

Stop Pathogens Before They Start

S.T.O.P. Pathogens Program Guide

Background

Pathogen awareness and mitigation are one of the most critical issues facing the cannabis industry. Pathogens such as Hop Latent Viroid and *Fusarium* result in major economic losses that can equal billions of dollars of lost revenue industry-wide. With margins in the industry becoming increasingly narrow, implementing effective measures to limit revenue loss due to pathogens is critical.

- S** Sterile Environment
- T** Test Regularly
- O** Organize & Observe
- P** Protect Your Borders

There is no single solution or activity that can eliminate the threat of pathogens in a cultivation facility. Effective pathogen prevention stems from understanding the biology and transmission of economically damaging pathogens and using this information to create a comprehensive package of activities that work together to minimize disease. The creation of these types of programs can be difficult given the varied biology of pathogen types and the complex nature of their interaction with the environment. To help cannabis cultivators face this challenge, TUMI Genomics has created a pathogen mitigation program called S.T.O.P., which outlines critical steps needed to limit crop loss due to disease.

S Sterile Environment

Your goal as a cannabis cultivator is to create the most sterile environment possible for your plants. Minimizing exposure to pathogens by strict cleanliness protocols can go a long way to preventing disease. The critical steps in a sterile environment are outlined below.

1. Protect your plants from people

Everyone entering your facility, whether they are employees or visitors needs to cover up their street clothes. Lots of pathogens and pests can be introduced on clothing including fungal spores, insects (which bring viruses), and bacteria. Individuals entering a facility should wear scrubs, disposal body suites, or freshly cleaned lab coats.

Special attention should be given to the bottom of shoes, which can bring in pathogen-contaminated soil from outside. Shoes should be sterilized in a disinfectant bath or mat at the entrance to your facility and then covered up with booties. Gloves are critical for all individuals touching plants both to protect the plants and help facilitate hand sterilization while trimming.

2. Continuously sterilize surfaces and equipment

Any surface or equipment that comes into contact with plant material can potentially spread pathogens. Daily disinfection of surfaces, floors, tables, and equipment is critical to limiting spread. Ten percent bleach (1 part household bleach: 9 parts water) is broadly effective at sterilization and is readily available. Whenever a room is cleared, careful, comprehensive cleaning should be done before a new crop is rotated into that room.

3. Sterilize planting media

While often overlooked, potting media like coco may not be presterilized and could be a source of pathogenic fungi and bacteria in your facility. Most coco brands have guidelines regarding effective sterilization, but effective methods include: Heat sterilization, bleach, or hydrogen peroxide.

More specifics can be found here: <https://coir.com/growing-medium/how-to-sterilize-coco-coir/> Unsterilized or improperly sterilized planting medium is a common source of pathogenic fungal pathogens that can infect roots, foliage, or buds, leading to final product failure.

4. Remove plant debris promptly

Pathogens and insects love to grow and feed on dead plant material. Do not give them the opportunity. Plant matter that falls to the ground should be picked up and disposed of promptly, outside of the facility, in a covered trash container.

Do not allow dead plant matter to accumulate for extended periods inside your facility, outside in burn piles, or near your water supply. Clean floors regularly with a disinfectant such as dilute bleach. Always wet surfaces before cleaning- do not dry sweep. Dry sweeping will increase the likelihood of fungal spores and plant debris going airborne and spreading disease.

5. Remove sick plants carefully

If a plant is identified as infected, that plant should be removed carefully and promptly. It is critical to remove sick plants gently to not induce new breakpoints that can allow infected sap to contaminate surfaces or allow an increased spread of fungal spores. Sick plants should be sealed in plastic bags and disposed of in a closed-lid trash can. DO NOT compost sick plants, as many pathogens survive for extended periods in soil and can reinfect healthy plants through the roots.

6. Sterilize your cutting tools and hands between each plant

One of the most efficient ways pathogens spread is via contaminated cutting tools. Viruses, viroids, fungi and bacteria can all be transmitted by dirty cutting instruments. Because it is not always obvious if a given plant is diseased, it is critical to treat each plant as though it is potentially infected. As you move between plants, scissors should be sterilized in a 10% bleach solution for 60 seconds.

