When we are growing hemp for human consumption and medicinal purposes, we are typically growing for the production of an array of different cannabinoids, flavonoids and terpene oils that are held in the tiny resin glands that cover the flowers. These resins are made up of hundreds of different cannabinoids, some we know of and understand and many we don’t yet. Testing is becoming more robust daily and we will see much more plant potential discovered.

Due to nearly a century of prohibition, many cultivars and information have been lost. In the underground market only varieties with high Delta-9 THC were developed. This was mainly for the purpose of freeing the mind and spirit, otherwise known as “getting high.” However, during this time it was anecdotally discovered that many medical benefits were also being realized.

With the Drug War ending and hemp returning to American fields, we are discovering the benefits of all the other cannabinoids. Now varieties are being developed that are a high percentage of the “minor” cannabinoids, such as CBD, CBG, CBN, CBC.

As new genetics are developed that produce high concentrations of each minor, the industry will be met with new demands. Being on the forefront of these demand will enhance profits and marketability of your crop.
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LAB TESTING FOR TOTAL THC COMPLIANCE
Hemp will soon be legal in Thailand. Going forward, hemp will be legally defined as less than 1.0% Total THC to be in compliance. (Total THC is defined as the combination of Delta-9 THC + THC-A, where THC-A is converted to Delta-9 THC by multiplying by 0.877).

If you are looking to have compliant hemp that is able to be imported into Thailand, then it is better to err on the side of Total THC compliance. Variables such as hemp genetics, growing season length, growing conditions, late harvest, and general margin of error in testing can increase total THC beyond legal limits. This is where purchasing stable and compliant genetics that have a history of being compliant in your growing region is beneficial. Buy from a trusted source, and know when the expected test and harvest dates are for those particular varieties and regions.

Other tests that we highly recommend for your crop:

- Heavy Metal Testing
- Pesticide Testing
- Mycotoxins
- Yeast
- Molds
VIROID AND VIRUS TESTING INSPECTION/LAB TESTING

There are limited labs that can offer a range of viroid and virus testing. Viroid, virus and diseases are hard to identify without laboratory tests. There are currently over 15 virus, viroid and detrimental diseases that are rampant in the cannabis industry. Testing for these diseases is your responsibility because of the importance of eliminating the spread of diseases to future clones, seeds and other growers. Most of these detrimental diseases can prohibit production in very quantifiable numbers. It is more expensive to grow an unhealthy plant than a healthy plant. It is advisable to become familiar with local resources that are willing to receive potentially diseased plants for analyzing and lab testing.

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UNIT 2

THE IMPORTANCE OF pH

MINERALIZATION
Cannabis absorbs nutrients more effectively when the pH around the root zone is between 5.8 and 6.5.

**Natural soils with**
- pH values of 5 (acid)
- pH values of 6 (sub-acid)
- pH values of 7 (neutral)

**Nutrient Availability**
- pH levels between 6-7: Calcium, Magnesium - photosynthetic efficiency, Potassium, Nitrogen
- pH levels below 6: Manganese, Micronutrients (can become toxic when too concentrated), Phosphorus, Iron, Boron, Zinc, Copper
pH SCALE

Hydrochloric Acid
Water
Sodium Hydroxide

Acid
Neutral
Alkaline
THE IMPORTANCE OF pH

The power of Hydrogen, or pH, is a scale that determines the basic or acidic nature of a substance or solution. Determining your soil pH and your water source pH, will greatly help maximize the efficacy of amendment applications and overall plant health. All the different elements and minerals have varying levels of pH that they will become more advantageous, or most proficient for uptake in your plants.

It is also desirable for greenhouse/nursery growers to measure the EC (electrical conductivity) of their container media to estimate if enough nutrients are being provided; similarly they will measure the pH to determine if the nutrients present in the media are in a form easily available to be absorbed by roots.
How to test the pH of water and nutrients before feeding:

1. Measure the pH after adding nutrients and after mixing the solution. Use the pH meter or drops/ litmus paper to test level.

2. If using a meter (recommended) it is vital to make sure your meter stays properly calibrated.

3. Add “pH up” and “pH down” products in small doses to reach the desired pH. If pH is too high, add “pH down”, and vice versa.

4. Most tap water is alkaline and requires “pH down”. A little goes a long way!

5. THE POUR-THRU METHOD FOR TESTING pH OF CONTAINER MEDIA

6. The pH and EC meters that we use typically measure only a water solution; and therefore cannot be directly inserted into the container media. So to measure these properties we have to find a way to extract a water solution from our container media. The simplest approach is called the “Pour-Thru Method”. In this procedure we will water the plant with enough water so that some solution runs out the bottom of the pot. (i.e. leachate). We then collect the leachate to directly measure pH and EC. An advantage of this method is that you do not need to pull out media from a container and disturb plants while they are growing.
AMENDMENT INPUTS

You can add fertility and mineralization to your soil in a number of ways, depending on availability, time of year, and by which means. Compost, cover cropping, crop rotation, and mineralization are key factors in soil preparation before your field is ready for crop production. When planning these components out, it is best to think at least one full season ahead, if not 18-24 months. Some minerals, like Calcium lime, take up to 12-18 months before they reach their full potency. When we rely on natural processes and slow release nutrients and minerals, we may not see their full potential instantly, therefore, planning ahead is ideal for maximum yields.

