CC-9 Economic Botany; Drug Yielding Plants

1. TOBACCO

Morphology

Tobacco, *Nicotiana tabacum*, is an herbaceous annual or perennial plant in the family Solanaceae grown for its leaves. The tobacco plant has a thick, hairy stem and large, simple leaves which are oval in shape. The tobacco plant produces white, cream, pink or red flowers which grow in large clusters, are tubular in appearance and can reach 3.5-5.5 cm (1.25 -2 in) in length. Tobacco may reach 1.2-1.8 m (4-6 ft) in height and as is usually grown as an annual, surviving only one growing season. Tobacco may also be referred to as Virginia tobacco or cultivated tobacco and originates from South America. The cultivated tobacco plant normally grows to one or two feet high. The five flower petals are contained within a Corolla and can be colored white, yellow, pink, or red. The tobacco fruit measures at 1.5 mm to 2 mm, and consists of a capsule containing two seeds.The leaves, however, are the most economically important part of the plant. The leaf blades are enormous, often growing to 20 inches long and 10 inches wide. The leaf shape can be ovate (egg-shaped), obcordate (heart-shaped) or elliptic (oval, but with a small point at one end.)

The leaves grow toward the base of the plant, and can be lobed or unlobed but are not separated into leaflets. On the stem, the leaves appear alternately, with one leaf per node along the stem. The leaves possess a distinct petiole. The underside of the leaf is fuzzy or hairy.

While the leaves are the plant part containing the nicotine, the nicotine is manufactured in the plant roots. Nicotine is transported to the leaves via the xylem. Some species of *Nicotiana* have very high nicotine content; *Nicotiana rustica* leaves, for example, can contain up to 18% nicotine.

Uses

Tobacco is a stimulant and the dried leaves of the tobacco plant can be cured and used to produces tobacco cigarettes, cigars and snuff or for pesticide production.

Tobacco Types

Several types of tobacco are grown, depending on their use:

- **Fire-cured**, used for snuff and chewing tobacco
- **Dark air-cured**, used for chewing tobacco
- **Air-cured (Maryland) tobacco,** used for cigarettes
- **Air-cured cigar tobaccos**, used for cigar wrappers and fillers
- **Flue-cured**, used for cigarette, pipe, and chewing tobacco
- **Burley (air-cured),** used for cigarette, pipe, and chewing tobacco

Fire-curing is basically what the name suggests; open fires are used so that the smoke can reach the leaves. The smoke makes the leaves darker colored and more distinctly flavored. No heat is used in air curing except to prevent mold. In flue-curing, heat is applied in such a way that no smoke reaches the leaves hung in racks.

Other Potential Uses

As smoking rates have been vastly reduced over the last 20 years, other uses have been found for tobacco. Tobacco oils can be used in biofuels, including jet fuel. And researchers in India have patented an extract from tobacco called Solansole for use in several drug types that could treat diabetes, Alzheimer's disease, cystic fibrosis, Ebola, cancer, and HIV/AIDS.

Propagation and Processing

Basic requirements Tobacco grows very well in a wide range of climates and will grow optimally at temperatures between 20 and 30°C (68–86°F) in areas where there is a dry period to facilitate harvest of the leaves. The type of soil depends on the variety of tobacco being grown but the best yields are usually obtained in loam to sandy loam soils. The soil should have a pH between 5.0 and 6-6. Tobacco plants are easily damaged by waterlogged soils and quality can be affected by high salinity. Plants should therefore be grown in a well draining and well aerated soil.

Propagation Tobacco is propagated from seed on protected (covered) seed beds or in the glasshouse and transplanted to the final growing site. Seeds grown outdoors are protected for the first few weeks to prevent weather damage to the emerging young plants. seedlings are transplanted after 30–60 days when they are approximately 15 cm (6 in) in height. The young plants should be spaced 46–61 cm (18-24 in) apart.

General care and maintenance The best quality tobacco leaves are produced when the the flowerheads of the plants are removed, a process known as

topping. Topping plants promotes the development of suckers which should also be removed. Suckers are removed through the use of chemicals in commercial tobacco production with some hand removal also necessary. Fertilizer and irrigation requirements of tobacco vary with the variety being grown but generally, tobacco has a requirement of 40-80 kg per hectare of nitrogen, 80-90 kg per hectare of phosphorous and 50-110 kg per hectare of potassium.

Harvesting Tobacco is harvested by hand in most parts of the world by picking 2–3 leaves from each plant per harvest. In the USA and Canada, tobacco plants are mechanically harvested by cutting the stalks of the plants. Only fully mature leaves should be harvested when hand picking is practices and harvests should be carried out at weekly intervals. After harvest, leaves are usually tied in pairs to cure.

Tobacco is cultivated as an annual but is actually a perennial and is propagated by seed. The seeds are sown in beds. One ounce of seed in 100 square yards of soil can produce up to four acres of flue-cured tobacco, or up to three acres of burley tobacco.

The plants grow for between six and 10 weeks before the seedlings are transplanted into the fields. The plants are topped (their heads removed) before the seed head develops, except for those plants that are used to produce next year's seed. This is done so all the plant's energy goes to increase the size and the thickness of the leaves.

The tobacco suckers (the flowering stalks and branches, which appear in response to the plant being topped) are removed so that only the large leaves are produced on the main stem. Because growers want the leaves to be large and lush, the tobacco plants are fertilized very heavily with nitrogen fertilizer. Cigar-wrapper tobacco, a staple of Connecticut agriculture, is produced under partial shade—resulting in thinner and less damaged leaves.

Plants grow in the field for three to five months until harvest. The leaves are removed and purposely wilted in drying barns, and fermentation takes place during curing.

Tobacco Leaf Harvesting, Curing, and Fermenting

Harvesting Tobacco Leaves

Tobacco is harvested in one of two ways. The oldest known method in use is simply cutting off the stalk at the ground using a curved knife.

The other way to harvest tobacco leaves originated in the nineteenth century. They started to harvest the tobacco plant by pulling individual leaves off the stalk as they ripened, tobacco leaves ripen from the ground upward, so tobacco plant may be pulled several different times before the tobacco plant is entirely harvested. This is also known as "Cropping" or "Priming". These are terms used for pulling leaves off tobacco. The first crop at the very bottom of the stalks are called "sand lugs" as they are often against the ground and are coated with dirt splashed up when it rains.

