



## Industrial Hemp Uses and Products

Industrial hemp and marijuana are different cultivars bred from the same species, *Cannabis sativa*. While biologically related, the plant has been bred for different purposes, and the traits exhibited in cultivars grown for industrial hemp and marijuana are distinct. Industrial hemp is grown for its fiber and seeds, while marijuana cultivars are grown for high levels of THC. Industrial hemp is a plant with many uses, including food, fiber, fuel, industrial, and personal care products. A partial list of potential uses of industrial hemp can be found below.

### Industrial Hemp Plant Uses

#### Fibers

Textiles: clothing, shoes  
Industrial textiles: rope, nets, carpet, tarps  
Industrial products: paper, building materials

#### Leaves

Farm and landscaping: mulch, composting, and animal bedding

#### Hemp Oil

Foods: oil, food supplement; birdseed  
Personal care: soap, beauty products, moisturizer

#### Seeds

Seed cake  
Protein flour  
Animal feed (currently illegal)

## Industrial Hemp for Bioremediation

Industrial hemp is very healing to the natural environment around us. Hemp is one of the best plants for use in phytoremediation (healing the soil with plants).

*In 1998, Consolidated Growers and Processors (CGP), PHYTOTECH, and the Ukraine's Institute of Bast Crops, used a process called "phytoremediation." Phytoremediator plants help remove contaminants in soils. It can also be used to remove radioactive elements from water, clean up toxic metals, pesticides, solvents, explosives, gasoline and toxins from landfills.*

*So, guess which one is considered one of the best at that task?*

*You may have guessed it...industrial hemp.*

*Hemp extracts toxins and pollutants from the soil and groundwater. Hemp absorbs carbon dioxide (CO<sub>2</sub>) and accumulates the toxins in its tissues and root systems, but remains undamaged. This makes hemp effective at eliminating toxins such as metals, pesticides, solvents, explosives and petroleum from the earth without the need to remove any of the contaminated topsoil. This process helps leave a clean, balanced and nutrient-rich soil, which can then be safely used for agriculture or improving surrounding areas.*

"Hemp is proving to be one of the best phytoremediative plants we have been able to find," said Slavik Dushenkov, a research scientist with PHYTOTECH, regarding industrial hemp being planted to help clean up and stop further soil contamination near the Chernobyl site. <http://www.cannabissoils.ca/hemp-as-a-phytoremediator/>

Contamination of land and water is a growing concern for the health of the environment. Conventional practices in the remediation of contamination usually involve expensive processes such as landfilling or incineration of soil. Phytoremediation uses plants to accumulate certain metals in plant biomass or accelerate contaminant breakdown.

Hemp is a suitable crop for phytoremediation of contaminated soil because, although hemp is not considered a hyperaccumulator (A hyperaccumulator is a plant capable of growing in soils with very high concentrations of metals, absorbing these metals through their roots, and concentrating extremely high levels of metals in their tissues) it is able to remove significant quantities of contaminants *which are generally stored in its roots*.

In many studies hemp has displayed a very high tolerance to contaminants. It also has a greater adaptability to different soils and climatic conditions and has added benefits of being a rotational crop which can improve soil quality.

Also related to phytoremediation, hemp can be used as a "mop crop" to clear impurities out of wastewater, such as sewage effluent, excessive phosphorus from chicken litter, or other unwanted substances or chemicals.

## Barrier planting & Erosion Control

Hemp can be used as an effective erosion control method: fiber blankets produced from agricultural fibers such as *hemp* are used to combat weeds and to *prevent erosion* on and around newly constructed berms and steep highway banks by motorways. *Hemp* fibers greatly accelerate the establishment of vegetation. Over time, the natural fiber will decompose completely and vegetation coverage it created reduces erosion. Typically, blankets are used for the following applications: slope protection, channel and ditch linings, reservoir embankments and spillways, culvert inlets and outfalls, dikes, levees and riverbanks. Strong hemp fibers combined with a biodegradable cellulose backing is a sustainable alternative to products made with polypropylene scrim (synthetic plastic fibers).

## Industrialization & Environmental Remediation

In the late 1700's, the Industrial Revolution brought about the age of big machines and mass production.

Manufacturing was rapid, and the range of product dispersal grew just as quickly.

Since that time, there has been a battle between propelling our economy forward, and keeping our environment safe.

Today, we frequently hear concerning news about environmental disasters, and the damage they cause. Just days ago, a deadly oil spill in Borneo covered 7000 hectares of mangrove forest, and polluted an estimated 80km of coastline.

Whether these events are anthropogenic (originating from human activity) or natural disasters, as society, we face the aftermath. We have to answer the question of how to take back our broken and contaminated land.

An increase in demand for land in areas, means we need to address contamination using effective remediation techniques. **Remediation is a complicated process, and varies greatly between air, water, and soil. Here we focus our attention entirely on soil remediation via the use of cannabis.**

## Soil Remediation

Soil contamination can be rapid, as is the case for many environmental disasters. However, heavy metals can also accumulate in soil over time through anthropogenic activities.

When we think about pollution on this earth, we are quick to envision smog blanketing our big cities. Or waves of plastic water bottles coating undeserving shorelines.

It is not often that one thinks of soil pollution as a major threat. However, heavy metals accumulate in soil in concentrations much greater than in water and air. Heavy metals cycle through our ecosystems, and are considered to be one of the most toxic pollutants. As contaminated areas increase, we find that one of our biggest environmental challenges is *right beneath our feet*.

In the past, soil remediation has been achieved predominately by chemical means. These methods are invasive and expensive. Chemical remediation is also *currently facing* not always effective because heavy metals, unlike organic contaminants, don't undergo degradation. Heavy metals can undergo speciation in soil, which is the movement into different chemical forms. Some heavy metal forms are bound to the soil, while others are free for use within our ecosystems.

The microbes and plant roots can take up these free metals. They may also move further up into the plant, for potential consumption by animals. This has the benefit of removing the metals from the soil, but inevitably cycles the metals through our ecosystems. Heavy metals are a huge public health problem and therefore, must be dealt with in a way that removes them from the cycle entirely.