MINERALIZATION

Dolomitic lime, rock phosphate, granite meal, and wood ash can be applied to most soils to compensate for any soil deficiencies. Locked-up elements get slowly released from applied minerals over time in high organic content and alive active soils. In their colloidal form, different microbes ingest these minerals making them available for plant uptake after excretion.

The more active your soil food web is, the more available these processes are to your plants. Many minerals have trace elements that form the building blocks of plant vitality and resilience. These minerals may also keep hemp from needing to look for more toxic chemical compounds found in soils to uptake.
Some minerals, like Calcium lime, take up to 12-18 months before they reach their full potency.
UNIT 3

COVER CROPPING FOR ADDED FERTILITY

SOIL MICRO-ORGANISMS SOCIETY
COVER CROPPING FOR ADDED FERTILITY

**FALL**
- Crimson Clover
- Daikon Radishes
- Buckwheat
- Turnips
- Collards
- Cereal Grain

**SPRING**
- Vetch*, Rye and Wheat
- Dutch White Clover
- Austrian Winter Peas*
- Spring Oats*
  *Before April 15th

**SUMMER**
- Buckwheat
- Clover
- Sudan Grass
- Cowpeas
  (can grow up through hemp - use caution)
FERTILIZERS, COMPOST & AMENDMENTS

- Determining your applications of nutrients and minerals should be determined by analyzing your soil’s existing nutrient and mineral profile through a soil test.

- Decide whether to purchase dry amendments, which can be mechanically spread with an attachment on your tractor, by hand, or choose liquid fertilizers that can be pumped through drip line irrigation applications. Typically, applying 20-50 tons, or yards, of eighteen to twenty month old composted materials per acre is enough to incorporate into your soil for encouraging biological activity and nutrient content.
SOIL MICRO-ORGANISMS SOCIETY

I.M.O. (INDIGENOUS MICRO ORGANISMS)
These are the citizens of the soil food web, diverse populations of made up of bacteria, nematodes, protozoa, and mostly fungal dominant species known as mycorrhizae. This balance aids in decomposition of organic material, increases nutrient availability, improves yields, reduces pathogenic microorganisms and a boost in plant defenses.

L.A.B. (LACTIC ACID BACTERIA)
These are like the emergency workers in the soil, a probiotic that can restore balance after disturbances or disasters. LAB is able to digest minerals which are not easily absorbed by plants. Can be applied as a foliar spray or soil drench. LAB helps increase fruit and leaf size, but use at reduced amounts as plants mature.

SEA (DILUTED SEAWATER)
A ratio of fresh water to sea water, 20:1, creates a solution that is full of minerals and every element that plants can absorb. This solution sprayed onto fields can fulfill trace mineral requirements and improve soil quality by causing clay particles to clump together.

F.P.J. (FERMENTED PLANT JUICE)
Extract the essence of a plant by containing all the complex hormones by binding them with alcohol for immediate assimilation. Choose a flourishing weed that is found in or around the intended field. Layer the chopped weed with brown sugar in 1-inch layers. Apply pressure after each layer to remove all air. Strain liquid off after 7–10 days and store in cool dark place. Dilute 8ml/gallon for foliar spray during flower transition. Don’t use it in conditions of high nitrogen or precipitation.

F.F.J. (FERMENTED FRUIT JUICE) - Made with diced or mashed fruit diluted 65:1 with water and 1:1 with brown sugar, fermented for 4–8 days with periodic stirring. Pour off liquid and dilute at a rate of 1:1000 water. Apply as a root drench with LAB to increase effectiveness.
**O.H.N. (ORIENTAL HERBAL NUTRIENT) Medicine**
An alcohol ferment made with Cinnamon, garlic, ginger, Angelica, and licorice. Great as a foliar spray, 4ml/gallon as a pest prevention and fights root pathogens as a soil drench. Can be applied during all phases of plant's life cycle. Used frequently to aid in digestion and metabolism. Fights Pathogens by creating an unpleasant environment.

**F.A.A. (FISH AMINO ACID)**
A nitrogen-rich ferment that provides the fuel. It is made from fish heads, guts, and bones, crushed and fermented with an equal amount of brown sugar for 7-10 days. Pour the juice off and store. Dilute 8ml per gallon during the vegetative phase for a foliar spray. Continue to dilute by one third potency and spray every two weeks through flower. It can provide simple amino acids which help with rapid leaf growth. It is possible to use the FAA continuously to increase yield and improve taste and fragrance.

**BIOCHAR**
Is a type of porous charcoal that enhances plant uptake of nutrients and water. Because of its porosity and surface area it is able to hold nutrients and create microorganism habitat.