Curing Tobacco Leaves

Tobacco farmers refer to the drying of the leaf as curing. There are 3 main ways of curing tobacco. Curing methods vary with the type of tobacco grown. The tobacco barn design varies accordingly.

Air-cured Tobacco Leaves

Air-cured tobacco is carried out by hanging the tobacco in a well-ventilated barns, where the tobacco is allowed to dry over a period of four to eight weeks. Air-cured tobacco is generally low in sugar content, which gives the tobacco smoke a light, smooth, semi- sweet flavor. These tobacco leaves usually have a high nicotine content.

Flue-cured Tobacco Leaves

Flue-cured tobacco started by stringing the tobacco into tobacco sticks, which were hung from tier-poles in curing barn's "kilns". All flue-cured barns have flues which run from external fed fire boxes, which heat-cures the tobacco without exposing it to smoke, slowly raising the temperature over the course of the curing process. The procedure will generally take about a week. Flue-cured tobacco generally produces cigarette tobacco. Cigarette tobacco usually has a high content of sugar, with medium to high levels of nicotine.

Sun-cured Tobacco Leaves

Most to all sun-cured tobacco comes from countries that produce oriental leaves, such as Turkey, Greece, and the Republic of Macedonia. The sun-cured tobacco process works just how it sounds. The tobacco is placed in the sun uncovered, and is dried out naturally. Generally, oriental tobacco is low in sugar and nicotine and is very popular for cigarettes.

Fermenting (A.K.A. sweating) Tobacco Leaves

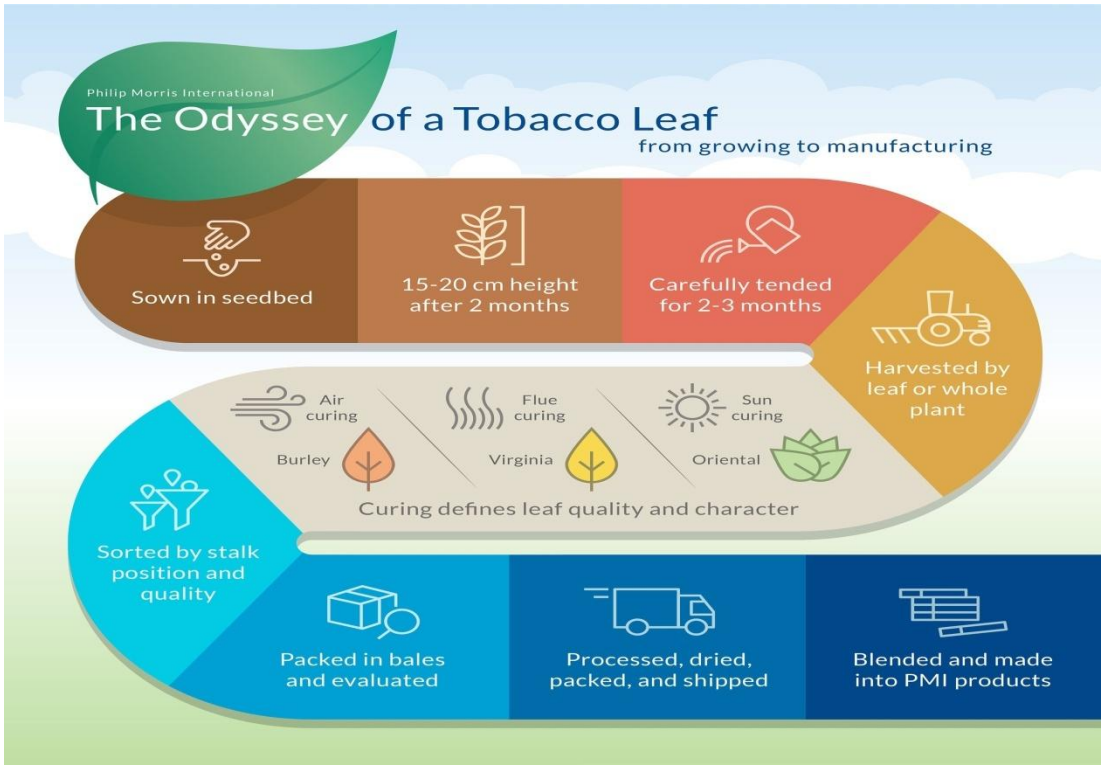
This is the process by which ammonia is released from the leaf to make it more sociable. It can be done by heaping the tobacco into large piles called pylons that raise the temperature and humidity, or by use of a kiln with a heater and humidifier. Under the raised temperature and humidity, enzymes in the leaf cause it to ferment. It is not necessary to spray a fermenting solution on the leaf as some suggest - the enzymes will do it naturally. Sometimes this is also referred to as curing. This system of maturing tobacco leaves came from the days when tobacco was shipped by sail. The ship would sit in port for a few weeks, with very humid temperatures and bails stacked tight together. When the tobacco reached it's destination, it was found to smell and taste sweeter. There are two methods of fermenting, stacking and kiln fermenting.

