Industrial Hemp in Texas: 2. Initial Growing Considerations

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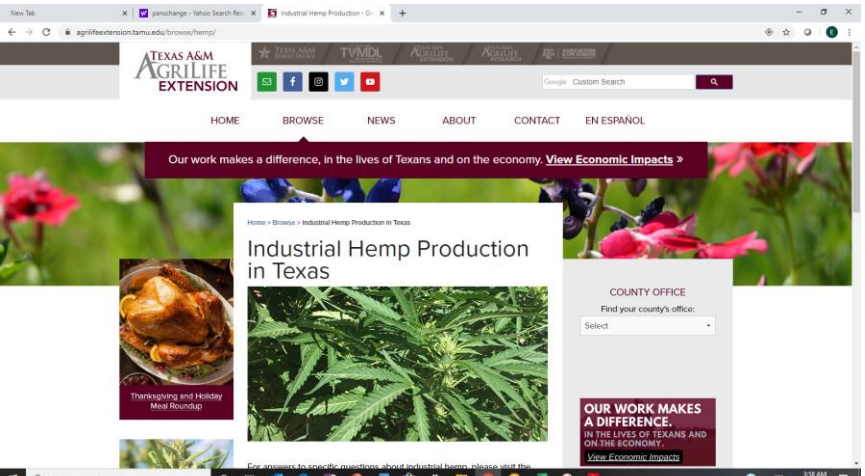
TEXAS A&M AGRILIFE EXTENSION

Texas—January 2020

January 2020

This is part of a series, "Industrial Hemp in Texas"

- Part 1: Preparing for an Industry
- Part 2: Initial Growing Considerations
- Part 3: Business Considerations
- Check regularly for updated and new information.
- All three sections plus other resources are available at https://agrilifeextension.tamu.edu/browse/hemp/



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- Texas A&M AgriLife does not endorse or discourage legal industrial hemp production as a viable agricultural production system in Texas relative to any other crop.

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Industrial Hemp Considerations

- Early AgriLife comment, now discounted: "***Requires 1/2 the water need for cotton with little herbicide/pesticide required***" (no, no, no); producers in similar environments like SE Colorado, Oklahoma are irrigating at near cotton levels, and more in some cases; AgriLife is unsure at this point about viability of dryland, especially for high-input cost CBD production.
  - Pest insects and especially weeds are an immediate problem in hemp farming.
- An early projection by Trostle suggests that Texas field-grown **rainfed** hemp for CBD (not fiber) should consider:
  - At-plant soil moisture + in-season rainfall (four months) ≥ 15"

Industrial Hemp Considerations

- One hemp farmer with four years experience in Colorado says "You can't starve a hemp crop into profitability." Meaning low inputs are not the way to go.
- He estimates that hemp can be grown on about 40% less water than corn, but you would not hold back any irrigation if you have doubts about whether you should irrigate more.
- With the excessive amount of production costs, you would not risk poor production if you could have irrigated more.

Hemp Seed

Grain from hemp plants for CBD production. Individual seeds are wrapped in a husk-like structure (green). These seeds are likely immature as CBD harvest has not yet occurred. The dark seed is a specific type of seed called an ‘achene,’ which is similar to sunflower (external seed husk, internal ‘meat’ or ‘heart’ for seed).

Seed & Stock Materials for Hemp

- Currently there are few certified varieties available, especially for CBD.
- Some Canadian fiber varieties are certified. Though these need to be tested in Texas, AgriLife anticipates some will be adapted to the Texas High Plains.
  - It appears hemp varieties may be broadly adapted, like sunflower.
- Many states have lists of ***Approved Varieties*** (e.g., CO, KS), but AgriLife does not yet understand how those lists were compiled or if there was any data used.
- Certification will be sought in the future for Texas.
- Larger farmers are producing their own seed or planting stock to minimize the purchase risks in for seed and planting stocks.

When Buying Planting Stock

- Again, remember much of the seeds, transplants, and clones have proven to be highly impure—not the same variety.
  - This appears to be a greater problem with seed.
- If seed is marketed as 'certified' you should ask for seed name and all documentation (by an independent third party) designating as certified (certification must be by a state department of agriculture or independent lab.
- Ask for information on purity, seed germination %, seed size, lot number, etc.

When Buying Planting Stock

- Buy only directly from the company who produced the seed/transplants/clones **or** their authorized dealer.

- Do not buy from someone who is only a ‘reseller’ of seed or planting stock (often an internet seller with no physical location).

- Will they guarantee the seed or planting stock?

- Single hemp plant for CBD production. Floral structures all the way to the bottom of the plant. Harvest method? Will have to process whole plant in order to get all floral structures for CBD extraction. Hand harvest and drying of plants then later hand removal of floral buds gives high %CBD but is very time consuming.

- Multiple floral structures at the top of the plant (main stem). Some CBD harvest methods will take off the “top crop” for higher %CBD yield in mechanical harvest. The rest of the plant may not be harvested. That portion of the plant could be used for fiber once processing facilities are active.

Trichomes (small protruding structures) produce cannabinoids. Note the sticky appearance.

- More trichomes
- Some suggest that harvest for CBD and other cannabinoids should occur when the trichomes change from white to milky white. Note that THC potential increases with time. Growers should test their THC levels over time.

Poor stand, Roosevelt Co., NM, 2019

Planted in early June (too-late planting)

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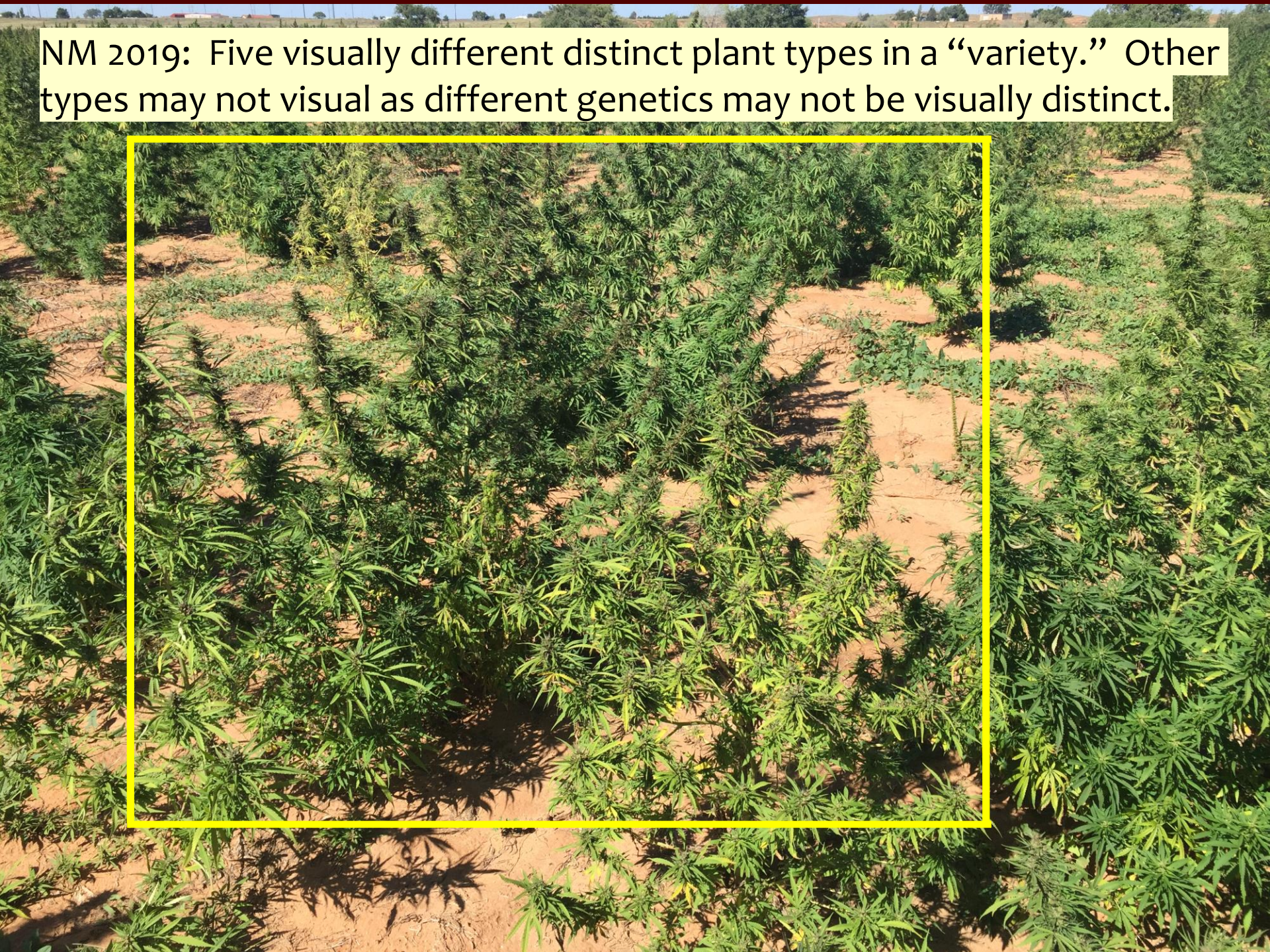
NM 2019: Five visually different distinct plant types in a “variety.” Other types may not visual as different genetics may not be visually distinct.