**W.C.A. (WATER SOLUBLE CALCIUM)**
Transfers accumulated carbohydrates into sugars and is extremely important during flower and seed production. Apply as a foliar spray at a rate of 4-8 ml/gallon a few times throughout the flower cycle.

**ENDO/ECTO MYCORRHIZAE**
Many beneficial fungus which are able to create a mutualistic association with plant roots. A single ounce of healthy soil can contain more than a mile of mycorrhizae. They are able to break down nutrients into plant accessible forms. The mycelium (fungal roots) are able to retrieve nutrients from areas beyond the reach of plant’s roots. In addition, they provide moisture to plant roots creating drought resistance. They are able to outcompete pathogenic fungus and bacteria. Mycorrhizae are also able to trap non-beneficial nematodes. They bind organic matter to mineral particles to give soil its tilth, and improves water uptake.

**BENEFICIAL NEMATODES**
Microscopic worms in the soil that can feed on over 200 soil. Microorganisms, including cannabis-root-parasitic nematodes. They also release nutrients into the soil.

**ENDORHIZA/ ECTORHIZA**
These are rhizosphere bacteria that colonize the root zone and can also colonize plant tissues. Endorhiza bacteria support plant growth, as well as suppress plant diseases by providing phytohormones. Ectorhiza bacteria assist plants in tolerating the phytotoxic effects of environmental toxicants. Both play a role in localized ‘flavor’ or terroir.
SOIL & BED PREPARATION

When selecting equipment, ask if this is a piece of equipment that you will use for one season or multiple seasons. When considering purchasing tools and equipment that you need for your operation, you should consider whether to rent or own. When purchasing, factor in taxes, depreciation and maintenance. In renting equipment, consider the frequency of need and the possibility to split the cost with neighbors who could use it for a day too.

Tillage - This a delicate process of preparing the field for planting. Proper tillage techniques assist in the aeration of the soil, creating tilth, encouraging living organisms, water retention, accessing available nutrients and mineralization.

**Equipment that is recommended for this process are:**

- **Mower** - To cut plants above ground
- **Turning Plow** - Flips sod, or plant material
- **Chisel Plow** - Breaks up subsoil, aerates soil and rips through rough field after using the turning plow.
- **Fine Tooth Harrow** - Busts up smaller clods that is often dragged behind the Chisel Plow after second or third pass across field.
- **Spader** - Incorporates both cut plant material and soil while maintaining soil strata or structure in one pass across field.
- **Cultimulcher** - Creates a fine seed bed ready for planting
- **Light Disc** - chops up remaining residues on fields after harvest, and helps break up clods in field before planting.

To set up a proper irrigation system you must need a basic understanding of:

- Water pressure
- Flow rate
- Fertilizer application rates/titration
Drip irrigation will deliver water and fertilizers in a controlled and deliberate fashion. It also greatly reduces the water needed due to its efficiency in delivery. In combination with mulch you will lose very little water to evaporation.
SYNERGISTIC VS ANTAGONISTIC NUTRIENTS
SYNERGISTIC VS ANTAGONISTIC NUTRIENTS

GROWTH PHASE

- Nitrogen: Roots are extending and branches and foliage growth are increasing during this phase. While plants are blasting off in growth, their increased appetite for Nitrogen will allow them to uptake more Magnesium. Like French fries and ketchup!

- Sulfur: Stimulates Calcium, Molybdenum and Copper availability

- Zinc and Molybdenum: Stimulate Sulfur

FLOWERING PHASE

Day length will trigger the plant to divert its energy into making flowers: During this phase you will need Calcium (enhances the size and sweetness) as well as more Phosphorus, which will increase the plants appetite for Manganese. To increase benefits, here are different combinations that can have a synergistic effect when applied together:

SYNERGISTIC RELATIONSHIPS

- Gypsum: Applied with lime, will help keep light airborne lime from flying away.

- Kelp, Humates, Mycorrhizae, PGPR: Plant growth-promoting rhizobacteria that can increase yields by 50% when used together. This combo is loaded with natural plant stimulators, micronutrients and the ability to uptake available nutrients.

- Myco Fungi + Trichoderma + PGPRS: Trichoderma fights off the pathogens while the other two build a nurturing home for your crops roots.

- Bacterial + Fungal Inoculants: Facilitate metabolites and hormonal production, such as gibberellins, and cytokinins, which stimulate the cannabinoids and terpene volumes, increases plants biodefenses and delivers fuel needed to the roots.

ANTAGONISTIC RELATIONSHIPS

- Aggressive Tillage: Destroys the soil microbiome, exposing precious systems to the sun and elements.

- Myco Fungi + Soluble Phosphorous: Inhibits the colonization of beneficial fungi in the root zone

- NH3 (ammonia) & Earthworms: Direct contact with anhydrous ammonia will kill over 10% of the earthworm population each time it is applied. It will also wipe out a large population of diverse microbes that will take weeks to recolonize.