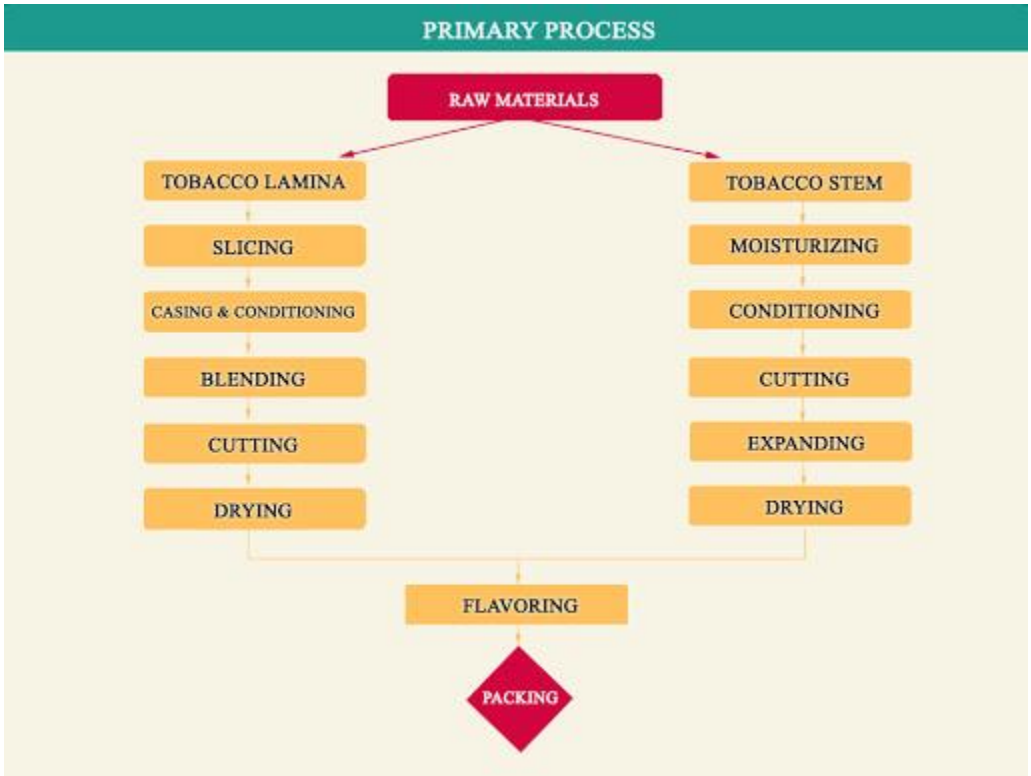
Stacking

The stacking tobacco fermentation method is used by large growers. Stacks of tobacco weighing around 100 lbs each are wrapped in burlap and allowed to "sweat". The internal temperature is closely monitored. When it reaches 140 degrees, the stack is broken down to release tar, ammonia, and nicotine. The stack is torn down and rebuilt several times until the temp will no longer reach 110 degrees. The stems are they stripped and stacked in a cooler place (65 degrees to age for a time 6 weeks to 6 years).

Kiln fermenting

This is what the smaller grower must use if he or she wants to smoke the fruits of their harvest any time soon. The kiln is a small, insulated container with an artificial heat source that helps to simulate the fermentation. The leaves are placed in the kiln with the lid shut. Heat and humidity are carefully controlled (temp 100 to 130 degrees and 65 to 70% humidity), and the kiln is left on 24 hours a day. Kiln fermenting lasts about 4 to 6 weeks and the relative humidity must be carefully maintained during this time. A short aging period will follow of 4 to 6 weeks or longer until the leaves can either be rolled into cigars or cut for cigarette, pipe, or chewing tobacco.


Philip Morris International
The Odyssey of a Tobacco Leaf
from growing to manufacturing
Sown in seedbed
15-20 cm height after 2 months
Carefully tended for 2-3 months
Harvested by leaf or whole plant
Air curing
Flue curing
Sun curing
Burley
Virginia
Oriental
Curing defines leaf quality and character
Sorted by stalk position and quality
Packed in bales and evaluated
Processed, dried, packed, and shipped
Blended and made into PMI products


PRIMARY PROCESS
RAW MATERIALS
TOBACCO LAMINA
SLICING
CASING & CONDITIONING
BLENDING
CUTTING
DRYING
TOBACCO STEM
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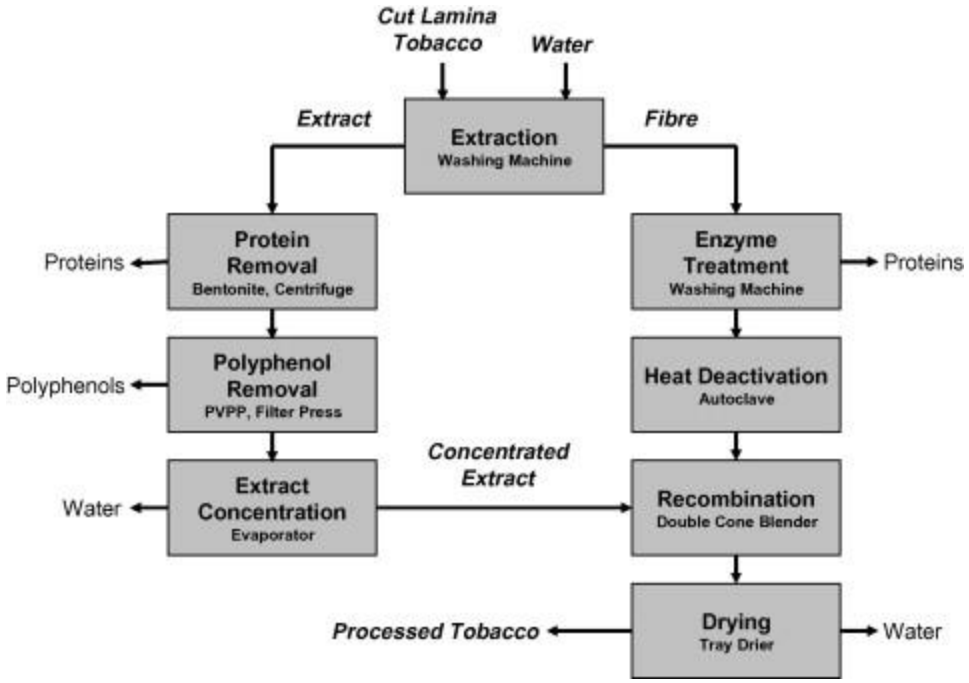
PACKING



HEALTH HAZARDS OF TOBACCO: SOME FACTS

About half of all tobacco-related deaths occur at ages 35-69 years, making tobacco the most important cause of premature death in developed countries.

- Many of those who die from smoking were not particularly heavy smokers, but most of them did start smoking in their teenage years.
- Smokers in their thirties and forties have five times as many heart attacks as non-smokers. Heart attacks are the main way in which smoking kills young tobacco users. In industrialized countries, tobacco is responsible for 75-80% of all heart attack deaths in young smokers under the age of 50.

"No single factor could have as much impact on the rising toll of cardiovascular deaths around the world as tobacco cessation".