Colorado hemp production for CBD. Underground drip lines for irrigation but no plastic sheeting for weed control. 60” wide rows X 60” in-row spacing, from feminized seed. Harvest mechanically? Drying?

Another hemp field, Colorado. 6’ tall plants. It is not clear how this field will be harvested for CBD since the biomass is great.

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Dryland hemp field for CBD and seed, southeast Colorado. August, 2019 (deep soil moisture @ planting, near avg. rainfall)

Field planted with regular seed at lower cost so field is 50% male plants (lighter colored plants). Mechanical harvest of a "top crop" for about 12-16" for grain and remaining raw material for CBD extraction. It is uncertain if the %CBD levels will be high enough to be marketable.

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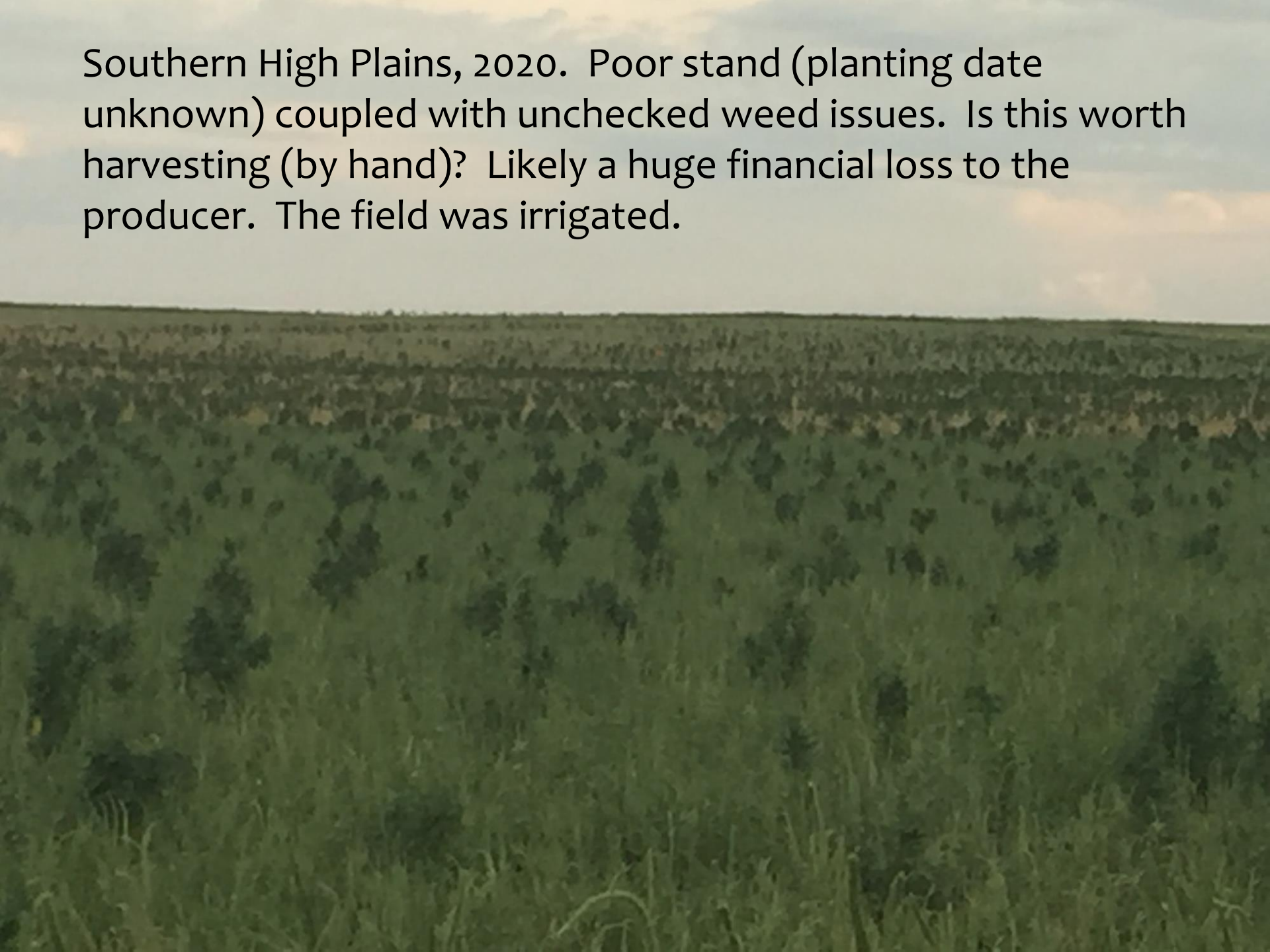
Poor quality feminized seed that had low germination and poor vigor was planted in early June in northeast New Mexico (at least 1.5 months too late?) when seed became available). The farmer's seeding rate if he had paid commercial retail rates would have been about $3,400 per acre, but the contractor provided the seed, bearing much of the risk. Irrigated.


Southern High Plains, 2020. Poor stand (planting date unknown) coupled with unchecked weed issues. Is this worth harvesting (by hand)? Likely a huge financial loss to the producer. The field was irrigated.

Prior to CBD Extraction

- Material for CBD extraction is ground and then any seeds removed (another step required).
- The seeds at right are likely immature and should not be planted (some have been sold as planting seed little or no poor germination).
- An independent germination test should reveal this low seed quality—if you can get the seed in advance to test it. (Make that your condition for purchase.)

Bast (external) fiber

The valuable bast fibers lie under the barky material (which is peeled back, at right) and branches of a hemp plant. This variety and production system is different than common CBD production methods. Plants are up to 8' tall. AgriLife is unsure yet how this is harvested optimally. Combines that harvest portions of the plant for CBD have problems with this strong material wrapping around internal combine moving parts and even causing combine fires.

Hurd (pith) for fiber

- This internal fibrous material is considered waste material by some, but it has desirable properties for industrial uses as well. Isolation methods require a decorticator and other equipment. In this image the outside barky material has been stripped away leaving the internal portion of the stem.

Clones for CBD Production (Female only)

- One means of getting all female plants in a field for higher CBD is to use cuttings from mother female plants, maintained under controlled lighting.
- Cuttings are treated then placed in a growth medium for rooting & later transplanted in the field.
- Clones are expensive and likely used only for small-scale high CBD growth.
- Clones can also be generated by tissue culture.

Large Scale Hemp vs. Small Scale Crop

- Most of the pictures you just saw are from larger field-scale production.
- There is another side that involves greenhouse, and "hobby farm" production that is about 1 acre of less. This surely involves complete hand production—establishment, maintenance, harvest, drying, and isolating dried flower.
- There is some interest in using lower cost "hoop houses" for production which can extend the production season forward as well as later in the fall.

consider possible growing demand (though that demand is
proven medical benefits). Since other countries don't produ
possible export market if import regulations are practical? (

re farming hemp this year, it might be a good time to panic. The US can only reasonably
me 22.5M lbs of 10% CBD Hemp in a year, and we're currently growing closer to 180M. Here is
k look at the current hemp surplus we are staring in the face:

Search ...

Is America Growing Too Much Hemp? You Might Be Surprised...

RECENT POSTS

emp-plant-farm-....jpg

There is more than one way to grow CBD hemp

- You will read or hear about individual producers that believe their way is best. They might even say that other methods, like planting straight run seed and not rogueing males, or the %CBD you might get from that practice, are not possible.

- This depends on grower objectives.
- Remember, in any crop producing maximum yield is NOT the most profitable.
  - It takes too much effort or cost to maximize.

There is more than one way to grow CBD hemp

- For CBD, there are many different production practices:
  - Seed type: planting straight-run seed (meaning field will have males and female plants; some growers rogue the males out and some don't), feminized seed, transplants (of feminized seed), clones.
  - CBD content in dried material: at little as 2% (a few extractors will handle this material due to economic considerations) to ~15% (preference is ~8% and higher).
    - CBD from **dried flower**—floral structures—is much higher.
    - CBD from **biomass**—partial or whole plant—will be much lower.
    - What is your goal? What does your buyer want?

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There is more than one way to grow CBD hemp

- For CBD, there are many different production practices:
  - Planting pattern: 5’ rows with 5’ between plants (~1,750 plants per acre), 30” rows with seeds 24” apart, even drilled.
  - Irrigation: surface drip irrigation under a plastic sheet (helps control weeds), pivot irrigation (sprinkler during establishment then LEPA drag socks), even furrow irrigation. What about dryland?

