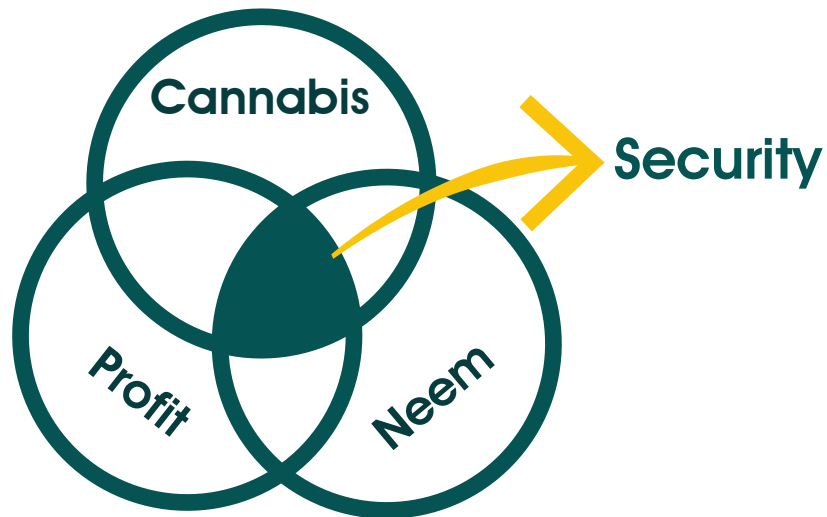




# Primal Group's Green Economy

## Industry Review: Cannabis



2020

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# Cannabis: A New Market Opportunity

## Inside America's \$7 Billion Legal Cannabis Industry

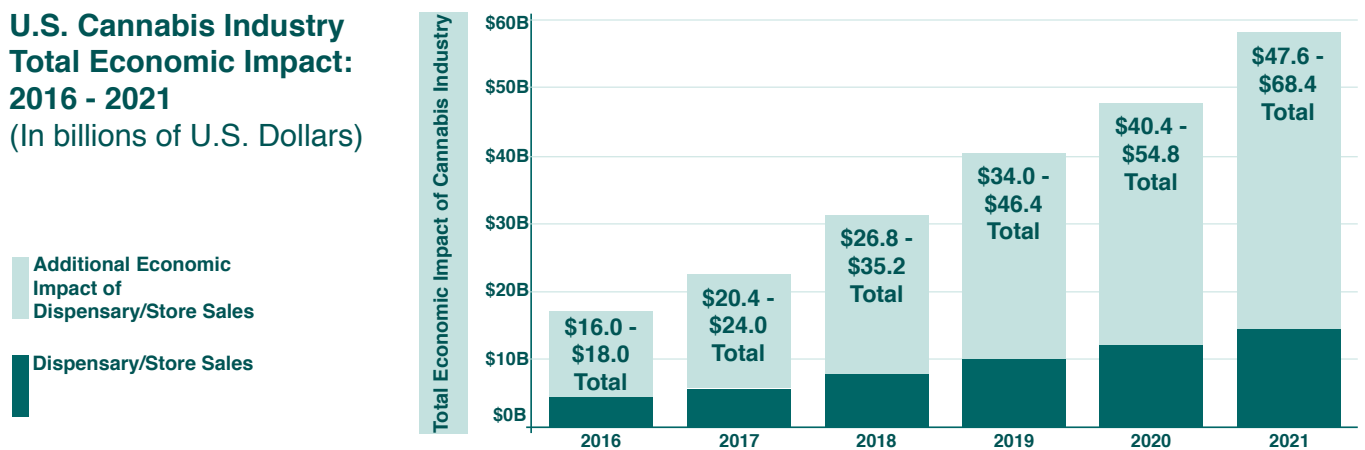
The legal cannabis market in the United States has grown by an impressive 34% to \$6.73 billion in 2016 alone. Industry forecasts expect the market will reach \$21.6 billion by 2021 at a compound annual growth rate (CAGR) of 26%<sup>1</sup>. Only Cable Television (19%) in the 1990s and Broadband Internet (29%) in the 2000s have matched such rapid growth, yet this still remains only a drop in the estimated \$50 billion spent on illegal cannabis across the country<sup>2</sup>. Many high profile investment banks, asset managers and private investors are paying close attention to what is widely being referred to as the 'green rush'. After years of small-plot cannabis cultivation, out of sight from the authorities, the crop will become mainstream and industrial.

Cannabis is in the midst of a rapid transformation from an industry dominated by black-market players into a legal and impressive economic force, quickly becoming a major generator of jobs, tax revenue and new business opportunities. Whether as a medical solution to a variety of ailments or simply for personal use, cannabis is quickly becoming mainstream. Daily cannabis consumption in the United States has risen from 3.9 million people in 2002 to 8.4 million in 2014<sup>3</sup>. Fewer Americans consider cannabis harmful

than ever before, with only 33% of 595,500 adults surveyed by Lancet Psychiatry advocating against cannabis legalization in the same year. In 2002, the figure was closer to 51%<sup>4</sup>. The share of Americans who favor cannabis legalization also continues to rise, with 60% in agreement last year and only 37% in opposition (3% abstained)<sup>5</sup>. The ongoing shift in public opinion will only lead to more support for pro-cannabis legislation as well as more demand for cannabis and cannabis-related products. Much like alcohol after the prohibition era, legal cannabis is a new market set to become a major economic driver and job creator for the American economy.

According to Cowen & Co., the legal cannabis industry in the United States is expected to reach \$50 billion by 2026 at a CAGR of 24%. Cannabis stocks grew by over 236% in 2016, significantly outperforming all other major indices<sup>6</sup>. New Frontier expects that the legal cannabis market will create more than 250,000 jobs as early as 2020<sup>7</sup>. This is more than the expected jobs from manufacturing, utilities or even government, which according to the Bureau of Labor Statistics will all decline in the same period. Above all else, it will be the sheer economic impact of the cannabis industry that will ensure it's survival

### U.S. Cannabis Industry Total Economic Impact: 2016 - 2021 (In billions of U.S. Dollars)



Source: Marijuana Business Daily. US Marijuana Industry's Economic Impact to Approach \$70 billion by 2021 (2017)

1. Arcview Market Research. The State of Legal Marijuana Markets, 5th Edition. (2017). 2. Forbes. Total Marijuana Demand Tops Ice Cream in the US (2017). 3. The Guardian. Ten Million More Americans Smoke Marijuana Now than 12 Years Ago (2016). 4. The Lancet. Increasing Number of US Adults Marijuana as Fewer People Consider the Drug as Harmful (2016) 5. Pew Research Center. The Support for Marijuana Legalization Continues to Rise (2016). 6. Entrepreneur. Cannabis Stock Index Grew 236% in 2016 (2017). 7. New Frontier Data. US Cannabis Market Creates 283,422 Jobs by 2020 (2017).