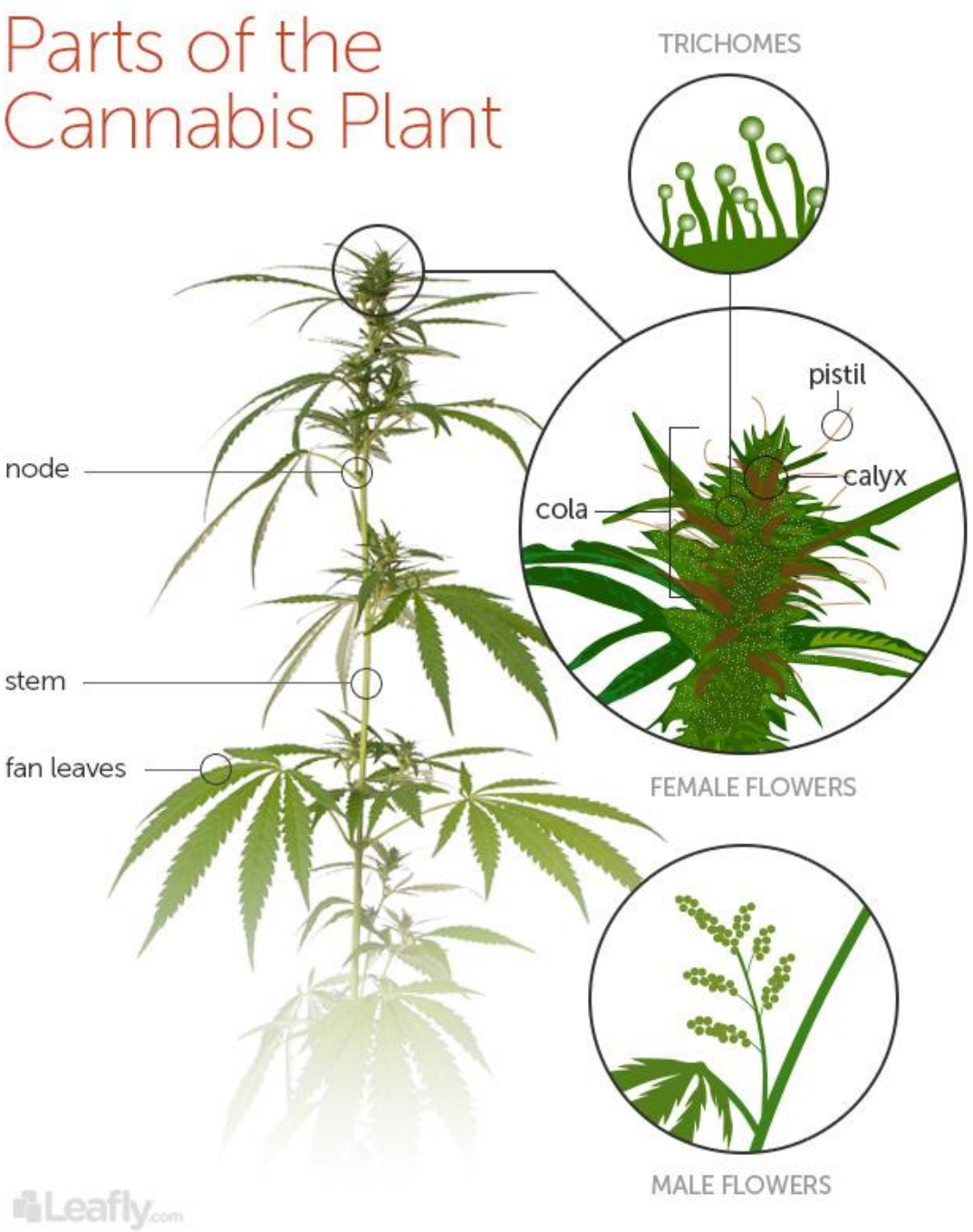
- Lower tar cigarettes do not substantially reduce the risk of heart attack in smokers.
- In the 1990s, smoking is estimated to be the cause of one in five male deaths from cardiovascular diseases in developed countries (and about 6% of female CVD deaths).
- Smoking causes about 30% of all cancer deaths in developed countries (40-45% of male cancer deaths, and 10-15% of female cancer deaths). On average,

about 90-95% of male lung cancer deaths in developed countries, and 70-75% of female lung cancer deaths, are due to smoking.

- If all tobacco-caused cancer deaths could be eliminated, then death rates from other causes of cancer for men and women would be similar in different industrialized countries and would have shown a stable, or even slightly declining trend over the last three or four decades.
- In 1995, WHO estimates that smoking was the cause of about 1.44 million male deaths in developed countries, and 475 000 female deaths in these countries. This represents one in four male deaths and about 10% of female deaths.
- Between 1950 and 2000, tobacco will have been the cause of over 60 million deaths in the developed countries (52 million men, 10 million women).

2. CANNABIS

Morphology



ANATOMY AND MORPHOLOGY OF THE CANNABIS PLANT

Knowing the parts of the cannabis and understanding their roles can help you pick out the highest quality strains at The New Amsterdam. In this post, we will covering the anatomy of the female cannabis plant, because the males do not produce cannabis flower we all know and love.

Just like most plants, cannabis begins with roots that transition into a stam. The cannabis stem is long and thin. The intersections between new stem offshoots and older stems is called the Node. The nodes are used to tell the sex of the plant, as indicators to when the plant is ready to be pruned, at the plant's temperature needs. Then there are the iconic marijuana fan leaves, and at the very top is the cola, which is where the flower blooms from. There are numerous colas amongst the budding sites below the main cola at the top.

The flower itself originates from a small nodule called the calyx. These small nodules are shaped like a water drop are what form the flower itself. Nodes normally have a large collection of trichomes on them.

Trichomes are the glands that secrete cannabinoids. When you look at a flower, the shining crystals on the tiny leaves, called sugar leaves, the crystallized secretions of Terpenes, THC, CBD, and other cannabinoids. A flower with a lot of these crystallizations will have higher cannabinoid counts, and typically be higher quality bud.