There is more than one way to grow CBD hemp

- For CBD, there are many different production practices—Harvest:
  - METHOD: **By hand**—hanging up to dry or possibly mechanical handling, threshing out floral structures; **increasing levels of mechanization** to the point that hands never touch the crop in harvest, baling, drying, threshing out any seed, etc.
  - TIMING: **Early vs. Late**—early harvest has lower CBD yield and lower total biomass but low potential for THC. One guideline among CBD growers is harvesting hemp when the trichomes turn from white to milky white. But if you are in doubt—even if you are testing for THC—about potential elevating THC then always harvest sooner rather than later.

There is more than one way to grow CBD hemp

- For CBD, there are many different production practices—Drying:
  - Dry or semi-arid/arid regions: partial or complete field drying. Will depend on harvest method. Over-dry material is 'crumbly' and could lead to loss of dry matter (especially if floral structures) significantly lowering dried flower or biomass yield.
  - Humid regions/frequent rainfall: partial field drying or mostly indoor drying (drying floral structures stripped off the plant, hanging up whole plants). This may limit field size. One industry rule of thumb: about 1 cubic foot of drying space for 1 square foot of growing area.

Major Hemp Issues that Lead to Failure 1

- Poor quality seed or other genetic resources
  - Most varieties grown for CBD have a marijuana background so have been grown in pampered environments. Field conditions are tougher, and this has led to many failures. These “varieties” are also more prone to become “hot” with THC.
  - Typical hemp planting seed is about 26,000-30,000 seed per pound, test weight about 44 lbs./bushel.
  - Varieties for grain and fiber may be more hardy, and less likely to develop an issue with THC. They are further removed genetically from marijuana varieties, and have had extensive development since they were not illegal. Many varieties are certified in Canada, Italy, Poland, etc.

Major Issues that Lead to Failure 2

- Lack of openness among some in the hemp industry—statements and promises about A) the profits you can make, B) how many growers or acres a hemp contractor might have.
- There no guarantees.
- Underestimating the cost and time of production.
  - One Colorado farmers estimates land prep through the point of extraction, $13,000 per acre; USDA's national composite average is $19,000 per acre (and revenue of ~$25,000 acre—on past prices).

Major Issues that Lead to Failure 3

- Not understanding the agreement with a buyer.
- Not having a legally binding contract with that buyer.
  - There is still financial risk when prices collapse, or the buyer is not well capitalized and can't pay you for your crop.
  - If this appears to be the case, retain possession of your crop.

Major Issues that Lead to Failure 4

- Buyers that do not have the capital or line of credit to purchase your crop in spite of a contractual agreement, a handshake, or a promise.
- You have the right to ask and verify with a prospective buyer how they are funded and can afford to purchase your crop.
  - Using modest numbers of 1,000 lbs. dried material per acre, 10% CBD, and $2/dried lb., a buyer needs up to $20,000,000 capital/line of credit for each 1,000 acres.
  - Examples of verification: Statement from a bank, a letter extending a line of credit to the buyer which you can verify, buyer's payment history with previous growers, etc.

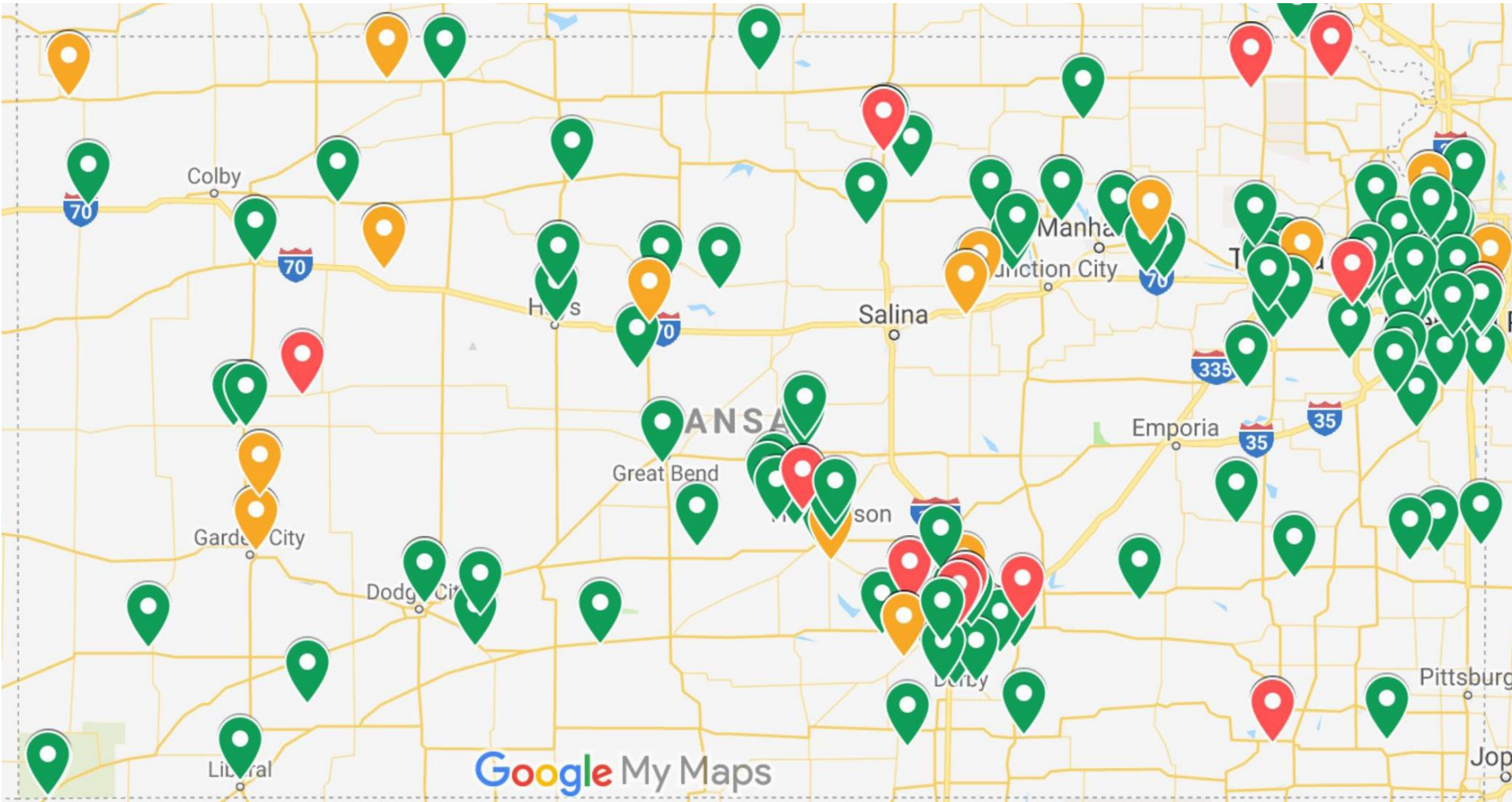
Major Issues that Lead to Failure 5

- Not having that agreement reviewed by your attorney before signing.
  - An attorney is there to protect YOU!
  - They have a version of “fiduciary” responsibility to you in recognizing what is best for you.
  - You might find it hard to follow their advice if you want to grow hemp really bad, or you are afraid you might “miss out”.
- Remember, contract terms should be negotiable; if not then consider another buyer.

First Year Kansas Industrial Hemp (2019)

Green—Licenses; Gold—Processors; Red—Suppliers

- Licenses, not actual plantings; concentrated in urban areas likely in small acreages (< 5 acres)



Greenhouse production, courtesy North Carolina State University. These are older woody plants so the production goals are uncertain. .

Hoop House

- For climates with cold weather, these can extend the growing season up to 45 days on each end.
- 30’ X 100’, ~$8,500 (FarmTek); roof sheet replacement about $1,500 (5.2 oz./12 mil).

Tomatoes & Blackberries (AgriLife Lubbock)

Hoop house production with plants grown directly in soil (not pots).

Germplasm & Seed 1

- Purity of genetics and seed
- Sources
- “Approved” hemp varieties (by states dept. of agriculture) vs. certified varieties. These are not necessarily the same. Approved varieties may or may not have some degree of assurance of purity.

Germplasm & Seed 2

- Texas Dept. of Agriculture appears they will require certified “AOSCA” seed lines (see https://www.aosca.org/hemp/).
  - Not yet determined if or how Texas Dept. of Agriculture will address standard seed certification in the way we expect in other crops.
  - TDA proposed rules will not permit clones or transplants to be brought into Texas. (Likely neither planting method for 2020; Texas entities will prepare to provide these in 2021.)
  - This may be a challenge since so many hemp lines are not pure.

