

HEMP BENCHMARKS®

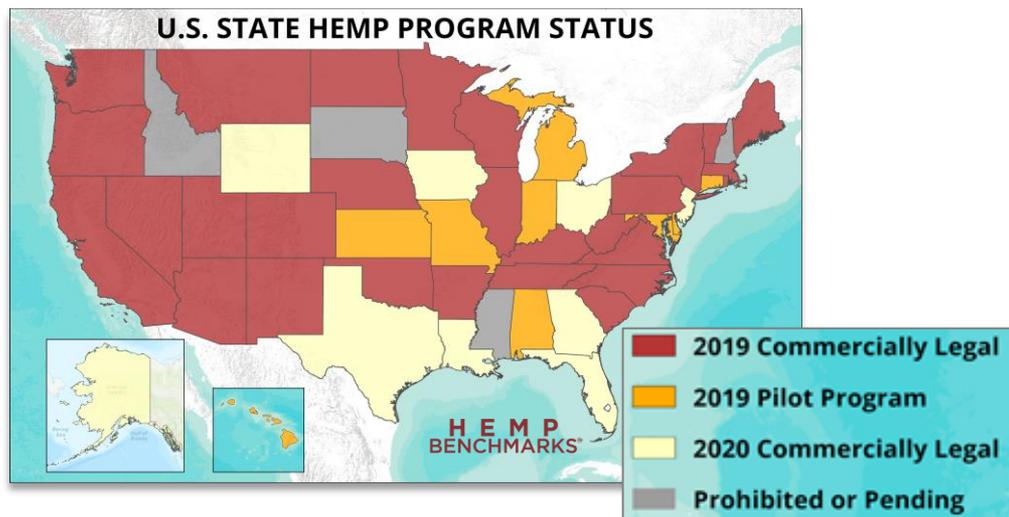
U.S. Wholesale Hemp Price Benchmarks

September 2019

U.S. Region Products	Units	Assessed Price	Low	High
Biomass (0 – 25k pounds)	\$/ %CBD / pound	\$3.07	\$2.00	\$4.72
Biomass (25k – 100k pounds)	\$/ %CBD / pound	\$2.99	\$1.80	\$4.17
Biomass (100k – 1M pounds)	\$/ %CBD / pound	\$2.74	\$1.90	\$3.60
Biomass (1,000,000+ pounds)	\$/ %CBD / pound	\$2.09	\$1.55	\$2.70
Dry Flower (Bulk)	\$/ pound	\$364	\$100	\$650
Clones	\$ each	\$4.47	\$2.00	\$8.00
Industrial Seeds	\$/ pound	\$10.85	\$5.28	\$18.40
CBD Seeds (Non-Feminized)	\$/ pound	\$2,450	\$2,300	\$2,600
CBD Seeds (Feminized)	\$/ seed	\$1.08	\$0.50	\$2.50
Crude Hemp Oil	\$/ kilo	\$1,737	\$850	\$3,689
Refined Hemp Oil	\$/ kilo	\$4,973	\$1,823	\$8,343
CBD Isolate	\$/ kilo	\$3,767	\$2,300	\$6,000

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Commodity market participants benefit from increased price transparency.

Hemp Benchmarks® is an independent Price Reporting Agency (PRA). Our goal is to bring price transparency to wholesale hemp markets in order to allow businesses to operate with confidence and efficiency.

We do not have physical or financial exposure to the commodities that we assess, and therefore do not profit from liquidity, volumes or price movement, avoiding the potential for any perception of conflicts of interest that could arise for marketplaces and exchanges.

U.S. Price Commentary

Wholesale prices continued to erode for the most part in September, with only Industrial Seeds seeing an increase.

Biomass prices persisted in their downward slide this month, with rates for both the smallest and largest volume brackets declining by the largest magnitudes from August's price assessments. Feedback from our Price Contributor Network for the past couple of months indicates that lower biomass prices at the start of the September harvest are due to producers looking to unload older inventory. Industrial seeds saw another significant increase this month as some hemp cultivation operations start to think of the next harvest and focus on buying seeds with ideal genetics.

Product	Units	July 2019	Aug 2019	Sept 2019	MoM \$Chg	MoM %Chg
Biomass (0 – 25k pounds)	\$ / %CBD / pound	\$3.91	\$3.80	\$3.07	(\$0.73)	-18.7%
Biomass (25k – 100k pounds)	\$ / %CBD / pound	\$3.41	\$3.10	\$2.99	(\$0.11)	-3.2%
Biomass (100k – 1M pounds)	\$ / %CBD / pound	\$3.27	\$2.96	\$2.74	(\$0.22)	-6.7%
Biomass (1,000,000+ pounds)	\$ / %CBD / pound	\$3.32	\$2.95	\$2.09	(\$0.86)	-25.9%
Dry Flower (Bulk)	\$ / pound	\$352	\$414	\$364	(\$50)	-14.3%
Clones	\$ each	\$5.13	\$4.67	\$4.47	(\$0.20)	-3.9%
Industrial Seeds	\$ / pound	\$7.21	\$8.60	\$10.85	\$2.25	31.2%
CBD Seeds (Non-Feminized)	\$ / pound	\$3,490	\$2,460	\$2,450	(\$10)	-0.3%
CBD Seeds (Feminized)	\$ / seed	\$1.14	\$1.10	\$1.08	(\$0.02)	-1.8%
Crude Hemp Oil	\$ / kilo	\$2,238	\$2,310	\$1,737	(\$573)	-25.6%
Refined Hemp Oil	\$ / kilo	\$5,451	\$5,475	\$4,973	(\$502)	-9.2%
CBD Isolate	\$ / kilo	\$4,574	\$4,478	\$3,767	(\$711)	-15.5%

Source: Hemp Benchmarks®

Become a Member of our Price Contributor Network

Join us in our mission to promote price transparency and receive exclusive content and analysis made available only to members.

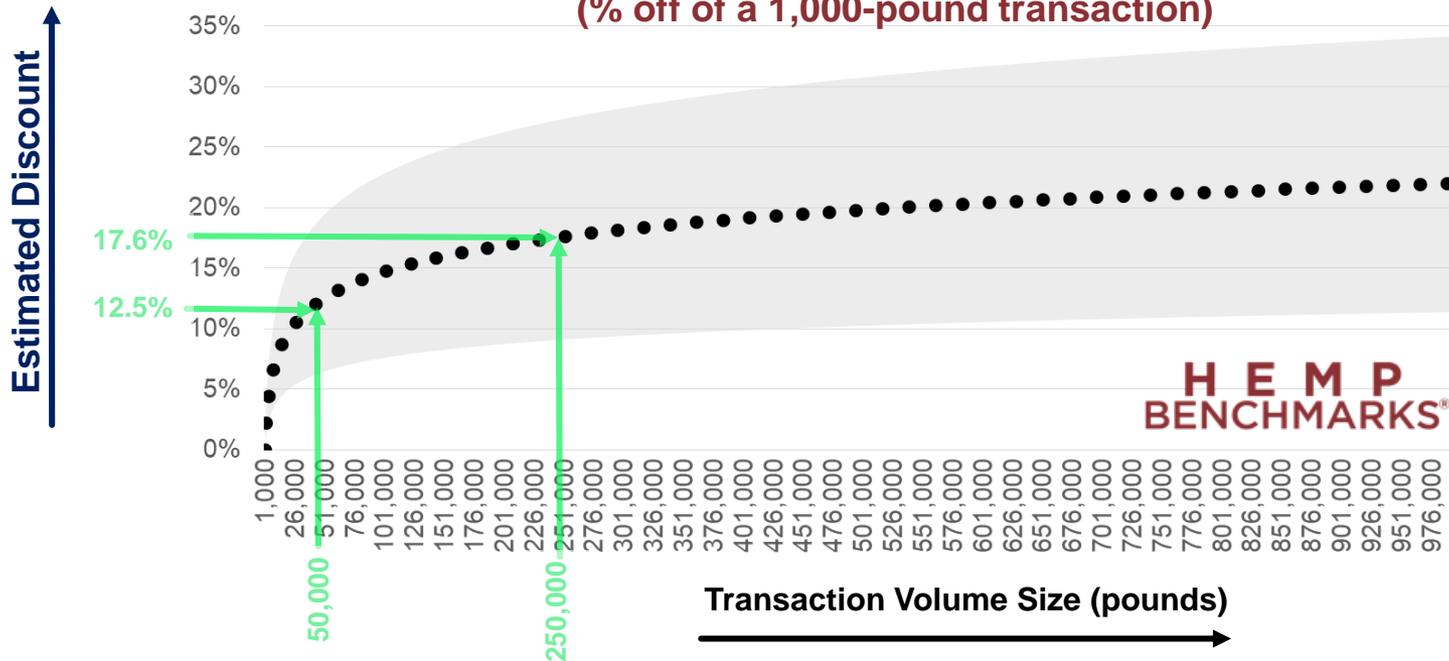
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Biomass Volume Discount Pricing

Volume discount pricing is a strategy that provides a financial incentive for purchasing a product or service in large amounts. In simple terms, customers purchasing more generally receive a lower price per unit.