Finally, come the pistils. The pistils are the small, orangish brown, hairs that sprout from the flower. Although the pistils and a certain amount of aesthetic pleasure, they barely effect the potentency or flavor of the bud.

Cannabis Harvesting and Processing

It takes at least eight weeks for indoor cannabis plants to finish the flowering stage. It takes even longer for outdoor cannabis plants to be ready for harvest. After waiting patiently for the cannabis flowers to reach peak maturity, cultivators must take on the task of harvesting. Depending on the size of the garden, harvesting cannabis plants can be a very time consuming process. This has many cannabis growers turning to automation devices, which can alleviate some of the labor associated with the harvest. As with other crops, a cannabis harvest is generally done in stages. Although every garden is different and harvest techniques will vary from garden to garden, there are some steps that every cannabis grower should follow during the harvest process. After all, the way a cannabis plant is harvested and/or processed after the harvest will have a significant impact on the quality, potency, and longevity of the finished product.

Cannabis horticulturists with commercial operations stand to benefit the most from streamlining the harvest process. Having an efficient harvest process can reduce costs associated with labor and increase the overall return on investment. There are three stages that all cannabis horticulturists must go through at some point during the harvest process. The three stages are: the removal of the large fan leaves, trimming or

removing the remaining leaves in close proximity to the flowers, and removing the flowers themselves from the stems. Aside from these three steps, which address the physical removal of portions of the plant, other crucial stages of the harvest process include the drying, sorting, and curing of the cannabis flowers.

Fan Leaf Removal

Once a grower has deemed his or her cannabis plants ready for harvest, the first stage is to remove the large fan leaves. The large fan, or sun, leaves are easily identifiable as the stereotypical cannabis leaf. These leaves can be plucked by hand, cut with scissors, or removed with a device, such as a hand-held hedge trimmer. The large fan leaves do not contain a high amount of the sought-after cannabinoids like the leaves closer to the flowers or the flowers themselves. Because of this, many growers simply dispose of them. Once the fan leaves are removed, a cannabis grower has two choices: to trim the remaining leaf material while the plant is wet (wet trimming) or to begin the drying process and remove the remaining leaf material by hand or with an automated trim machine after the plant has dried.

Drying

Drying the cannabis plants is either done after the wet trim method or right after the large fan leaves have been removed (if the grower is opting for a dry trim method). Cannabis plants are usually hung upside down to dry and are either cut into smaller, more manageable sections (branches) or left as an entire plant during the drying stage. The ideal conditions for drying cannabis are temperatures between 65-75 degrees F with humidity levels around 45-55%. If possible, drying should take place in complete darkness as UV light from the sun or artificial lights could damage some of the cannabinoids or terpenes in the flowers. Generally speaking, it should take roughly 7-10 days to dry the cannabis plants. A grower will know the drying process is complete when he or she can bend the stem of a dried plant and the stem snaps.

De-stemming

If a wet trim method was implemented and the drying process is complete, the flowers can be de-stemmed and stored in the appropriate holding containers for the curing process. A cannabis cultivator who chooses a dry trim method and wishes to use an automated trimmer should begin the de-stemming process after the plants have dried. A sharp pair of garden scissors can be used to make a cut at the base of each flower to remove it from the central stalk. Although many growers de-stem by hand (with scissors), there are automated devices available that actually remove the flowers from the stem. Automating the de-stemming process can save a lot of time and effort, especially for commercial cannabis operations.

Sorting

Sorting cannabis flowers can be an important step in maximizing the efficiency of the harvest process. Separating the dried cannabis flowers into different sizes allows the cultivator to further process the flowers more effectively and efficiently. For example, processing the same size flower material in an automatic trim machine equates to more timely and more effective trimming. Automating the sorting of the cannabis flowers can have a dramatic impact over the entire harvest process, especially for large scale operations that already utilize other automated devices. Once the cannabis flowers are sorted, they can be further processed in a trim machine or other processing device depending on size. Sorting can also be done after the trimming process is complete. Sorting the trimmed flowers by size can make them more marketable.

Trimming

When done by hand, dry trimming can be a tedious and slow process. When done by the right machineyou can achieve the hand-trimmed look while maintaining quality and saving an immense amount of time. Thanks to gravity working its magic during the drying process, the leaves that need to be removed are now stuck against the flowers. The purpose of dry trimming is to remove as much of the leaf material surrounding the flowers as possible, thus exposing just the flowers (the most potent part of the cannabis plant). When dry trimming is done by hand, commercial cannabis grow operations need multiple workers to assist. Hired hands are not only costly, but also require micromanagement and increased security measures. This is why so many serious cannabis growers are relying on automation devices like commercial trim machines. After the flowers are properly dried and de-stemmed, they can be placed in the automated trim machine to receive a final manicure before the curing process.

For those who opt for wet trimming, this would occur before the drying process. Many growers choose a wet trim method because it makes it easy to access the leaves. For a smaller grow operation, where the leaves will be trimmed by hand, a wet trim method may be the most efficient way to trim. For large scale operations, where growers are using more automated methods, trimming the material after the flowers have been dried is often more efficient.

Curing

The curing process is the grand finale of the harvest process and is done after all trimming has been completed. During the curing process, the flowers continue to dry very slowly and this enriches the flowers's flavor. Containers used for the curing process should be stored in a cool, dark place where they can be examined daily. For the first week or two, the containers should be opened ("burped") once or twice a day. This lets out some of the built up humidity and allows some fresh air in. After the first week or so, the containers can be opened less frequently (anywhere from once a day to once every other day). After a couple of months, the curing process is complete and the cannabis flowers should be at their peak flavor. A proper cure can prolong the shelf life (potency, flavors, and odors) of the cannabis flowers.

The harvest process for cannabis is similar to that of many other crops in that there is no single right way to do it. However, as automation devices become more commonplace, more and more commercial operations will follow the particular methods that best maximize efficiency and effectiveness. Automation devices that aid in the trimming, de-stemming, and sorting of cannabis flowers are essential tools for commercial cannabis growers who wish to remain in an evolving, competitive market. These tools will not only reduce the costs associated with labor, but will also ensure the cannabis flowers get processed quickly and efficiently in order to best preserve the cherished potency, flavors, and odors.