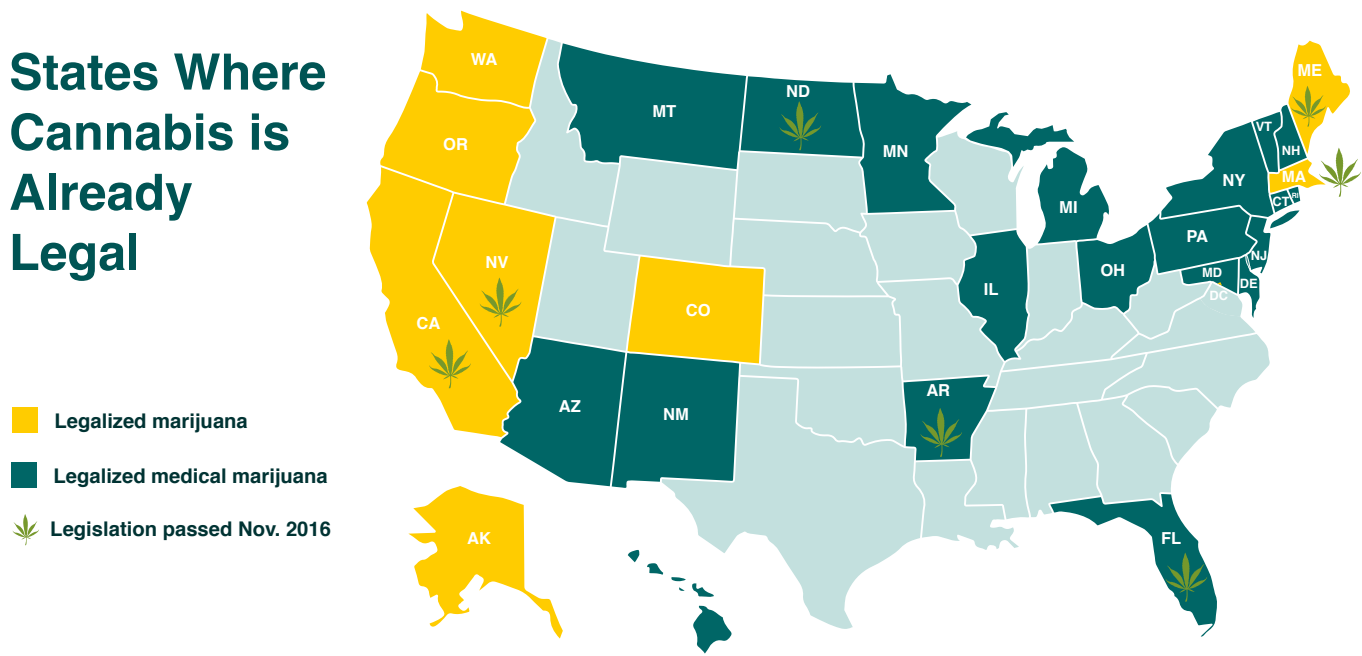
and outperformance in the medium to long term. The US cannabis industry is poised to inject nearly \$70 billion every year into the American economy through wages, taxes and ancillary markets by 2021. This is a substantial amount of capital that will drive more towns and states to accept cannabis businesses into their communities<sup>8</sup>.

Another sign of legitimacy in the growing cannabis market is the increasing complexity of financial products associated with the crop. Online marijuana trading platforms such as Americanex and the Canadian Cannabis Commodities Exchange are already in operation. Futures markets will be next on the agenda. Privateer Holdings, the world’s first private equity company devoted exclusively to the legal marijuana industry, launched in 2010 and is the first in the cannabis business to cross the \$100 million mark. Their portfolio includes medical marijuana producer Tilray, Bob Marley’s marijuana brand Marley Natural and Leafly, known to many as the ‘Yelp’ of the cannabis world. Tuatara Capital raised \$93 million to invest in cannabis businesses ranging from Willie Nelson’s brand Willie’s Reserve to TeeWinot Life Sciences, a biopharmaceutical firm specializing in

cannabis production. Madman Capital, Poseidon Asset Management and Casa Verde have raised over \$150 million dollars for investing in consultancy, data analytics, biotechnology, packaging and delivery services<sup>9</sup>.

Australia, Bangladesh, Cambodia, Canada, Chile, Colombia, Costa Rica, the Czech Republic, Germany, India, Jamaica, Mexico, the Netherlands, Portugal, South Africa, Spain and Uruguay are countries around the world that have decriminalized cannabis. As one of the fastest growing markets in the United States, the ‘business for bud’ is attracting increasing interest and consequently capital investment. From Denver to Los Angeles, legal cannabis dispensaries are becoming as common as coffee shops, and yet the industry continues to experience some growing pains. Cannabis remains illegal on the federal level in America, which has led to conflicting state laws, restrictive legislation and problems for cash-only marijuana business owners and operators.

## States Where Cannabis is Already Legal



Source: Business insider (2016)

8. Marijuana Business Daily. US Marijuana Industry’s Economic Impact to Approach \$70 by 2021 (2017). 9. Investopedia. Want to Make Money in Marijuana? Read this first. (2016)





## Understanding the Regulatory Hurdles in Cannabis Financing

2016 was a significant year for cannabis legislation in America. As Donald J. Trump was elected as 45th President of the United States, eight state laws were passed to allow either medicinal or recreational cannabis use. This means that 29 states in the US today have comprehensive medicinal marijuana laws and nearly 1 in every 5 Americans live in a place where adults can legally consume weed recreationally. The government even owns Cannabis Corner, a cannabis store where all profits go to special city projects. This recent easing of legislation has enabled a new industry to thrive on the state level. Yet federal regulations still prohibit the production, sale and distribution of cannabis, causing concern for new participants in the marketplace.

Cannabis, whether for medical or recreational purposes, remains illegal under federal law in the United States. The first US government regulation for cannabis was the Marijuana Tax Act in 1937. As with the Harrison Narcotic Act in 1914, Congress deemed an act taxing and regulating drugs, rather than prohibiting them, less susceptible to legal challenge. This outlawed the possession and sale of cannabis on the federal level. Listed under Schedule 1 of the Controlled Substances Act in 1971, the federal government deemed cannabis as having no medical use and a high potential for abuse. This was mainly regarded as an attempt to stifle the counterculture movement, especially when the Shafer Commission, or the National Commission on Marijuana and Drug Abuse, recommended that marijuana be decriminalized less than a year later. If removed from its Schedule 1 classification, scientists and physicians would be able to access cannabis and evaluate its medicinal properties in greater detail. This decision has remained in effect to this day, but is now finally being reconsidered in light of unprecedented push back from the electorate, government officials and business owners around the country.

In the meantime, these outdated laws have become a burden for organizations and investors who are interested in entering the new and exciting cannabis market. One of the biggest deterrents in investing in the cannabis space at the moment is the conflict between state and federal laws and the uncertainty that this causes in the market. Any business that handles the physical production, distribution or sale of the crop across the US risks facing asset forfeiture if they do not comply with the regulations in the Cole Memorandum, the expectations set forth by the then-Attorney General James Cole for states that have legalized cannabis.

A major concern for cannabis producers is Tax Code Section 280E, which states that no deduction or credit shall be allowed for any amount paid or incurred in carrying any physical element of the trade in controlled substances. This enables the Internal Revenue Service (IRS) to set drastic monetary penalties. The Green Solution Retail Inc, has recently failed to receive an injunction to avoid IRS audit for this very reason.

Another issue is the fact that financial institutions in the United States are regulated at the federal level, which means that cannabis businesses are forced to operate without a bank account. This is a clear security concern for those handling millions of dollars in cash.

Dispensaries and grow operations around the country have been forced to shut at a moment's notice. In 2015, California authorities seized 329 outdoor grow sites and hauled away 2.64 million plants<sup>10</sup>. While this is indeed becoming less common as the legislative environment eases, many mainstream investors and organizations are holding off on any cannabis-related investments, leaving many opportunities open in the market place.