Germplasm & Seed

- Need for production testing of varieties: Adaptation of hemp varieties to different regions of Texas and suitability for cannabinoid production or grain or fiber.
- It appears that hemp varieties are widely adapted:
  - You would likely not plant a well-adapted corn hybrid from Texas in North Dakota. In contrast a sunflower hybrid that performs well in different Texas regions is also likely to perform well in North Dakota.
  - A hemp variety that consistently tests low for THC will be safer choice vs. a variety that produces more CBD (or fiber) but is more prone to higher THC.

Germplasm & Seed

- Will there be certified varieties in the way you take for granted in wheat, cotton, corn, peanuts?
- And who would administer a program?
  - In Texas, this would be Texas Dept. of Agriculture, but it will take time to implement a program
  - Seed certification has to start with pure genetics, and that likely would only be originating with established seed companies (not Internet re-sellers)

Germplasm & Seed

- What protections can a grower have on seed, transplants, or clones?
  - Use an escrow account for seed/transplant/clone payment until grower is satisfied the genetics is what it is claimed to be?
  - Obtain a seed sample of the same lot of planting seed you would by to run a germination and vigor test on before you purchase?
    - Not likely for feminized seed due to cost.
  - In both cases the seller has little reason to accommodate either request if seed supplies are short.

Different Flower Types among Hemp Lines

- Hemp has two general types of varieties: the more common indeterminant photoperiod sensitive (PS) and determinant (or 'autoflower', the term the hemp industry uses).
- PS lines in general enter the reproductive phase based on days becoming shorter (actually it is longer nights). So if planted early in the year vs. a month or two later, the plants may start to flower about the same time (though this is not always the case, which might be due to the difficulty in assessing a specific 'variety' because the seed is not purely one genetic line).

Different Flower Types among Hemp Lines

- Indeterminant/autoflower varieties will at some point enter reproductive growth based on “maturity”. This means a general number of days (or ‘heat units’, the cumulative effect of heat over time) in response to environment will trigger reproductive growth.
- An indeterminant variety will begin reproductive growth and reach flowering quicker in a hot environment (e.g., perhaps 5 days) where if the environment is moderately warm it will take longer (perhaps 65 days).
- Plants are small and generally have lower yields (but this is changing).

Different Hemp Flowering Types

- Texas A&M AgriLife will research the differences of photoperiod sensitive and indeterminant hemp lines at different locations across the state using different planting dates.
- This will take time.
- We will include the use of variety trials to help accomplish this.
- The work will apply to all hemp uses, whether CBD, grain, or fiber.
- Your seed provider may have some recommend-ations for hemp type you plant.

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Genetic Types for CBD

(an experienced hemp farmer's suggested maximum price for 2019-2020)

- 26,000-30,000 seed per pound
- **Straight run seed**—50% male & 50% females. Will you rogue males or not (CBD)?
  - Cost? (a range, a few $ up to $180/lb.; depending on planting pattern/goal, fraction of a lb. to 3 lbs/acre)
- **Feminized seed**, $1 **per seed** ($0.80 max)
- **Transplants**, $3-5 each? ($2.25 max)
- **Clones** (no tap root), up to $10 each ($4 max)
- Larger operators want to produce their own planting stock (*"we can only trust ourselves"*).

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Hemp seedlings being prepared
for feminized seed production.


Hemp plants producing feminized seed in a controlled environment. Outside air is filtered to remove possible introduction of male pollen.

Major Questions for a Texas Hemp Industry

- *Will herbicides, fungicides and insecticides be readily available for hemp production?* There are currently no labeled crop protection chemicals. A short list of suppressive/ repellent products recently cited by EPA for possible labeling were organic products only, which are not likely sufficiently effective (and cost effective) for large-scale production.
- It will likely be at least 2 to 3 years minimum before traditional commercial herbicides, insecticides, and fungicides are labelled for commercial use (will depend on whether chemistries are adapted from other crops, or new testing is required).

Soils & Suitability for Hemp

- Industrial hemp does not like poorly drained soils. No prolonged "wet feet." Optimum soil pH appears to be 6.0 (slightly acidic) to 7.0, possibly up to 7.5 but we see hemp growing well in Colorado on soils with pH up to 8.0 (slightly alkaline, or basic).
- For prospective Texas hemp growers in Texas coastal soils that are heavy in clay and poorly drained (Beaumont to Corpus Christi), the Texas Blacklands (Temple/Waco arcing north and east to northeast Texas), etc.:
- Soil texture suitability for desirable drainage:
  - Poor: clay, silty clay, sandy clay
  - Marginal: sandy clay loam, clay loam, silty clay loam
  - Good: silt, silt loam, loam, sandy loam

Soils & Suitability for Hemp

- Little soil testing research or development of nutrient response curves has occurred in any state. This data takes years to develop.
- Some farmers suggest that nutrient needs are comparable to a corn crop's yield potential under the same field production conditions.
  - Possibly 25-50% more than a cotton crop on same field?
  - Others suggest fertility requirements are comparable to a high-yielding wheat crop on the same field (less fertilizer requirement than corn).
- Tests for "Hemp Soil"? No need to spend extra money, standard soil tests are just fine. AgriLife staff can help you interpret results for suitability.

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Soils & Suitability for Hemp

- In addition to nitrogen (N) growers believe that phosphorus (P) and potassium (K) have a significant role in hemp production.
- Caution: Some growers and agronomists believe that high (excessive?) fertilize N rates could elevate THC.
- Little is known about possible micronutrient needs in hemp like iron (Fe), zinc (Zn), etc.
- The Texas A&M Soil Test Lab (http://soiltesting.tamu.edu/) is evaluating using soil test data from other universities until Texas can generate our own data. For specific questions on soil testing for hemp contact Trostle or Dr. Tony Provin, A&M soil test lab director, (979) 845-4816, soiltesting@tamu.edu

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Labeling for Pesticides for Hemp

- For evaluation in an EPA program for limited acreage crops for possible labeling (2019):
  - Herbicide: bromoxynil (a limited use weak broadleaf herbicide that often is better in a tank mix; the most common brand name is 'Buctril', but there are many generics).
  - Fungicide: azoxystrobin (this is a major fungicide; Quadris, Dynasty, etc.).
- A limited number of growth regulators and a few other chemicals labeled. Also, some other materials (12, mostly for organic) that don't' require tolerance testing.

Labeling for Insecticides for Hemp

- No insecticides currently labeled.
- Other states: fall army worms, corn earworm/cotton bollworm, and similar insects. Grasshoppers?
  - Will these insects feed on the general leafy foliage or damage floral structures which have high CBD?
  - Role of beneficial insects in hemp?
- Other insects that might become an issue in Texas?
  - Different species of stink bugs, white flies and the numerous diseases they transmit, aphid species?
- Texas A&M AgriLife point entomologist for hemp: Dr. Holly Davis, Weslaco, (956) 969-5604, holly.davis@ag.tamu.edu

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Got Weeds?

Current Weed Control Strategies

- Hemp is NOT for your weedy ground.
  - In Texas we even say this for crops like guar and sesame which DO have a few labeled herbicides.
- A major issue in hemp—no labeled herbicides. Most common weeds from growers in neighboring states/regions:
  - Pigweed/Palmer ameranth/carelessweed.
  - Bindweed masses get into biomass in mechanical harvest leading to wet ‘hot spots’ in bales.

Current Weed Control Strategies
& *AgriLife Extension Weed Scientists*

- Plant early to get ahead of weeds? (Probably won't work very well in Texas).
- Tractor cultivation (possibly with GPS) for large acreages, possibly plastic mulch, or hand hoeing (several hundred $ per acre).
- Texas A&M AgriLife Extension weed scientists that can help develop integrated weed control strategies for hemp, including pre-plant management & crop rotation:
  - South & Coastal Texas—Dr. Josh McGinty, Corpus Christi, (361) 265-9203, joshua.mcginty@ag.tamu.edu
  - Central & Northeast Texas—Dr. Scott Nolte, College Station, (979) 845-4880, scott.nolte@tamu.edu
  - Texas High Plains—Dr. Pete Dotray, Lubbock, (806) 746-6101, pdotray@ag.tamu.edu