Uses & Effectiveness

Possibly Effective for

- **Multiple sclerosis (MS)**

  Spraying a cannabis extract under the tongue seems to improve symptoms of multiple sclerosis such as muscle spasms, the need to urinate, and nerve pain in some people with MS. In the UK, this product is approved as a prescription drug to treat muscle spasms in people with MS. In Canada, this product is approved to treat nerve pain in people with MS. This product is not available as a prescription medicine in the US. Some early research suggests that taking a specific cannabis extract (Cannador, Society for Clinical Research) by mouth helps to reduce muscle stiffness and spasms in people with MS. But other cannabis extracts don't seem to help to reduce spasms or tremors or help with walking. Some early research shows that smoking cannabis may reduce muscle spasms, pain in the arms and legs, and tremors in people with MS.

- **Nerve pain**

  Most research shows that smoking cannabis can moderately reduce nerve pain caused by HIV and other conditions. The pain relief lasts for about 2 hours.

Health Hazards

Heart disease: Cannabis might cause fast heartbeat and high blood pressure. It might also increase the risk of a having heart attack.

However, in many cases, people who experienced these events after smoking cannabis had other risk factors for heart-related events such as smoking cigarettes or being overweight.

A weakened immune system: Certain chemicals in cannabis can weaken the immune system. This might make it more difficult for the body to fight infections.

Allergies to fruits and vegetables: Cannabis might increase the risk of an allergic reaction in people with allergies to foods like tomatoes, bananas, and citrus fruit.

Depression: Cannabis use, especially frequent use, might increase the chance of getting depression. It can also worsen symptoms of depression and increase thoughts about suicide in those that already have depression.

Diabetes: Cannabis use might make it harder to control blood sugar levels. It might also increase the risk for long-term complications from diabetes. Until more is known, be cautious using cannabis.

Liver disease: It is unclear if cannabis worsens chronic liver disease. While some weak evidence suggests that there might be a link, other evidence has not found a link. Until more is known, be cautious using cannabis.

Lung diseases: Cannabis can make lung problems worse. Regular use over a period of years might increase the risk of lung cancer. Some people develop a type of lung disease called emphysema.

Schizophrenia: Using cannabis might make symptoms of schizophrenia worse.

Quitting smoking: Using cannabis might make it harder to quit smoking. Early research suggests that people who use cannabis and want to quit smoking cigarettes are less likely to quit smoking after 6 months than people who don't use cannabis.

Stroke: Using cannabis after having a stroke might increase the risk of having a second stroke.

Surgery: Cannabis affects the central nervous system or the brain and nerves. It might slow the central nervous system too much when combined with anesthesia and other medications during and after surgery. Stop using cannabis at least 2 weeks before a scheduled surgery.

3. PAPAVER

Morphology

Erect robust annual herbs, glaucous, glabrous rarely sparsely setose, about 50-100 cm tall. Stem simple or branched. Root stock, erect, slender, conical. Leaves alternate, broadly lanceolate, ovate oblong, shallowly pinnatifid about 5-25 x 2-7 cm across, base obtuse or rounded, margin serrate-dentate, apex obtuse to acute, glaucous, glabrous both above and beneath, lateral veins and midrib impressed above, and prominent beneath, petiole glabrous about 1-2 cm long, upper cauline leaves, smallers and becoming more shallowly lobed, subsessile towards the shoot, base cordate-amplexicaul. Peduncles glabrous or sparsely bristly, about 5-25 cm long. Flowers bisexual, solitary, terminal, about 3-10 cm across, white, pale pink, pale purple, sometimes with black blotch at the base, flower buds oblong-ovoid, apex obtuse, about 1.5-3 x 1-2 cm across, Sepals 2, free, deciduous, ovate-orbicular, early caducous, glabrous, petals 4, obovate, overlapping, apex rounded wavy, white, pale pink, pale purple, sometimes with black blotch at the base, about 3-6 x 3-8 cm across. Stamens numerous, usually as long as the ovary, filaments filiform, slender, yellowish, about 5-10 mm long, anthers oblong-elliptic, about 1-1.5 mm long. Ovary ovoid-globose, unilocular, superior, glabrous, about 10 mm long, ovules numerous, stigmatic rays disc yellow, enlarged, opposite to placentas, rays about 7-18. Fruits capsules, globular-ovoid, base rounded, apex flat topped, glabrous, about 2-7 x 5-6 cm across, dehiscing by subapical pores or persistent disc. Seeds many, globose, reniform, pale grayish white, black or grayish brown, about 0.3 mm across, rich in oil.

Processing

The opium poppy does best in temperate, warm climates with low humidity and requires only a moderate amount of water before and during the early stages of growth. In addition, the opium poppy is a "long day" photo-responsive plant. As such, poppies require long days and short nights before they will develop flowers. The opium poppy plant can be grown in a variety of soils-clay, sandy loam, sandy, and sandy clay-but it grows best in a sandy loam soil. This type of soil has good moisture-retentive and nutrient-retentive properties, is easily cultivated and has a favorable structure for root development. Clay soil types are hard and difficult to pulverize into a good soil texture. The roots of a young poppy plant cannot readily penetrate clay soils, and growth is inhibited. Sandy soil, by contrast, does not retain sufficient water or nutrients for proper growth of the plant. Excessive

moisture or extremely arid conditions will adversely affect the poppy plant's growth, thus reducing the alkaloid content Poppy plants can become waterlogged and die after a heavy rainfall in poorly drained soil. Heavy rainfall in the second and third months of growth can leach alkaloids from the plant and spoil the harvest. Dull, rainy, or cloudy weather during this growth stage may reduce both the quantity and the quality of the alkaloid content.

In August or September, toward the end of the rainy season, highland farmers in Southeast Asia prepare fields selected for opium poppy planting. By this time, the ash resulting from the bum-off of the previous dry season has settled into the soil, providing additional nutrients, especially potash. The soil is turned with long-handled hoes after it is softened by the rains. The farmers then break up the large clumps of soil. Weeds and stones are tossed aside and the ground is leveled off.