Based on the data we have collected over the past six months, we have calculated the volume discounts that biomass purchasers received each month when doing deals greater than 1,000 pounds. Each month has shown a drastically different discount curve (as represented in the grey area) dictated by the absolute price level, season, and transactions collected. The black dotted line below shows the average of the past six monthly discount curves and represents a good proxy that buyers and sellers can use to settle trades of various sizes.

U.S. Biomass Volume Purchase Discounts (% off of a 1,000-pound transaction)



Ask us how
our pricing
can help
negotiate
your next
transaction

Increased Supply of Hemp Biomass, CBD Products Expected as 2019 Harvest Commences, but Cultivation and Processing Issues Could Dent Potential Market

The 2019 industrial hemp harvest is underway in North America, and all signs point towards another record crop. But while consumer demand for hemp products shows no sign of declining, there are indications that this historic harvest - the first in the United States since the national legalization of hemp under the 2018 Farm Bill - might also make history for some unwanted reasons.

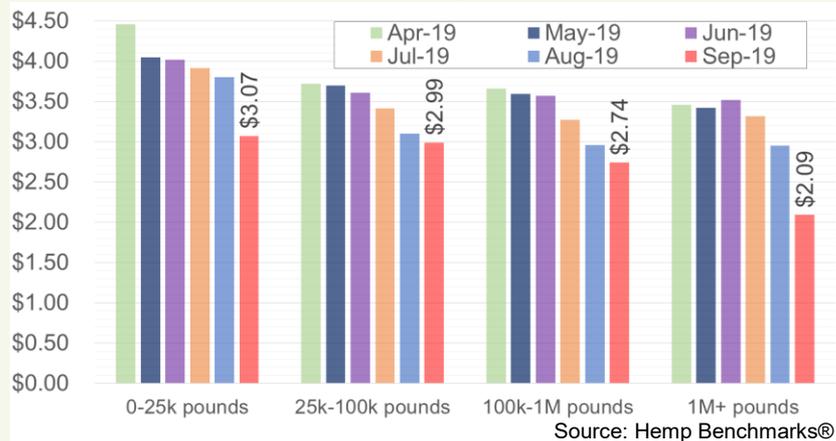
As stated, there is virtually no doubt that the yield from this year's crop will significantly exceed the amount of biomass generated last year. In what follows we provide a revised estimate of how much CBD-rich plant material will be produced this fall from harvests that have already taken place or will occur in the next few weeks.

Meanwhile, farmers - especially those new to the industry and those that scaled up significantly - are discovering that the hard work does not end with raising a successful crop, as simply drying the plant material and ensuring that it remains saleable can be a difficult undertaking. If those hurdles are cleared successfully, the question of how much functional processing capacity is online in the U.S. remains hard to determine definitively, raising the possibility that portions of this year's harvest could ultimately go to waste if serious bottlenecks arise. And, as it has for the entirety of

this year, all of this activity is taking place as federal, state, and local regulatory schemes are still under construction.

Yet, with demand for CBD still high and what will almost certainly be a record amount of biomass on offer, the amount of hemp-derived CBD products that could be produced this year will also expand to unprecedented levels, constituting a market potentially worth billions of dollars. We provide estimates of how much of various types of hemp-derived CBD products could be manufactured from this year's crop, along with their current wholesale market value, in the section starting on page 12. Of course, significantly increased supply of hemp biomass and CBD products could have a dramatic impact on wholesale prices, which we will continue to monitor and assess monthly.

U.S. Biomass Wholesale Pricing Trends (\$ / %CBD / pound)



Revisiting Estimates of Biomass Yield

In last month's Hemp Benchmarks report, we provided estimates of how much CBD-rich biomass would be generated from this year's harvest. Generally, we assumed that half - or more - of the roughly 480,000 acres licensed for hemp production that we counted at the time would be planted, with 90% of that acreage devoted to CBD-rich cultivars grown for the purpose of producing biomass for extraction. We further assumed that 40% to 50% would be harvested successfully at an average yield of 1,000 pounds of biomass per acre.

Feedback received from various state agriculture departments and reports from other outlets in the interim have caused us to adjust slightly our previous approach to calculating the amount of biomass suitable for CBD extraction that will make it to market this year. Instead of assuming that 50% to 60% of licensed acreage was planted nationwide this year, we now assume that 50% was planted. The other assumptions, stated just above and articulated in detail in last month's report, remain constant.

Overall, reports from numerous states indicate that the percentage of licensed acreage that was actually planted with industrial hemp varied from less than 10% to almost 60%.

In regard to the major hemp-producing states, Jessica Quinn, Colorado's Registration and Compliance Coordinator for the state's Industrial Hemp Program, stated that there are 85,917 acres currently registered for hemp in Colorado this season, along with 13.8 million square feet of indoor and greenhouse production

capacity. Brian Koontz, Colorado's Industrial Hemp Program Manager, also stated that so far 49,455 acres - or 58% of the total amount licensed - have been reported as planted. "And I think that's a pretty conservative number," he told Hemp Benchmarks, because many growers are still submitting their planting reports to the state.

A September 1 report from the Mail Tribune quoted Pete Gendron, of the Oregon SunGrowers Guild, as stating that, of the acreage licensed for hemp cultivation in the state, he expected about 60% to make it to market.

The Kentucky Department of Agriculture provided an estimate to Hemp Benchmarks in mid-September that about 25,000 acres of the 60,000 licensed for hemp production were planted, or a bit over 40%.

A mid-September report from the Shelburne News quoted a University of Vermont extension professor of agronomy as stating that she knew of about 4,000 acres planted with hemp of the 7,800 licensed in the state, or just over 50%.

Meanwhile, accounts from other states tell of significantly lower planting rates. The Virginia Department of Agriculture and Consumer Services stated to Hemp Benchmarks that registered growers in the state had planted about 1,900 acres outdoors and over 1.9 million square feet indoors, with both amounts constituting 17% of the acreage and square footage licensed at the outset of the season, respectively.

A late August report from Fox 10 Phoenix suggested that Arizona's hemp crop has been almost a complete "bust" this year, due to high heat, weeds, and pests. One market participant in Arizona stated to Hemp Benchmarks that less than 10% of the licensed acreage in the state was planted, but due to Arizona officials not releasing such information publicly that remark cannot be verified independently at this time.

Still, if only half of the current hemp crop makes it out of the fields during this season's harvest, and even if demand for hemp products remains high, there are concerns that supply might overtake demand in the near future. As we pointed out in previous reports, the amount of acreage licensed for hemp production this year grew by roughly four times compared to 2018.

"I don't think anyone has learned their lessons," a farmer in central Oregon, now on his second season growing hemp, told Hemp Benchmarks. "We were the only ones in a three-mile radius that were growing industrial hemp last season. We now have 20 or more small farms growing hemp in our region." Other Oregon market participants quoted in the Mail Tribune article cited above also expect prices for hemp biomass and smokable flower to fall on increased production in the wake of the autumn harvest.

As noted above, our approach to estimating how much CBD-rich biomass will be suitable for extraction has been adjusted. Furthermore, new information on the total amount of acreage licensed for cultivation nationwide, contained in the table on page 23, has caused us to revise our estimate of the amount of such biomass be generated by the 2019 harvest. Previously, we

estimated that between 85 and 130 million pounds of CBD-rich biomass suitable for extraction would be generated from roughly 480,000 acres licensed for hemp cultivation.

Now, we count about 535,000 acres licensed for hemp production nationwide, based on data from states that share such info, leading to an estimate of between 96 and 120 million pounds of CBD-rich hemp biomass suitable for extraction. The table below shows how much such plant material would be worth at different price points, assuming an average potency of 8% CBD.

U.S. Produced Hemp Biomass Estimated Market Value By Product Price

- \$3.50 / %CBD / Pound : \$2.7 Billion to \$3.4 Billion Market Value
- \$3.00 / %CBD / Pound : \$2.3 Billion to \$2.9 Billion Market Value
- \$2.50 / %CBD / Pound : \$1.9 Billion to \$2.4 Billion Market Value
- \$2.00 / %CBD / Pound : \$1.5 Billion to \$1.9 Billion Market Value

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Weather & Crop Reports

The record-breaking heat of July and August in large areas of the U.S. has given way to more seasonal temperatures across much of the country, with many hemp growers reporting good growing weather in September.

Still, reports from hemp farmers as to the condition of their crops are highly variable overall. Some more experienced market participants recounted to Hemp Benchmarks that their harvests were expected to come in with few to no problems, while others dealt with extreme weather, as well as more mundane issues.