10. National Drug Intelligence Center. Marijuana (2016).

## Entering the Fragmented Market Through Cannabis Crop Care

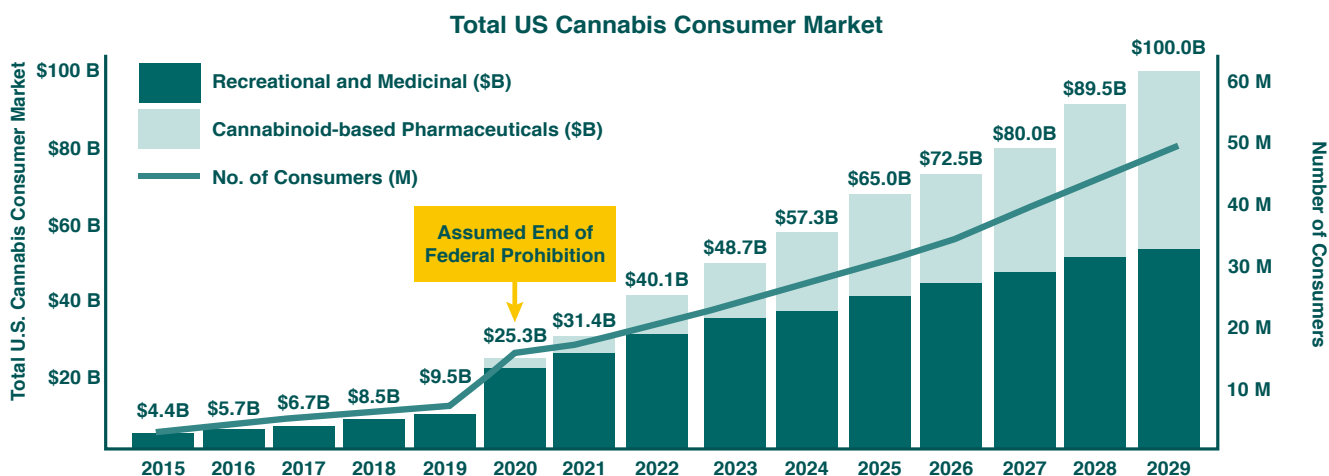
Cannabis industry insiders all agree that investing in businesses that handle the physical production, distribution, and sale of cannabis is at present risky and difficult in light of persistent legal pressures. One of the safest and most profitable ways to benefit from the impressive growth of cannabis is to invest in the ancillary markets on which the industry depends.

These ancillary businesses are quickly and quietly working across the United States to become household names in the cannabis industry. Federal legislation has kept barriers of entry low, margins high and major competitors like Walmart, Amazon and Home Depot, away. This is the perfect environment for entrepreneurs and investors to enter the market. From software and data analytics to crop care solutions and social media platforms, investors in these sectors are reaping massive benefits as legalization increases demand. So what is the best way to capitalize on the \$7 billion and rising market? Our money is on cannabis crop care.

Legal cannabis is quickly reaching an industrial level. After years of clandestine cultivation - in hidden wooded areas or small gardens, out of site from authorities - new businesses are setting up grow operations across the United States. In the midst of spinach, strawberries, and grapes, cannabis is making its way into big agriculture. Thousands of acres of farmland are now dedicated to the crop.

The United Nations estimates that law enforcement seizes only 20% of cannabis produced in the US<sup>11</sup>. If you consider that 2.64 million cannabis plants were seized in California in 2015, the state would have had 13.2 million plants. GFarms established the largest grow operation in the region, spanning 100,000 square feet of facilities across three greenhouses on seven acres of land. Colorado boasts a 36-acre field dedicated to cannabis, plus 21 other acres grown in indoor facilities around the state. AmeriCann has announced plans to build the nation’s largest grow facility in Massachusetts. These cannabis fields will begin on a 53-acre tract and include energy efficient greenhouses for cultivation, plant-processing spaces, facilities for creating infused products and even a testing laboratory. According to the Cannabis Business Times’ research, 77% of cultivators plan to add square footage to their existing operations in the next two years—an average of 22,300 square feet per operation<sup>12</sup>.

Whether in warehouses, greenhouses or even out in the field, farmers are realizing the value of cannabis as part of a productive crop rotation. Cannabis is also a highly adaptable crop, one that is easily maintained on a personal scale. With so many individuals and farmers interested in growing their own produce, the demand for cannabis crop care solutions is at an all time high.



Source: Ackrell Capital (2017)

11. United Nations. World Drug Report (2016) 12. Cannabis Business Times. Confidence Over Uncertainty: State of the Industry Report (2016).

# Developing Sustainable Systems for Cannabis Cultivation

**Increasing production quickly, efficiently and naturally, without sacrificing quality, is the ultimate objective for all cannabis farmers. Pioneering the future by integrating the best of the natural world with innovative technologies will ensure consumers always receive safe, certified and reliable products.**

## A Turning Point for Cannabis Crop Care

Cannabis legalization will not only have great economic benefits but will also help protect the environment. For years, surreptitious growers introduced synthetic crop care chemicals, waste and irrigation networks in otherwise pristine ecosystems. Given that cannabis production has developed and operated in unregulated settings, and with the absence of guidance from regulatory institutions such as the Environmental Protection Agency, various crop care practices have been adopted that place little to no importance on human safety and environmental impact.

Global patterns of cannabis cultivation have followed a fascinating development, from highly concentrated production in certain developing countries to decentralized production in almost every country around the world. Easing regulations and widespread access to knowledge and technology has enabled the plant to be grown nearly everywhere. We are entering a new age where consumers around the world are becoming informed and empowered by the unprecedented access to knowledge. A simple search online will give you the information necessary to set up new grow operations, while also warning you of the most substantial challenges in cultivation. This ranges from integrated pest management practices, humidity controls, temperature levels, yield consistency and maintaining a consistent product. A substantial amount of physical resources and knowledge are required for cultivation of any size and regardless of preparation, recreational growers and new entrants in commercial cultivation are currently relying on dangerous horticultural practices.

By legalizing cannabis, production will clean up

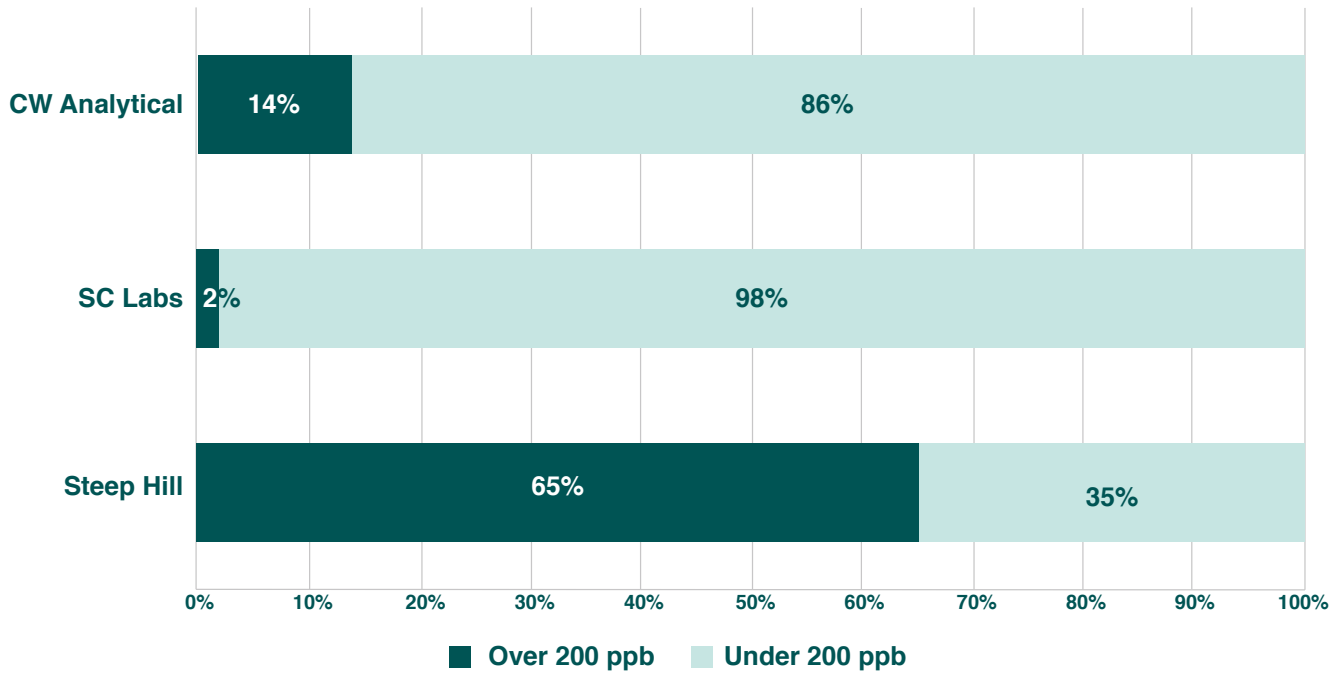
substantially as new regulations on grow operations will eliminate strain on public lands and meet higher standards for the use and disposal of toxic crop care chemicals. One major concern is the unregulated use of synthetic agrochemicals, which is quickly becoming a significant public health threat. Cannabis is a high-value crop that is frequently damaged by molds and insects. The recent surge in sales of immature clones has spread cannabis pests and diseases across several states. Synthetic pesticide and fungicide use has been increasing rapidly in response, despite the lack of research available on how damaging these chemicals are when consumed.