## In Situ vs. Ex Situ Remediation

Traditional soil remediation techniques are broken down into *in situ* (on-site) and *ex situ* (excavation and removal) treatments. *Ex situ* treatments are expensive, and are limited to smaller areas and surface soil.

Chemical or physical *in situ* techniques are less expensive, but often create infertile soil, which is unsuitable for agriculture. With a focus on sustainable approaches that result in agriculturally-stable land, phytoremediation is an *in situ* technique that is quickly gaining interest.

## Phytoremediation, Fibre Crops & Cannabis

Phytoremediation is the use of living plants to remove, degrade, or reduce the bioavailability of soil contaminants. Plants are masters at filtering toxins from the soil, but what happens to these toxin-rich plants once they have fulfilled their role?

Fibre crops are a group of plant species that are proving to be a promising answer to this question. Fibre crops encompass many different plant families, but their one common characteristic is that they have a large harvestable biomass. This biomass can be used as a commercial and industrial resource, and can even be used in the production of biofuels and energy.

Hemp (*Cannabis sativa*) species, with their ease of growth in most regions and low cost to rapidly produce, are a great candidate for phytoremediation. In a recent study, Cannabis plants demonstrated their ability to transfer several heavy metals from root to shoot, which is one of the criterion necessary for phytoremediation suitability. Not only is Cannabis a great option for heavy metal hyperaccumulation, but its bioenergy yield has been reported to be comparable to major energy crops and diminishing fossil fuels. Though researchers continue to discover more uses and potential for this versatile crop, soil remediation using hemp is not a new practice. Take these two environmental disasters, for example:

### ***Pripyat, Ukraine, 1986***

A catastrophic explosion at the Chernobyl Nuclear Power Plant results in a 30km wide "dead" zone in the surrounding area. This zone is now considered one of the most radioactively contaminated areas in the world. Almost immediately after the disaster, plant-based soil remediation techniques were implemented. Hemp plantings began in 1998, marking the first successful, documented use of hemp in soil remediation.

"Hemp is proving to be one of the best phyto-remediative plants we have been able to find"  
- Slavik Dushenkov, on Chernobyl soil remediation

## The Need for Organic Soil

If you've stuck with us through all this science, you've probably come to the conclusion that hemp wins! Soil remediation via cannabis is extremely promising. It is an effective technique in filtering soil toxins, and its products can also be beneficial for our environment. This is fantastic news for land remediation, but should also sound alarm bells for those using and growing Cannabis. The hemp we use, especially for our medicine and our food, has to be grown in organic soil. Plants are capable of absorbing almost all chemical elements from their environment. This means that what you put into your soil, will almost certainly end up in your bud.

## Capital and Overhead Cost

Starting a hemp farm isn't exactly cheap. Keep in mind that capital (money spent on land, equipment, etc.) and overhead cost (money necessary to keep your hemp farm operating) will likely be on the higher end of the monetary scale for first-time farmers. Already have a big piece of land? Perfect! Bigger operations mean bigger profits in the end. Keep in mind, though, that smaller hemp farms can also be a valuable investment if you do things right.



Aside from everything you need to set up your hemp farm and keep it running, there are likely going to be special permits that will need to be obtained through your state's department of agriculture. Some states (but not all) require a criminal background check for would-be hemp farmers.

## Hemp Cultivation 101

Despite what many people think, when it comes to growing, hemp isn't an easy crop to cultivate despite the fact that it's a weed. Many believe that growing a weed is easy, however, our experience is that "Hemp Farming Ain't Easy" due to many ecological factors and human error.

That being said, there are still a few things to keep in mind when you're ready to sow your seeds (or cut your clones).

If you're interested in growing the best hemp you can, keep the following tips in mind for a successful harvest come fall.

## 7 Tips for Successfully Growing Hemp

### 1. Start Small

When learning to grow hemp, it's best to start small. Sure, you might have a 100-acre plot of land — which is awesome. But that's also A LOT of land, and there are immense amounts of preparation and work that will go into it.

We advise that new hemp farmers to start small and experiment. Rather than start on such a massive scale, start small and go slow. Hemp production isn't going anywhere. And if things keep going the way they are in the CBD industry, hemp will be in demand for quite a while.

For your first-year farming, start with one acre, maybe two. Learn everything you can in that first year about growing hemp and plan on expanding the following season.

### 2. Understand Your Soil

When it comes to growing hemp, we can't stress enough how important soil quality really is. Assuming you've already got a plot of land where you're interested in growing, one of the very first things you'll want to do is get your soil tested. Soil testing kits are typically available from most extension offices in the state you live in. Once you get your results back, it's important not only to note the nutrient content of your soil, but also the texture of your soil as well. It's a common myth that hemp can be grown anywhere. It actually grows better in certain



types of soil over others. The best soil for growing hemp is loose, well-aerated loam that has high fertility and an abundance of organic matter. **The pH level of the soil should be 6.0-7.5.**

While well-drained or tilled clay soil can be used to grow hemp, soil that is structured poorly or **drains poorly typically results in crop failure**, right around the time seedlings and young hemp plants are prone to damping-off (a plant disease that occurs from poor soil drainage).

You can also grow a good hemp crop with sandy soil; however, this isn't the most desirable type of soil for hemp production. Why? Because sandy soil needs additional irrigation and fertilization in order to assure a successful harvest.

After you've determined you have the right type of soil to grow hemp, you'll also need to ensure that it contains the nutrients necessary for your plants to thrive. Hemp requires high levels of nitrogen, medium to high levels of phosphorus, adequate levels of sulfur and calcium levels that aren't in excess. **Aside from being planted in well-aerated, loamy soil, hemp thrives when organic matter added to soil is more than 3.5%.**

Keep in mind that hemp is a plant that is responsible for a process known as phytoremediation. This means that hemp will soak up whatever is in the soil it's planted in. Hemp is so adept at phytoremediation that it has been planted in abundance at the Chernobyl Nuclear Disaster site to pull radioactive waste from the soil. If you're growing your hemp for CBD, the importance of growing organic hemp can't be stressed enough.

