mercury, lead, those types of things and they can remove the Agronomy plant. This is made some people overly sensitive to think they need to test their regular agricultural soil for these heavy metals. The concern is it would be in material that would be consumed directly, like smoke or whatever, not necessarily extracted. We don't recommend, at

least in Texas, that a typical producer would be testing the soil for heavy metals and so forth. We just don't think that is probably necessary.

As far as a couple of things, some issues that we have learned from other states, Dr. Pierce could probably talk to us for a few hours about this with all of the people he has talked to, issues that lead to failure, poor quality seed is a big one, low germination, a variety of off types. You plant a variety, you expect the plants to be similar and they are not. We understand a lot of people just completely underestimate how much effort it will take to harvest and having enough drying space. On the business side, getting a reliable buyer that honors the contract is a difficult situation that many would be growers and existing growers have dealt with.

I will just reiterate what Dr. Pierce said. If you've got weeds, what we tell people on other crops that we might grow, at least that I have experience with, we have very few or no herbicide labels in hemp. Another example is Sesame. Those crops are not for your weedy ground.

A small Christmas tree, just a few pictures on what the hemp plants look like. You have vegetative structures on many branches on this plant. A lot of people affectionately call this their small Christmas trees. As this grows, here you can see some of the different floral structures alternating on the sides as you go at the stem. That is where your trichomes are. That is the most valuable part. For small acreage producer, they usually strip those off by hand after drying or maybe they have equipment that will help them achieve that.

Here is some on my own experience from 2020. In 2019, Roosevelt County, New Mexico, East Central New Mexico, late planted in June. We thought it was too late, this was a hot. The other thing we saw on the field, look like having planted a particular variety, they had as many as four or five distinctly different plant types. That tells me there was either a lot of contamination in that variety or in the breeding there had not been the processing needed to get uniformity in the variety.

Again, common production system, Rocky Ford, Colorado, here we have 5' x 5' with irrigation. This will require some mechanical harvest. This producer has 200 acres. It is way too much to try to handle a crop like that by hand.

We have questions in the southern Great Plains. What about hemp in dryland? My initial thought is that I think that hemp plants are hardy enough to grow adequately on dry land. We would not recognize this or recommend this for cannabinoid production. That is one of my objectives, looking at the production of hemp and what it may be in terms of production for fiber and a dryland setting.

Here is an example. This was a direct seeded operation. The plant the seed every few feet. This is the best of what this farmer had. Poor quality seed. His growing arrangement probably saved his skin. He was growing on a contract basis. He was paid a flat fee per acre to grow the crop. He was not out \$8000 or \$10,000 that could have gone into an acre of growing this. This is an irrigated crop. This is the best of what he had out of several circles. The lesson from this individual is we need better quality seed. He would have liked to have planted in the range a month and a half sooner than he could have when temperatures were not so high.

Growing issues, these are recent issues with people in Texas and beyond I talked to. Who will purchase your crop? That will be a very important question going forward for the rest of 2020 and into 2021. It makes sense. If you don't have a contract, you probably should not plant. I know that is kind of hard when people are hung up on, you know, a possible revenue of \$30,000, \$40,000, \$50,000 per acre and want a piece of the pie. The essential part that is needed is to have that buyer.

Good quality seed. Kentucky, I know the Kentucky Department of ag had a nice document earlier this year that Dr. Pierce showed where they looked at prohibitive varieties or varieties of concern. I looked at their data a lot. Many of the varieties that were designated as varieties of concern, I would have asked why. Keep in mind, a lot of that data in Kentucky, some of those hot tests may not have been the fault of the variety. It could have been the grower who did not harvest in time. They could have been a couple of weeks late when they should have harvested that crop and they went hot. That is automatically a destruct order.

Just a few more slides. I mentioned this earlier. Timely harvest and drying space. One of the hemp Industry manufacturers has this rule of thumb. You can see the pipe and rack system on the lower right. That is,. The rule of thumb, you need almost a cubic foot for every square foot of growing area. I have seen some growers are ready that have very quickly filled up the space they thought they would hang up there plants. You cannot jam them in to tie. If you do, you will not get proper drying and could have a mold issue.