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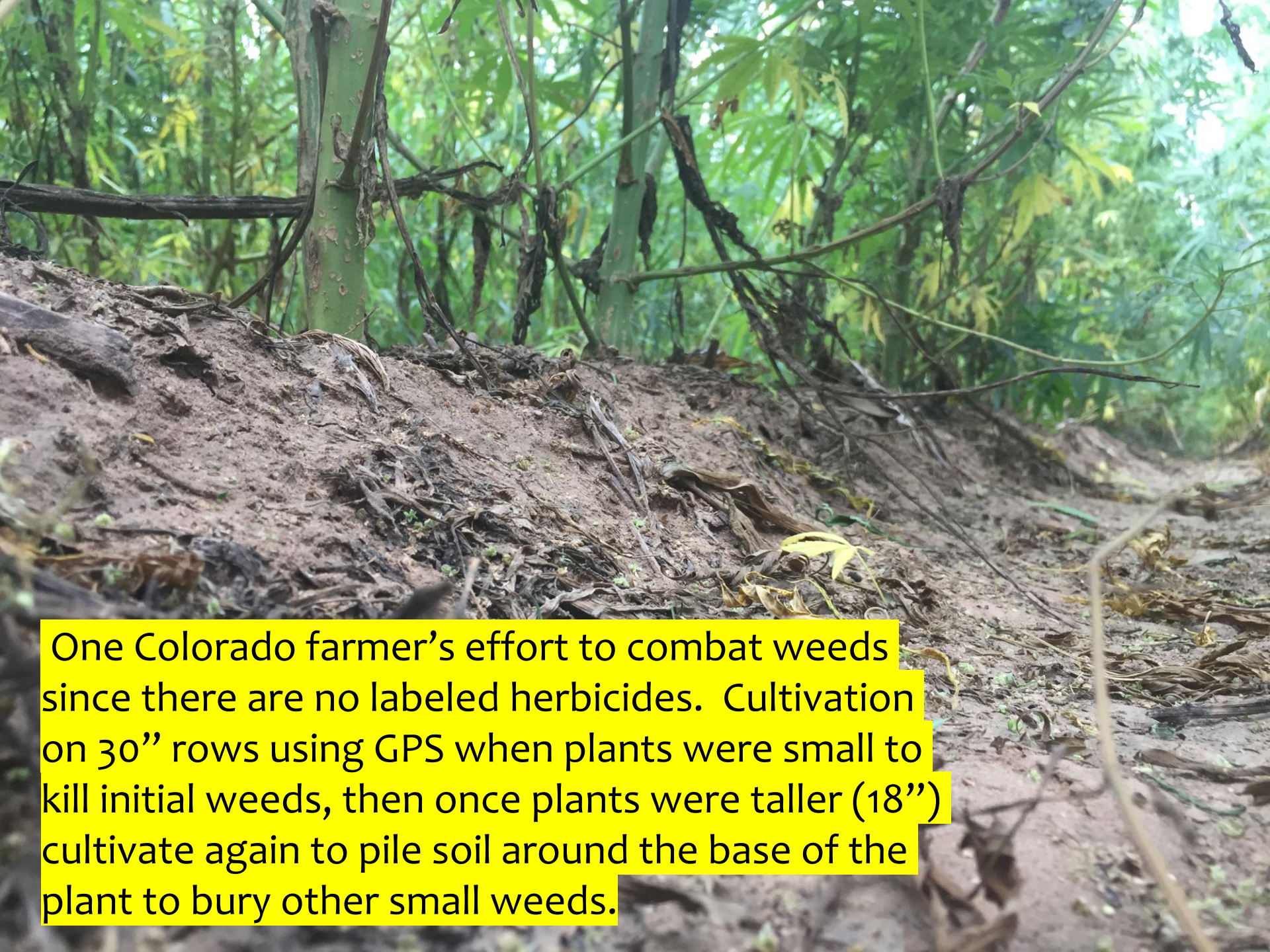
One Colorado farmer's effort to combat weeds since there are no labeled herbicides. Cultivation on 30" rows using GPS when plants were small to kill initial weeds, then once plants were taller (18") cultivate again to pile soil around the base of the plant to bury other small weeds.

Hemp as an Accumulator of Pesticide Residues, Heavy Metals, Etc.?

- Texas A&M AgriLife has not studied this issue yet, but a common concern we hear is that hemp accumulates residual chemicals from the soil (or maintains these residues in the plant) like herbicides, insecticides, etc.
- This concern also includes heavy metals (lead, cadmium, mercury, etc.).
- This issue was raised first by marijuana users and that industries concern about possibly inhaling other chemicals.
  - Note the irony!
- A potential issue in hemp consumable products?
- We are unsure this is actually the case. We will look for evidence in published scientific literature.

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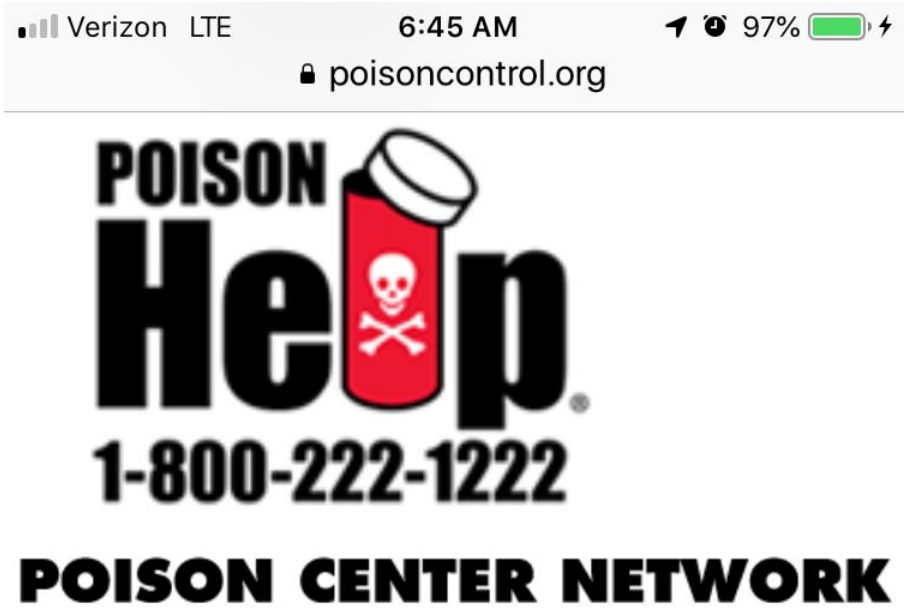
Sources of Label Information

- Labels for herbicides, insecticides, fungicides, seed treatments, growth regulators, etc.—access through **http://www.cdms.net**, click ‘Label Database’ then ‘Search’ then conduct either of two searches:
  - **A)** Enter product name then choose the specific product then its label or supplemental label (most common use)
  - **B)** Click “Other Search Options” (register for a free password) to search by active ingredient (looking for a generic?), find a class of chemicals (herbicides, fungicides, insecticides) labeled for a particular crop, etc.

Texas Poison Center Network

- http://www.poisoncontrol.org
- (800) 222-1222
- Put this in your Cell Phone!

  If you are blinded and can't see you can still voice dial (or call 9-1-1).



Plant Diseases

- Texas A&M AgriLife Extension plant pathologist Dr. Tom Isakeit, (979) 862-1340, t-isakeit@tamu.edu
- Drafting a preliminary write-up for more likely potential diseases to industrial hemp (November 2019)
- Cotton Root Rot, expected susceptibility in Texas
  - Present in about 1/2 of the state (low in west Texas, none in the High Plains, low in far east Texas); if you have seen it in your fields, plant your first hemp where you think the disease pressure is lowest.
- Powdery mildew in humid/coastal areas.
- Others? Rhizoctonia, Pythium, viruses

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Hemp & Animal Pests

- Is hemp susceptible to animal pests? Wild hogs? Deer?
- Texas A&M AgriLife has not heard of deer affecting hemp in other regional states. If this were an issue, I think we would have heard about it by now.
- Wild hogs—we do not know if wild hogs will damage hemp, bed down in the fields, try to eat the seed or transplants. The general moderate odor of hemp plants might be a repellant.

Hemp Planting Seed & Seed Treatments

- No use yet of basic of seed treatments like metalaxyl (not labeled!) to prevent damping off, seedling death.
  - Since hemp seed is expensive, you would like this.
- Other states: No known need yet for a seed insecticide.
  - Wireworms, beetles, etc. When you plant such expensive seed you would like to have this protection.
- Southern High Plains observations: Hemp plants 10-12” tall dying for no observable reason.
- All seed potential seed treatments need to be tested on hemp to ensure no interference with germination.

Planting Dates for Texas?

- Based on practices and advice in regional states there is significant uncertainty.
- AgriLife research on this topic won't be here for you for at least two years.
- Established genetics and seed companies (not seed resellers or internet resellers) will have some suggestions for your Texas region.

Planting Dates for Texas?

- Contrasts:
  - Lower Rio Grande Valley vs. High Plains.
  - Hot temperatures in the Rolling Plains vs. rainy season in East Texas.
- Research questions: What is the effect of planting date on harvestability (if mechanical), cannabinoid content, fiber yield and quality, etc.?

Planting Dates for Texas?

- Soil temperatures? "Like corn", that is a minimum of about 50º F. But is that too early, especially for fragile seed?
  - Avoid any freezing temps on seedlings?—This suggestion comes from some genetic/seed companies (seems reasonable until it is tested).
- To what extent is photoperiod sensitivity a factor?
- Many failures in nearby states attributed to planting late in early summer when soil conditions have become hot (bare soil in direct sunlight).
  - Often because growers couldn't get seed in time.