### 3. Sowing Your Hemp Seeds/Using Cannabis Clones

Growing any kind of plant seems like it would be a fairly basic process, right?

Stick a seed in the ground and water it until a seedling pokes its head out. Super simple. When it comes to growing hemp, things get a little more complicated.

Keep in mind that you have a couple of options. These include using hemp seeds or hemp clones. What's the difference? Let's take a deeper look.

#### Hemp Seeds

Before you begin, it's vital you understand that when it comes to the hemp plant itself, there are several different genetics. If you're growing hemp for the purpose of CBD, the last thing you want is a variety of hemp that is intended for stalk and fiber (such as in making various textiles).

Something else to keep in mind is that cannabis has been prohibited for years. This means that hemp seeds are a bit different than commercial seeds for standard vegetable crops (think tomatoes, cucumbers, etc.). **While commercial seeds are typically genetically stable (meaning the seed will produce identical plants of the same phenotype), hemp is a bit different.**

Consistency might not always be the same, which is why it's paramount you do your research before purchasing hemp seeds.



Don't assume that you can just buy any old bag of hemp seeds from the store, stick them in the ground and watch them grow into a lucrative cannabis field. Because cannabis was prohibited for so long, it's a bit behind when it comes to finding seeds that will produce consistent results.

In an interview, founding chair of the National Hemp Association, Michael Bowman, explained where farmers interested in hemp production get seed, noting that Canada and Europe were the best options. Bowman put it like this:

"The challenge is the .3 THC limit. There is a lot of seed available outside of the U.S., but we don't know how acclimated it is to latitudes and longitudes here and how that correlates to THC limits at harvest. If farmers bring in seed and the crop busts the .3 limit at harvest, it becomes marijuana under the law and must be destroyed. That will keep a brake on some robust expansion until we get a good feel for how those genetics are going to express themselves in different environments. It will take another year."

Don't want to wait a year? There are already options to purchase hemp seeds — it's just a matter of ensuring that you're going to get a consistent crop, which is something vital in any farming industry.

If you don't want to go the seed route, there's always the option of clones.

## Hemp Clones

While seeds are a bit easier to find, hemp clones can offer superior consistency when it comes to hemp cultivation.

What exactly are clones?

Simply put, clones are the cuttings from a "mother" plant. These clippings then grow their own root systems and become plants that are genetically identical to the original plant, which can grow year after year.

Clones are taken from the healthiest lower branches of the mother plant. Once they are cut from the plant, they are then rooted in water, cloning solution or rockwool. Roots typically sprout from the clone in 2–3 weeks.

Hemp clones, however, aren't exactly common to come by, which can make sourcing clones for your hemp farm a bit difficult depending on the state where you live.

## 4. Planting Your Hemp

When it comes to actually planting your hemp into the ground, there are some important aspects to keep in mind.

First of all, you'll want to pick the best date to plant your crop. There are different growing zones throughout the U.S., so each state will be a bit different when it comes to the time of year you actually get started. As a general rule of thumb, plant your hemp when all danger of frost has passed. **Ideally, soil temperature will be between 46–50 degrees Fahrenheit.**

Also, keep in mind that soil moisture is necessary for seed germination. **Seeds should be planted at 0.75-1.25.**



**Spacing between each hemp plant is subject to what you're growing your hemp for.** When it comes to hemp, crop spacing is highly determined by your intended yield. Crop spacing will be different for fiber, seed and the manufacturing of CBD. Hemp crops that are intended for fiber can be planted closer together, while hemp planted for seed and CBD manufacturing will need to be planted farther apart.

**When growing hemp for CBD, farmers should anticipate 1,000–1,600 plants per acre. When growing hemp for fiber used in industrial purposes, this number skyrockets to up to 30,000 plants per acre or more.**

## 5. Watering Your Plants

Just exactly how much water do hemp plants need to thrive? **It's assumed that hemp requires 20–30 inches of rainfall during its growth cycle.** If precipitation is less than this, irrigation will be necessary.

**Keep in mind that the absorption of water increases each day until flowering begins. After this, absorption of water significantly decreases, then increases again during the late flowering and seed formation period.**

According to the USDA Farmer's Bulletin No. 1935, "Drought conditions, if accompanied by high temperatures, appear to hasten maturity before the plants are fully grown.... Hemp requires a plentiful supply of moisture throughout its growing season, especially during the first 6 weeks. After it has become well rooted and the stalks are 20 to 30 inches high it will endure drier conditions, but a severe drought hastens its maturity and tends to dwarf its growth. It will endure heavy rains, or even a flood of short duration, on light, well-drained soils, but on heavy, impervious soils excessive rain, especially when the plants are young, will ruin the crop.... The hemp plants in puddled areas of a saturated field will be ruined within two days; it is imperative that the field be well-drained. On the other hand, if the slope of a field is too steep, precipitation will run off the field before it can be retained."



## 6. Nutrients

Nutrients needed for a successful harvest will be largely determined by a soil test. According to the Agricultural Analytical Services Lab at Penn State University, when soil contains optimum levels of potassium (K) and phosphorous (P), the following nutrients are recommended for a potential 1,500-pound crop: 150 lbs nitrogen (N), 30 lbs phosphate (P205) and 20 lbs potash (K20).

Hemp is also subject to a variety of different diseases and garden pests. Some of the most common diseases include grey mold (*Botrytis cinerea*), white mold (*Sclerotinia sclerotiorum*), root rot and blight. Common garden pests that like to prey on hemp include aphids, grasshoppers, flea beetles, grubs and cutworms.



Pesticides are not permitted to cultivate Hemp under the Final Hemp Act. Many growers prefer to stick with organic farming processes. There are plenty of natural solutions that will help keep pests off your hemp plants.