The 2019 Atlantic Hurricane Season is far from over, but with the growing season reaching its conclusion hemp farmers in the

Southeast may have already experienced the worst it has to offer in regard to their operations. In the continental U.S., Hurricane Dorian was blamed for wind and flood damage to some crops in eastern North Carolina. Paul Adams, of the Plant Industry Division of the state's Department of Agriculture and Consumer Services, remarked to Hemp Benchmarks on September 10, "Some damage definitely occurred to hemp fields from the storm," but he did not know its extent. However, another market observer characterized damage to hemp crops in eastern North Carolina as minor. Heavy rains and high winds were also reported in South Carolina.

Ed Glaze, a hemp farmer in central Alabama, says his plants are doing well, but would do better with some additional precipitation. "This is right around when it should be harvested," he told AL.com in early September. "It is also the time we run out of rain. Right now, these plants are wanting their six inches of rain and the forecast is nothing but sun for a week. I would love to have some rain." Otherwise, though, Glaze stated that his crop was in good shape with strong flower development. Some other Alabama farmers reportedly had to plow their plants under due to their being overgrown by weeds.

Further up the East Coast, a spokesperson for Virginia's Department of Agriculture and Consumer Services told Hemp Benchmarks on September 12, "Registered industrial hemp growers in Virginia continue to report being impacted by excessive rainfall and hot weather." More detailed information from Virginia officials is scarce as growers in that state are not required to submit harvest reports.



In New England, an official with the Vermont Agency of Agriculture, Food and Markets stated to Hemp Benchmarks, “Some growers that purchased feminized seed had varying results on plants actually being males,” while germination rates in general were another issue. Some accounts of mold and problems with corn borers were also reported to Vermont officials by farmers in the state. However, Vermont’s industrial hemp crop being grown for CBD was characterized as generally in good shape by state agriculture officials.

Gary Fish, State Horticulturalist with the Maine Department of Agriculture, Conservation and Forestry, also told Hemp Benchmarks that weather, pests, and diseases have not been an issue for the state’s hemp growers since the wet spring gave way to summer.

Moving west, a Colorado processor with associated farms in both Greeley, in his home state, and Montana said to Hemp Benchmarks that the Greeley crop was being brought in with no problems. In Montana, a good crop is also expected, with a projected yield of roughly 2,000 pounds of CBD-rich biomass per acre. The processor stated that the yield from the Montana farm was lower than he had hoped for, and was due to late planting as a result of the poor spring weather. However, the late planting allowed the crop to flourish and experience little to no loss.

A separate Colorado hemp processor that has partnered with farms outside of Pueblo, in the southeastern part of the state, told Hemp Benchmarks late this month that, while one of their plots may have been stressed a bit by high heat, the overall expectation

was that the crop would come in well when it is harvested in early October.

Meanwhile, a report from the Durango Herald published on September 14 stated that some hemp farmers in the southwestern portion of Colorado are seeing reduced crop yields, as well as crop failure, due to the spring weather, disease, and logistical issues. One grower quoted in the report stated that she had to destroy 60% of her plants that ended up being males.

As we have pointed out in our [Cannabis Benchmarks](#) reports, summer light-deprivation harvests of high-THC cannabis in Oregon in both July and August swelled to levels significantly larger than those documented last year. Numerous Oregon farmers are growing both cannabis and hemp, particularly in the southwestern part of the state, suggesting that hemp biomass production could also be strong if harvests are able to be brought in prior to the region’s customary autumn rains.

For hemp farmers that are waiting until next month to bring in their crops, the 30-day outlook from the National Weather Service’s Climate Prediction Center, issued in mid-September, expects above-normal monthly mean temperatures across the U.S. into October. Monthly precipitation amounts are also expected to be above-normal in parts of the Pacific Northwest, as well as the Southwest, Northern Plains, and the southern section of the nation’s Eastern Seaboard. However, the Center adds that there is “high uncertainty, low forecast confidence” in its October precipitation outlook.

More Hard Work Post-Harvest

With the harvest season underway, some new hemp farmers are coming to realize that difficulties do not subside after a crop is cut down. The significantly larger scale on which industrial hemp is grown compared to cannabis has also presented challenges for growers who converted from cannabis to hemp, particularly in dealing with the vast volumes of biomass that must be dried successfully before it can be processed.

The first Colorado processor cited above told Hemp Benchmarks that his associated farm in Greeley was being operated by cultivators with lengthy experience in the state's legal cannabis industry. While the crop came in successfully, as we noted above, the processor stated to our analysts that the cannabis growers running the farm were considering not undertaking the same endeavor next year, as it was simply too much work.

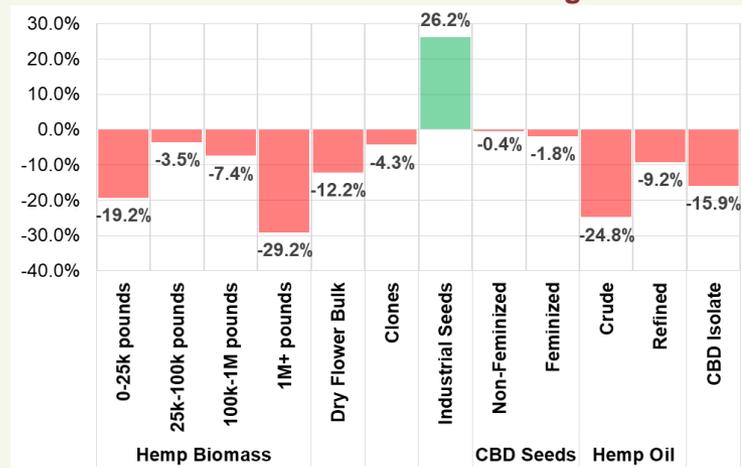
Similar accounts have surfaced across the country. A hemp cultivator and broker in Pennsylvania was worried that some "newbie" hemp growers had not given real consideration to their post-harvest procedures. "Everyone jumped the gun to grow more acreage without looking at the harvest drying plans," he said. "I'm getting maybe four or five calls a day about, 'can you help me dry this harvested material?'"

Some farmers reportedly found a way around such hurdles. In our August report we discussed the advantages and disadvantages of growing auto-flowering varieties of hemp. With harvests taking place, one Oregon grower told Hemp Benchmarks of an

advantage not covered in our prior report.

According to the farmer, he had in late August just completed a sale of 15,000 pounds of an auto-flowering hemp variety. Instead of the tribulations of shucking flowers and leaves, then drying the plant material, he stated that he sold the plants wet with all the biomass on the stalk for \$15 per pound. He said that he had never done a deal in that manner before, but he appreciated not having to handle drying and processing the raw biomass. He also said that much of the auto-flower hemp being grown by his associates in Oregon is being sold in this way, as buyers want control of the drying and curing process with the goal of producing high quality smokable flower.