The opium poppy plants form leaves in the first growth stage, called the "cabbage" or "lettuce" stage. After a month of growth, when the opium poppy is about a foot high, some of the plants are removed (called "thinning") to allow the others more room to grow. The ideal spacing between plants is believed to be 20 to 40 centimeters, or about eight to twelve plants per square meter, although some researchers in northern Thailand have reported as many as 18 plants per square meter. During the first two months, the opium poppies may be damaged or stunted by nature through the lack of adequate sunshine, excessive rainfall, insects, worms, hail storms, early frost, or trampling by animals. The third month of growth does not require as much care as the first two months. Three to four months after planting, from late December to early February, the opium poppies are in full bloom. Mature plants range between three to five feet in height. Most opium poppy varieties in Southeast Asia produce three to five mature pods per plant.

Opium Harvesting Methods

The scoring of the pods (also called "lancing," "incising," or "tapping") begins about two weeks after the flower petals fall from the pods. The farmer examines the pod and the tiny crown portion on the top of the pod very carefully before

scoring. The grayish-green pod will become a dark green color as it matures and it will swell in size. If the points of the pod's crown are standing straight out or are curved upward, the pod is ready to be scored. If the crown's points turn downward, the pod is not yet fully matured. Not all the plants in a field will be ready for scoring at the same time and each pod can be tapped more than once. A set of three or four small blades of iron, glass, or glass splinters bound tightly together on a wooden handle is used to score two or three sides of the pod in a vertical direction. If the blades cut too deep into the wall of the pod, the opium will flow too quickly and will drip to the ground. If the incisions are too shallow, the flow will be too slow and the opium will harden in the pods. A depth of about one millimeter is desired for the incision. Using a blade-tool designed to cut to that depth, scoring ideally starts in late afternoon so the white latex-like raw opium can ooze out and slowly coagulate on the surface of the pod overnight.

If the scoring begins too early in the afternoon, the sun will cause the opium to coagulate over the incision and block the flow. The opium oxidizes, darkens and thickens in the cool night air. Early the next morning, the opium gum is scraped from the surface of the pods with a short-handled flat, iron blade three to four inches wide. Opium harvesters work their way backwards across the field scoring lower, mature pods before the taller pods, so as not to inadvertently spill the sticky ooze. The pods will continue to secrete opium for several days. Fanners will return to these plants-- sometimes up to five or six times-to gather additional opium until the pod is totally depleted. The opium is collected in a container which hangs from the farmer's neck or waist

The opium yield from a single pod varies greatly, ranging from 10to 100 milligrams of opium per pod. The average yield is about 80 milligrams. The dried opium weight yield per hectare of opium poppies ranges between eight and fifteen kilograms of opium. As the farmers gather the opium, the larger or more productive pods are tagged with colored string or yarn. These pods will later be cut from their stems, cut open, dried in the sun and their seeds will be used for the following year's planting. The wet opium gum collected from the pods contains a relatively high amount of water and needs to be dried for several days.

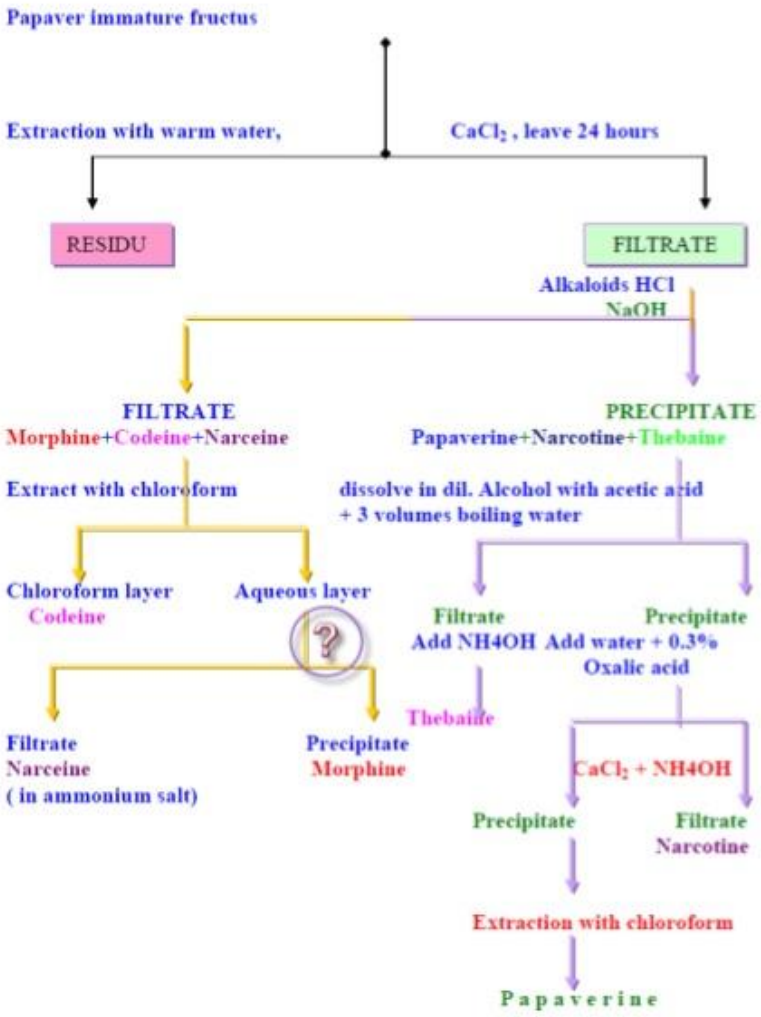
High-quality raw opium will be brown (rather than black) in color and will retain its sticky texture. Experienced opium traders can quickly determine if the opium has been mixed with tree sap, sand or other such materials.