Companion planting is a cultivation technique that can help plants maintain increased resistance to various diseases and garden pests. Companion planting has a history of some 10,000 years; it was implemented by Native American tribes who planted corn, beans and squash together, as they found when planted together these particular plants thrived.

Companion planting with hemp is something that shouldn't be underestimated. Common companion plants for hemp include basil (the pungent smell is a natural pest deterrent), chives, cilantro, and sage (all help deter aphids, flies, spider mites and beetles), peppermint (deters harmful insects and attracts beneficial ones), garlic (a natural fungicide), beans (help supplement nitrogen into the soil) and chrysanthemums (help protect against microscopic worms that can ruin root structure).

## 7. Harvest

Harvest. The moment every farmer waits for after a long growing season. If you've ever grown anything (even one tomato in your backyard), you know how anticipated (and exciting) this time of year truly is.

When it comes to harvesting hemp, the time which it is done is determined by the type of hemp being cultivated. Hemp that is planted for CBD is typically harvested around early October, or when the plant is approximately 16 weeks old and the flowers have ripened and are full of seed.



Hemp grown for fiber, on the other hand, is generally ready to harvest between the time of early bloom and seed set. Industrial hemp also goes through another process in harvest known as retting, which helps break the bonds between the two different variations of fiber in the hemp plant.

## Industrial Hemp Farming: Equipment You'll Need to Get Started

For farmers preparing to tap into the vast potential of the United States' growing hemp industry, it's essential to have the right tools for the job. And, if you're planning on farming hemp on an industrial level, you'll need more than a shovel and handful of seeds. What you'll need is industrial hemp farming equipment and genetically superior hemp seeds.

You'll want industrial hemp farming equipment for tilling, planting, and harvesting. Thankfully, if you're already in the grain farming industry, you'll be able to repurpose at least some of your equipment to handle your hemp crops.

As the hemp industry gains traction in the US, more and more companies are designing equipment to meet the specific needs of hemp farmers. However, the industry is still lagging, which means that most hemp farmers are still working via trial and error to develop custom modifications to prevent bushy plants from clogging their machines.

## Taking Care of Tilling

Though it's tempting to go for maximum biomass if you're focused on hemp fiber or seed crops instead of the more finicky and lucrative CBD market, you're still better off creating raised beds rather than broadcasting seeds throughout your entire field. If you're planning on tapping into the CBD market, you won't even have the option, as raised beds will yield higher quality crops with more potent flowers for producing CBD.

The key to effectively creating raised crops is to make sure they are consistent in size and shape. This is best done with an industrial raised bed shaper — the same that you would use as a tomato farmer. Thankfully, you won't need to be modifying the device for creating hemp beds.

If you don't already have a bedder in your tool kit, one brand to look at is Kennco Manufacturing, which has taken a special interest in designing industrial hemp farming equipment for the US market. Kennco's SuperBedder Bed Shaper produces tight, even beds and is touted as having "durable 'sweeps' to cut and roll the soil into press pan, and push finer soil to center of the bed where you plant." It's designed for hemp farmers working more than 100 acres. Depending on the shaper, it's possible to create beds about 3 feet high and about 30 inches wide.

Another piece of equipment you'll want to consider bringing on board for your hemp farm is a plastic mulch layer. What it does is puts down strips of plastic mulch on your beds, securing them with soil.

Again, Kennco specifically markets its high-speed plastic mulch layer to the hemp industry, claiming that it is an "extremely cost-effective, versatile, and durable money saving too for all growers." However, there are many other plastic mulchers out there that will do the trick.

## **Planting Your Hemp Crops**

As with tomatoes, cabbage, broccoli, strawberries, tobacco, and many other crops, a transplanter is going to be an important piece of equipment for your hemp farm.

C&M transplanters, which have been in the North American market for more than 25 years, are proving to be particularly popular with hemp farmers. They are designed to set plants up straight, provide consistent plant-to-plant spacing, and have no slippage. Though this particular brand is well-liked by hemp farmers in the United States, really any reliable transplanter will do the trick on your farm.

## **Irrigation Equipment**

Though hemp is often pushed as a drought-resistant crop, you're most likely still going to need an irrigation system as the crop needs at least 25-30 inches of rainfall during the growing season. This is slightly more than corn and soybeans.

According to researchers from Colorado State University, irrigated hemp fields end up producing almost three times as much yield when compared to non-irrigated fields in Colorado.

There are a variety of irrigation systems you might want to explore for your hemp fields, including center pivot, linear move, traveling gun, solid set, micro-sprinkler, and drip irrigation.

The center pivot irrigation system is one of the most commonly used, and they are often fitted with an end gun to extend the radius of the system. As with most irrigation systems, the name gives a clear idea of how it works: basically, a center point is established and the irrigation system pivots around that point in order to cover your entire field.

Many hemp farmers transitioning from other crops lean on systems they already have the gear for, though there is also a push among farmers to use drip irrigation. This irrigation system can reduce your water consumption by as much as 60 percent and increase crop yields by 90 percent when compared to conventional irrigation methods, which is why it's quickly gaining traction. It's also possible to use it to help manage the nitrogen levels in your soil.

## **Hemp Harvesting**

The industrial hemp farming equipment you'll need to harvest your crops with is what you'll need to start thinking about with regards to customize your machinery.

The tough, fibrous nature of hemp makes it a particularly difficult crop to harvest, as hemp can easily get wrapped up in any machinery with rotation, pickup heads, or rolling bearings. It can get so bad that you'll have to stop to cut or burn it out.

Experience has shown that a haybine has weak results with hemp crops, while a disc mower ends up with hemp balling up at the ends. One solution is to use a sickle bar mower and leave the crop on the ground for about a month to allow it to dry before flipping it with a rotary rake.



For grain crops, newer models of combines are going to be well-suited for hemp harvesting, as they have bigger cylinders and cleaning areas. Additionally, headers can be operated at a higher level to accommodate for all types of hemp.