Debate about Hemp Planting Dates

- Issue raised by eastern Colorado & Oklahoma growers.
- Growers that have been planting in May believe they need to move forward to April.
- Translated to the Texas High Plains or the northern Rolling Plains (Vernon, Chillicothe, Wellington) farmers in nearby states have suggested these areas might even consider late March plantings.
  - Texas A&M AgriLife is hesitant about this but sees the evidence to consider it—it will be a research testing priority.
- What to make of these thoughts?

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Can hemp seedlings withstand cold?

- Southeast Colorado hemp farmers have observed hemp seedlings emerging in early March.
  - Last average spring 32º F at Springfield, CO is ~May 2.
- This does not mean these seedlings readily survived a subsequent hard freeze or performed well.

Emerging hemp first week of March, 2019, SE Colorado.

Texas & Last Average 32° F Date

- This date ranges ±10 days in most of Texas

Amarillo	April 16
Lubbock	April 4
Vernon	March 30
San Angelo	March 28
Commerce	March 22
Nagadoches	March 16
Waco	March 11
Uvalde	March 10
LaGrange	February 26
Wharton	February 19
Corpus Christi	Inconsistent, February 3
Weslaco	Sporadic, plant > Feb. 1

Texas & Last Average 32º F Date

- Soil temperatures of 50º F are not a concern at any of these dates.
- Soil temperatures are likely at least 5 degrees warmer at these last freeze dates.
- A general consensus among several entities—farmers, seed companies, industry—suggests that planting at or shortly after your last average 32 F freeze date is probably satisfactory.

What about Late Planting in Texas?

- Fall planting in Alabama in Sept. 2019; October variety trials planted in Florida.
- Could hemp be planted in Central & South Texas in August (heat!) or even early September in the Lower Rio Grande Valley?
- PS varieties or autoflower?
- Fall risk to tropical storms for an expensive crop?
- Other crops like corn and grain sorghum are rarely planted late in lower coastal Texas because they don’t perform as well as when spring planted.

Hemp & Crop Rotation

- As a general principle, crop rotation is a sound management practice for maintaining healthy productive soil.
- Crop rotation also reduces the possibility that damaging plant diseases or soil pests will reduce production.
- There is little if any data on crop rotations that include hemp in the U.S.

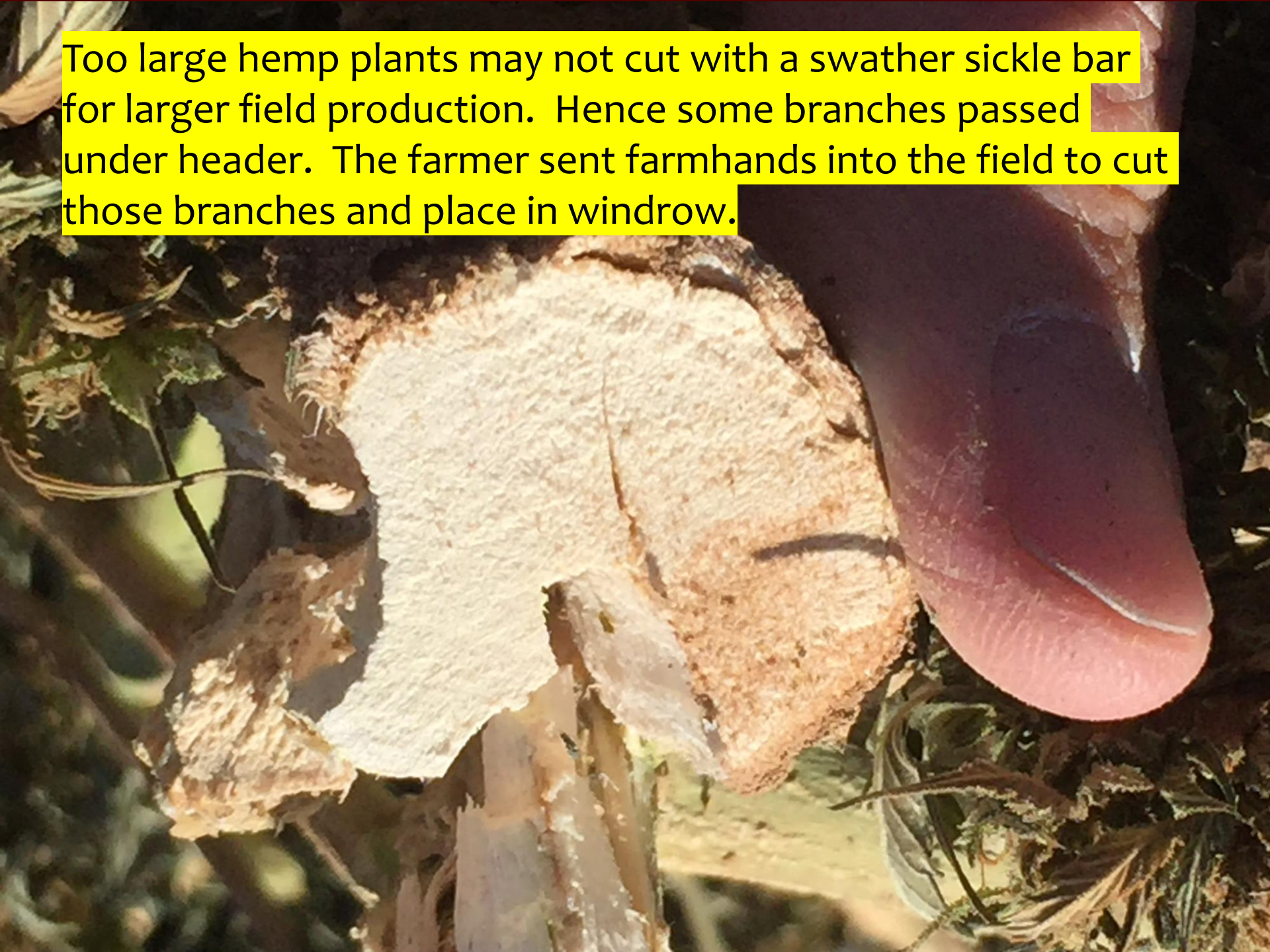
Hemp & Crop Rotation

- Hemp should be a favorable rotation with grass crops (corn, grain sorghum, wheat/small grains).
- There is some question about the degree of rotation benefits with broadleaf crops including cotton.
  - Crop rotation is still likely favorable to the other crop, but there is the possibility that some plant diseases—more likely from a broadleaf crop—could also be a pest for hemp. We don't know yet. This will be important for cotton.
- At this time Texas A&M AgriLife would not recommend growing hemp in consecutive years on the same field.

The following pictures are examples of large scale hemp farming for CBD production.

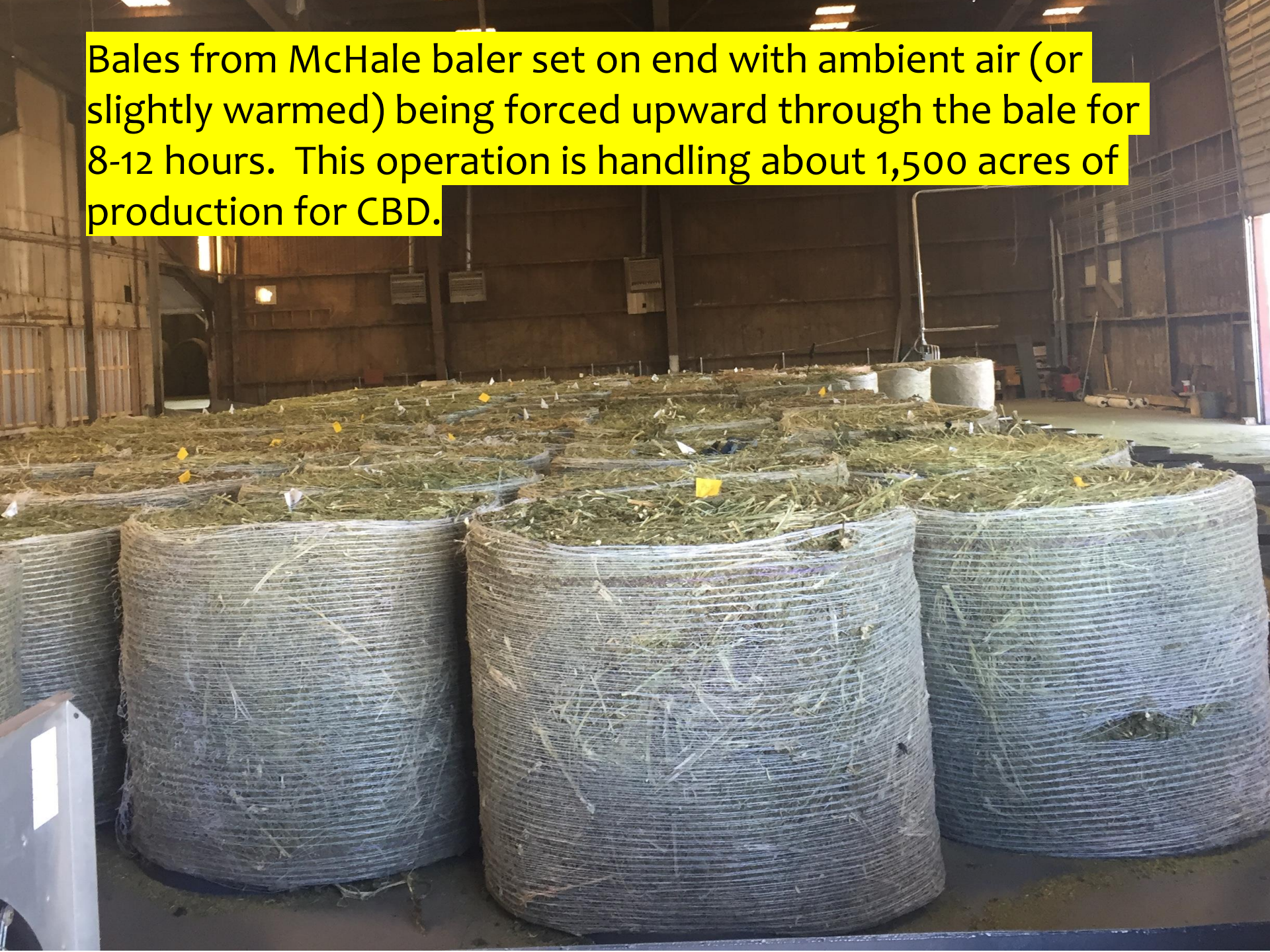
Colorado CBD hemp harvest: plants cut by hand, conveyed into old peanut drying trailer (has perforated floor) then hooked up fans to force air through plants for drying). This is in contrast to hanging up to dry by hand.