Growth only occurs at the rate permitted by the most limiting factors, therefore... Increasing plentiful nutrients has little effect on plant growth. The nutrient in the least supply will limit plant growth. Plants are only limited by one nutrient at a time. Agricultural yield is proportional to the amount of the most limiting nutrient

Chemical reactions - output limited by the reagent with the smallest quantity
WEED MITIGATION

A weed is a plant that is other-than the intended plant wished to be grown in a specific space. Often, the unintended plant growing, will uptake nutrients and water away from the plants you wish to nourish. Here are a few examples of procedures and equipment that will reduce the pressure from weeds on your cash-crop:

- **Cultivator Tractor** - Tractor dedicated to cultivation specifically

- **Sterile Seed Beds Tillage** - Roughing up the soil to get rid of the weeds after they have germinated. Sterile seed beds are beds in which weed seeds have been allowed to germinate, and then are killed before direct-seeding or transplanting your crop.

- **Plastic Solaration** - For smaller garden areas, you can cover the planting space with clear plastic to heat up the soil and burn up any germinating weed seeds underneath. By removing and reapplying the clear plastic between periods of dry and rainy weather, you will allow weed seeds to germinate, and then burn them up.

MULCHING METHODS

- **Hay Mulch** - Buy hay bales that are seed-free, spread hay 3-6 inches thick around your planted crop. This allows organic material to cover your soil, keeping weeds from germinating and preserving moisture. This encourages organisms to interact in this zone, thus creating pathways for air and water flow. The hay mulch also keeps the plants free of mud and water splash. Hay should be mulched around your planted crop after you have cultivated and cleaned your field of germinated weed seeds, and can no longer get into the field with your tractor. Typically when your plants are 2’ to 3’ tall.

- **Plastic Mulch** - Laying plastic over your soil beds will keep moisture in your soil, prevent weeds from germinating, and allow soil biology to be closer to the surface. You will have to manually remove plastic at the end of the season after harvest, or use another piece of equipment to mechanically remove plastic and debris from field at the end. Innovative brands do boast a biodegradable plastic that is made to degrade at different rates depending on your environmental requirements.
COMPANION PLANTING

Companion plants can help assist pest control by diverting non-beneficial insects from your crop:

- Buckwheat
- Okra
- Sunflowers
- Crimson Clover
- Marigolds
- Cosmos
- Zinnias
- Amaranth-Cucumber Beetles
- Sorghum
- Collards
- Mustard Greens
- Radishes
- Bush Beans

MULCHING METHODS - continue

- Drip Line Layer - This usually comes with a plastic layer that lays the drip line beneath the plastic as you lay the plastic. Having a drip line will allow for more control on irrigation and fertilization.

- Ground Clover - Ground Cover crops are typically ones that will either vine across the ground of the planted field during the entirety of the season (sweet potatoes, winter squash, pumpkins, or watermelons). Other examples: low growing crops like white clover that can be planted under your hemp plants after your last cultivation.

SYNERGISTIC VS ANTAGONISTIC NUTRIENTS
“If one crop nutrient is missing or deficient, plant growth will be poor even if the other elements are abundant. Like a barrel with unequal boards, one nutrient becomes the limiting factor.”
NUTRIENT DEFICIENCIES

GROWING FROM SEED
Nitrogen (N)

Zinc (Zn)

Iron (Fe)

Sulfur (S)

Potassium (K)

Phosphorus (P)

Magnesium (Mg)

Manganese (Mn)
NITROGEN

Excess
Stems & foliage weakness
“Greenness” moves up
Bottom leaves turn dark
Water transport weakens
Harvest tastes green

Deficiency
Plants are shorter with smaller leaves
Leaves lose luster
Yellowing progresses upward
Lower leaves yellow & curl
Leaves begin dropping
Premature flowering & low yield

MAGNESIUM

Excess
Stunted growth
Dark green foliage
Symptoms appear as an overall salt toxicity

Deficiency
Overall sickly appearance
Deficiencies exist 4-6 weeks before outward signs appear
Interveinal yellowing and irregular rust-brown spots appear on older and middle-aged leaves
Older leaves dry, often curl & drop

PROSPHOROUS

Excess
New leaves grow thin blades/develop interveinal chlorosis
Leaf tips and margins burn
Less internodal space
Causes calcium, magnesium, zinc & iron deficiencies
Lower leaves curl & develop spots
Dry buds have a chemical taste
Root tips die back

Deficiency
Growth slows
Weak & susceptible to diseases & pests
Petioles turn purplish color & leaves turn bluish green
Dark copper-colored or purple to black spots on lower leaves
Severely affected leaves with dark brownish/purple curling leaves

POTASSIUM

Excess
New leaves grow thin blades/develop interveinal chlorosis
Leaf tips and margins burn
Less internodal space
Causes calcium, magnesium, zinc & iron deficiencies
Lower leaves curl & develop spots
Low pH: Root zone is acidified & root tips die back spots

Deficiency
Older leaves turn pale & suffer chlorosis
Leaf margins & tips turn rusty color and “burn”
Stem branching may increase
Flowering retarded & diminished
Stems often become weak, scrawny & sometimes brittle

SULFUR

Excess
Overall smaller plant development and uniformly smaller, dark green foliage
Leaf tips and margins could discolor and burn when excess is severe