Most studies on pesticide toxicity on crops are based on oral ingestion exposure. Inhalation presents a different set of risks, as chemicals enter the bloodstream without undergoing first-pass metabolism by the digestive systems. Synthetic pesticides on cannabis can be transferred into cannabis smoke with efficiencies as high as 70%<sup>13</sup>. Steep Hill Labs found that about 84% of medical cannabis samples tested by the lab over a 30-day period tested positive for pesticide residues<sup>14</sup>. A chemical residue belonging to myclobutanil, a key ingredient in pesticide Eagle 20, was found in more than 65% of samples tested. Commonly used by growers due to its effectiveness against powdery mildew and other pests, myclobutanil turns into hydrogen cyanide or prussic acid when burned. This is a colorless and extremely poisonous compound that can be lethal in high doses.

According to the Centers for Disease Control and Prevention, hydrogen cyanide affects organs most sensitive to low oxygen levels, including the brain,



### Percentage of California Cannabis Sample with Myclobutanil Over 200 ppb\*



\*parts per billion

Steep Hill Labs (2017)

cardiovascular system and lungs<sup>15</sup>. This has led to the EPA releasing a letter indicating that they will accept applications for Special Local Need (SLN) registrations for pesticides intended for use on cannabis. The first real acknowledgment of the cannabis industry by a federal agency that regulates traditional agriculture, this is a clear sign that momentum is growing in this space and it is only a matter of time before cannabis crop care enters the mainstream.

Growers are in a difficult position, as many are dependant on synthetic chemical pest management and crop care techniques without fully knowing the true impact of their use. The disconnect between the

willingness of some states to regulate, sell, and tax marijuana and the federal reluctance to enable further research leaves an increasing number of people without the information to make informed, science-based choices. One solution is the application of safe, natural and biological crop care solutions that cause no negative environmental impact and most importantly are non-toxic to the consumer and the environment. A more informed public and consumer will seek greater accountability and transparency in sustainable methods for cannabis production, a shift already seen across fashion, food and Beauty & Personal Care (BPC) markets.



15. Centers for Disease Control and Prevention. Hydrogen Cyanide (AC): Systematic Agent (2016).

## Ensuring Transparency and Credibility in the Cannabis Industry

Cannabis is set to become one of the most highly regulated industries in the United States. While this may seem like an initial challenge to overcome, it is a fantastic opportunity to help ensure that transparency exists within the marketplace and across the entire supply chain. Walk into any licensed cannabis farm in North America and one of the first things you will notice are the barcodes. Every plant has one and many growers and retailers are utilizing radio frequency ID chips to keep a precise record of where the cannabis plant was grown, which cultivation practice was used and whether any agrochemicals were sprayed.

Setting up a cannabis cultivation business is a significant challenge due to the complex, and often confusing regulations from a state-licensing board that is unfamiliar with the industry. Additionally, each state has their own regulations and some require cannabis businesses to adopt vertical integration, forcing them to operate from seed to sale. State advisory boards also have advisory panels on specific topics such as synthetic agrochemical use, packaging and distribution. Gone are the days where growers can spray crops with chemicals without fear of any consequences. Strict testing regimens are being employed nationwide. State-level Cannabis Enforcement Divisions regularly show up unannounced to verify the cultivation practices as well as the amount of flower produced by the operation to ensure that this matches with what the state has recorded in their real-time inventory systems. Microsoft's entrance into the already crowded field of cannabis compliance software in early 2017 speaks to the widespread implementation of cannabis regulation that will take place in the short-term.

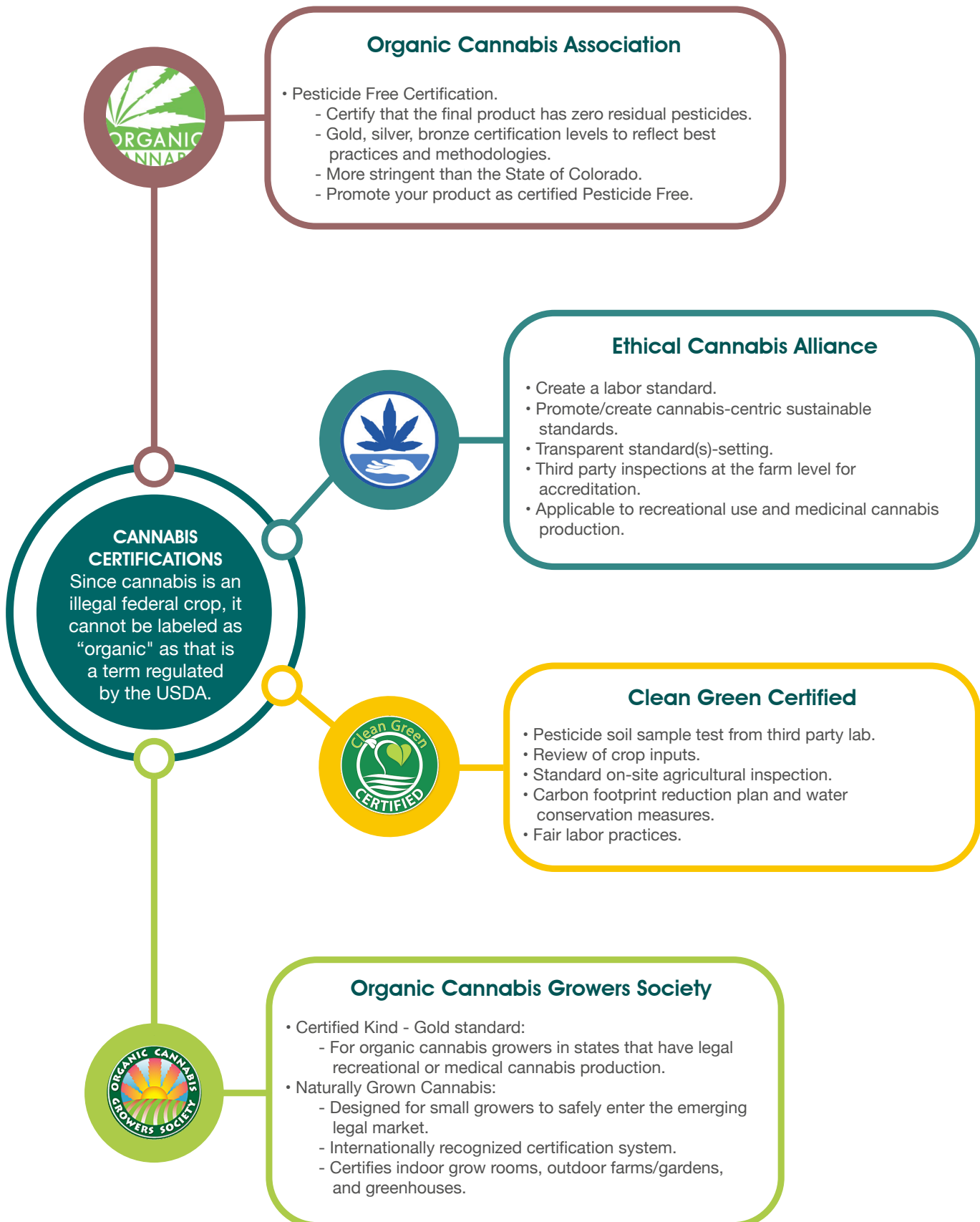
The California Bureau of Marijuana Control issued a draft plan that set some of the strictest regulations in the country for solvents, pesticides and microbial contaminants such as fungus and bacteria in the sticky bud, pills and edibles sold at medical cannabis dispensaries. California's proposed regulations are highly technical and subject to change, but many in the business agree they are equivalent to a ban of synthetic pesticides. The proposal sets parts per million limits for 88 different solvents, chemicals and pesticides, including myclobutanil, and the insecticides carbaryl and malathion, which are commonly used to control bugs that attack fruits, vegetables and cannabis plants. As one of the first states to legalize