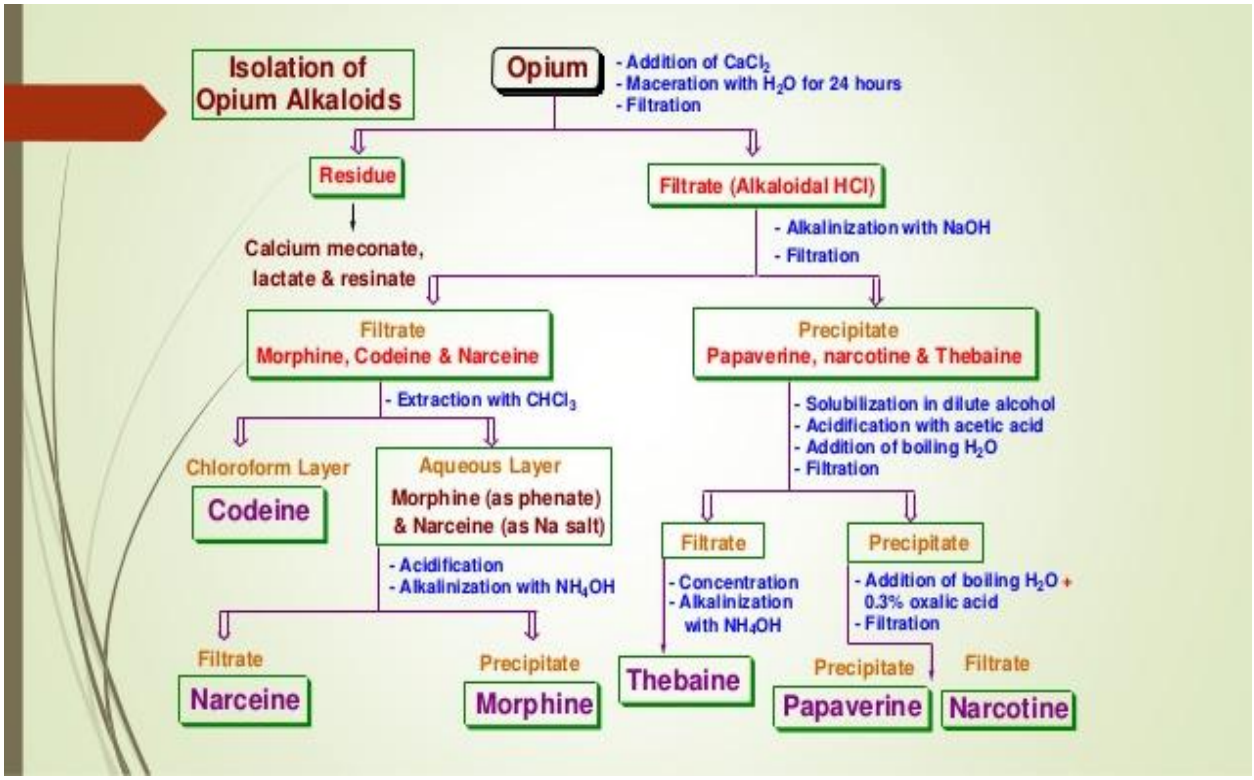
Raw opium in Burma, Laos and Thailand is usually sun-dried, weighed in a standard 1.6 kilogram quantity (called a "viss" in Burma; a "choi" in Laos and Thailand), wrapped in banana leaf or plastic and then stored until ready to sell, trade, or smoke. Opium smoking is common among most adult opium poppy farmers, whereas heavy addiction is generally limited to older, male farmers. The average yearly consumption of cooked opium per smoker is estimated to be 1.6 kilograms.

A typical opium poppy farmer household in Southeast 'Asia will collect 2 to 5 choi or viss (3 to 9 kilograms) of opium from a year's harvest of a one acre field. That opium will be dried, wrapped and stacked on a shelf by February or March. If the opium has been properly dried, it can be stored indefinitely. Excessive moisture and heat can cause the opium to deteriorate but, once dried, opium is relatively stable. In fact, as opium dries and becomes less pliable, its value increases due to the decrease in water weight per kilogram.

Before opium is smoked, it is usually cooked. Uncooked opium contains moisture, vegetable matter and other impurities which detract from a smooth-smoking product. The raw opium which is collected from the opium poppy pod is placed in an open cooking pot of boiling water, where the sticky globe of opium alkaloids quickly dissolve. The soil, twigs, plant scrapings, etc. remain undissolved. The solution is strained through cheesecloth to remove these impurities. The clear brown liquid, sometimes called "liquid opium," is actually opium in solution. This liquid is then re-heated over a low flame until the water turns to steam and is driven off into the air. When the water has evaporated, a thick paste remains. This paste is called "prepared opium," "cooked opium," or "smoking opium" and itis dried in the sun until it has a putty-like consistency. The net weight of the cooked opium is generally about twenty percent lighter than the original raw opium. Likewise, cooked opium is also more pure than in its original, raw form.

Isolation of Opium Ingredients





Use

Poppy extracts have traditionally been used to relax smooth muscle tone, making them potentially useful in the treatment of diarrhea and abdominal cramping. The extract has been used as a sedative analgesic and antitussive. Poppy seed oil is used as a vehicle for chemotherapy delivery and to diagnose fistulae. However, there are no clinical trials to support these uses. Morphine is prepared from the opium poppy.

The chemistry of the genus Papaver is well known. When the unripened seed capsule is scored, a milky latex exudes. The dried latex is known as opium, which contains more than 30 alkaloids. The most important of these alkaloids are morphine (20%), noscapine (5%), codeine (2%), papaverine (2%), and thebaine (1%). Codeine is the most widely used opium alkaloid and is obtained from natural sources or through the methylation of morphine or synthetic transformation of thebaine.

Because of the medicinal importance of morphine derivatives, efforts have been made to identify a species of Papaver that contains high levels of a suitable starting compound for the commercial synthesis of codeine. In some varieties of P. bracteatum, thebaine constitutes 98% of the total alkaloid content.

Commercially, thebaine may be readily converted to codeine, oxycodone, hydrocodone, or dihydrocodeine. P. bracteatum may become the species of choice as a legal source of alkaloid precursors. Poppy seed oil, used as a vehicle for pharmacological substances as well as oil-based paints, varnishes, soaps and liniments contains saturated palmitic and stearic acids and oleic, linoleic, alpha-linolenic, and other unsaturated fatty acids. Poppy seeds and their oil contain only minuscule amounts of opium alkaloids.

Health Hazards

Opium is known for its highly addictive qualities. It has been associated with poisoning and characterized by symptoms of sedation, sluggishness, and abdominal contractions. Allergy and anaphylaxis to poppy seed have been reported.

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