You can have multiple cutting tools in a single bleach solution and switch between them as you trim. Gloved hands should also be sterilized between plants using 10% bleach in a spray bottle.

**Alcohol, heat, and hydrogen peroxide are not effective methods to remove viroid contamination. More information can be found here ([link to tool sterilization paper](#)).

T Test Regularly

Because many pathogens present asymptotically or symptoms are not apparent until substantial spread has occurred, regular testing and culling of infected plants are necessary to limit economic loss from pathogens. Starting with clean, tested stock and regular pathogen screening is standard practice in general agriculture and the economic benefits of testing are well established. You can read more about this issue [here](#).

TUMI Genomics' recommended testing schedule is adapted from established clean stock programs in other vegetative crops. The general testing schedule we recommend is outlined below.

1. Mother Stock

For most cultivators, the mother plant collection is one of the most important assets. Often unique, irreplaceable varieties are stored as mother stock and mother stock disseminates every other plant in your facility. Therefore, keeping these plants free from disease is critical. We recommend growers test mother stock plants at least every six weeks and prior to putting mother plants into production. This stage of testing is analogous to testing of G1 or nuclear stock for clean stock programs in general agriculture.

2. Clones

Once clones are cut and rooted, we recommend testing a small subset of these clones before moving them into the veg room. The state of California's clean stock program recommends testing G2 clones to a level where you are 95% confident that 5% of the clones are disease-free. The number tends to fall somewhere between 5%-10% of clones. Because at this stage the testing is serving as a final screening function, these tests can be pooled such that 5 or more clones can be grouped into a single test. This will help ensure that no diseased plants are moved into production where they could threaten the success of a harvest.

3. Vegetative State

Once plants have tested disease free from the mother through clones, cultivators can feel confident that the plants they move into veg rooms are healthy. However, if a diseased plant is spotted during regular scouting, that plant should be tested before disposal so that if a new pathogen is threatening the facility, the pathogen mitigation program can be adjusted to deal with the potential threat.

4. Water Testing

Often overlooked, but a critical consideration, is ensuring that the water supply moving through the facility is clean and free from mold and fungus. We recommend that facilities test the water in the main tanks and lines at least every 6 months to ensure that no pathogens have taken up residence.

Organize & Observe

A critical aspect of pathogen mitigation programs is organizing a facility to minimize the spread and impact of pathogens. Often small changes in your workflow or plant labeling can go a long way in preventing pathogen spread.

1. Control the flow of work in your facility

When performing general maintenance on your plants, organizing the order in which each room is worked can impact the movement of pathogens in the facility. Because pathogens can travel on employees, starting the day caring for diseased plants can increase the risk of the infection spreading to the rest of your crop. To minimize this possibility, plant maintenance duties should begin in the most valuable room (usually the mother room) and move to the room with the highest pathogen pressure (usually the flower room). If possible, assign mother room care to specific employees that understand how pathogens spread and are well-trained in effective tool sterilization.

2. Group clones together according to mother plant

Another simple step that can help limit the loss due to pathogens is to make sure each cut clone is labeled with the exact mother plant (not just variety) that clone was taken from. Clones cut from the same mother should all be kept in the same clonal tray. The reason for this system of organization is to minimize plant loss if an infection is discovered in a mother plant after cutting clones. If it is recorded where plants from each mom are geographically and they are grouped, then the loss can likely be limited to a single tray. However, if clones from that mother are dispersed or their location is unknown then loss of the whole clone crop is possible.

3. Replace mother plants frequently

While individual cannabis plants can remain in the vegetative state almost indefinitely, it is not recommended to keep mother plants for longer than 3-4 months. As plants age, they become more susceptible to stress allowing increased access by opportunistic pathogens such as *Fusarium* and *Pythium*.

4. Maintain adequate distance between plants

Densely packed plants increase the likelihood of pathogen spreading due to poor airflow between plants and increased plant-to-plant contact. Ensure that plants are placed roughly one foot apart and are not touching each other.