medicinal and recreational cannabis, many states are extremely likely to follow suit when setting up their regulatory frameworks. "It's a very high bar and it's going to send ripples through the industry, and I think that's a good thing," said Hezekiah Allen, Executive Director of the California Growers Association, which advocates for more than 600 marijuana business owners.

As consumers become more educated and aware of cannabis cultivation's more dangerous traditions, producers and their governments will continue to adopt policies in favor of safe and agro-ecological practices. This will further expedite the industry's transition to safer and sustainable cultivation methods to protect resources, prevent environmental degradation and ensure safe cannabis throughout the marketplace.



## Cannabis Certifications Currently Available:





## Shaping the Future of Cannabis Cultivation with Natural Innovations

Professional cannabis growers around the country are going green and campaigning to create programs that aim to regulate the use of synthetic agrochemicals. An industry once characterized by negative connotations and a lack of research finds new opportunities in sustainability. Clean Green Certified, Certified Kind and the Organic Cannabis Association are the leading authorizing bodies in this space. Over 250 growers across the nation are in the Clean Green certification program and a Clean Green certified grower has won the High Times medical cannabis cup every year since 2010<sup>16</sup>. In June 2017, the Organic Cannabis Association merged with fellow non-profit

the Ethical Cannabis Alliance. This has resulted in the formation of the Cannabis Certification Council, which will independently certify cannabis products as “Organically Grown” and “Fairly Produced”. These certifications give consumers assurance that they are purchasing safe, clean and environmentally friendly products that support their local communities.

The transition towards organic cultivation practices for cannabis will ultimately lead to better yields, flavor and quality.

## Over 250 growers across the USA are Clean Green Certified



# The Neem Solution

An evergreen and part of the Meliaceae (Mahogany) family, neem has been celebrated for its remarkable healing properties as far back as 5,000 BC by the Harappa and Monejo civilizations. Described in ancient Indian Ayurvedic texts as 'Sarva roga nivarini' (the universal healer of all ailments) and 'Nimba' (giver of good health), neem's name in Sanskrit is 'Arista' - meaning 'perfect, complete and imperishable'. Fast-forward to the present day and this incredible resource is becoming renowned for its contributions to sustainable agriculture, healthcare, and environmental protection due to its high nutritional content as well as a variety of antibacterial, antimalarial, antiviral and antifungal properties.

**Renowned institutions such as the Mayo Clinic, University of Oxford, the Massachusetts Institute of Technology and the National University of Singapore are currently investigating the extensive benefits that neem offers.**

## An Essential Resource in Organic Crop Care

The fact is that healthier cannabis, with higher yields, can be produced without the use of synthetic chemicals that exhaust natural capital and pollute the environment. This can be achieved with neem, one of the most effective and comprehensive solutions in cannabis crop care.

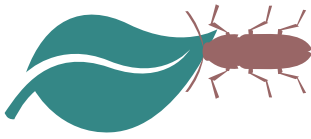
Referred to by the United Nations as the 'Tree of the 21st Century', neem is an extremely powerful, cost-effective and non-toxic alternative to synthetic agrochemical use. Neem boasts a complex chemical structure, as the seeds contain approximately 200 biologically active compounds, of which azadirachtin, nimbin, nimbidin and nimbolides are major molecules<sup>17</sup>.

Effective against an estimated 600 species of insects, neem oil acts on the hormonal systems of pests and therefore does not lead to the development of resistance in future generations. Azadirachtin, a chemical compound found exclusively in the neem tree, holds the secret to organic and sustainable crop care. Biodegradable and non-toxic to mammals, azadirachtin disrupts the growth cycle of insects and deters them from feeding on plants. By affecting the hormonal balance of insects, azadirachtin reduces their rate of reproduction and inhibits normal feeding behavior. As neem-based products must be ingested to take effect, only insects that feed on plant tissues are prone, thereby eliminating any risk towards pollinators and other natural insects that are beneficial to our environment<sup>18</sup>. Neem is also used as a natural fertilizer, helping to strengthen soil health while protecting plant roots from illness.





## Neem offers these comprehensive modes of action:



**Feeding Deterrence:** The presence of complex chemical compounds such as azadirachtin, salannin and melantriol disrupts the digestive ability of leaf-eating insects. The associated feeding deterrence can be so strong that pests will refrain from ever eating again, eventually starving to death.



**Insect Growth Regulation:** Ecdysis, or molting, is the shedding of skin to facilitate the growth stages of pest larvae or nymphs. This process is governed by the enzyme ecdyzone. Neem suppresses ecdyzone, trapping the pest in their larval stage, eventually causing death.



**Oviposition:** Neem reduces pest populations by preventing females from laying eggs.



**Repellence:** Neem contains compounds that repel insects in much the same way as garlic sprays.



**Sterilization:** Most susceptible males are sterilized by neem compounds, and many of the female species are similarly affected. The sterilization of eggs has also been recorded.



**Fungicidal Control:** Neem acts as a contact fungicide by inactivating key enzymes and interfering with metabolic processes.



**Induced Resistance:** Crops treated with neem produce and accumulate elevated levels of specialized proteins and other compounds, which inhibit the development of fungal and bacterial diseases. In effect, the crop's immune system is triggered to defend against destructive diseases.

## Neem is effective against these types of pests:



### Orthopteras

Grasshoppers, crickets and locusts

### Homopteras

Aphids, leafhoppers, psyllids, whiteflies, scale insects, mealybug



### Thysanopteras

Thrips Coleoptera: Mexican bean beetles and cucumber beetles

### Lepidopteras

Moths, armyworms, fruit borers, corn borers, caterpillars, pink boll worm, cutworm, Stem borers, Semi loopers, diamond black moth, plum moth, leaffolders and tobacco horn worms.



### Dipteras

Leafminers, pod flies, fruit flies, horn flies and houseflies

### Hymenopteras

Sawflies (mustard saw flies)



### Heteropteras

Ear head bugs, milkweed bugs, rice bugs, green vegetable bugs, East African coffee bugs, red cotton bugs and lacewings bugs

### Mites

Carmine spider mites, citrus mites and two spotted spider mites







# Neem Cake's Vital Nutrients



Return to the soil to  
nourish plants and crops.

Ensure Fertility of the Soil 

Are compatible  
with soil microbes  
and rhizosphere  
microflora 

Protect Plant Roots From:

Pests



Diseases



Nematodes



Boost  
Organic  
Content

Benefit  
Soil  
Texture

Increase  
Water  
Retention<sup>19</sup>

Neem cake increases yields by  
**15-25%** when compared with all  
other natural fertilizers<sup>20</sup>.

Has more nitrogen, phosphorous, potassium, calcium and magnesium than ordinary farmyard manure. It is used to fertilize rice, cotton, sugarcane and a wide variety of other crops, including but not limited to coconut trees, tomatoes, eggplants, chilli, okra, tobacco, spinach, potatoes and cannabis.