Month-on-Month Price Change

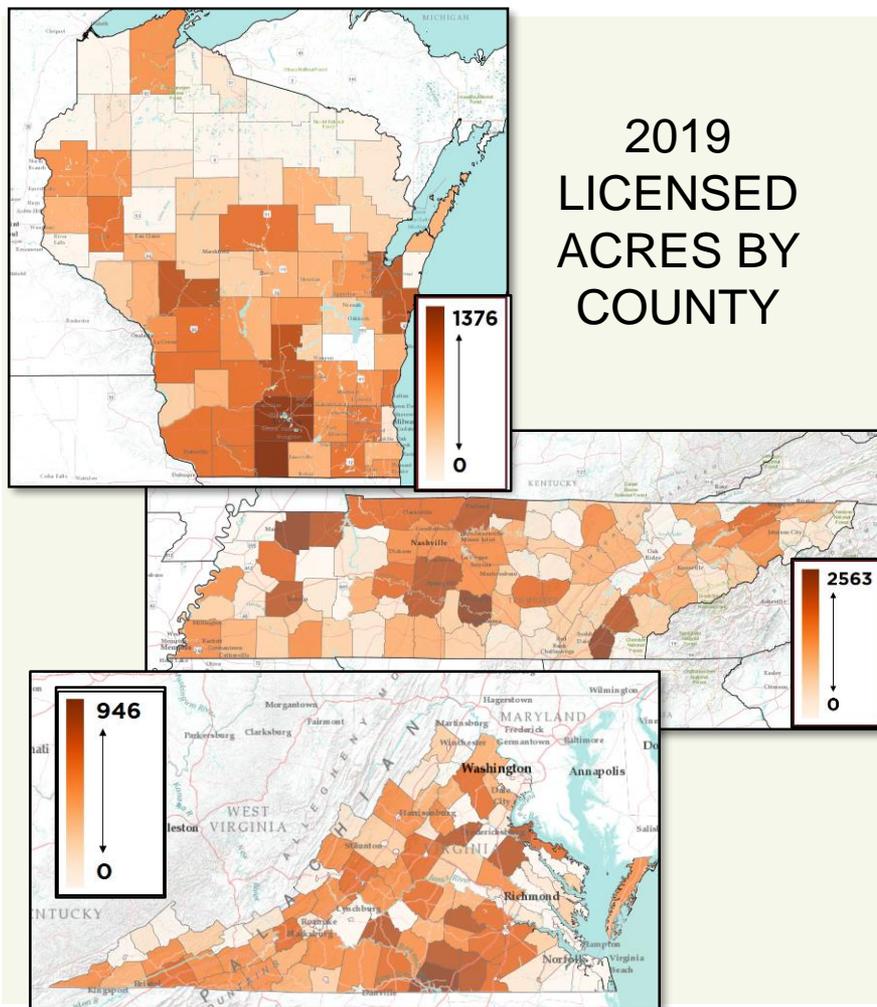


Source: Hemp Benchmarks®

HEMP BENCHMARKS®

U.S. Wholesale Hemp Price Benchmarks

September 2019



Proper Genetics Matter

For farmers looking ahead to 2020 and beyond, difficulties experienced this growing season, some of which we recounted just above, are prompting an increased focus on the quality and verifiability of hemp genetics. Concerns about seed germination rates, the sex of resulting plants, CBD and THC potency, and resistance to pests and environmental conditions have become important factors for cultivators. On top of such considerations, farmers need to be able to ensure that the seeds they are getting are as advertised.

“Genetics is everything,” a Northwestern grower told Hemp Benchmarks. “It’s going to get you in a better position to be profitable, and selecting the profitable seeds will help you win every time. You have to seek out the genetics and find out which ones work for you and which ones don’t.”

Bob Pearce, a professor of agronomy with the University of Kentucky Extension program, told AgWeb that many growers have not done the necessary research about hemp genetics for their crops. Additionally, ignorance, along with unscrupulous sellers willing to take advantage of it, can lead to a devastating season.

“You can’t look at a seed and tell if it’s feminized,” he said. “Right now, we’ve got a lack of seed certification and lack of knowledge, so people are unfortunately able to commit fraud. I certainly hope that’s not the majority of what we’re dealing with, but you can’t protect yourself if you pretend otherwise.”

Actual Processing Capacity Remains Hazy

Turning back to current considerations, there are major concerns about the lack of hemp processing equipment, which could lead to a repeat of the post-harvest processing bottleneck seen last year in many parts of the U.S. While we have seen large-scale investment in extraction and distillation equipment for hemp-derived CBD this year that has significantly expanded hemp processing capacity, it is unclear whether the additional capacity will be enough to handle the dramatic increase in the supply of biomass.

“There were so many people waiting and waiting for their contracts to be filled,” the central Oregon grower quoted above said about the 2018 harvest. “We were burned by a company that promised everyone the moon; came and picked up product and never paid for it. It’s not something new, not something just in our area. It’s all over.”

Roger Cockroft, the CEO of Delta Separations, a California-based maker of hemp processing and extraction equipment, blames the potential processing bottleneck on the reluctance by financial institutions to make loans for such machinery. The banks, he told the National Association of Farm Broadcasting News Service in mid-September, are “scared that the FDIC will penalize them for supporting anyone that has the word cannabis in their supply chain.”

Cockroft also had a dire prediction about how the lack of processing facilities could hurt the current hemp harvest. “With

such a small processing capacity in the U.S.,” he said, “up to 90% of what’s in the ground will most likely rot in the field when Crop-October rolls around. That could mean a loss of up to \$7.5 billion.”

That being said, a recent report from Vote Hemp says states that license their hemp processors reported a nearly five-fold increase in processing licenses issued compared to last year. The report also pointed out that several hemp production states, including Colorado, “do not license processors so processing capacity is actually significantly higher.” It further noted that much of that growth is largely for CBD extraction facilities. Meanwhile, “More investment is needed for fiber and grain processing.”

Some of the new CBD processing facilities are looking to meet the challenge of handling increased volumes of biomass in a big way. At the end of August, Colorado-based Paragon Processing opened what is believed to be the largest hemp processing facility in the U.S. According to a company press release, the 250,000 square-foot facility offers full-scale processing of one million pounds of hemp biomass per month, with plans to quickly ramp up that processing load to two million pounds per month during the 2019 harvest.

It should be noted that market participants have told Hemp Benchmarks that an operation’s actual, functional processing capacity can be significantly smaller than its hypothetical maximum. Basic issues such as required maintenance of equipment and receiving poorly bucked biomass can reduce processing capacity. For example, the Colorado processor quoted above said that while one of his facilities could conceivably handle

30,000 pounds of biomass daily, it can “comfortably” process 5,000 pounds per day. However, even with harvests coming in, he did note as recently as mid-September that his facilities still had capacity to take in more biomass, indicating that his operation, which is providing CBD products to major national retailers, is not strained at this time.

Agricultural engineers, meanwhile, have been scrambling to come up with hemp-centric harvesting and processing equipment for international use. “There’s huge demand for effective and affordable technology, particularly for small and medium-sized operations,” Kehrt Reyher, Editor and Publisher at HempToday, said this past June in Poland, at a micro-summit on the issue.

One of the strategies presented at that meeting was the development of a variety of new, so-called “multi-cropping” machinery; a new generation of technology that can automatically cut and separate select different parts of the hemp plant in order to create biomass for extraction, as well as seeds and decorticated stalks for hurd and fiber. While that machinery has been around in Europe for some time, one veteran grower in the Pacific Northwest pointed out that attempts to import such equipment were held up by U.S. customs last season, making much of it unavailable for the 2018 harvest.

Estimates of CBD Able to be Produced from 2019 Harvest

Above, on page 6, we provided an updated estimate that between 96 and 120 million pounds of CBD-rich biomass suitable for extraction will be generated from this year’s harvest. Assuming

that sufficient processing capacity is available to handle the entirety of this year’s hemp crop, in what follows we calculate how much of various types of CBD products could conceivably be produced from the biomass harvested this year, as well as their current market value.

Of course, such an exercise comes with significant caveats. Processors extracting and manufacturing CBD products from hemp employ various methods and approaches, resulting in disparate levels of efficiency and yields. Additionally, shifts in demand and the development of new products, which are reportedly ongoing, mean that the intermediate and end products currently being sought by buyers could be different in the future. It is also very possible that bottlenecks at the processing level could result in usable CBD-rich biomass not being extracted and simply going to waste. However, the following calculations and assumptions have been reviewed by numerous market participants, who stated that they are reasonable overall.

As a final caveat, it takes several steps to ultimately generate hemp-derived CBD products that are compliant with the legal limit of 0.3% THC and able to be sold to consumers. Not every processor performs each step in-house and therefore the intermediate products not sold to consumers - namely crude hemp CBD oil and refined hemp oil, a category in our price assessments that includes full spectrum, broad spectrum, and THC-free distillate - are also traded wholesale. As a result, it is at this point difficult to accurately assess the overall value of the entire hemp-derived CBD supply chain with confidence. Instead, we provide

valuations for the amount of product conceivably able to be generated at each step of the process based on this month's assessed prices.

The initial step in making CBD products is to extract crude hemp CBD oil from hemp biomass. How much crude CBD oil can be extracted from hemp biomass depends on a number of factors, including the CBD potency of the biomass itself. Assuming an average potency of 8% CBD, our sources tell us that roughly 50 pounds of biomass is required to generate 1 kg of winterized crude CBD oil.

So, the estimated 96 to 120 million pounds of biomass with an average potency of 8% CBD could yield between 1.92 and 2.40 million kg of winterized crude CBD oil. Winterized crude CBD oil generally has a CBD potency of between 55% and 65%, along with 2% to 3% THC. At this month's assessed price of \$1,737 per kg, this amount of crude CBD oil would be worth \$3.3 - \$4.2 billion.

(Again, processing efficiency can vary greatly from operation to operation, with one Colorado extractor telling Hemp Benchmarks that they require less than 15 pounds of biomass that typically has a potency of 10% to 12% CBD to produce 1 kg of crude CBD oil.)

Due to its THC content, crude CBD oil is typically not compliant and must be processed further in a variety of ways before it can be sold legally as a hemp product with less than 0.3% THC. The first step following the production of crude is typically to distill it into what is referred to in our price assessments as "refined hemp oil;" market participants also frequently refer to the product generated at this step of the process as full spectrum distillate, as it contains

all the cannabinoids present in the plant, including THC. At this stage, refined hemp oil / full spectrum distillate typically has a CBD potency of about 80%, with around 3% to 5% THC.

