

A close-up photograph of green leaves with water droplets, serving as the background for the cover. The leaves are vibrant green and the droplets are clear and reflective.

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WHITEPAPER

8 CONSIDERATIONS for **Hemp Production** in the **Greenhouse**

8 Considerations for Hemp Production in the Greenhouse

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HEMP HAS CAPTURED THE ATTENTION of the greenhouse industry. The passing of the 2018 Farm Bill paved the way for legal hemp production in the U.S. and a slew of growers are exploring what it takes to grow hemp both inside and outside the greenhouse. The need for reliable, high-grade hemp clones and seeds, along with other hemp-derived products, has increased with these market developments. Commercial greenhouse growers are in the perfect position to supply some of that demand.

Several growers on *Greenhouse Grower's* 2019 Top 100 Growers list are already producing hemp, including Color Point (#8), Speedling (#13), Skagit Horticulture (#23), N.G. Heimos (#28), and Catoctin Mountain Growers (#89), to name a few. In the 2019 Top 100 Grower Survey, 13% of growers who responded said they have plans to pursue growing hemp within the next three years.

With so many greenhouse growers looking into this new crop, *Greenhouse Grower* decided to talk to six people working in the hemp industry about what factors greenhouse growers need to consider before deciding whether to grow hemp in a greenhouse. This whitepaper is by no means a comprehensive look at everything that goes into hemp production. Rather, it is meant to be a jumping-off point to get you started on your exploratory journey to hemp production in controlled-environment greenhouses.

Our Experts

Greenhouse Grower gives special thanks to the six people who shared their expertise with us for this whitepaper and to many others that provided background information. Know that you have many crop consultants, suppliers, and growers out there who are willing to assist you on your journey to hemp production, but also take caution. With all the upheaval in the hemp industry right now, it's prudent to do your homework to make certain the person you turn to has a good reputation for giving reliable information on successfully growing hemp.

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CONSIDERATION #1: What Do I Know About the Regulations and Requirements for Growing Hemp?

One issue we won't cover in-depth in this whitepaper is regulations, other than to say the 2018 Farm Bill allowed states to submit their own plans for primary regulatory authority over the production of hemp. These requirements vary by state. One of the first places to start before growing hemp would be to thoroughly research your state's regulatory policies to determine its requirements for items such as licensure, funding, seed certification, testing, plant disposal, and more. Most importantly, make sure you are determined to follow them.

"We do not need growers in this industry to try and skirt the system," says hemp grower Gary Pahl, who grows clones and liners for field production. "Follow the rules and regulations that are in place and produce an excellent product. Consumers that have used this product believe in this product. Don't let them down. They are everyone's customers."

One essential factor to contemplate is what happens once your clones or seedlings leave the greenhouse if you are selling to someone else in the field. The farmer buying your clones has the responsibility to obtain low-THC, CBD-right hemp clones, and liability for that belongs with him or her. For compliance purposes, the person buying your clones will need a certificate of analysis, which is a lab report listing the general characteristics of a variety, such as terpene profiles, THC content, etc. You should have a certificate of analysis for your mother plants. Without it, your clones may be useless to your buyer.

"If you are the one growing seedlings or clones, you are mainly passing along what you got when you selected them, but it is still important for a grower to understand that when they select genetics, they need to make sure they pick ones that are compliant," says Erica McBride Stark, Executive Director of the National Hemp Association.

As of September 2019, the hemp industry was awaiting final approval from the White House for federal regulations on hemp production proposed by the U.S. Department of Agriculture (USDA). Federal authorities expect to put those rules in place for the 2020 growing season.

What's the Difference Between Hemp and Medical/Adult-Use Cannabis?

Hemp and medical/adult-use cannabis may share the same taxonomic name (*Cannabis sativa*), but their difference lies in the cannabinoids present. In broad terms, a *C. sativa* plant dominant in cannabidiol (CBD), as compared to THC (Tetrahydrocannabinol), is a hemp plant. Legal definitions of what constitutes hemp narrow down to the percentage of delta-9 THC — 0.3% on a dry weight basis — which is the current world standard. However, there is additional language in the farm bill that mandates THC testing for compliance be "post decarboxylation or other similarly reliable method." This means total THC. The reason this language was inserted was to close a loophole where cannabis with very high levels of THCa, which would be marijuana if smoked, do not get grown under the hemp program.

Where Does Hemp Fit in Your Production Cycle?