## Top Cannabis Pests

One of the major concerns for cannabis producers is the development of a safe and integrated pest management system. Some of the most common cannabis pests include spider mites, aphids, fungus gnats, gray mold, green algae, and root rot. An entirely natural and systemic pesticide, neem is active against all of these while having a low to no toxicity factor for humans, animals and beneficials.



**Spider Mites:** Extremely common and devastating when growing cannabis, spider mites consume the chlorophyll of the plant, leaving little white or yellow spots and millions of eggs in their wake. They are known to appear and disappear at a moment's notice and can easily kill plants over the course of a single day. While they can quickly become immune to a variety of synthetic pesticides, neem acts on the hormonal system of mites and therefore leads to no resistance in future generations. By interfering with the spider mites' biological functions, such as reproduction, feeding and metamorphosis, infestations can be controlled. Neem is best used at low concentrations and with regular application, paying particularly attention to the underside of cannabis leaves. This effectively repels what is considered cannabis' most dangerous pest<sup>21</sup>.

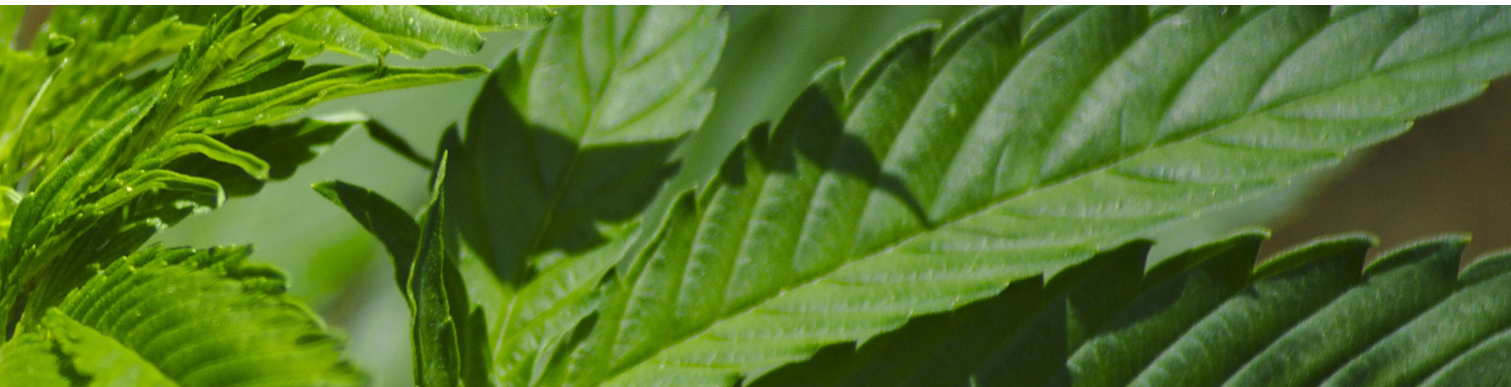
**Aphids:** These are tiny, yellow-winged bugs that commonly set up shop underneath cannabis leaves to consume its nutrients. Infestations happen extremely quickly as females give birth up to 12 times per day. Neem's most powerful active ingredient, azadirachtin, acts as a repellent against aphids as well as a wide variety of garden pests such as mealy bugs, beetles and ants<sup>22</sup>.



**Fungus Gnats:** These are black bugs that swarm around the soil and lower portion of the cannabis plant. Only three to five millimeters in size, these gnats grow well in wet soil and can have an immediate and damaging effect on plant health and yields. They are extremely common in the dark and damp conditions typical of nutrient film and hydroponic operations. Used as a soil drench, neem kills these pests almost immediately and is often used to prevent them from laying eggs and developing larvae<sup>23</sup>.

**Whiteflies:** Known as aleyrodidae, whiteflies are soft-bodied, winged insects closely related to aphids. They can be found in almost any region, but they are so tiny that they are usually camouflaged. Neem quickly and easily gets rid of whiteflies, while also preventing nymphs from turning into adults<sup>24</sup>.



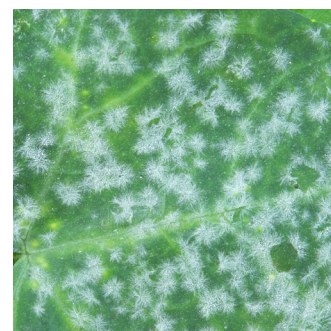


Neem is celebrated in the cannabis community for its strong antifungal properties. Growing cannabis in a warm, moist, densely packed warehouse, cannabis cultivation often results in mold and fungus breakouts. These breakouts can result in production halts due to the need to completely sterilize the grow space. This is often time-consuming and costly.



**Botrytis (Gray Mold):** One of the more devastating fungal diseases to affect cannabis crops, grey mold thrives in cool temperatures with a high level of humidity. This one pest can destroy a whole grow operation in less than a week if left untreated. While implementing sound ventilation systems is one of the most effective treatments, neem oil can be used for prevention through sprayed application on plants in order to create a protective barrier that prevents germination<sup>25</sup>.

**Mildews:** Fungi such as powdery mildew and downy mildew are also very damaging to cannabis plants. They usually appear when there is too much moisture, in places where there is no sunlight, or when plants are too close to each other or a wall. These fungi take the form of a white powder, directly attacking the leaves, stems and fruit of one's crops, and spreading quickly. While normal doses won't completely eradicate powdery mildew from mature infected plants, regular spraying will clean off the mildew, keeping it at bay. The sooner neem is applied, the better<sup>26</sup>.



**Septoria:** Yellow leaf spot, also known as leaf septoria, is a fungal pathogen aimed specifically at cannabis. Yellow leaf spot will harm the leaves and often times the stems of the plant, although it won't cause the crop to die off. It will dampen yields if for any reason septoria is not properly treated<sup>27</sup>.

**It's important to note that one of the reasons why neem is such a safe option for crop protection is how quickly it degrades in the environment. Extreme temperatures, exposure to ultraviolet light and mechanical removal by rain or snow can remove neem from the application area. While necessary to repeat applications more often than with synthetic crop care chemicals, production is increased. This is due to the fact that using organic compounds such as neem over synthetics reduces the flush time at the end of the growth cycle required to rid the plants and environment of these dangerous chemicals.**



