



Cannabis Applications

Cannabis crops must be held to the highest standards. Unfortunately for growers, the fungus that causes powdery mildew is spread by airborne transmission. The good news is that Fresh-Aire UV ultraviolet germicidal irradiation (UVGI) systems are proven to sterilize airborne bacteria, mold and fungus and prevent them from being transmitted throughout a facility. UV is a powerful tool for cannabis operations to maximize their yields and achieve the highest quality, healthiest product possible.



Tubular Rack System

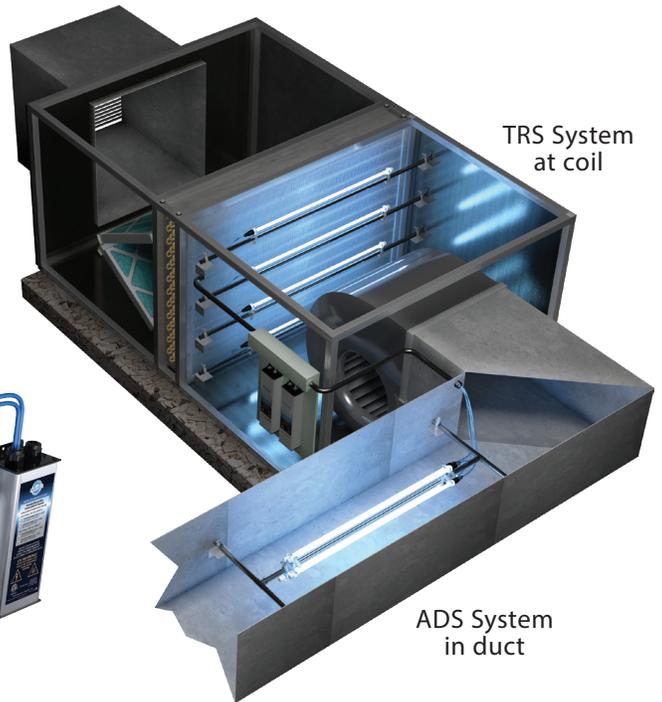
Sterilize mold and other biological threats on coils and air system surfaces with the TRS system. It also saves energy and maintenance costs associated with commercial HVAC. A biofilm (mold on coils) of only 0.002" can reduce efficiency by 37%. The Tubular Rack System from Fresh-Aire UV® offers easy and flexible installation. It is designed for use with standard 1/2" EMT tubing or use our optional custom stainless steel tubing.



TRS System

Airborne Duct System

Maximize airborne kill of dangerous pathogens such as mold, bacteria, and viruses with the ADS system. This duct-mounted UVGI system is designed for intensive air stream UV-C irradiation. The system features from 2 to 6 Fresh-Aire UV® high-output germicidal UV lamps which sterilize airborne biological contaminants as they pass by. The ADS system is fully customizable and can be configured to fit a wide variety of installation parameters addressing any duct size or air-stream velocity.



TRS System at coil

ADS System in duct



ADS System



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UV Products for Sustainable and Bio-dynamic Cannabis Farming

Ultraviolet Light – A Nontoxic Strategy for Improved Cannabis Crop Yields

THE PROBLEM: MOLD and BACTERIA

Mold and bacteria are microorganisms that attack and destroy plants and in many cases decimate crops. Microorganisms cause more crop loss than all other organisms combined¹, and it is estimated there are more than 8,000 species of mold that affect plants².

Cannabis crops are highly susceptible to damage caused by microorganisms. The most common losses are attributed to mold with the two most problematic species being *Botrytis cinerea* or "Gray Mold" and *Sphaerotheca macularis* or "Powdery Mildew".



Cannabis plant infected with "Gray Mold"

ISSUES of MOLD in GROWING ROOMS

Climatic conditions within *Cannabis* growing rooms are ideal for the reproduction and spread of disease causing microbes. The humid conditions found in these environments helps proliferate the growth of mold on *plants* and surfaces. Once a plant becomes infected, the mold will release spores into the air where air movements and the ventilation/air conditioning

systems can rapidly spread mold spores to other plants.



Typical Cannabis Growing Room

In addition to the spread of spores, the ventilation system further compounds the problem with the development of an internal bio-film. This in turn becomes a significant reservoir of mold. If left untreated, the ventilation system will continuously grow mold, spread its' spores within the growing room and potentially infect and decimate the entire crop.