Greenhouse growers have a few options for producing hemp in the greenhouse, according to Controlled Environment Agriculture Division Leader for Griffin Greenhouse Supplies Tami Van Gaal. She says they might follow up an ornamental crop with a seedling or liner crop produced in late spring for planting into their own fields in early summer, or they might grow a naturally lit crop over the summer in space they are not using for other production. Year-round cultivation is also an option, and there's always contract growing to consider.

Van Gaal offers a comparison for growers to a crop they might be more familiar with — poinsettias. She says the propagation needs and risks are similar, and the needs around flower initiation are similar. For propagation, the main difference is the size of the cuttings. Hemp cuttings are enormous by ornamental standards.

"For fertility, overall ppm of nitrogen is similar to poinsettias, but the balance of nutrient and micronutrient is different. Calcium is still critically important," Van Gaal says.

CONSIDERATION #2: How Well Do I Know My Crop?

You can't grow a crop that you don't know inside and out. You not only need to inform yourself about the physiology, crop cycle, photoperiod, light requirements, etc. of hemp, you also need to know how to tell male and female cannabis plants apart.

Cannabis is dioecious, meaning male and female plants are separate, each with distinctive growth characteristics, although under certain conditions female plants can turn hermaphrodite. If you produce hemp, you must distinguish between male and female plants. When producing horticultural hemp for CBD production, all plants need to be female because they don't produce pollen and often contain a higher number of cannabinoids than male flowers.

Determining the sex of your plants is critical to avoid cross-pollination and unwanted seed production. The use of clones and reliable feminized seeds from reputable sources helps ensure you have female hemp plants. However, if you are not familiar with your seed type and source, you will want to be able to spot male plants in your crop.

There are also two important factors to understand about the connection between hemp plants and lighting. First, most hemp varieties/strains are photoperiodic, which in basic terms means the amount of light or dark they are exposed to affects their growth and development. Short-day lighting is essential during flowering, so a light deprivation system is a must for hemp production in the greenhouse.

The second factor is hemp's light requirements. Hemp requires at least as much light as tomatoes, says Tami Van Gaal, Controlled Environment Agriculture Division Leader for Griffin Greenhouse Supplies. This means most growers in the U.S. need supplemental lighting to increase light intensity and accumulated light on a crop.

"A common target for daily light integral (DLI) is 30 to 35 mol/m²/day for the flowering stage and 20 to 25 mol/m²/day for the vegetative stage," Van Gaal says. "When the crop is in flowering stage, this level of light needs to be achieved in a 12-hour day."

Additionally, you need to think about the genetics you want to use.

Tyler Van Wingerden is Vice President of Catoctin Mountain Growers, a greenhouse operation that grows hemp clones to maturity in the greenhouse and cultivates hemp outdoors, both for themselves and under contract for farmers. The operation grows other crops as well.

Terms You Need to Know

CBD – Stands for cannabidiol, which makes up nearly 40% of the plant's extract and is the second most abundant cannabinoid in cannabis plants. High-CBD cannabis strains don't have the psychoactive effects associated with cannabis.

THC – Tetrahydrocannabinol is the main active ingredient in cannabis responsible for the plant's potency and psychoactive effects. Only female cannabis plants produce THC.

Cannabinoids – The unique chemical compounds produced in cannabis plants that have a range of physical and psychosomatic effects.

Feminized seed – Seed developed using special techniques to result in a high percentage of seed developing as female, resulting in female plants.

Hermaphrodite – A female plant that produces male flower parts.

Dioecious – Male and female plants are separate, each with distinctive growth characteristics





Van Wingerden says genetics will be very important going forward, and growers need to find what works in their climate and conditions.

“Hemp is more sensitive and demanding than the current cuttings we root and grow. It will need more attention and specific care,” he says. “We have learned a lot of best practices from taking cuttings to finished mature plants. There is still much to learn, though. A lot of learning has happened in the cutting rooting stage. The cuttings need a very specific climate to root. We control humidity, light, and watering frequency to name a few.”

CONSIDERATION #3: How Well Do You Know Your Market?

Before growing hemp, you must clearly define the market for your product. Do your homework to ensure your buyer is trustworthy and reliable and keep a close eye on supply and demand changes in the market.

“We love the enthusiasm we are seeing for hemp, but there has to be a healthy dose of reality” says Erica Stark, Executive Director for the National Hemp Association. “We need to keep supply and demand in check and make sure hemp growers are successful. I encourage everyone looking into it for the first time to take it slow. We have seen a lot of crop failure. Growers need to know that having hemp grow and having it be commercially viable are not the same things.”