## Cannabis Care and Treatment

Name	Identification	Neem Prevention and Control	Application
Spider Mites	Spider mites can be identified by their appearance (small, oval bugs with six to eight legs) or the damage they cause by nibbling away at the chlorophyll leaving little white or yellow spots in their wake. They also spin webs to protect their offspring so be on the look-out for the silky string on leaves and buds.	While they can quickly become immune to a variety of synthetic pesticides, neem acts on the hormonal system of mites and therefore leads to no resistance in future generations. By interfering with the spider mites' biological functions, such as reproduction, feeding and metamorphosis, infestations can be controlled. Neem is best used at low concentration and with regular application, paying particular attention to the underside of cannabis leaves, as this effectively repels what is considered cannabis' most dangerous pest.	To apply a premixed neem oil solution correctly, thoroughly wet the plant, agitating the sprayer constantly and paying particular attention to the undersides of the leaves. Periodically soak the plants and the soil underneath with a neem oil spray to control spider mites as well as other sap-sucking insects. Never apply neem oil when temperatures are above 90° F or when the plants are water stressed.
Aphids	Aphids are tiny, yellow winged bugs that commonly set up shop under cannabis leaves. They reproduce quickly, (females may give birth as often as 12 times per day) so infestations can happen quickly and should be remedied immediately. Because they consume nutrients within cannabis, the resulting leaves will appear yellow and wilted.	Neem acts as a repellent against not only aphids, but also a wide array of other garden pests including mealy bugs, cabbage worms, beetles, leafminers, ants, and caterpillars.	Neem oil needs to be sprayed directly on infested foliage and requires thorough coverage. Don't use oils or soaps when temperatures are above 90° F, since they can burn plants.
Fungus Gnats	These are black bugs that swarm around the soil and lower portion of the cannabis plant. Only three-five millimeters in size, these gnats grow well in wet soil and can have an immediate and damaging effect on plant health and yields.	Used as a soil drench, neem kills these pests almost immediately and is often used to prevent them from laying eggs and developing larvae.	Mix neem oil with castile soap and spray. This natural neem oil remedy is safe enough to use around plants but strong enough to destroy gnat larvae affecting your plants. Castile soap has many uses around the home and is safe and biodegradable. To make the neem treatment for killing gnats, please do the following: In a spray bottle, mix 2 tsp. neem oil with 1 tsp. of castile soap (alternatively use a normal dishwashing liquid). Fill the bottle with water and shake well. Spray liberally around the roots of infected plants to help kill off any gnat larvae and eggs that may be in the soil. Spray on the leaves to repel gnats and fruit flies from damaging your plants. This natural neem spray is also effective against mosquitoes and can also kill spiders.
White Flies	Known as aleyrodidae, whiteflies are soft-bodied, winged insects closely related to aphids. They can be found in almost any region of the plant, but they are so tiny that they are usually camouflaged.	Neem quickly and easily gets rid of whiteflies, while also preventing nymphs from turning into adults.	Mix one gallon of water and spray all leaf surfaces (including the undersides of leaves) until completely wet. Test plants by administering neem oil to a small section and waiting 24 hours. This kills on contact.
Gray Mold (Botrytis)	Grey mold is difficult to detect from the onset and appears on buds as blue-ish green hairs that are not too dissimilar to lint. Quickly turning to dark brownish spots, this mold leaves your buds feeling slimy. If your stems are infected, they will turn yellow and all growth above the infection will wilt.	Neem oil can be used for prevention by spraying it on plants in order to create a protective barrier that does not let mold germinate.	Mix neem oil in a bottle with water and shake it well. Spray the mix all over the leaf surfaces until completely wet. Reapply until infection has been cured.
Damping Off	Sprouted seeds won't emerge from the soil and seedlings will rot at the soil line. Older plants will turn yellow and also rot at the soil line.	Organic gardeners have reported success using sprays created with diluted neem oil	Dilute neem oil with water. Shake the mix and spray it over the leaf surfaces until completely covered.
Green Algae	Green algae is slimy in its appearance, thrives in light and is usually found on the surface of your growing medium.	Azadirachtin, one of neem's active ingredients, stops insects from feeding and developing. The beauty of using neem oil in the cannabis garden is its low toxicity factor for humans, animals and the beneficial bugs you want to keep around.	Neem oil can be applied as a foliar spray, soil drench and is safe to use in hydroponic systems. In the latter, apply one tsp. of neem oil per quart of water. The oil will be taken up by the root system and distributed throughout, protecting the plant from attack. As a foliar spray, test an inconspicuous area of the cannabis plant before applying to the whole plant. Wait 24 hours to see if it is well tolerated. Once confirmed, spray the leaves lightly. This should be done weekly until there is no longer evidence of pests or disease. Do not apply in extreme temperatures or during the day. Apply at night to allow the leaves to absorb the oil.
Downy Mildew	Look out for pale yellow spots on the top sides of leaves, with a gray-ish spawn mirroring the spots on the leaf's underside.	Neem oil is effective at combating gray mold, root rot, green algae, septoria and powdery mildew due to its fungicidal properties and its powerful effects can be seen within a 24 hour period.	Mix up a solution of neem oil spray and thoroughly spray all the surfaces of the plant liberally. Spraying with 2.5 tsp. per gallon of water every 7 to 14 days is recommended.
Powdery Mildew	Starting off as small white spots on the top of leaves, powdery mildew progresses to a fine pale powder on leaves, shoots, and stems. Leaves will then turn yellow and plant growth will grind to a halt.	Neem oil can destroy and prevent powdery mildew. This spray can also work well for other fungal diseases.	Professionals have had better results controlling powdery mildew with sprayed neem oil compared to baking soda (sodium bicarbonate). While normal doses won't completely eradicate powdery mildew from mature infected plants, regular spraying will clean off the mildew and keep it at bay. Neem oil also works as a preventative measure.

# The Neem Way For Organic Crop Care



### Safer

Entirely biodegradable, no hazardous residue is left on land or water



### Non-Toxic

For human consumption and non-target pests.



### Improves Yield and Increases Potency

Neem's high nutritional content is thought to boost yields, increase potency and improve flavor



### Highly effective

Neem-based pesticides provide multiple protective layers against pests

## How to Prepare a 0.5% Neem Oil Emulsified Foliar Spray for Cannabis

The neem solution should be sprayed on all leaves, including the underside, as well as the soil around the roots.

### Ingredients:



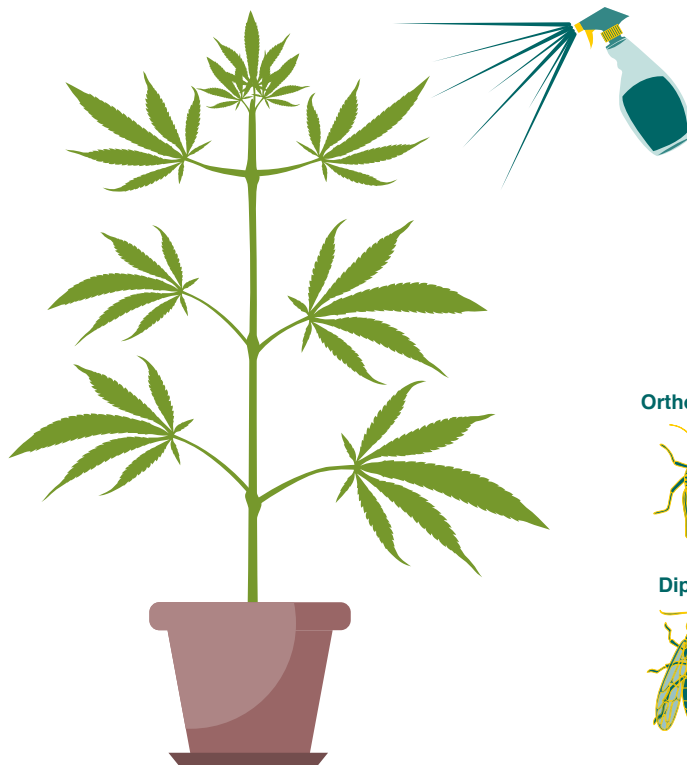
5 ml (1 Tablespoon)  
100% Neem Oil.



1-2 ml (1/3 Teaspoon)  
Insecticidal Soap.



1 liter (1/4 Gallon)  
Warm Water.



1. Combine the insecticidal soap with a small amount of warm water.
2. Slowly add neem oil while stirring vigorously.
3. Mix this with the rest of the water.
4. Keep shaking the mixture while spraying.

Orthopteras



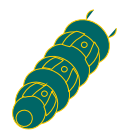
Homopteras



Thysanopteras



Lepidopteras



Dipteras



Hymenopteras



Heteropteras



Mites



# Capitalizing from the Cannabis Market with Neem

We are in great need of innovation and technology in cannabis crop care. Over the past century, the most damaging solutions were also the most accessible, cheap and globally utilized. Today, focusing on short-term gains over the long-term health of our planet is no longer a viable option. Consumers worldwide are calling for action. As people become more educated and aware of agriculture's more dangerous traditions, pressure is placed on producers and their governments to change archaic policies in favor of organics. This will further expedite the industry's transition to safer and sustainable practices around the world.

## The Value of Protecting Crops Naturally

Growth, profit and consumer demand are reaching unprecedented heights for businesses who align purpose with profit by offering products and services that prioritize social responsibility and environmental protection. This is particularly relevant for cannabis, which will start to prioritize green cultivation practices due to increasing regulations.