5. Observe your plant regularly

While not all pathogens are visible by eye, careful observation of anything out of the ordinary can help cultivators spot issues before a serious problem develops. Assign a dedicated scout to observe and record any concerning symptoms as well as monitor for small insects using sticky cards and a small magnifying glass. Remember to check on the undersides of leaves for small insects and at the base of main stems for signs of fungal growth. Ensure that employees are trained to recognize symptoms of common pathogens and are encouraged to report anything suspicious. Post symptoms and photos of the most serious pathogens, Hop Latent Viroid, *Fusarium*, *Pythium*, Powdery Mildew, etc. where they can be easily referenced.

6. Record Data

Keeping thorough records of plant age, movement, symptoms, and the resolution of any problems will allow cultivators to continually improve on their pathogen mitigation protocols. Careful records can also allow plants to be easily traced should a problem develop.

Protect Your Borders

The most effective way to protect your facility is to stop pathogens from entering in the first place. Analogous to screening for regulated pathogens before allowing agriculture products into the country, nothing should be allowed to cross the borders of your facility without being tested and/or sterilized.

1. Test all new material upon entry

One of the most common ways pathogens gain access to a cultivation facility is by bringing infected plants. All materials entering your facility should be placed in a dedicated quarantine space that does not share common tools, water, or materials with the rest of the facility. New material should be tested for economically impactful pathogens at least twice; once upon entry into the quarantine space and once 2-3 weeks later.

During the waiting period between testing, observe new plants/clones carefully to ensure there are no obvious, concerning symptoms including wilting, leaf discoloration, fungal growth in the crown area, slow growth, or evidence of insects. After two negative tests and no outward symptoms, new varieties can be added to the regular testing cadence for the rest of your plants.

While introducing new material via seed can reduce the frequency of pathogen introduction, many pathogens can transmit within seeds or on the seed surface. Seeds should be sterilized in 2-5% bleach for 2 minutes and rinsed in clean water before planting. Plants from seed should be held in a quarantine area and tested for pathogens prior to introducing those varieties into your main rooms.

2. Request evidence of pathogen testing

If you are buying a season's worth of clones, waiting 2-3 weeks for two negative tests can often be logistically impractical. When buying clones, inquire as to whether the mother plant the clones were cut from was tested for pathogens. If testing was done, request the test results so you can conduct your own investigation to make sure the testing lab is performing high-quality assays. Do not purchase material that has not been tested. Bringing untested material into your facility is not worth the risk.

3. Require visitors and employees to disinfect shoes before coming through the front door

Soil pathogens, such as *Fusarium*, pose a serious risk to cultivation facilities. These pathogens are common and can easily be carried into your facility on the bottom of shoes. Place a disinfection mat or bath or 10% bleach outside of the main entrance or in an airlock space and require visitors to disinfect the bottom of their shoes before entry. Employees can also keep a dedicated pair of work boots at the facility that are frequently disinfected.

4. Limit entry of pets and house plants

While we all love our furry friends, pets can bring in a variety of pathogens in their fur and paws. It is best to limit exposure of your plants to pets or other animals. House plants also harbor pathogens and insects that can readily spread in your grow room. Decoy plants should be used carefully, as many plant species carry high levels of viral pathogens, such as tobacco plants.

5. Limit weed growth

Weeds outside your facility can act as reservoirs for many pathogens and insects. Even if you have a strictly indoor grow facility, dense weeds surrounding the building can increase the chances of airborne pathogens being carried into your facility. Keep weed levels low on the property and make sure infected plant material that was removed from the facility is not mixing with weeds growing on your property.

6. Ensure adequate filtration

Unfiltered water and air can be a major vectors for fungal spores and water pathogens such as *Pythium* and *Fusarium*. Ensure that all air and water being brought into the facility passes through a strict filtration system and/or the water is appropriately sterilized. Replace filters promptly according to manufacturer's instructions. To stop bacterial and fungal contamination from entering your facility in the air,, it is absolutely necessary to use a high-efficiency particulate air (HEPA) grade filter for the incoming air and a full heating, ventilation, and air conditioning (HVAC) system.

7. Install insect screens

While being significant pests, insects are also vectors for many cannabis pathogens including fungal and viral diseases. Install exclusion screens in places in your facility where insects may gain access, including the air intake area. Be sure to deal with insect outbreaks quickly.