Colorado CBD hemp harvest: Common method for larger acreages. Draper header drops plants in windrow for baling. Ideally this is done for green plants for 1-2 days of field drying before baling. This poor field crop froze at 19 F on October 9, 2019, so plants are excessively dry and floral structures and trichomes are falling off, losing CBD.


Too large hemp plants may not cut with a swather sickle bar for larger field production. Hence some branches passed under header. The farmer sent farmhands into the field to cut those branches and place in windrow.

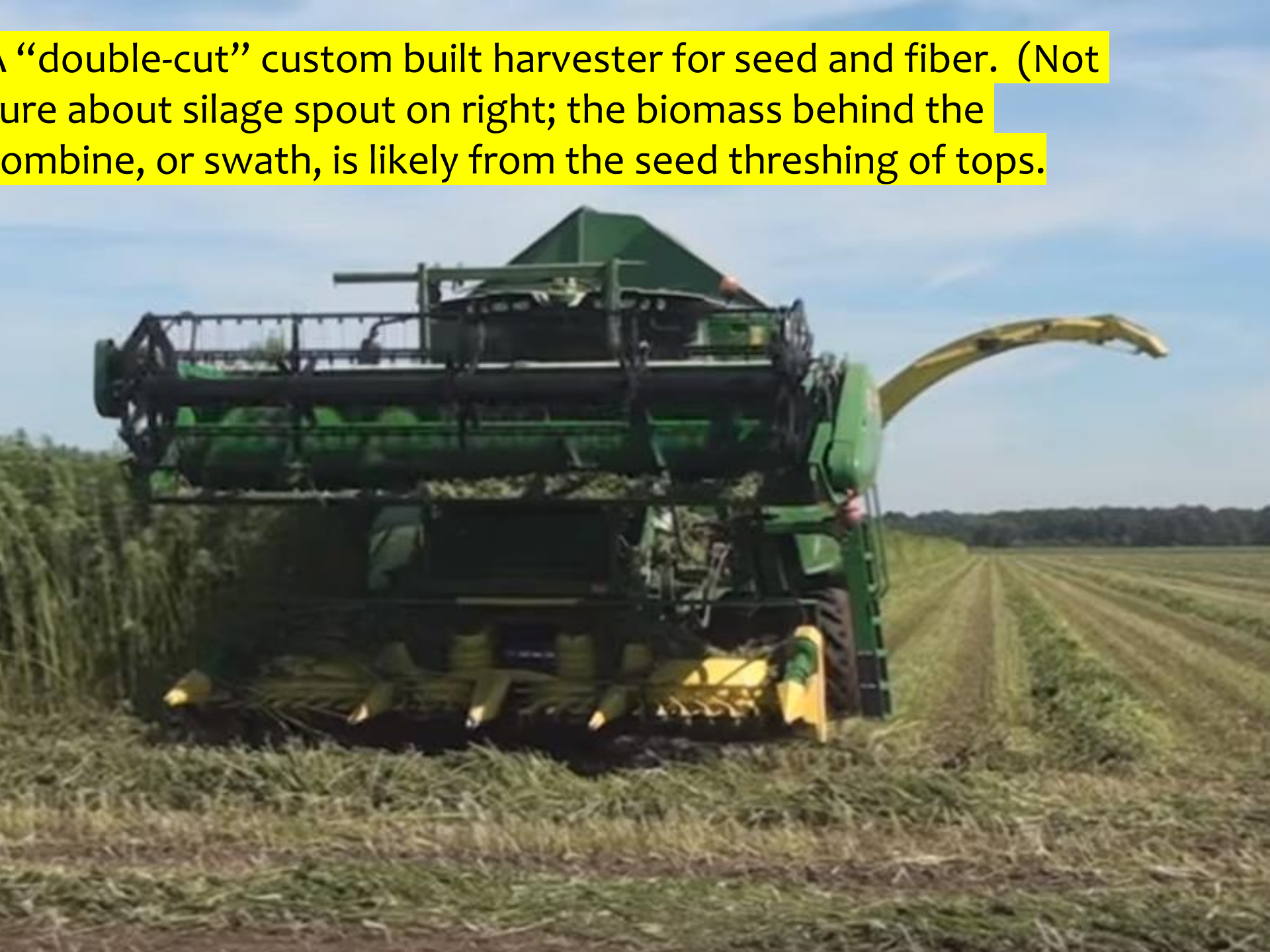
Western Colorado: Swathed hemp field cut just before a freeze that is ready for baling. Field used surface drip irrigation under a biodegradable plastic sheet. Field planted transplants through the sheeting on 60” rows, plants 24” apart within the row.

Baler model gathers field hemp (up to 80% moisture) using computer programming to control the density of the bale in order to accommodate < 24 hours of forced-air drying to about 12-14% moisture.


Bales from McHale baler set on end with ambient air (or slightly warmed) being forced upward through the bale for 8-12 hours. This operation is handling about 1,500 acres of production for CBD.

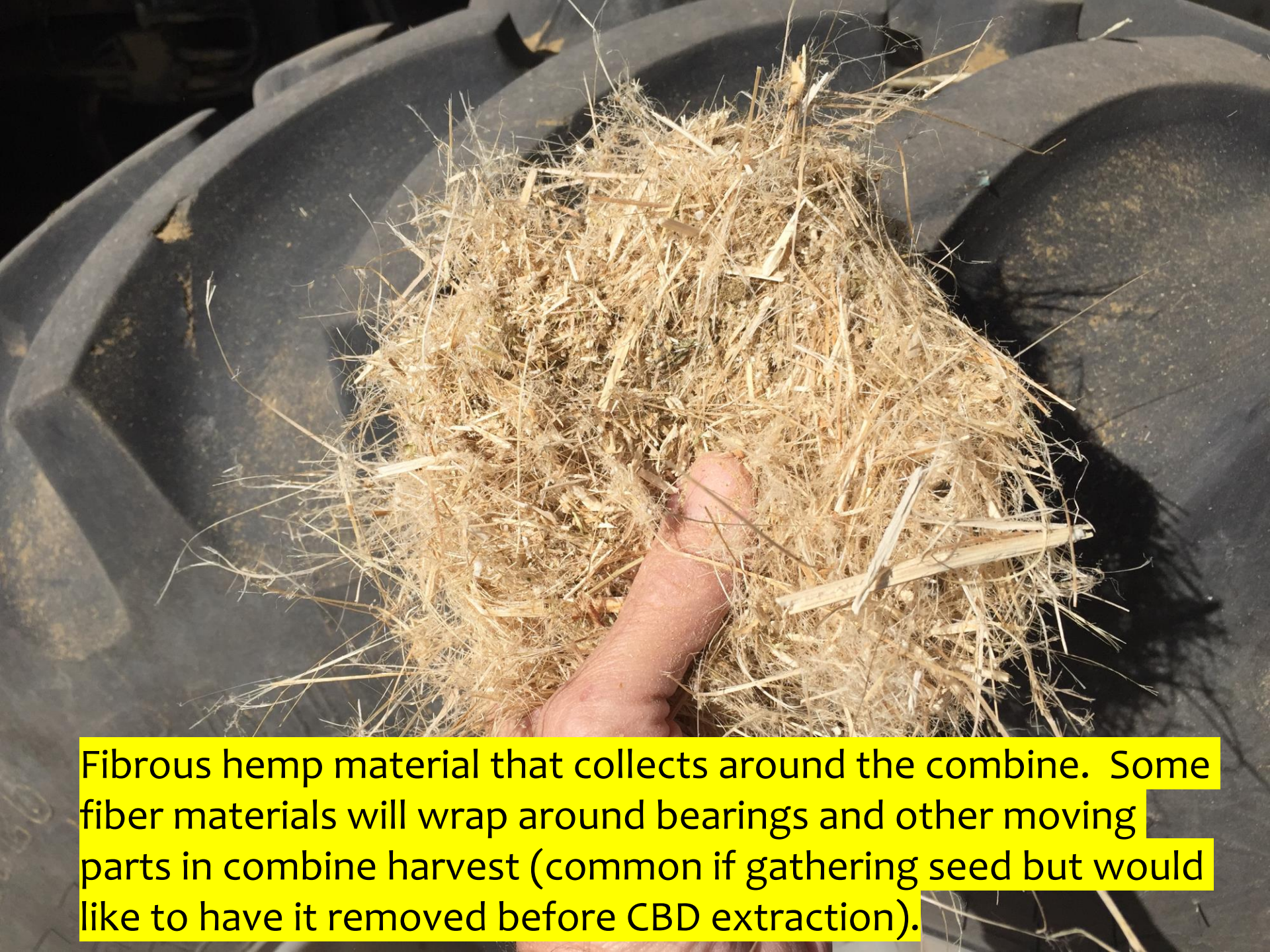
Bales are then turned upside down to continue drying. Moisture is probed by hand for ~14% moisture, and if needing more drying remain on the floor for the next cycle as new bales are added.