Our sources have told us that in the process of producing refined hemp oil / full spectrum distillate from crude CBD oil, about 30% is lost. Consequently, the amount of crude CBD oil stated above could generate between 1.34 and 1.68 million kg of refined hemp oil / full spectrum distillate. At this month's assessed price of \$4,973 per kg, this amount of refined hemp oil / full spectrum distillate would be worth \$6.7 - \$8.4 billion.

At the moment, the two primary forms in which hemp-derived CBD reaches consumers are THC-free distillate and isolate, which constitute or are incorporated into various end products. In the process of manufacturing THC-free distillate from full spectrum distillate, market participants tell us that there is an additional 15% loss. Based on that formula, between 1.14 and 1.43 million kg of THC-free distillate would be able to be generated from the amount of broad spectrum distillate stated above.

As we noted at the outset of this section, our price assessments currently amalgamate full spectrum, broad spectrum, and THC-free distillate. At this month's assessed price of \$4,973 for refined hemp oil, this amount of THC-free CBD distillate would be worth \$5.7 - \$7.1 billion. However, for THC-free distillate specifically the value would likely be higher, as making THC-free distillate requires extra steps, additional equipment and solvents, and is generally a more involved process, according to extractors.

A percentage of this year's harvest will ultimately go toward making CBD isolate, although the dramatic erosion in the price of isolate over the summer indicates that the isolate market has a significant overhang of supply. CBD isolate typically has a potency of 95% CBD or more, with no THC. Feedback from hemp processors has told us that between 2 and 2.5 kg of crude CBD oil are required to generate 1 kg of isolate. Based on our estimate of the amount of crude that could be produced from this year's crop, as little as 768,000 kg or as much as 1.2 million kg of CBD isolate could be produced. At this month's assessed price of \$3,767 per kg, this amount of CBD isolate would be worth \$2.9 - \$4.5 billion.

As noted, the estimates for the amounts of THC-free distillate and CBD isolate just stated are hypothetical maximums that could be generated if the entirety of this year's crop were devoted singularly to producing each product.

In reality, some of the hemp grown this year will be sold as dry flower for smoking and vaporizing, some will be employed to produce THC-free distillate, and some will be devoted to manufacturing CBD isolate. Additionally, market participants have told us that they are receiving an increasing number of inquiries for water-soluble forms of CBD, which requires more processing.

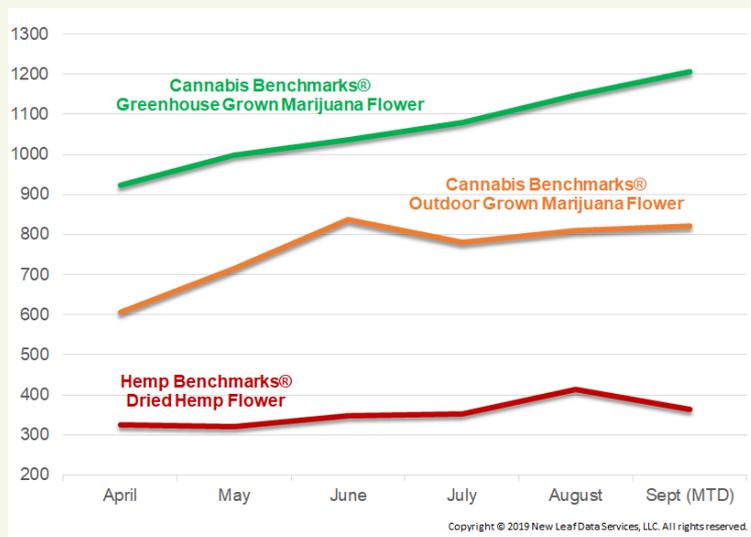
Overall, we have been told by numerous processors that THC-free distillate is the end product in the highest demand currently and is "becoming the norm," in the words of one Colorado extractor. CBD isolate is the end product for which there is the second-highest demand, although, as noted above, the market for isolate is reportedly well-supplied while the preferences of wholesale buyers

shift to THC-free distillate. Full spectrum distillate is also reportedly seeing high demand. As our previous price assessments have shown, refined hemp oil, in which full spectrum distillate is included, maintained value through the spring and summer months more so than crude CBD oil or CBD isolate.

Feature – Comparing Wholesale Prices from Cannabis Benchmarks and Hemp Benchmarks

The chart below shows monthly average wholesale prices for greenhouse and outdoor-grown cannabis / marijuana flower as assessed by our Cannabis Benchmarks division, compared with recent monthly rates for dry hemp flower. Dried hemp flower is largely grown outdoors, but some is reared indoors or in greenhouses. The premium commanded by cannabis / marijuana flower over hemp has been increasing as rates for the former have been on the rise on strong demand in legal cannabis markets. Additionally, regulatory and compliance costs for hemp growers are significantly lower compared to those to which cannabis / marijuana cultivators are subject, allowing them to maintain margins at lower selling prices.

**U.S. Wholesale Spot Price Comparison
Hemp Flower vs. Marijuana Flower
(\$/Pound)**



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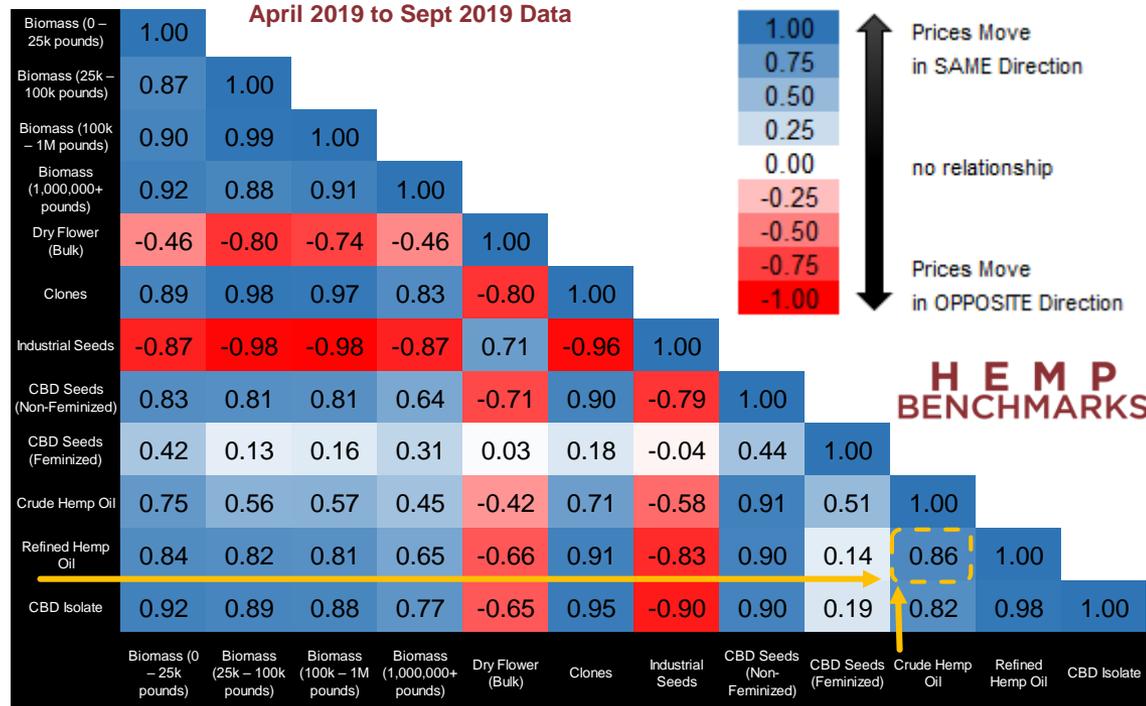
H E M P BENCHMARKS®

U.S. Wholesale Hemp Price Benchmarks

September 2019

Wholesale Prices - Correlation Matrix

April 2019 to Sept 2019 Data



What does this mean?

This wholesale price correlation matrix was generated from historical Hemp Benchmarks price assessments. It shows which product prices move together, move in opposite directions, or have no relationship at all.

Correlations range from 1 to -1. If two products have a perfect positive correlation coefficient of 1, then the prices for each have been observed to move in the same direction, either up or down, by the same magnitude. A perfect negative correlation of -1 means that prices for two products move in opposite directions. A correlation of 0 indicates no relationship at all.

Interpretation

The correlation matrix shows most product prices are positively correlated, indicating that they generally move in unison and the hemp value chain is highly interconnected. The exceptions are Dry Flower (Bulk) and Industrial Seeds, which show strong negative correlations. In other words, as prices have been deteriorating for most products, rates for these two product types have been on the upswing.

Example:

The correlation between Refined Hemp Oil and Crude Hemp Oil is +0.86. This means that, based on currently available data, the prices of these two products have almost always moved in the same direction by nearly the same magnitude month-to-month.