Deficiency
Bud formation is slow & weak
Young leaves turn lime green to yellowish & growth is stunted
As shortage progresses, leaf veins yellow & lack succulence
Leaf tips can burn, darken, and hook downward
Long purple streaks may appear the length of the stem when combined with nutrient deficiency
Stems turn “woody”

Mobile Nutrient
Immobile Nutrient
MOLYBDENUM

Excess
Causes iron deficiency
Leaves discolor

Deficiency
Upper leaves drop
In cold weather older & middle leaves yellow with possible interveinal chlorosis
Leaves become distorted, margins become dry
Lower leaves drop

IRON

Excess
Leaves turn bronze with small dark brown leaf spots
Phosphorous uptake is impaired.
Signs appear in lower leaves

Deficiency
Growth is slowed down & harvest diminished
Young leaves & shoots develop interveinal chlorosis starting at the opposite end of leaf tip
As deficiency progresses more & larger leaves start showing interveinal chlorosis
Leaves may develop necrosis & drop

COPPER

Excess
Interveinal iron chlorosis
Fewer branches grow
Roots start to decay or become thick and slow-growing

Deficiency
Young leaves & shoots wilt, contort and may die back
Leaf tips and margins turn dark green to copper-gray & may die back
Growth is slow & yield decreases

MANGANESE

Excess
Young and newer growth develops chlorotic, dark orange to dark rusty-brown mottling on the leaves
Tissue damage shows on young leaves before progressing to older leaves

Deficiency
Young leaves show interveinal chlorosis symptoms first
Necrotic (dead) spots develop on severely affected leaves, becoming pale and falling off
Telltale signs of manganese deficiency is where margins remain dark green surrounding interveinal chlorosis
Symptoms spread from younger to older leaves as the deficiency progress

ZINC

Excess
Zinc overload is very rare but extremely toxic. Severely toxic plants die quickly
Excess zinc interferes with iron’s ability to function properly and causes an iron deficiency

Deficiency
New and young leaves exhibit interveinal chlorosis & develop small, thin blades that contort & wrinkle
Stem tips fail to elongate & growing shoots/tips become “bunched up”
The leaf tips & later the margins discolor & burn
Reduces internode spacing stunts new growth and can severely diminish yield

BORON

Excess
Leaf tips yellow before appearing burned
Leaves yellow and drop

Deficiency
Stem, tip and roots grow abnormally
Growth shoots appear burned & may contort
Necrotic spots develop between leaf veins
Leaves thicken & become brittle
Rust colored corky stems develop
Root tips often swell, discolor & stop elongating

CHLORINE

Excess
Yellowish-brown leaves are smaller and slower to develop
Young leaves develop burned tips and margins
Both severe deficiency and excess of chlorine have the same symptoms.

Deficiency
Leaf tips and margins burn, turning a bronze color
Young foliage turns pale green & wilts
Roots develop thick tips & become stunted

* Mobile Nutrient
* Immobile Nutrient
WHERE TO LOOK FOR DEFICIENCIES

Look to the bottom leaves to indicate lack Nitrogen, Phosphorus, Potassium and Magnesium.

Look to the leaves in the top of the plant to show deficient signs in Manganese, Molybdenum, Calcium, Boron, Iron, Zinc, Sulfur and Copper.

MOBILE/IMMOBILE NUTRIENTS

Immobile nutrients show nutrient deficiency & excess on newer leaves.

Toxic salt buildup locks out nutrients causing deficiencies.

Mobile nutrients show deficiency & excess on older leaves.

Overwatering causes deficiencies & rot roots.
GROWING FROM SEED

GERMINATE SEED
Seedlings like a warm and moist low-light environment. The more you can provide consistency in this, the better germination results you will have.

HEMP GROWS BEST
When the outdoor temperature is between 60-80°F (16-27°C) indoor growers can simulate this time of year to achieve the same outcomes.

1. FILL TRAYS
Fill your propagation trays with medium that consist of a mix of peat moss, vermiculite or perlite. You want this light and well draining.

2. WATER TRAYS
Getting your trays watered properly on the first time is important. Be sure to water the trays evenly and allow to drain well.

3. PLANT SEED
Make an indent in the soil approximately 1 inch deep to prepare a space for the seed to drop in. Plant seed carefully in hole with the ‘belly button’ facing down if possible.

4. GIVE LIGHT
Fluorescent light or even indirect daylight is strong enough for the seeds to become a small plant. Making sure there is sufficient light will help avoid overstretched seedlings.

5. NURTURE
Maintain a warm and moist environment with light over your trays. Be cautious to never let your medium dry out while also avoiding over watering. A soft approach is best. Be patient as your new plants emerge, some may pop through at different times.

6. TRANSPLANT
Field: depending on your designated hardiness zone you can properly plan to go to field with good root establishment and warmer weather.