Large acre harvest in eastern Colorado for CBD. Grain is removed from sample and biomass for CBD collected in a trailer behind the rotary combine.


A “double-cut” custom built harvester for seed and fiber. (Not
ure about silage spout on right; the biomass behind the
ombine, or swath, is likely from the seed threshing of tops.

The dilemma of over-drying in the field or the effect of a strong freeze: plant tissue are very dry, crumble, and lead to lost CBD production.

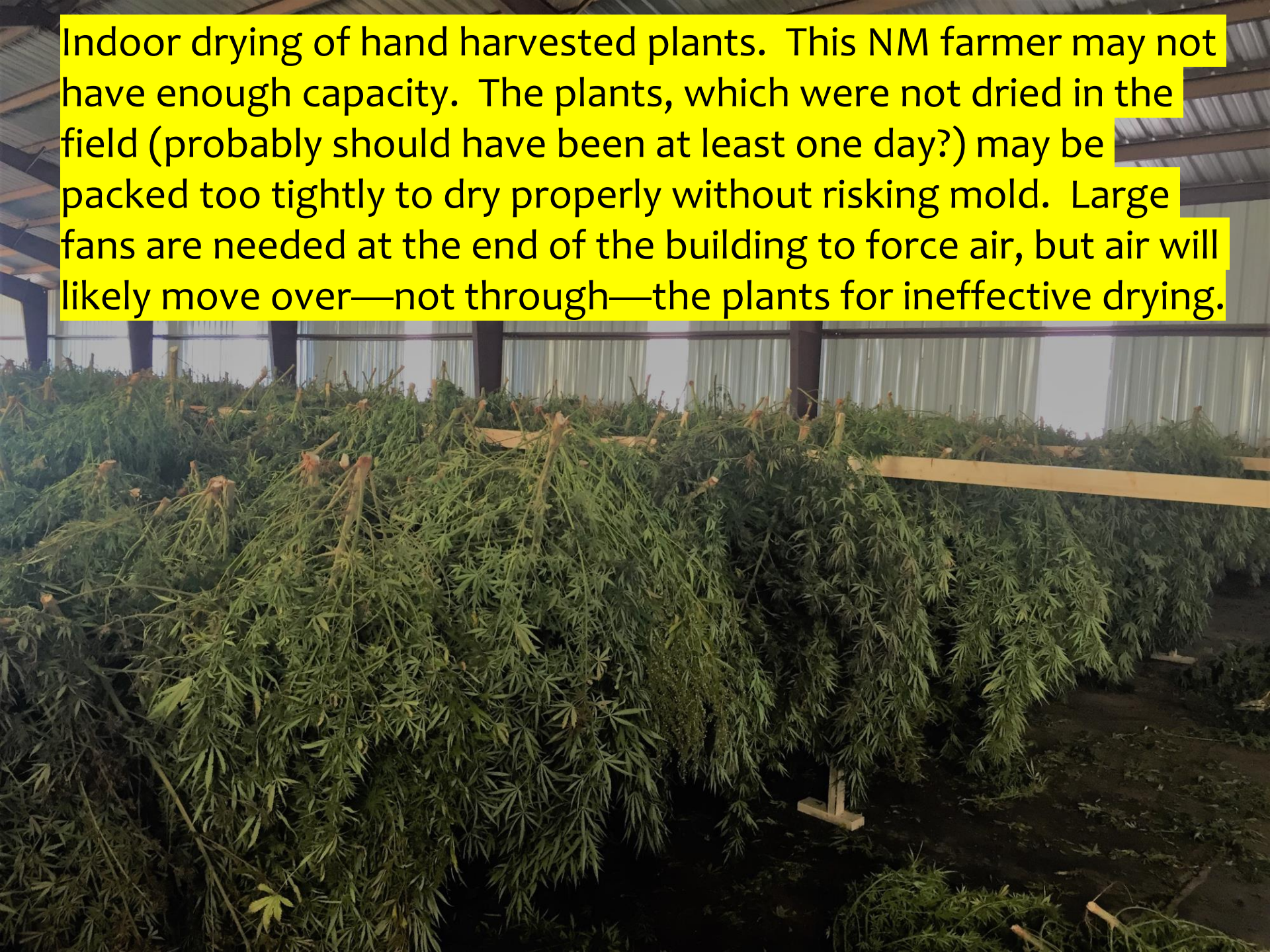
Some farmers in the Southern High Plains conduct harvest operations at night similar to alfalfa farmers, who bale & rake at night in order to gather the most important component of alfalfa—the leaves—in the forage harvest.



Fibrous hemp material that collects around the combine. Some fiber materials will wrap around bearings and other moving parts in combine harvest (common if gathering seed but would like to have it removed before CBD extraction).

Trailers pulled behind combines to collect biomass for CBD extraction.

Another bale type of baler that receives the bulk CBD biomass (in this case must be dry) then bales and wraps for transport to a processing facility. The baler is >$500,000.


Indoor drying of hand harvested plants. This NM farmer may not have enough capacity. The plants, which were not dried in the field (probably should have been at least one day?) may be packed too tightly to dry properly without risking mold. Large fans are needed at the end of the building to force air, but air will likely move over—not through—the plants for ineffective drying.

- Rack drying of hand harvested plants.
- This hemp for CBD tested 2.7% THC and discussion is occurring with the state dept. of agriculture to see if limited processing might be allowed else who crop is destroyed—full 100% financial loss.

Example of small stripper machine that removes floral structures from hand harvested hemp for high % CBD extraction.

Hemp Industry Concerns for CBD

- A concerning number of farmers still don't seem to know how they are getting their crops out of the field and dried.

- Many are crossing their fingers for a solution to present itself at the last minute. Mother nature could still do serious damage.

Hemp Industry Concerns for CBD

- One of the largest farming and processing companies in Kentucky has hit a roadblock in their expansion project and the effect is rippling to farmers and operators across the state.
- Many didn't plan on equipment or crews to get their crops harvested, dried, and processed.

Examples of State Results

- North Carolina, 2016-2018: 10.8% of hemp samples tested for THC failed (above 0.3% THC), which means the default requirement is crop destruction.
  - 89% is pretty good, but if you were one of the 11% it was devastating news.
- Utah, 2019.
  - First year of production. Licenses were a little late, significant amount of late planting. The cumulative result of lack of preparation by grower (and Dept. of Agriculture?), poor seed, late planting, pests, lack of harvest plans, weather damage, and contractor refuse to buy/take delivery: 58% of the crop either failed or has not gone to market.
  - **Will Texas do better in our first year in 2020?**

Preliminary Hemp Resources

- Read a lot. If you are truly interested in growing hemp read, talk, ask. Get the answers you need. It will require time.
- Texas A&M AgriLife Extension agency website, https://agrilifeextension.tamu.edu/hemp/
  - This includes a list of Texas A&M AgriLife faculty and staff with roles in hemp education and future research.
- Consider private & commercial websites, but also especially universities and state departments of agriculture including Texas' hemp page:
  - https://www.texasagriculture.gov/RegulatoryPrograms/Hemp.aspx

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