If you are wanting to avoid buying new harvesting equipment only to have to modify it, Hempflax has released their double cut combine, which “is suitable for harvesting hemp and other bast fiber crops.”

In a single stage, the machine is able to divide the stalks, seeds, and leaves of your crop.

If you’re planning on focusing on fiber hemp crops, a bailer will also be a necessary piece of equipment to have in the barn.

## Final Thoughts: Industrial Hemp Farming: Equipment You’ll Need to Get Started

If you’re already growing grain or fiber crops at the industrial levels — or those focused on raised-bed crops — adding hemp to your field rotation shouldn’t require a great deal of new equipment.

Nonetheless, until more companies in the US begin manufacturing equipment specifically for hemp, you’ll need to be prepared to experiment a little and make modifications when necessary in order to maximize your yield.

No matter what kind of equipment you settle on, make sure you talk to the experts about the best seeds for your fields.



# Hemp Farming Equipment

There are many ways to grow hemp, with some methods being more sophisticated than others. Hemp farming requires substantial agricultural knowledge and research, as the exact equipment used will depend on the precise growing methodology.

Another critical factor in which equipment a farmer chooses is whether or not the hemp will be used for textiles or for CBD oil. If used for textiles, hemp can be planted at a much higher density – up to 400,000 plants per square acres – but if CBD production is the goal, the density drops substantially to a maximum of around 1,600 plants per acre.

This is because textile hemp is grown similarly to wheat, with tall stalks that are then used for industrial applications. CBD hemp, on the other hand, is cultivated to be small and leafy, staying lower to the ground, with the plant's flowers used for oil production.

Here is some of the equipment involved in the hemp farming process:

## A. SOIL PREPARATION (Suggested Machinery with approximate values/prices)

1. **PLOW** - Moleboard - \$1,200.00 - \$2,500.00
2. **DISC** - \$8,000.00 and up
3. **TRACTOR** - 100 H.P. - Pricing various (can supply suggestions)



## B. PLANTING

1. **GRAIN DRILL** - 510 or 5300 - \$2,500.00 and up

### Grain Drill

A seed drill streamlines the process of sowing hemp seeds and can be used to plant many acres of the crop efficiently.



### Transplanter

If not starting from seeds, a transplanter can be used to move a substantial quantity of early hemp plants into the field, placing them with the appropriate spacing and position.



## **C. HARVESTING**

1. Combine - \$75,000.00 +/-
2. Grain Head (15 ft width) - \$30,000.00 and up

### **Combine**

Also used for harvesting wheat, a combine is used to cut and collect the hemp stalks and grain material. This equipment is typically used when harvesting textile-based hemp crops, as it is a rough process that would compromise the structure of the plant when used for CBD production.



### **CBD Hemp Harvester**

Explicitly designed to harvest hemp used for CBD oil production, this harvester works differently than the combine. The CBD hemp harvester carefully cuts each hemp plant and loads it onto a trailer, without damaging the plant's structure. A typical harvester processes up to 5 acres of CBD hemp per day, and can also be used for cannabis crops.



### **Hand Harvesting**

Another method of critical harvesting (for CBD) is to hand harvest. Hemp can be harvested with Clippers or Heavy-Duty Circular Saw type weed wacker. This allows for more precise harvesting in tight spaces or where quality is required for CBD production - Smokable Flower.



## **D. CLEANING SEED**

1. Purchase Ben Elkin cleaner - Cleaner needs to be purchase and kept. \$500.00 - \$1,000.00 +/-



## **E. SEED STORAGE**

- Containers could be totes, amount to be determined by acreage harvested.

## **F. BALE STOCKS**

1. Round Bailer - \$10,000.00 and up. Must be a wide head to follow Combine.

## G. DRYING (Important!)

### How should I dry my hemp?

The answer depends entirely on how many acres you have and what you plan to do with the product.

#### Small farms

You may feel tempted to use drying machines for your hemp biomass or flower. After all, machines get the job done significantly faster and are more convenient than hang drying. But according to every expert we talked to, mechanical drying methods ultimately compromise CBD potency, as well as other cannabinoids and terpenes.

“When you’re chopping plants to get them in a dryer, then running them at high heat, you are doing everything possible to ruin the terpenes. You’re also reducing the CBD concentration, so you’ll end up with less yield,” said Ryan Kelly, Founder at Mobile Hemp Drying Co.

So if you run a farm less than 5 acres, consider building an indoor drying structure and investing in the labor required to complete this meticulous process.

#### Large farms

Manual drying isn’t feasible for all hemp producers. If you grow dozens or hundreds of acres, you probably don’t have space, overhead resources, or time to hang-dry hundreds of thousands of pounds. Moreover, when you hang-dry, you leave hemp exposed to mother nature’s elements for weeks, increasing the likelihood of contamination. That can be incredibly risky if you live in a humid state like Florida, where mold and mildew contamination is widespread. But Industrial hemp drying machines can cost upwards of a quarter-million dollars. Unless you’re a farmer with 1,000 acres and a full turnkey operation, consider outsourcing the drying process to a local hemp processing company.

### What are the most popular drying machines and methods?

#### Manual Drying

**Hang or Screen Drying.** According to Oregon CBD’s step-by-step cultivation guide, **you’ll need about 5,000 sq. feet of dry room space to hang whole plants.** However, if you’re shucking the plants before drying, you’ll only need a 50’x50’ barn, according to Jeremy Sanchez, CEO, and Co-Founder of Honest Pharm Co. You’ll also need to choose between racks, wires, or screens to determine if you are laying or hanging your hemp. Whenever you’re drying in a barn, you’ll also need fans and dehumidifiers to keep air flowing evenly and prevent moisture buildup.

#### Freeze Drying.

But barns are not your only option anymore. In fact, **hang drying hemp in freezers is becoming more popular as the technology evolves to protect hemp’s terpene-filled trichomes.** But this isn’t your grandmother’s freezer. North Slope Chillers apparatus quickly freezes flowers, transforming the water into ice crystals. As soon as the crystals form, the presser inside drops to create a vacuum for “sublimation drying.” That sublimation is later pulled into a colder condensation unit, leaving behind freeze-dried flower that retains its color, flavor and texture.