Federal Regulatory Update



Federal Regulatory Update

A variety of federal agencies have spent the past month grappling with hemp regulations, guidelines, and protocols.



As mentioned in last month's report, the U.S. Department of Agriculture has spent much of the summer struggling to finalize and issue its first-ever regulations for hemp production. Back in June, the USDA's Agricultural Marketing Service (AMS) said the agency would release the new federal regulations in early August.

However, as we noted last month, an AMS official said the regulations were being delayed as the agency struggled to formulate an approach that meets the Farm Bill's requirement for a THC testing protocol.

Recent media reports say those rules have been completed and submitted to the pertinent federal agencies for final approval, and should be released by the end of September. Bill Richmond, chief of the AMS's Hemp Program confirmed to Hemp Benchmarks, "The draft rule has been submitted for interagency review, which includes the Office of Management and Budget."

USDA Looks at Canadian Hemp Market

At the end of August, the USDA issued a report on Canada's industrial hemp market. The report noted that Canada has been growing hemp, primarily for seed, for decades now. Additionally, the nation's 2018 Cannabis Act, along with legalizing recreational cannabis use, eased regulatory controls on industrial hemp.

It also noted that that the "production and distribution of cannabinoids and cannabinoid containing-products are highly regulated" in Canada, "with products appearing in licensed cannabis stores or for medical purposes." In other words, unlike the current situation in the U.S., CBD products are not permitted to be sold widely at general retail outlets in Canada, despite cannabis being federally legal. Instead, CBD products can only be sold by provincially or territorially authorized adult-use cannabis retailers or by federally-licensed medical cannabis sellers.

USDA and Crop Insurance

In late August, the USDA's Risk Management Agency (RMA) announced that hemp crop insurance would be available starting in 2020 for certain industrial hemp growers as part of the Whole-Farm Revenue Protection (WFRP) program.

"Numerous producers are anxious for a way to protect their hemp crops from natural disasters," RMA Administrator Martin Barbre said in a press statement. "The WFRP policy will provide a safety net for them. We expect to be able to offer additional hemp coverage options as USDA continues implementing the 2018 Farm Bill."

Hemp producers, according to the USDA, can now get WFRP coverage if they are part of a state or university pilot program. Other producers will have to wait “until a USDA-approved plan is in place” in their region. The program allows coverage of all revenue for commodities produced on a farm, up to total insured revenue of \$8.5 million.

However, contained in the RMA’s announcement are numerous caveats specifying what future crop insurance policies will not cover. WFRP provisions state that hemp having THC above the compliance level will not constitute an insurable cause of loss. Additionally, hemp will not qualify for replant payments under WFRP. Consequently, growers that purchase seeds that do not germinate, are not feminized as advertised, or ultimately grow into plants that test “hot,” will not be eligible for insurance payouts.



Under the 2018 Farm Bill the U.S. Food and Drug Administration has sweeping authority over hemp-derived CBD products. As FDA Principal Deputy Commissioner Amy Abernethy noted in July during testimony before the U.S. Senate, a wide spectrum of hemp products - including foods, dietary supplements, cosmetics, and human and veterinary drugs - must “meet any applicable FDA requirements and standards, just like any other FDA-regulated product.”

As mentioned in last month’s report, FDA officials said they would have an update on their regulatory efforts by early autumn. However, FDA promises to establish regulations for those products, and in particular hemp-derived CBD, have yet to take place, which has left the status of CBD in a legal and administrative limbo for producers, manufacturers, retailers, and consumers. As a result, according to a press statement issued in early September by the Baker Donelson law firm, the FDA “has been under immense pressure from Congress and stakeholders to issue its regulations and provide the clarity needed for the hemp market to advance.”

Tribal Concerns

During her Senate testimony, the FDA’s Abernethy said that her agency understands that its efforts to regulate hemp products, “must occur in close collaboration with our Federal, state, tribal, and local regulatory partners.” Yet, some Native American tribes are concerned about the lack of movement by the federal government on the much-anticipated hemp regulations.

“Our tribal government, about two months ago, passed a 49-page plan and submitted it to the USDA,” Alex White Plume, of the Oglala Lakota tribe in South Dakota, told Voice of America (VOA) in a report published September 5. “But we haven’t gotten any response yet.”

“I’m three weeks away from harvest,” he added. “Right now, it’s just tense. And sometimes it’s overbearing, cause you don’t know whether you are going to be able to sell or not.”

Patty Marks, a Washington D.C.-based attorney who works with the Oglala Lakota and other hemp-growing tribes, believes there might be more than bureaucratic issues behind the federal delay. “So right now, there are seven tribal plans sitting at the Department of Agriculture,” Marks told VOA. “Agriculture, with some help from friends in the Department of Justice, have been slow-walking it. And this is just my opinion - there are some folks at Justice who just don’t like cannabis.”

The FTC Issues More Warning Letters

In September, the Federal Trade Commission sent out letters to three companies that sell CBD-infused oils, tinctures, capsules, “gummies,” and creams. An FTC statement said the letters warned those unnamed businesses, “that it is illegal to advertise that a product can prevent, treat, or cure human disease without competent and reliable scientific evidence to support such claims.”

Earlier this year the FTC and the FDA sent out similar joint letters to three other CBD sellers, warning those companies, “about the potential legal consequences of making unsupported health and efficacy claims in advertising” regarding their products.

According to a September 12 article in the National Law Review, the FTC’s latest warnings signify a “slight deviation” from past enforcement measures, in that the FTC decided to act on its own in September. “CBD market participants should only expect more regulatory scrutiny, review, and action over time,” the article continued, “especially as regulations continue to develop.”

The EPA and Pesticides for Hemp

The rapidly-growing hemp market is also putting pressure on the federal government to come up with regulations for pesticides that can be used to protect crops. “The long gap in large-scale industrial hemp production followed by a surge in production over the last five years has resulted in a lack of knowledge that puts hemp growers in a difficult position when developing new pest management practices,” two experts in the field wrote recently in Entomology Today.

“Although some states have a list of allowable pesticides for use on hemp, currently no pesticides are broadly labeled for hemp pests in the U.S.,” they continued. “Thus, a unique opportunity exists to focus on cultural, mechanical, and biological control methods as pest pressure increases, which is especially important for hemp that is grown for consumable and medical use (specifically hemp oil and grain cultivars and CBD cultivars).”

The U.S. Environmental Protection Agency (EPA) has taken steps when it comes to approving pesticide applications for hemp. In late August, the EPA announced a 30-day public comment period on ten existing pesticide applications under consideration.

“We hope this transparent and public process will bring hemp farmers and researchers increased regulatory clarity in time for next growing season,” EPA Administrator Andrew Wheeler said in a statement, “something they have asked for since the passage of the 2018 Farm Bill and the legalization of commercial hemp.”

Hemp, Cannabis, and Banking

There are signs of movement on Capitol Hill regarding measures that would protect financial institutions that work with cannabis-related businesses from prosecution. Those efforts, if successful, could also ease the way for banks and other financial services to work with the hemp sector.

The website Marijuana Moment says a bipartisan bill on shielding banks that work with state-legal marijuana businesses will get a floor vote in the House of Representatives by the end of September. Meanwhile, Senator Mike Crapo, chair of the Senate Banking Committee, is supporting a vote on legislation that would allow banks to work with cannabis businesses in cannabis-legal states. Crapo told Politico's Zachary Warmbrodt he hopes to have a vote on that measure by the end of the year.