How much hemp to grow? The first point here at the bottom of the slide, I think we already see, to some extent, the commoditization of hemp. We are seeing more farmers enter the market. In 2019 I met or visited with four different farmers in the southern High Plains that had anywhere from 1000 to 3200 acres for Max EBD. If you are a grower that is thinking about growing one or 2 acres. If somebody is growing 1000 or more, what is there for you? How could I possibly exist in the space? I think it may come back to your goals. If you've got, maybe some higher-quality type factor that you can manage, that is certainly consideration. Somebody in 2020 says I am going to grow 5 acres and it is the first time. Maybe just start with an acre or two and shrink that down a little bit. Another issue here, since we are here today, what about hemp as a cover

crop or soil builder? I think, in terms of the plant itself, it could be a suitable candidate, however, it is probably not viable because under current rules, you would have to have inspections and licensing. If you grow hemp anywhere there is cover for any use, the landowner or grower has a three-year responsibility to grow for the next three cropping seasons. As far as the hemp and per acre production costs, these are very general budgets you see in several states where you were looking at maybe a transplant, possibly clones, small acreages, just a couple acres we see estimates. When you have a completely hand managed operation, that will cost approximately \$10,000-\$15,000 per acre. I used a generous 2000 pound yield. I think I should have used 1500 instead. That would be a% CBD and that would be \$7200. It does not look like something you can make money on. The one example I know that is occurring in the southern High Plains is the fully mechanized operations where there is no hand management outcrop. They are using lower cost Street run seed. Yes, it produces male plants. They fertilize the females. The CBD may be a couple% lower but these farmers believe they can keep their production costs under about \$4000 per acre. At the very modest levels of CBD, the projections for folks in the area where I am, the estimates are they could be in the range of \$5000-\$6000 per acre on revenue. We will see how that turns out. Again, some farmers are simply growing it based on a flat fee, rather than taking the risk of all of the expenses.

Anyway, that is a brief overview. Some of my perspective is really more from being new to hemp in contrast to Dr. Pierce. I absolutely look forward to December when I can sit down with people and say, what do we learn about our first year crop? We will do a lot of that learning here. We will continue to learn from states like Colorado and Kentucky. That is what I have for here. We need to do some questions and answers.

Thank you. [Indiscernible - low volume] are there any questions? I do not see any questions. Does anyone have any questions? Would you please put them in the chat?

Bob, if you are back on the line, you have had a half hour to think about a few things you might want to add, in addition to what I have mentioned, or maybe, you are the experienced guy, maybe a correction or something like that, just maybe some additional perspectives?

Calvin, I think your first perspective and, don't get me wrong, to be an experienced person in hemp is just a few years of knowledge. We still have a lot to learn about this crop. I think the cautions that you have for the growers, we have experienced a lot of growing pains with this. We are not through with it yet, in terms of that aspect of it. Do we have any questions yet?

There are a couple I think. What are people doing to teach the public about the sustainability properties of hemp?

There are quite a few organizations that I am aware of. There are several hemp associations and those types of things that are trying to get the word out about what some of the potential is for hemp. Unfortunately, I think a lot of those folks are, you know, come across as maybe being overly zealous at times about that and overselling the potential of hemp. That is something we have to be realistic about. I have seen, we had our process, a fiber processor that made a lot of different products. I am convinced a lot of different things can be done with it. Can we do it in an economically viable way? So that hemp can replace something else that we are already doing and be less of an environmental issue than some other fiber crop that it might be replacing. [Indiscernible - Multiple Speakers]

This is a new crop. They make different products out of hemp and then the people who have production plans say now they will retrofit because they think it will be a viable market and then the farms will start growing it for that. How can all of those people collaborate to find out how it can work in the U. S. and what kind of products people will buy. Does that sound logical? [Indiscernible - Multiple Speakers]