Here are a few questions Van Gaal says to ask yourself as you start looking into your market for hemp:

- What is my end market?
- What is my customer base?
- What is my overall path to sales?
- Does the market want flower, distillate, or isolate?
- How will I cure my crop or produce the product to meet market demands?
- Are there any processors or extractors in my area?

Finally, once you have determined a market for your product, plant on a scale you can successfully handle.

“Start small and understand the crop before you invest more than you’re able to lose,” Van Wingerden says. “There is a lot of volatility in the market currently. It is hard to get a clear idea of the pricing structure. Be careful not to plan based on the highest price you’ve heard in the market.”

CONSIDERATION #4: What Structure Do I Plan to Use?

Whether you’re thinking about building a new greenhouse for growing your hemp or planning to use an existing greenhouse, you need to consider your overall setup and if it will help you or hinder you from achieving your end goal, especially when thinking about renovating an existing greenhouse.

“Greenhouses that lack the structure needed to support lights and a light deprivation system will need to be structurally enhanced,” Van Gaal says. “This might not be economically feasible, making it more cost effective to build a new structure.”

Additionally, Van Gaal adds that structures with low gutters or low heights (e.g., 7 to 8 feet) leave little space for lighting plants that grow 4 to 6 feet tall.

When building new, two of the biggest mistakes growers make are not planning enough square feet to allow for expansion later, and not finding out if the layout of the facility will allow for an efficient workflow. Owner of CannabiDol Consulting and Design John Dol says building a new facility out on paper first to see if it makes sense is a good way to make sure you have the most efficient layout for your purpose and will have room for any additional equipment you might need to grow and process hemp.

And if you're thinking about buying a facility or using one of your own, DoI recommends considering what it was used for prior to growing hemp. He gives the example of some tomato greenhouses he has seen converted over for growing cannabis.

"These types of greenhouses have long walking aisles in them that aren't always conducive to easily accessing the crop," he says. "A grower might do better to buy a facility or build one where he could install rolling benches and other equipment for more efficiency."

Another factor when choosing a structure to grow your hemp is supplemental lighting. A retrofitted structure may have limitations and pitfalls that a newly built facility doesn't have. Sometimes building new can help you avoid production bottlenecks common in facilities that were not originally built for hemp production.

"A growers' lighting decisions will be influenced differently when evaluating a preexisting building versus a new facility," says Sean Sangster, Horticulture Specialist at Fluence by OSRAM. "Retrofits are limited by preexisting physical structure (where lights can hang), amperage limitations for power, glazing material used for the walls and roof, existing building codes, and the weight limitations of the structure."

CONSIDERATION #5: What Is My Lighting Situation?

Maintaining a consistent daily light integral (DLI) year-round can be a challenge for hemp growers, who Sangster says need to maintain the same DLI they experience during their sunniest time of the year (typically summer) during their lowest light levels in fall, winter, and the beginning of spring.

As you assess your lighting situation for growing hemp, here are eight areas Sangster recommends evaluating:

- Initial cost: Price per fixture and the number of fixtures
- Energy usage: Efficacy of turning electricity into photosynthetic active radiation
- Lifespan: The L70 rating, often reported as 70% of its initial output.
- Bulb replacement cost
- Installation cost
- Shading of the fixture
- Uniformity of light plan
- Light quality: Influences crop response



Are Certain Hemp Cultivars Better Suited to Different Types of Lighting?

Cannabis responds differently to various growing practices depending on the cultivar involved. This is known as a cultivar-specific response. With multiple new hemp genetics hitting the market, Sean Sangster, Horticulture Specialist at Fluence by OSRAM, says he is starting to see different cultivation responses.

"More cultivars are bred to tolerate high light, therefore producing higher yields and secondary metabolites," he says. "How growers source genetics will greatly determine the quality and the proper strategies for maximizing the yield of those specific cultivars. Cannabis is pushing the limits of lighting further than any other crop grown indoors."

Generally, light quality, light intensity, and light duration are three most important traits that independently cause different responses in plants and influence certain plant characteristics in hemp production. Growers can manipulate all three traits to influence plant growth and development to produce longer, more robust fibers in the stalk of a plant, Sangster says. With hemp, the trait that takes precedence in importance often depends on the end-use of the product.

“If the intended end-use is oil and shelf flower products, then all three traits are essential in driving high-quality and consistent secondary metabolite profiles (what can be extracted for oil),” Sangster says. “If the fiber is used for industrial applications, light intensity is the most important trait.”

Another item to think about is whether LED or HPS lights work better for growing your hemp. LED lights have numerous advantages over HPS lights, such as decreasing thermal loads, increasing production yields, and reducing operation costs, according to Sangster, who says growers will want to address operating costs on two fronts. First, with improved efficiency, and second, with reduced fixture maintenance.