Informed consumers are living a healthier lifestyle and choosing organic foods, shaping a global market valued at US \$80 billion in 2016<sup>28</sup>. The market has increased five-fold since 1999 and is expected to double to \$161.5 billion in 2018<sup>29</sup>. With key demographics, particularly Generation Y, Z and millennials, embracing a more natural lifestyle, the demand will be present for the long haul and validates organics as a clear and profitable opportunity. The demand for organic food has increased by nearly 50% every year for the past five years<sup>30</sup>.

The global markets for agricultural bio-pesticides and bio-fertilizers are also showing impressive levels of growth. The global bio-pesticide market reached \$3

billion in 2015, and will account for 5% of the global crop protection industry. Forecasts place the bio-pesticide market value at \$6.6 billion in 2020, with a CAGR of 15%<sup>31</sup>. The global bio-fertilizer market was estimated at \$538 million in 2014 and is expected to reach \$1.8 billion by 2020 at a CAGR of 14%. As of 2013, there were approximately 400 registered biological active ingredients and over 125 registered biological products in crop protection<sup>32</sup>. By 2050, natural crop care solutions will equalize with synthetics in terms of market share<sup>33</sup>.

The global neem market is booming alongside its global awareness due to the growing interest of organic products worldwide. The neem market is expected to grow from \$653 million in 2015 to \$1.8 billion in 2022 at a CAGR of 16.3%<sup>34</sup>. Neem is an import-led market, mostly dependent on exports from Asia and Latin America. Currently highly fragmented, the market has several small-size players who do not have a fixed channel for international sales on a large and industrial scale.





## Most Popular Registered Neem Products Currently on the Market

Brand Name	Company	Ingredient	Percent	Size	Price Per Ounce (Usd)
70% Neem Oil	Lawn & Garden Products Inc. (Monterrey)	Clarified Hydrophobic Extract Of Neem Oil	70.0%	1 Pint / 16 Fl Oz / 473.16 Ml This Product Contains 5.46 Lbs Of Clarified Hydrophobic Extract Of Neem	\$1.11
Aza-Direct Biological Insecticide	Gowan Co.	Azadirachtin	1.2%	2.5 Gal Contains 0.0987 Lb (44.8 G) Azadirachtin Per Gallon	\$2.16
Azaguard	Biosafe Systems	Azadirachtin	3.0%	32 Flz. Oz., 1 Gallon, 2.5 Gallons. Contains 0.28 Lb (128 Grams) Of Azadirachtin Per Gallon.	\$4.65
Azamax Botanical Insecticide Miticide Nematicide	Parry America-Hawthorne Hydroponics Db General Hydroponics	Azadirachtin	1.2%	4, 16 Fl. Oz., 1 Gallon And 1 Quart. Contains 0.35 Grams Azadirachtin Per Fluid Ounce	\$3.25
Azasol	Arborjet Inc	Azadirachtin	6.0%	0.25 Oz, 0.75 Oz, 6 Oz, 2 Lb	\$8.89
Azatrol Hydro Botanical Insecticide	Pbi/Gordon Corporation	Azadirachtin	1.2%	4 Oz	\$6.03
Azera Insecticide	Mclaughlin Gormley King - Valent	Azadirachtin	1.2%	1 Gallon (Contains 0.10 Lbs Of Azadirachtin And 0.11 Lbs Of Pyrethrins Per Gallon)	\$2.63
Bayer Advanced Natria Neem Oil Concentrate	Bayer Advanced Llc	Clarified Hydrophobic Extract Of Neem Oil	70.0%	24 Oz	\$1.14
Bonide Bon-Neem II Fungicide/Miticide/Insecticide Concentrate	Bonide Products Inc	Clarified Hydrophobic Extract Of Neem Oil	70.0%	8 Fl. Oz. (236.5 Ml)	\$0.30
Bonide Neem Oil Fungicide Insecticide Miticide Ready To Use	Bonide Products Inc	Clarified Hydrophobic Extract Of Neem Oil	0.9%	32 Fl. Oz. (946 Ml)	\$0.30
Bonide Rose Rx 3 In 1 Multi-Purpose Fungicide Insecticide Miticide Concentrate / Ready To Use	Bonide Products Inc	Clarified Hydrophobic Extract Of Neem Oil	70.0%	24 Oz	\$0.44
Debug Tres 3.0	Agro Logistic Systems Inc	Azadirachtin	3.0%	4, 8, 32 Fl. Oz And 1 Gallon. Contains 0.28 Lb (1.28 Grams) Of Azadirachtin Per Gallon	

Other products include: Debug Turbo - Agriculture, Horticulture & Greenhouse Use. Ecozin Plus 1.2% Me. Ferti-Lome Triple Action Insecticide/Fungicide/Miticide. Ferti-Lome Triple Action Ready-To-Spray. Fruit Tree Spray Plus. Garden Safe Fungicide 3 Concentrate. Gordons Professional T&O Products Azatrol Ec Insecticide. Molt-X. Monterey Neem Oil - Rtu Ready To Use. Natural Guard Brand By Ferti-Lome Neem. Natural Guard Neem. Neemix 4.5. Nimbiosys Neem Oil For Organic Gardening. Nimbiosys Neem Oil For Organic Production. Ornazin 3% Ec Botanical Insecticide. Ortho Tree & Shrub Fruit Tree Spray Concentrate. Plasma Neem Oil Ec. Safer Bioneem Multi-Purpose Insecticide & Repellent Concentrate.

## An Essential Resource with Multiple Applications

Neem is well on its way to becoming an essential resource in cannabis crop care for the same reasons it is being utilized across agriculture. Natural and more sustainable solutions such as neem not only offer yield and nutritional benefits, but also ensure that crops enjoy stronger resilience and better health. This is occurring at a time when the world's largest food and agrochemical institutions are under fire for their comprehensive reliance on synthetic chemicals that damage the environment. With greater access to information, facilitated by the 3.6 billion people connected to the Internet today, consumers are becoming increasingly informed of dangerous practices and are driving the industry's transitions toward safe, healthy and environmentally beneficial solutions such as neem. The almost exponential growth in the cannabis industry makes the neem opportunity even more interesting, especially considering that some of the most recognized growers in the field have already incorporated this powerful resource in their crop management systems.

The United Nation's tree of the 21st century also happens to be one of the most versatile trees on the planet, offering innovation where we need it the most - across agriculture, healthcare and environmental protection. A cost-effective and non-toxic solution to synthetic agrochemical use in modern agriculture, neem is effective against over 600 species of insects, strengthens soil nutrition and increases livestock health. With over 200 compounds found to be effective against inflammation, infection, fever, skin conditions and dental illness, neem is also a clinically proven

solution to a variety of ailments. All parts of the neem tree contain a wide range of medicinal benefits due to its antimalarial, antifungal, antibacterial, antiviral and anti-carcinogenic properties. Finally, neem has an extremely high rate of photosynthesis, liberating more oxygen and sequestering more carbon than many other tree species. Its drought resistance properties together with an impressive capacity to filter air and water pollution make it an ideal tree for global reforestation efforts. As a naturally diversified product with applications across several of mankind's most significant industries, neem production is a rare and valued service in a world where supply is limited while demand continues to increase.

Ensuring a positive and profound impact across society, the environment and the economy is the next frontier for entrepreneurs. As the need to solve some of the world's most significant challenges increases in severity, we have a profound opportunity to invest in the solutions, drive productive change and create true value. Investing in products such as neem is not only about simple diversification, it acknowledges the need to prepare for mankind's future. Sustainability in business is not just socially responsible; it is essential for survival and global prosperity. This is why we at Primal Group have ensured that sustainability remains at the very forefront of our business model. By focusing on the solutions needed to sustain a global population racing away to 10 billion by 2050, we are committed to ensuring environmental protection, social responsibility and value creation for generations to come.

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