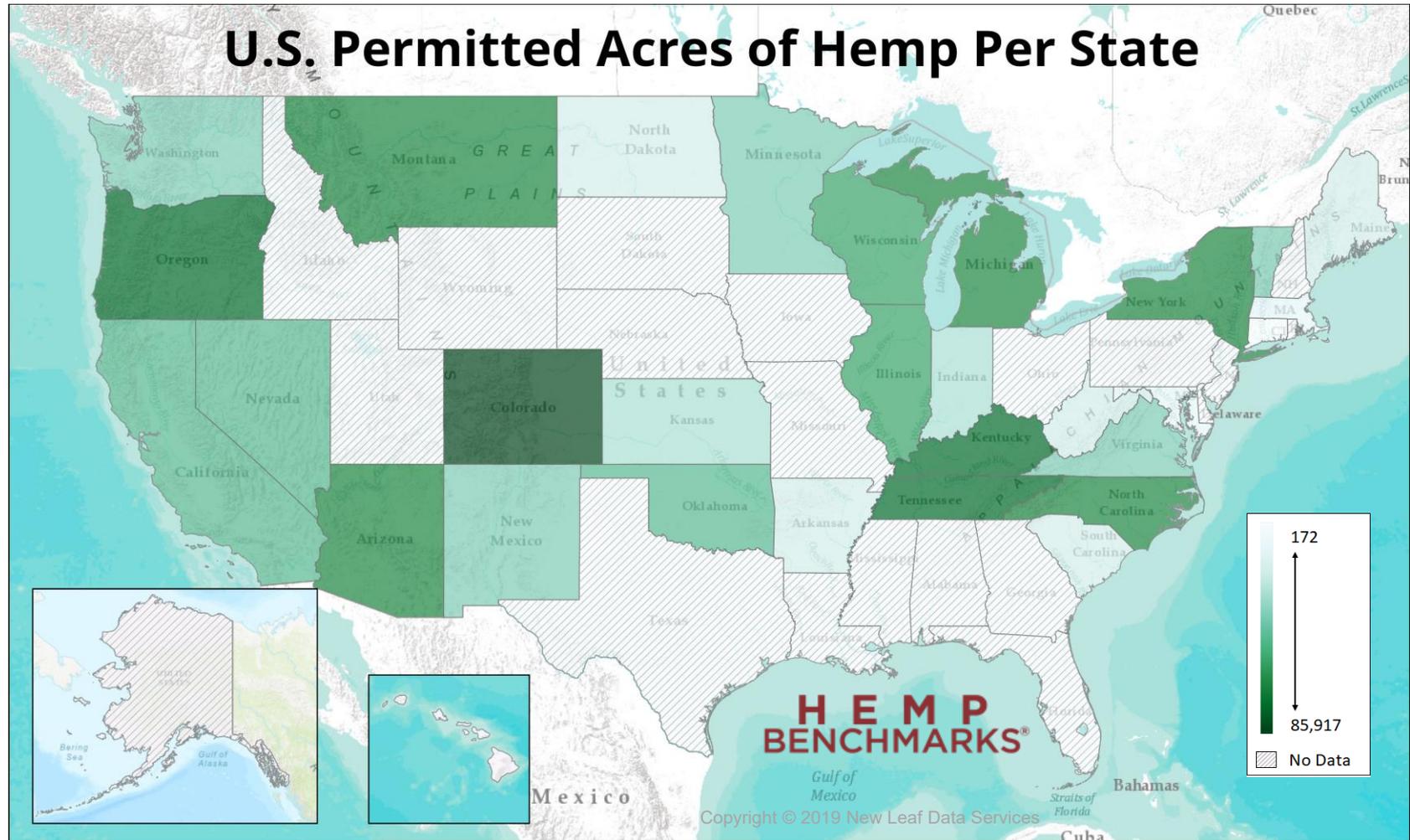
"Crapo doesn't support cannabis legalization," Warmbrodt tweeted. "But he says he's been compelled to act because cannabis businesses without bank access are forced to transact in cash and there are issues surrounding transactions with businesses like plumbers [and] hardware stores ... that serve the industry."

On the Business Side

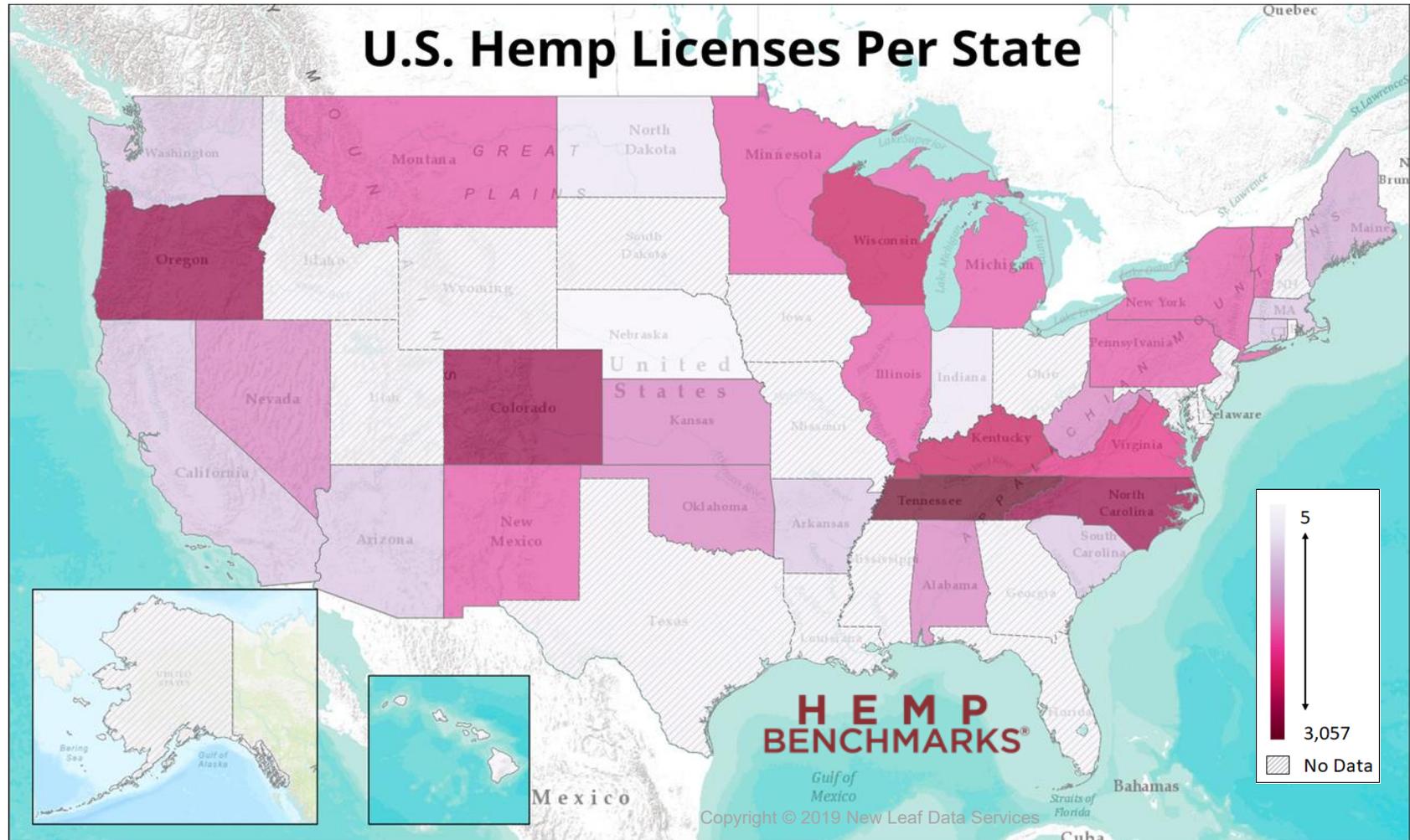
Several news items in September underscore how hemp-derived CBD has become more accepted by both the business community and consumers.

Charlotte's Web Holdings, the company responsible for the famous Charlotte's Web hemp brand, has secured what is reportedly the nation's first-ever patent for a hemp cultivar. The news was first reported by Leafly, based on documents filed with the U.S. Patent and Trademark Office (USPTO) in July. The patent is for, "a new and distinct hemp cultivar designated as 'CW2A.'" The cultivar is described in the patent documents as hardy, cold-resistant, and capable of producing up to 6.24% CBD with less than 0.3% THC.

Two Colorado-based beverage businesses that manufacture soft drinks infused with hemp extract, meanwhile, are joining the Coors Distributing Company's list of suppliers. The partnership, according to a press release, marks "Coors' entrance into the burgeoning hemp space." The press release states that the beverages from DRAM Apothecary and Colorado's Best Drinks (CBD) began to be sold by Coors Distributing Company on September 11, with the first deliveries to retailers following two days later.



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UNITED STATES COVERAGE

STATE	# of Licenses	Permitted Outdoor Acres	Permitted Greenhouse Sq Ft	STATE	# of Licenses	Permitted Outdoor Acres	Permitted Greenhouse Sq Ft	STATE	# of Licenses	Permitted Outdoor Acres	Permitted Greenhouse Sq Ft
Alabama	205			Louisiana				Ohio			
Alaska				Maine	162	3,000		Oklahoma	225	9,606	
Arizona		37,000		Maryland		1,400		Oregon	1,883	61,640	10,156,710
Arkansas	101	3,200		Massachusetts	102	730	147,000	Pennsylvania	323		
California	114	8,862		Michigan	541	32,243		Rhode Island	5		
Colorado	1,933	85,917	13,800,000	Minnesota	314	7,667	681,077	South Carolina	113	3,300	
Connecticut	82	294		Mississippi				South Dakota			
Delaware				Missouri				Tennessee	3,057	37,432	115,144,316
Georgia				Montana	277	42,000		Texas			
Florida				Nebraska	10			Utah			
Hawaii	30	172		Nevada	207	10,030		Vermont	570	7,800	
Idaho				New Hampshire				Virginia	700	7,000	
Illinois	530	18,860		New Jersey				Washington	115	7,000	
Indiana	60	5,300		New Mexico	404	7,448	7,600,000	West Virginia	178	2,531	
Iowa				New York	267	20,727		Wisconsin	1,247	16,958	
Kansas	203	5,732		North Carolina	1,523	33,908	10,076,710	Wyoming			
Kentucky	1,047	60,000		North Dakota	56	3,212		TOTAL	16,584	531,528	157,605,937

State Updates

Below are updates on developments in industrial hemp and CBD production, market formation, legislation, and regulation at the state level.