Beware of Cross Contamination

Cannabis plants are open (wind and/or insect) pollinated, and hemp pollen can travel for miles, which means female hemp plants could cross-pollinate when grown near other hemp crops. When this happens around crops intended for CBD production, the value of the plants degrades because CBD decreases and THC levels increase.

“While a commercial grower may be attentive to the presence of males and hermaphrodites in their crop, it’s impossible to control surrounding crops,” says Tami Van Gaal, Controlled Environment Agriculture Division Leader for Griffin Greenhouse Supplies. “Know where the hemp crops are within five to 10 miles of your facility. Get to know those growers and talk about their roguing (removing plants with undesirable characteristics) practices. Then watch for seed set on your crop.”

CONSIDERATION #6: What’s Your Crop Protection Strategy?

On the pest and disease fronts, primary pathogens that can plaque hemp include powdery mildew and botrytis, while spider mites, thrips, fungus gnats, aphids, and hemp russet mites round out top pest threats. The need for a strong integrated pest management (IPM) program when growing hemp is an important component for preventing problems and growing a successful hemp crop, even more so with the narrow to non-existent options for using traditional crop protection chemistries. Before growing hemp, familiarize yourself with the regulations in your state and plan out your crop protection strategy in advance. It’s also helpful to brush up on your knowledge of biocontrols.

“In the case of hemp, a strong preventive plan is essential, as the chemistry toolbox is very limited,” Van Gaal says. “Current regulations for chemistry vary dramatically by state, with some states prohibiting any EPA-registered products. Growers should be attentive to this and ready for change and for manufacturers to add hemp to their labels.”

In August 2019, the EPA opened a public comment period regarding 10 pesticide applications it has received, saying it wants a transparent process that brings clarification to growers. The agency also announced it will carry out the application review process for pesticide use on hemp the same as any other crop, and it hopes to have registration of crop protection tools for hemp in time for the 2020 applications and growing seasons.

Meanwhile, greenhouse growers are making biocontrol a large part of their IPM programs for hemp growing, but pest control can still be a challenge, particularly when the plants don’t start out clean in the first place.

“The plants we received our first season came in with aphids and spider mites on them,” Pahl says. “By the time we established our biological program, the pests were already multiplying at an alarming rate. It took us a while to get everything under control, but since then we have had great success with the biologicals we’ve been using.”

Pahl sums up the lesson he learned from this experience, saying it’s important to pay attention to detail and stay ahead of the curve because trying to prevent the problems is better than reacting to them.

Remember that sanitation also plays an important role in IPM. A good sanitation program not only helps you prevent and manage diseases, it also helps you reduce the need for chemical controls. Discarding infected plants, using footbaths, sanitizing between seasons or crops, and disinfecting benches, pots, floors, and equipment all go a long way toward preventing problems.

Finally, don't assume that what is safe for use on vegetables is safe for use on cannabis. Dol says every grower should keep that question in mind when thinking about the safety of his or her crop for consumption.

"We just don't know enough yet, so growers need to be careful," he says.

CONSIDERATION #7: Is Your Ventilation System Adequate?

For hemp to thrive in its growing environment and to keep diseases at bay, your greenhouse will need an adequate ventilation system, equipped with circulation fans. A few items to consider are:

- How much natural ventilation (roof vents, sidewall vents, rollup sides, etc.) do I have?
- How much mechanical ventilation (exhaust fans) do I have?
- Am I in an area with very hot summers? (If so, you may not be a good candidate for hemp production.)
- Do I have cooling pads? (This may not be the best choice for high humidity areas.)
- What is my exhaust fan capacity?
- How long is my greenhouse? (If the house is too long, fan ventilation may not be your best option.)
- How much will my greenhouse be used during the summer?
- Will the locations of my current fans optimize air coverage? Do I need to add more?

CONSIDERATION #8: Am I Eligible for Crop Insurance?

The Whole-Farm Revenue Protection, or WFRP, is available to hemp growers in compliance with state and federal regulations beginning with the 2020 crop year. According to the USDA website, WFRP allows coverage of all revenue for commodities produced on a farm up to a total insured revenue of \$8.5 million. Producers can now purchase WFRP coverage if they are part of a Section 7606 state or university research pilot program. Other producers cannot purchase coverage until a USDA-approved plan is in place.

The USDA website also states that hemp found above the THC-content compliance level will not constitute an insurable cause of loss, and hemp will not qualify for replant payments under the WFRP.