## Rotary Drum Dryer

Rotary dryers work in a similar way to clothing dryers. When you add plant material to rotary dryers, they use heat to dry hemp as it rotates around. **Rotary machines** significantly reduce drying time by processing thousands of pounds per hour **at temperatures ranging from 100 to 200 degrees Fahrenheit.**



## Belt or Conveyor Dryers

Belt dryers are generally shipping containers that hold a series of conveyor belts. As the hemp moves from one belt to the next, the plant material drops off and mixes around for a more even dry. Similar to rotary drum dryers, belt dryers generally operate at about 100 degrees Fahrenheit and higher.



## Forced air dryers

Like Ryan's Mobile Hemp structures—blows air through 53-foot trailers at 40,000 cubic feet a minute. This method increases the low humidity airflow at relatively low temperatures using a propane burner to dry the incoming air. This process ensures the temperature never exceeds 80 degrees. "By drying the air as it comes in, we avoid the heat damage you get from the belt and rotary dryers," said Ryan.



## Mobile Hemp Drying Co.'s Forced Air Dryer

### **What drying machine should I use for smokable hemp flower?**

If you are growing 5+ acres of smokable hemp flower, you may want to consider a company that uses forced air dryers.

"The temperature never goes above 80 degrees to be sure we don't smash the trichomes that contain volatile terpenes or cannabinoids,"

Forced air drying takes much longer than belt and rotary dryers due to the lower temperature at which they operate. But if you want to preserve your plants' color and therapeutic profile, this may be your best option.

### **How long does it take to dry hemp flower using forced air dryers?**

You'll wait about 36 hours to dry 2 acres of hemp. This process is slower than rotary and belt dryers but infinitely faster than hang drying, which takes several weeks.

### **What drying machine should I use for hemp biomass for extraction?**

If you're growing hemp biomass for fiber or CBD extraction, you don't need to preserve color and terpenes. You're probably more concerned with time and efficiency. If that's the case, you'll want to work with a drying company that employs a rotary, belt, or other high-heat drying method like Honest Pharm Co.

### **How long does it take to dry hemp using conveyor belt dryers?**

The answer will vary slightly based on the drying company you choose and whether they dry clean, chopped flower or the entire plant. A large, commercial, conveyor dryer that loads the biomass on the stainless steel mesh and forces large volumes of warm air up through the biomass that dries it very efficiently. As it passes through the dryer, the layer of biomass is turned multiple times to get the best uniformity and quality. After drying, biomass should be placed into large bags to keep it from absorbing any additional moisture or contained in a temperature/environmentally controlled building.

On average, one can belt dry about 300 pounds per hour.

### What should I ask a drying machine company before I make my decision?

When choosing a hemp drying company, you must review the budget, the scope of services needed, the end product, and the capabilities of the company you're considering. Before making your decision, ask the following questions:

#### Bucking services. (Stripping flower off the stalk)

If you're not bucking the plant yourself, you'll want to work with a hemp drying company that offers this service before drying the biomass. If the company doesn't provide bucking services, they may be charging you by the pound for stalks you don't need.

#### How do Drying Companies charge?

This question is critical. Some companies charge by the wet pound, which makes absolutely no financial sense. Look for companies that charge by the dry pound only.

#### At what temperature do you dry the hemp?

If you're looking for the highest yield of terpenes and cannabinoids, look for dryers that run at less than 90 degrees.

However, if you're primarily concerned with maintaining cannabinoids like CBD for extraction, the temperature can be a little hotter. 104 – 114 degrees is your sweet spot. Anything above that temperature may not be conducive to the highest yield of CBD.

#### How many pounds can be dried per day?

Make sure the hemp drying company has the capacity to process your loads in a timely manner.

#### Do drying companies mix hemp from multiple clients in a single dryer?

Industrial sized processing companies often mix hemp biomass from multiple farms to ensure they're getting the highest output from their machines. This strategy is excellent for their business but bad for yours if your clients expect precise cannabinoids or terpenes potency.

#### What does the dryer have in terms of risk mitigation/loss prevention?

Hemp drying is not a set-it-and-forget-it endeavor. It requires strict monitoring to get the best results. When you ask about risk mitigation, listen for answers like smart temperature controls, event heating, hydrometeors, and humidity sensors.

### Bottom Line

Correctly drying your hemp is key to ensuring a profitable end product. If you're unable to dry manually due to the size and scope of your operation, make sure to do your due diligence on the drying machines, methods, and companies who you're entrusting with your harvest. The choice can make or break your harvest.

## G. REPLANTING

All prices are for used equipment. It is recommended that machinery be purchased in Oklahoma.

Presently, there is a shortage in some machinery, especially Tractors. The farm machinery market is fluid.

# The Best Processing Environments for Hemp Products

Hemp farming equipment can take a single acre of hemp to yield approximately 700 lbs of hemp grain or produce 5,300 lbs of straw on average. That same straw can be transformed into about 1,300 lbs of fiber.

For the industrial hemp farming cycle and cultivation process to go as expected and yield an optimal harvest, growing conditions on hemp farms must remain stable and free from pests and diseases. While hemp can grow in a wide variety of soils, it tends to thrive on nitrogen-rich land that is non-acidic; **this type of land is also ideal for / similar to growing corn.** Therefore, soil tests to evaluate soil fertility and determine nutrient management are necessary for hemp cultivation. Hemp also prefers milder climatic conditions with a humid atmosphere. Hemp does, however, need at least 20-30 inches of rainfall during its growing cycle, and its demand for water increases until flowering begins.

But while adequate moisture is crucial when growing hemp, moisture retention during harvesting and processing are the enemy, and they can quickly reduce the quality of the crop. Because proper cleaning and drying are parts of processing, the processing environment should be stable. The raw materials need to be protected from direct sunlight, extreme temperatures, and high levels of oxygen. To achieve this, hemp processing plants should be climate-controlled, adequately ventilated, and regulated for moisture. The processing equipment should be designed to limit exposure to the elements, which can introduce dust and other contaminants.