Alabama

The state's first legal hemp crop is reportedly in good shape, according to local media reports.

Alabama Agricultural Commissioner Rick Pate was quoted in a September 6 report from AL.com as saying that samples taken in early September from 45 licensed growers have all tested below the legally-required 0.3% THC level. Pate added that some growers, mostly in the southern part of the state, had already begun harvesting.

Alaska

As we mentioned in last month's report, Alaska Governor Mike Dunleavy slashed funding for the state's hemp pilot program, during what the Anchorage Press described as "state budget chaos" in a report from August 27.

However, the Press report notes that over the summer the hemp program was restored by Alaska legislators and survived a gubernatorial veto. In late August, David Schade, the state's agricultural director, told the Press that he has been able to hire much of his staff back and the 15 hemp plants that were maintained during the budget fracas are apparently just enough to restart the hemp testing program.

California

In late August, the state's Senate Appropriations Committee put a hold on a measure that would have legalized the retail sale of hemp-derived CBD products in California. One of the bill's sponsors, State Representative Cecillia Aguiar-Curry, criticized how state and municipal regulators are limiting Californians' access to hemp-derived CBD.

"This position by the California Department of Public Health has put our state in an Alice-in-Wonderland world," she said in a press statement, "where adult consumers can walk into a licensed marijuana dispensary and purchase all manner of recreational cannabis products, but they cannot legally purchase non-psychoactive hemp products that they believe can bring them calm or reduce their pain."

However, she added, "I am confident that we will have a bill ready for the Governor to sign at the beginning of next year, so that our California hemp farmers and producers of hemp-CBD can take advantage of this new multi-billion dollar opportunity."

Colorado

As we noted above, state agriculture officials provided available planting information to this outlet. However, it came with a caveat: a member of the state's industrial hemp program emailed Hemp Benchmarks, "We are showing about 45,000 planted acres, but that number is not solid. We will not have that number tallied, nor will we have Harvested Acres tallied, for another month or so as we are still getting 60-80 reports in daily right now."

Connecticut

In addition to the number of licensed growers and acreage permitted for hemp cultivation listed in the table on page 23, an early September press release Governor Ned Lamont announced that Connecticut had licensed two hemp processors and 21 manufacturers this season as part of the state's new pilot program.

Idaho

The Colorado-based company that is currently suing Idaho to get its \$1.3 million hemp shipment back is reportedly willing to drop its lawsuit if the state will return the hemp and allow the transshipment of hemp through Idaho in the future, according to a September 13 report from the Idaho Press.

In January, the Idaho State Police seized several tons of industrial hemp in a truck shipment and arrested the driver on trafficking charges. Big Sky Scientific, in a written statement in mid-September, offered to settle "this case and all future cases, including claims for money damages, against the State if it will just give back Big Sky's industrial hemp and allow it to continue to do its business by shipping its lawful product through Idaho in interstate commerce."

The Press report cited above states that the Idaho Attorney General's office has declined to comment on the statement, given the ongoing nature of the case.

Kansas

A September 16 report from local outlet KSNT stated that 2,400 acres of industrial hemp were planted in Kansas this year, 42% of the over 5,700 acres licensed in the state for that purpose.

Kentucky

In addition to the licensed growers and acreage approved for hemp cultivation in the state, shown in the table on page 23, Kentucky Department of Agriculture spokesperson Sean Southard stated to Hemp Benchmarks that the state has also licensed 202 hemp processors.

Ohio

Although hemp was legalized in Ohio earlier this year, state residents who want to cultivate and process the plant will have to wait for the finalization of state and federal regulations, and for the USDA to accept Ohio's hemp program.

"Barring any roadblocks, all indications suggest that state and federal regulators hope to have the programs in place in time for the 2020 growing season," according to the Ohio State University Extension's Farm Office bulletin for September.

South Carolina

David DeWitt, Clemson University Extension agronomy agent and statewide coordinator for industrial hemp in South Carolina, told Southeast Farm Progress in early September that he estimated total statewide hemp production at 2,000 acres, or about 60% of the acreage licensed for hemp cultivation.

Editor's Notes

Following feedback from market participants, Hemp Benchmarks® has this month altered the manner in which we assess prices for feminized CBD hemp seed. Instead of assessing the price per pound of such seed, as we did previously, price per seed will now be used going forward for this category.

In the state licensing and acreage table on page 23, changes were made to the number of licensed growers in both Colorado and Tennessee. Previous reports listed the total number of cultivation licenses issued in each state. As numerous growers hold multiple licenses, this month's table lists the number of individual farmers that are licensed in each state.

PRODUCT DEFINITIONS

BIOMASS

Dried hemp plant materials including the stalks and leaves that may include flowers/buds and/or seeds that have been harvested. Free of mold, grit, minimal (< 0.1%) non-hemp organic matter, and at least 80% dry. An industry-wide acceptable moisture content is necessary to establish uniform pricing for hemp biomass. Any hemp biomass material that is above the standard moisture content will result in decreased value and an adjusted sale price to reflect a lower volume of the end product to account for further water evaporation. Biomass can also be milled, ground or pressed into pellets.

DRIED CBD FLOWER

Dry flower is the dried flower and bud fraction of a hemp plant that has been removed from the stalks and contains minimal stems. Flower is suitable for smoking and for use in pre-rolled joints.

HURD (Decorticated)

Hemp stalks are stripped of the outer bark/shell/skin of the stalk using a decorticator, ranging from hand-cranked to automated electric processing. The removal of the hard outer bark/shell/skin of the hemp stalk exposes the fiber core of the plant which is then readily usable for production.

HURD (Non-Decorticated)

Hemp stalks with the outer bark/shell/skin intact. The hemp stalks may or may not have gone through a retting process that allows microbes and moisture to break down the stalk, making the fiber easier to remove.

CLONES

A clone refers to a plant that is an exact reproduction of an original parent plant, known as a mother plant, through asexual propagation. A clone is made by taking a stem cutting (or tissue culture) from a mother plant and placing the cutting into media to facilitate root growth. Once the roots begin to grow, the clone is transplanted into a field or cultivation facility.

INDUSTRIAL SEEDS

Industrial hemp seeds comprise a broad range of hemp cultivars used to grow hemp biomass, hemp seed and grain for food oils and food products, and fiber for woven and non-woven applications.

CBD SEEDS (Non-Feminized)

Hemp plants that are pollinated naturally or with traditional breeding techniques produce both male or female seeds. These are known as regular, or non-feminized, seeds and generally result in an even split between the two sexes.

CBD SEEDS (Feminized)

Feminized seeds are seeds that have been modified to produce almost 100% female plants. There are a few techniques that can produce reliably feminized seeds. Feminized hemp seeds can be genetically modified to produce only female plants by eliminating the X chromosome. A non-genetic technique is to stress a healthy female plant by interrupting its light cycle during flowering. Another common and controlled method is to spray female plants with a colloidal silver or silver thiosulphate solution.

CRUDE HEMP OIL

Crude hemp oil is extracted from the hemp plant and contains all of the cannabinoids, terpenes and other plant compounds found in the biomass. Processors use a number of different methods to extract crude oil from hemp. Supercritical CO2 extraction uses pressurized carbon dioxide (CO2) to pull CBD (and other phytochemicals) from the plant. Solvent extraction uses ethanol or hydrocarbons, such as butane or propane, to process hemp biomass into crude oil. Other processes use olive oil or water as a solvent.

Crude hemp oil is often "winterized." Crude oil is winterized to remove organic plant compounds, such as lipids, waxes and chlorophyll, that increases the potency of the oil and creates a more transparent distillate.

REFINED HEMP OIL

Crude hemp oil is further refined through distillation to produce refined hemp oil, which includes full spectrum oil and broad spectrum oil.

CBD full spectrum oil distillate is refined hemp oil extract that contains all the compounds found naturally occurring in the plant, including all the cannabinoids, terpenes and essential oils.

CBD broad spectrum oil distillate is refined hemp oil extract that includes all the compounds found naturally in the plant, except broad spectrum oil has been processed to remove all or substantially all of the THC.

CBD ISOLATE

CBD isolate is the purest form of CBD, which is produced by removing all other compounds found in the plant including terpene, flavonoids, plant parts and other cannabinoids. CBD isolate comes in a granular or powder form and is odorless and tasteless. The end product contains 0% THC and is made up of 96% to 99.9% CBD.