Container: once the seedling has a strong healthy root ball, apply a mycorrhizae powder directly to roots, before up-potting to next container size.
6

VEGETATION & FLOWER MAINTENANCE

Female Plant

Male Plant
Sexing the Crop

Females are distinguished by the development of bracts with small white hairs on their nodes. The plant then starts pushing out more of these hairs until they swell up from the bottom up. This means the plant is now forming ‘calyces’ that eventually stack up to become the flower or bud as we know it.

Males are recognized by the formation of pollen sacs on the plant’s nodes. This happens before, or around the same time as female reproductive organs should be forming. The male pollen sacs can be distinguished pretty easily hanging from the side of the plant; instead of the upward facing hairs from the female plant.

Pruning for flower production

Pruning the plant will allow for better airflow and the plant’s energy to be concentrated into the more productive parts of the plant. It also allows for better light penetration on the buds that have been selected, increasing cannabinoid production. When pruning for flower production anywhere from 20 to 50% of the foliage and branches can be cut back to the stalk. Leaving a canopy where each top has maximum sun exposure.
Thinning and deleafing the plant usually includes removing small non-productive stem and flower nodes from the bottom one-third of the plant, and up from the inner stalk, and out each branch from the first and second nodes. The idea is to remove anything that is wasteful of the plant’s energy, and be able to “see-through” each plant where adequate airflow can occur and sunlight can penetrate through the canopy to inner parts of plant. With all varieties, pruning and thinning should happen for the final time no later than three weeks into the flower cycle. Cutting back excessively after this time can cause the plant to stunt. Each branch typically has a larger and broader “water-leaf” that is the solar power for that branch. Avoid removing these larger leaves located at the base of the branch and stalk, during vegetation this slows the photosynthesis and productivity of the entire branch water and nutrient uptake.

However, as buds swell and mature it’s a good idea to remove any water leaves that may be shading any flowers from sunlight. It is also ideal to remove any dead material lying beneath the plants that would allow for unwanted molds, pests or disease to harbor.
“As buds swell and mature, it’s a good idea to remove any water leaves that may be shading any flowers from sunlight”
UNIT 7
PEST MANAGEMENT

BENEFICIAL INSECTS
As your plants go through their beginning stages, keeping a clean growing environment is the best type of prevention. Spraying plants routinely with alternating daily applications of soaps, citric acids, essential oils, sulphur and activated microbial foliar tea applications through the vegetative stage will reduce the populations of harmful pests, creating an advantageous space to introduce beneficial insects in a more timely manner.

**Pests that need to be quickly identified using a 60x-100x microscope or hand lens loop:**

- Russet Mites
- Aphids
- Broad Mites
- Spider Mites
- Root Aphids
- Caterpillars
This figure shows the Spider Mites, one of the harmful pests.
Beneficial insects should be considered as a means to reduce pests on your crop. In releasing beneficial insects, proper timing, environmental factors and predator selection should be considered. Identifying the amount of pest pressure, the stage of development and type of pests you have, will correlate to which beneficial insects you need, and when you will need to introduce them.

“...The lifespan of beneficial insects varies from product to product, and also depends on whether or not you’re using the beneficial insects for prevention or outbreak treatment. Most products need to be reapplied every 2 to 3 weeks for outbreak treatment and sometimes slightly more frequently for preventative treatment, as the beneficial insects do not have a liable food source."
Beneficial Pests Suggestions:

+ Green Lacewings
+ Amblyseius Swirskii
+ Californicus
+ Predatory Mites
+ Ladybugs

**This figure shows the Ladybugs one of the beneficial insects**
UNIT 8

HAND HARVEST

POST HARVEST HANDLING
HARVEST METHOD

- Mechanical harvest using a variety of different equipment options
- Combine + bale method
- Hand harvest

These methods may require different space configurations. Keep in mind, safety, work-flow, proper handling, fire hazards, structural limits, personnel capacity, electrical loads, and convenient access. Remember, FGP is here to answer any of your harvest plan questions!
HAND HARVEST

- Labor - 6 skilled laborers can harvest half of an acre per 8 hours from field to hanging plants in an enclosed clean facility. Dependent on distance from field to facility.

- Tools - Hand clippers, loppers, cutting tools, tarps, and parachute cord.

- Trailer or Tobacco Trailer - used to move the cut plants from the field to drying facility. When moving crops from the field to facility, it is recommended to keep the material dry and out of the direct sunlight. If you are using an enclosed trailer, be sure to minimize the time of exposure to adverse weather.

- Transportation - When transporting harvested material on public roads, be mindful of exposure of crop material, smell, and time of day to avoid a public nuisance. Attracting unwanted attention is not necessary, and could cause unwanted attention that could pose safety concerns. In addition, be mindful of the temperature and duration of time that your crop will be in route. Mid-day heat can degrade your crop quickly.

- Protective Equipment - You will need long sleeve shirts, gloves, boots, long pants, and brimmed hat. Keep Hydrated

- Clean Handling Procedures - Keep plants from contacting the ground. If there is mud, mold or rot, take precautions in removing dead parts of the plant before entering drying facility. You may need to dunk plants in a diluted hydrogen peroxide solution before entering drying facility if your crop has an issue with powdery mildew on the leaves. If your plants are wet from rain during harvest, shake them of excess moisture before entering drying facility. Be sure that the drying facility is capable of reducing the moisture content in a timely and evenly manner.