Mold in Growing Room HVAC system Cooling Coil

ISSUES of MOLD on PLANTS - POST HARVEST:

In many cases *Cannabis* products may not reach the consumer for months and in some cases years



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after harvest. This can lead to yield loss to growers and health issues with consumer. The microorganisms posing post-harvest issues can be categorized into two groups. Group one are molds such as "Gray Mold", "Powdery Mildew", *Cladosporium*, *Fusarium*, and *Alternaria*. These organisms infect the living plants and remain with the product post-harvest. Group two includes mold such as *Aspergillus*, *Penicillium*, *Rhizopus* and *Mucor*³. These organisms are saprophytes and invade only dead plants causing post-harvest product loss in drying rooms and product storage.



Typical Cannabis Bud Drying Room

In addition to product loss, all mold can pose significant health risks. Individuals with upper respiratory problems such as asthmatics and those whom are immunocompromised should never be exposed to mold contaminated product.

CHEMICAL CONTROL of MOLD – and related ISSUES:

Fungicides such as DeMethylation Inhibitors (DMI) and Sterolbiosynthesis Inhibiting (SI) are commonly used in agricultural to protect crops from fungi and mold. The negative impact from the use of chemicals, in addition to extra costs, can include plant stress, pathogen resistance to chemical treatments and interference with bio-

control of diseases that are kept in check by naturally occurring microflora.

THE FRESH-AIRE UV NON-TOXIC & SUSTAINABLE STRATEGY

FRESH-AIRE UV is a manufacturer of ultraviolet (UV) emitting systems used for purposes of delivering safer products and healthier environments. In addition to working with Hospitals, Pharmaceutical manufacturers and Food producers we are currently performing work and conducting research on UV solutions for the *Cannabis* industry.

We view any process, whether it is growing crops or protecting hospital patients from infections, as multi-faceted problems requiring multi-faceted solutions. As such, we take a systemic approach when developing effective solutions to a problem.

For *Cannabis* growers we recommend a three step, systemic and non-toxic application of Ultraviolet (UV) energy for disease control and prevention. We have identified all critical phases of the process with the intention to minimize unwanted microbial effects in each phase.

#1 – UV-LED TREATMENT in GROWING ROOM:

The first step in the *FRESH-AIRE UV* non-toxic strategy is the treatment of the cannabis plant with UV-LEDs. *FRESH-AIRE UV* has developed a UV-LED system that is deployed in lieu of chemical fungicide treatment.



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UV LEDs for Photosynthetic Treatment of Plant

How it Works: UV functions in two specific ways to protect plants against infection. The first is a biological response, by the plant, when exposed to UV energy. Though it is well understood that plants have a photoreceptor for visible light, a UV photoreceptor has only recently been described at the molecular level. The plant's UV photoreceptor is linked to a specific molecular signaling pathway, allowing the plant to acclimate itself to the UV wavelength. As this happens the cells of the plant are constantly adjusting to accommodate changing demands and environmental stresses including becoming more resistant to infection by pathogens⁷.

The second way UV works to protect plants is through its germicidal properties. Studies have demonstrated significant reductions of Powdery Mildew on tomatoes, roses and grapes^{4, 5, 6} with short exposures to UV during the growing cycle. The short exposures were low enough not to be phytotoxic to the host plant but high enough to be germicidal to the Powdery Mildew.

The *FRESH-AIRE UV UV-LED solution* is currently undergoing Field Trials in the Southwest and Northeast U.S. Preliminary data indicate compelling plant recovery and Powdery Mildew reduction on certain species of cannabis.

#2 - UV-C TREATMENT of GROWING, DRYING & STORAGE ROOM HVAC SYSTEMS:

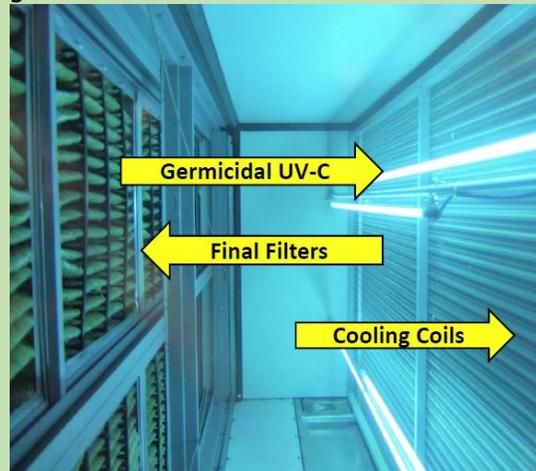
FRESH-AIRE UV UV-C germicidal solutions applied within HVAC systems control the growing, drying and storage room environments. It has been demonstrated HVAC systems can quickly become heavily contaminated with bio-films made up of bacteria and mold^{8, 9, 10, 11, 12}. The species of mold and bacteria that are commonly isolated from HVAC systems are those most typically related to *Cannabis* disease.