## The Different Uses and Processing of Industrial Hemp

From the roots to the leaves, each component of the hemp plant can be processed and made into an industrial hemp product. Therefore, the harvesting and processing methods depend on the intended application.

The hemp stalk is one of the most versatile components of the plant. It can be used to make rope, paper, insulation, building materials, and animal bedding. The stalk's bast fibers are used to make hemp textiles, and they can be blended with other fibers. CBD extracts also come from the plant's stalks and stems through the process of CBD isolation.

The hemp flowers and buds can be used to extract seed oil. Hemp oil comes directly from the seeds in the hemp flowers. The hemp seeds on their own can be used in a variety of ways. Hemp seeds are touted as a superfood and can typically be found in health food stores today.

If a hemp product manufacturer only needs to harvest the hemp plant for its flowers and seeds, the remaining stalks and leaves will be regarded as waste. However, this hemp biomass can be used by another manufacturer to make fibers, cloths, or cords. The stalks can be fermented and turned into hemp ethanol or biofuel.

The processing equipment needed will depend on the end product. All the hemp plant's components will go through cleaning and drying. Generally, the plant's stalks will go through decortication and retting processes. Hemp flowers, buds, and leaves will go through bucking and de-hulling for the seeds. Bucking, also known as de-budding or destemming, refers to the process of removing the flower and leaves from the hemp plant's stem.

## Processing for the Hemp Plant's Flowers and Seeds

Getting the timing right to harvest for seed production can be tricky because seeds mature at varying rates, with different seeds maturing at different times on the same plant. Sometimes, the lower seeds near the stalk will have already matured and split open, while the seeds at the top aren't quite ready. The challenge of hemp harvesting is to do it when there is the least risk of losing seeds. Premature harvesting will only result in non-viable seeds.

Careful handling of the hemp seeds is crucial and requires the removal of the mature seeds from the flower heads. Because whole hemp seeds have hard outer shells, de-hulling hemp seeds is required to get them ready for the market. Historically, the de-hulling of seeds was done manually, making shelling hemp seeds a long and labor-intensive process.

Hemp farm equipment such as bucking machines, which also referred to as destemmers or debudders, speed up the industrial hemp production process. The flowering head of the plant is cut for seed processing while the stalks are sorted for fiber processing. While some hemp processors may take untrimmed material to process as is, others will use the material to produce other hemp-based products, such as oils or distillates.

Before storage, hemp seeds need to be properly cleaned and dried. To prevent damage, low-impact transfer mechanisms, such as conveyors, are used to transfer the seeds. Other types of machinery, such as augers that are run at high speeds,

could potentially damage the seeds. Those traditional methods, which also include bucket elevators, tend to place more importance on speedy outputs than maintaining the material's integrity.

## **Processing for the Hemp Plant's Stalks**

Harvesting for fiber production usually begins when plants are in early bloom. Historically, harvesting was done manually by hemp farmers to ensure the stalks would not be damaged. The core or the hurd is separated from the fiber by hand. Because of the fiber's strength, pulling it from the stalks took a lot of manual force. Today, technology allows hemp crop harvesting and processing to be done by machines with equipment that is advanced enough to take care of the careful separation of the hemp fiber from the stalk.

There are two approaches to separating the hemp bast fiber from the woody core of the hemp called the hurd. This can be done mechanically through decortication or by the retting process. This bast fiber of the stalk is what is often turned into industrial products like rope, canvas, textiles, and clothing.

Retting refers to the process of separating the fiber from the rest of the plant, and it is crucial for ensuring the quality of the fiber produced. The quality can be quite complex as it requires breaking down the bark tissue that binds the fiber. Before hemp can be processed, the retted fiber must be dried to 10-15% moisture.

There are several retting methods, which include dew retting, water retting, warm water retting, green retting, and chemical retting. Dew retting can take up to five weeks, while water retting takes 7-10 days. Green retting uses an all-mechanical process to separate the fiber, and it is most often used in the production of textiles and paper. Of all the methods, chemical retting is the fastest as it dissolves the pectin in as little as 48 hours. This retting process is said to yield the highest quality product.

After decortication, the fiber is scutched and hackled. Scutching refers to the dressing of the hemp in preparation for spinning. The process separates the impurities from the raw material, such as seed particles and other matter. Scutching was once done by hand, but it is now done by a machine called a scutcher. Scutching hemp results in long fibers called lines. Hackling or combing removes the hurd particles and any broken fibers and helps align the fibers in a continuous sliver.

## **The Best Equipment to Process Hemp Fiber**

During the bucking phase, the best destemming equipment will not pull or pop the delicate hemp flowers but rather, cuts them gently off the stem. When they are cut in this manner, there's a minimal risk that the large crown buds will fall apart into small pieces. The goal is to keep the structure of the buds intact and fully preserved.

Because hemp decortication makes up the bulk of the hemp's processing requirements for hemp fiber processing, hemp manufacturers need cutting-edge technology that streamlines the decortication process. A good decorticator system uses a reactor that passes hemp stalks through the machine to efficiently separate the hemp into pulp. Highly efficient decorticators can process tons of hemp per hour, and they are designed to process and decorticate hemp into a variety of different hemp products.

A modern decorticator separates the fiber from the rest of the stem and uses post-processing to remove the fiber's resins and gums. A hammermill is used to separate the plant's hurd from the bast fiber. The bast fiber is then cleaned, carded, refined, and cut to size. Once ready, the fibers can then be pressed tightly and prepared for baling. Processed bast fibers arrive at hemp product manufacturing facilities packaged in compressed bales similar to hay.

The hemp straw or stalk can also be used to make hemp pellets. To make hemp pellets, manufacturers use a pelletizer machine similar to the one used to make grass pellets. Hemp pellet mill systems should be paired with a suitable conveyance and transporting system to maintain the integrity and temperature of the hemp pellets.