POST HARVEST HANDLING

Getting your crop from the field to your desired drying location is all about time, labor, and a well thought-out system. Once your plants are cut, you have a limited time before those plants begin to decompose. With proper handling, the idea is to remove excess moisture that will slow down decomposition, and provide a space that will allow you to properly stabilize your crop for continued processing.

The second most important concept to master in this stage is organization of your different varieties and cultivars. Keeping your labeling system consistent and organized from start to finish with each plant will ensure that you are able to track the overall performance of each variety you grew during the season. This will allow you the opportunity to both market the material correctly, giving credit to the breeder, and take note of any fair constructive criticism throughout the growing process, to the feedback of the final purchase.
Drying Management

A successful harvest begins by having your drying facility ready to receive plants before harvest begins. Be sure to have all the necessary climate controls installed to ensure everything works properly ahead of time. Create a consistent climate that is a dry, cool climate for curing. Be sure to have an idea of the labor you will need for this aspect of the project. These will be long days that are generally coupled with cold or wet weather. Be prepared to have H2A or skilled labor that can endure the long hours and whether dependent work conditions. Remember to have your labeling system in place before harvest.

Things that can influence harvest dates:

Knowing when the flower cycle begins in your region is crucial to timing out your harvest. Depending on the flowering cycle of your variety, you will need to plan on getting your crop tested four to six weeks prior to that date. Early flowering varieties will begin to flower several weeks prior to later flowering varieties. Most tests will begin around mid-August until mid-September, while different varieties can begin to be harvested mid-August all the way to mid-October. Some extreme late varieties will even grow until late November! Because of the high volume of participants in the state program, it is advised to plan ahead in securing your testing date by the governing authority. Most varieties will be harvested between September and October, so plan accordingly.

- If imminent severe weather is upon you, the decision must be made to take your crop early and save what you have. Going through the investment in trellis can assure your crop stays in the field and can weather the storms.

- When using clones, you may have a pre-determined harvest date based on your plants being mature at the same time. When using seed, your maturity rate may vary slightly, even within the same variety.

- You may receive testing results back from the governing authority that are compliant at the time of sampling. However, knowing that cannabinoid profiles can change with time, harvesting within the 15 to 30 day time period, will decrease your chances of your crop becoming out-of-compliance.
Knowing when the flower cycle begins in your region is crucial to timing out your harvest.

Most varieties will be harvested between September and October, so plan accordingly.
Harvest Tips:

- Determine through physical observation using a magnifying loop, the milkiness of the cannabinoid trichomes.

- Take the time to remove molds, fungus, and rot before hanging in the drying facility. This can be accomplished in the field, or right before hanging. Use clean cutting shears, or horticultural scissors.

- Remove plants from field in manageable sizes, keeping the material out of direct sun for long periods of time or stacked on top of each other where decomposition can happen rapidly, creating excess moisture and heat.

- Use tarps and plastic totes while harvesting in the field to keep your plant material free from, mud, dirt, bird droppings, water, dust, and bacteria.
Curing begins after the initial drying stage (this allows for the plant material to be stabilized for storage for a longer period of time, while maintaining the smell, taste, and smoothness of the flower). Curing is usually reserved for the smokable flower and higher end markets. Typically, the larger hanging plants will be broken down once more into 12”-18” lengths, removing any excess branches or stems and leaves. This allows for more flower to branch ratio, less moisture potential, and prepares the material for the eventual manicuring of the plant into “trimmed” flower.

When condensing the material into your curing containers, this is a good time to begin grading your material into different size and quality. Large, medium, and small material should continue to be labeled and put into corresponding bins for organization (come time to trim and prepare material for sale). Buds should feel dry and the stems should easily snap when broken. Buds should be able to take pressure from a finger squeeze without crumbling into finer material. You can avoid this by adding some soaked wet large stems or wet paper towels to your bins or bags with caution given to not have the wet material directly touching the flower. Be sure to remove any wet items that were added for rehydration purposes after a few hours. Additionally, you can lightly spray your material with filtered water to bring the moisture back up in the container (if doing this, go slow).

The curing stage will take 2-6 weeks requiring daily visual checks and remembering to inspect both top and bottom of the material for even drying and curing. If the bottoms of the bins or bags become moister than the tops, you may be able to “flip” the material from bottom to top for more even drying. Avoid curing near any overpowering smells, as they can tend to be absorbed by drying plant material.

Storage

Ideally, you want to store your harvested crop in a climate controlled space, out of the light. The more stable the storage environment you have the more value you can retain in your crop by avoiding cannabinoid degradation due to heat or improper airflow. During your daily/weekly inspections, each bag or container should be inspected for mold prevention. It would be wise to closely monitor the storage containers from the top to bottom to avoid deterioration of your crop’s value and make adjustments as needed.