Mold on HVAC Cooling Coil Compartment & Coils

How it Works:

The application of UV-C in HVAC has become an accepted and cost effective technology for improving HVAC system hygiene, as well as, germicidal air treatment^{9, 10, 11, 12, 13, 14, 15}.



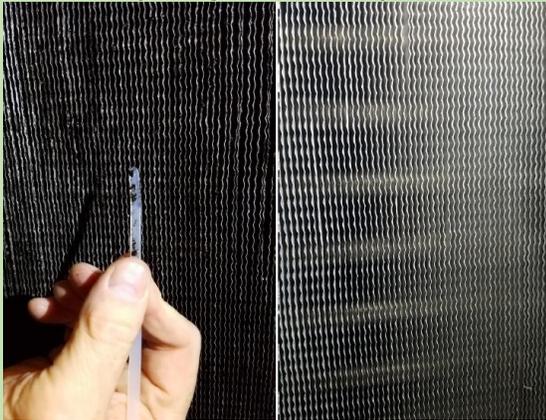
UV-C Germicidal Treatment of HVAC Filters & Coils



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FRESH-AIRE UV custom designs every UV-C system to meet the customer's requirements and is built to fit the configuration of the existing HVAC system. The UV-C energy field, or total amount of UV-C energy, is designed specifically to achieve a desired disinfection level of the HVAC cooling coils and filters. When utilizing a UV-C system within the HVAC system the air being introduced to and recirculated within the room is continuously being disinfected by the UV-C.



Pre (Heavy Mold Growth) & Post (No Mold Growth) UVC Installation HVAC Cooling Coil

#3 - UV-C TREATMENT of PRODUCT IN DRYING ROOMS:

The two most common methods used to dry (or cure) the harvested *Cannabis* are oven drying or air drying. Oven dried product suffers less mold contamination than does air dried product. However, consumers prefer air dried product due to certain negative effects oven drying can cause.



Typical Cannabis Bud Drying Room



Cannabis Buds in Drying Room Racks

How it Works: Air drying generally is conducted in bud drying rooms where temperature and humidity are tightly controlled. The freshly harvested cannabis buds are placed in racks and suspended from the ceiling of the room. Fans positioned on the ceilings and or walls of the room perform the air drying of the buds. In addition to drying the buds the fans are in some cases set up to gently rotate the cylindrical racks. The *FRESH-AIRE UV* solution in these areas requires installing UV-C lamps on the drying room ceilings and walls. The exact lay-out and number of UV-C devices is determined by the size and configuration of the room in addition to drying



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time and predetermined disinfection rates. The UV-C devices will inactivate mold and bacteria that reside on the surfaces within the room, bud racks and buds. Additionally, UV-C devices can inactivate spores that may be transported and recirculated around the room by the drying fans.

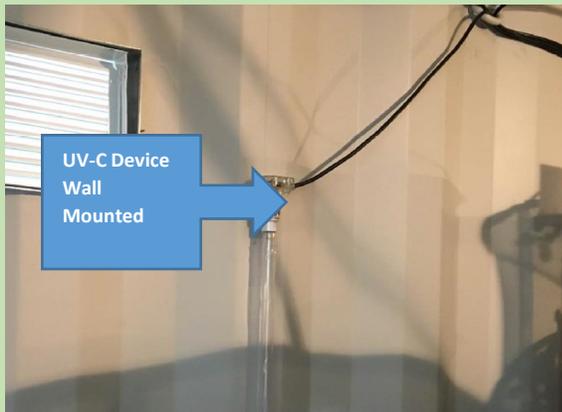
FRESH-AIRE UV NON-TOXIC STRATEGY for CANNABIS DISEASE CONTROL

With objectives to sustain crop yields, improve quality, and reduce the use of toxic chemicals...FRESH-AIRE UV solutions benefit growers by enabling nontoxic pathogen control...Applying nontoxic and environmentally friendly pathogen control solutions...Let FRESH-AIRE UV assist you in achieving your sustainable and bio-dynamic goals!



UV-C
Device
Ceiling
Mount

Ceiling Mounted Germicidal UV-C Devices in Product Drying Room



UV-C Device
Wall
Mounted

Wall Mounted Germicidal UV-C Devices in Cannabis Bud Drying Room

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From the leader in HVAC & Healthcare UV Disinfection



UVGI DISINFECTION
Airborne | Coil | Air Handler | Surface

**Prevents Powdery Mildew
Controls Microbes & Odors
Improves Plant Viability**



Tested & Validated Results

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IMPROVE PLANT VIABILITY | HELP ELIMINATE
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| REDUCE MAINTENANCE COSTS | AIR-
HANDLER DISINFECTION | HELP CONTROL
THE SPREAD OF MICROBIAL CONTAMINATION



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