In terms of sustainability on hemp, what about the sustainability of the CBD market. I think medical research is more free to do research. I think there has been a fad expert to some of the CBD. Maybe that is why the increase. I have seen charts that had the CBD market at \$25 billion by 2025. I think that has already slowed down. Established farmers I have met in the southern Great Plains seem to be as interested in fiber, rather than the cannabinoid. We have the announcement of a fiber processing plant in the region. In terms of just moving on here, we have a question. This is Dave's question. What about molecular techniques? We talked about photo period sensitivity. Hemp is very young and terms of breeding any insect or disease resistance. My university system does have an individual that is interested in using the gene editing techniques to work with hemp. It would be a long process. If that becomes classified as a genetically engineered crop, I think there will probably be a broad resistance to hemp varieties, even if there are different varieties, I think there will be a broad pushback or reluctance for that. That would be a broad perspective on that.

I tend to agree with that. What we see in terms of molecular techniques is along the lines of marker assisted breeding, where you could identify and follow it without having to grow the crop all the way out. You might see some of that. The sustainability arguments could be made a little less appealing.

Here is Jim's question about the heavy metals comment. That sounded intriguing. To be used for remediation? This is something I don't know much about. My first thought was, because the fiber varieties have inherently lower THC. In Kentucky, the Department of ag has very few, if any, that were for grain that had THC. I thought maybe the fiber varieties might be, if they could do the remediation, they might be a possible means there. There is certainly probably more work to be done with that. The research we would site right now would be in other countries. Again, it would have to be the regulation, you know, the USDA would be recommending hemp be grown anywhere, regardless of the purpose, under the current guidelines.

In thinking about that, there is a concrete where you use hemp fiber is one of the binding agent in that. I have this idea that if we were able to do some remediation and you could put it into something like that, you tie those materials up, essentially, in another available form. There could be some potential for remediation. [Indiscernible - Multiple Speakers]

What kinds of wheat competition? [Indiscernible - low volume]

All of the above.

We've got the ragweed and the peak weed here. This is been a good year for Johnson grass, apparently. It has really been tearing up some of our plots this year.

I think on the weed question, let's separate that out into grasses, versus broad leaves. If we do have, you know, at least a limited number of traditional agricultural herbicides labeled for help, I think grass control will be fairly relatively easy. We have a couple products that are used on minor crops. One active ingredient, for example is well-known. That would certainly address a lot of the grass issues. The broad leaves, that will take more research. Certainly, producers I have met to date, this is one reason why some producers either need a thick stand, if it is a fiber crop and they are growing for a cannabinoid with straight seeding they maintain the row spacing they can cultivate to suppress some of this we control issues. [Indiscernible - Multiple Speakers] [Indiscernible - low volume]

what about funding? [Indiscernible - Multiple Speakers]

I certainly hope that we will see more development work that has been done. A colleague of mine here has been successful in getting a grant to look at a rotational study that included hemp. Prior to the Farm Bill, it wasn't possible, certainly, for federal agencies to get involved. Since then, I think we are beginning to see some opportunities develop. Hopefully, we will continue to see that.

One thing we were hopeful of here is that a lot of state departments of agriculture have what they call a specialty block program for specialty crops. However, when you look at the USDA list, at least Texas follows the list and hemp is excluded from that particular funding mechanism. I think a year ago, we had optimism there would be private funding available for hemp research. That gradually, as a prices for cannabinoid hemp dropped and we saw the interest in those funding opportunities dry up as well, we saw the possibility of private partnerships there. This is from Jim talking about water stressed area. Hemp is a fiber crop . I think, you know, we have a question there, Jim. We don't know yet. I think it is worth researching. The first grant I have gotten on hemp is for looking at hemp fiber in the semiarid region of the high plains versus very limited irrigation probably in the 6 inch range. We have to find a variety appropriate for the region down here. [Event has exceeded scheduled time. Captioner must proceed to captioner's next scheduled event. Disconnecting at 1:30. Thank you.]

to captioner's next scheduled event. Disconnecting at 1:30. Thank you.]

[Event Concluded] [Event Concluded]