## The Best Equipment to Process Hemp Seeds

The de-hulling process for seed processing involves a hemp seed shelling machine that de-hulls and removes the outer shell. The equipment for hemp seed shelling consists of an input hopper, spiral elevator, and a de-hulling and separating unit. It also involves a device for back-flowing materials and collecting kernels. This gentle machine not only removes the seed's crunchy skin but cleans it of hull residues. The kernels are separated from the seeds thanks to the equipment's vibrating de-separator. After separation, the shells flow out and are discharged. Any back-flowing materials will be de-hulled and separated again.

For most hemp farmers, the preferred method for harvesting hemp for seed is straight combining. The combine header is positioned just high enough to cut the crop below the seed head, minimizing the amount of fiber that makes its way into the combine. When moving hemp seeds from the combine to the dryer, bin, cleaner or de-huller, and finally to the processor, the seeds need to be handled gently because they can easily become damaged. For this reason, seeding equipment, such as a gentle conveyor system, is crucial to ensuring the hemp seeds move from each phase of the processing safely. Hemp seeds are very delicate and burst easily. When this happens, they can become infested with germs or turn rancid.

To keep product blends at the correct ratios, the best type of equipment for conveying hemp is the tubular drag conveyor, often referred to as tubular and/or tubular drag cable & disc conveyors. Tubular drag conveyors are also best for processing hemp pellets and similar hemp products.

The problem with traditional equipment like screw augers, bucket elevators, pneumatic, belt conveyors, and vacuum conveyors is that they're not ideal for maintaining consistency. When these conveyors have poor inlet designs or high conveyor speeds, materials may degrade, separate, or break. These methods are also susceptible to temperature changes, friction, and heat, which can threaten the integrity of the material.

Tubular drag conveyor systems can efficiently move many types of delicate materials, including hemp while keeping the plant parts like seed and fiber intact. The right tube systems will feature a modular design with a wide range of tube diameters and materials that can accommodate diverse applications.

Tubular drag conveyor technologies feature an innovative combination of conveyance tubes with cables and discs attached at set intervals that gently handle materials from an inlet within an enclosed tube.

Tubular drag conveyor systems feature stainless-steel tubes with either nylon or UHMW discs attached to a stainless-steel cable. Systems are moved by top-mounted drive units and pulled by sprockets that don't touch or affect the materials being conveyed. Because of the machine's slow-moving method of conveying, which runs about 100 feet per minute, materials are pulled from the infeed points to discharge ports as the cable and disc assembly passes through the tubing.

## How to Maintain Quality in Hemp Processing

When the 2018 Farm Bill was signed into law, it designated the Agricultural Marketing Service (AMS) to lead the USDA Hemp Production Program. The farm bureau, hemp association, and other regulating bodies will ensure hemp producers operate their industrial hemp programs according to their individual plan and in compliance with federal laws, including following rules and guidelines for food processing and hemp marketing to maintain quality control and food safety.

Ensuring the highest quality hemp products starts post-harvest during the drying phase. When hemp is dried quickly and cleaned, there is less risk of damage and loss of product. When hemp is not dried quickly enough, or it is harvested too wet, it can become contaminated with bacteria or fungi. Without adequate ventilation, the harvest may spoil, making it unsuitable for processing.

To yield the highest quality hemp seeds and fibers, gentle conveyance of materials is crucial. Cable conveyor and tubular drag conveyor systems are the gentle, clean, and cost-effective way to move materials around your hemp production facility.

To maintain quality, the processing environment should also be dust- and contamination-free. When choosing conveyance solutions, find tube conveyors that are designed to eliminate places where fine particles may accumulate. Discs should be solid and have no screws or bolts, and cables should be "jacketed" with nylon casings. Steel connectors should also be made of stainless steel. And for easy cleaning, all the equipment should be removable or able to be cleaned-in-place (CIP).

The enclosed tube keeps materials clean and safe while in transit, reduces waste, and keeps the hemp facility clean. It is also gentle enough to convey delicate hemp materials without breaking them. This smooth and gentle conveying system helps reduce waste by preventing degradation, material damage, and contamination.

#### Conclusion

Success in the industrial hemp industry depends on how efficiently and safely your hemp materials move around your production process facility, ultimately determining the difference between profit and loss. That's why the right tube conveyor system for your hemp processing facility should be modularly designed and customized for your site, ensuring that all systems are optimized with component parts that are the right size, tube diameter, and material to suit your facility's unique configuration, available space, and specific applications.

## **HEMP REMEDIATION CONSIDERATIONS**

1. Recommend that we conduct the Remediation over 4 parcels (if possible) with each parcel utilizing a different strain of hemp. Each parcel between 5-20 acres.
  - (a) Otto #2 x BaOx;
  - (b) Carolina Dream;
  - (c) Wild Bourbon; and
  - (d) Golden Redwood
2. **Initial Baseline** Soil Testing/Sampling
3. Site locations
4. Site Preparation, ie, moleboard, disc, harrow
5. Planting - Drill
6. Irrigation, ie, Natural vs. human
7. Harvesting
8. Post Harvest Testing of Soil & Biomass
  - (a) At time of harvest;
  - (b) 1 month post;
  - (c) 3 months post;
  - (d) 6 months post;
9. Regulation consideration for biomass use as Pellet(s)
  - (a) Pellets to burn - pellet stoves
  - (b) Pellets for Liquid absorption
10. Destruction of biomass if not suitable for pelletizing
11. **Hemp grow licensing/hemp remediation considerations (same license of modified license)?**
12. Use of hemp seeds for future years growth - requires Grain Head
13. Drying, Storage considerations
14. Supply Chain considerations
15. Funding considerations (possible Federal Superfunding). If so, what is the process?
16. Manpower, student researchers, etc.
17. Weather considerations - dry periods, wet periods, timing of harvesting/drying
18. Misc. Considerations

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