Any breathable bags should not be in direct contact with the floor. Moisture can come up from the ground and enter a bag, causing potentially harmful molds to form. Avoid storing in facilities that are susceptible to attracting birds, mice or any varmints that could hinder the quality of material. Make sure material is dry before storage. If the plant continues to decompose and is still moist, the material can heat up and potentially catch on fire. Avoid storing material near any consistent smells, as the material continues to cure it can take on outside smells, decreasing its value.

While it has not been heavily regulated in the past, handling hemp material to food grade standards will become vital to on-farm production and storage will be required by most extractors in the future. Best to be ahead of the curve.
OUR GENETICS

FGP’s genetics are feminized (99.98%+), photo-dependent hemp varieties that produces CBD-rich flower for extraction in an average of 90 days. The female plants allow for maximizing yield and return. Additionally, the short time to maturity will allow for multiple cycles annually in regions with long growing seasons.

NOTE: These guidelines have not been validated for every grow environment and are intended to serve as a best practice. The Frontier Genetic Partners Technical Development team works with diverse field trial partners to continually improve guidelines.

SOIL PREPARATION

Proper soil preparation is necessary for a successful harvest. FGP’s genetic performs best in well-draining soils with a pH between 6.0 and 7.0. For greenhouse cultivation, we recommend using ProMix MP or a similar well-drained growing media formulation that will allow for very good drainage.

“The recommended minimum soil temperature for planting in the greenhouse is 75 F. Seeds should be sown at a depth of ¼ inch”
SOWING

Direct sowing into the final growing medium is highly recommended. Because FGP’s genetic is a day-neutral variety, transplant stress often triggers early flowering and subsequent low or irregular yields. No seed pretreatment is necessary. The recommended minimum soil temperature for planting in the greenhouse is 75°F. Seeds should be sown at a depth of ¼ inch. Seeds can be covered with a thin layer of vermiculite to prevent the seeds from floating during watering. Sowing FGP’s genetic seeds in the pot (three (3) to five (5) gallons) they will mature in is recommended, however, if transplanting is necessary, please refer to the section below. Germination is expected within three to five (3-5) days. Seedlings should be placed in full-sun conditions two (2) days after germination to prevent hypocotyl stretch.

FERTILITY

Exact fertility targets are not yet well established for hemp. When planted outside, a soil test should be performed before fertilizing to properly amend the soil to achieve ‘high’ fertility levels. For the greenhouse, we recommend using 15-5-15 Cal Mag fertilizer for the vegetative stage at an electrical conductivity (EC) of 1.8. When flowers appear, switch to 10-30-20 Bloom Booster at an EC of 1.8 for three (3) weeks. Then switch to 4-31-37 at an EC of 2.0 to finish the crop off. If plugs are grown in the greenhouse for field purposes or for transplanting into finished pots, fertilize seedlings with a 20-10-20 General Purpose Fertilizer at an EC of 1.5 before transplanting. If plugs are transplanted into a prepared outdoor field, follow the fertility guidelines outlined in the FGP’S GENETIC FIELD CULTIVATION GUIDE.
**LIGHTING**

Using HPS or LED lights to supplement natural lighting is recommended for greenhouse cultivation. Utilize lights that can achieve a minimum of 750-800 PAR. During the vegetative phase, hemp varieties require a minimum day length of 16-hours of light but will perform best under 24-hour light conditions. Early flowering and reduced yields may result if day length recommendations are not followed.

**WATERING**

It’s critical to monitor the potting media moisture after sowing; too much water during germination can have adverse effects on emergence rate. After seedlings have emerged, irrigation can be used more liberally. We recommend using water with a pH of 5.8-6.0 and always allow 25-30% runoff during each irrigation event to sufficiently flush salts and prevent them from building up in the root zone.

**TEMPERATURE AND HUMIDITY**

Maintain temperatures at or close to 80°F with relative humidity between 60-70%. Avoiding temperatures below 70°F or above 88°F is recommended.
Scouting early and often, beginning soon after emergence, will allow for early detection of disease onset and pests. Proper identification of diseases and pests is crucial for determining the best control method. For pests, the use of a sticky trap can often be beneficial. Biological Control Agents (BCAs) can often be used to control mildews and insect pests. Proper identification of insects is necessary for choosing a BCA, in many cases. Control agents are often specified by the governing authority. Always refer to the product rules within your country and local governments for pest and disease control.

Maturity and Harvest

Hemp maturity is cultivar dependent. FGP’S genetic matures on average 75 days after planting. Hemp is considered mature and ready for harvest when the majority of trichomes have shifted from clear to opaque with a cloudy or tan color. The use of a 10x hand lens can help identify the shift in trichome color. Refer to your state-specific guidelines for testing timelines. To ensure compliance, state testing of FGP’S genetic should occur two (2) weeks after flower initiation.

Lessening the machinery impact on the CBD-rich trichomes at harvest may result in a higher percentage of product for delivery to processing. While there are a multitude of harvesting methods becoming available, as of the publication date of this guide, hand harvesting is still the best way to maximize protection of the trichomes.