

Fusarium in Cannabis Technical Fact Sheet

Background

Fusarium is a soil-borne fungus consisting of hundreds of species. *Fusarium* has world-wide distribution and is a major cause of wilting disease and damping off in commercial crops, including *Cannabis*. Billions of dollars in losses across multiple crop types are attributed to *Fusarium*, making this fungus one of the most economically destructive pathogens across agriculture. While most species of *Fusarium* do not cause disease in *Cannabis*, certain types of *Fusarium* including *Fusarium oxysporum*, *Fusarium solani*, and *Fusarium proliferatum* result in severe symptoms and can lead to plant death.

Symptoms

Fusarium infections in vegetative *Cannabis* plants often show very few symptoms in the foliage. More established infections present with yellowing or necrotic leaves, drying of the leaf edges, and defoliation. Infected plants may take on a wilted appearance due to reduced flow of water through the xylem. Stunted growth and reduced volume in the root system are also common.

If the *Fusarium* infection has reached the surface, there may be white, cotton-like growth (mycelium) on the plant crown and evidence of decay. Brown rot is often visible within the stem near the crown area. At later stages, brown, decaying roots can also be seen.



Sources: Emerging diseases of *Cannabis sativa* and sustainable management, Zamir K Punja, et. al
Pathogens and Molds Affecting Production and Quality of *Cannabis sativa* L., Zamir K Punja, et. al

Fusarium spores germinate more efficiently under 12-hour light/dark cycles compared to continual light during vegetative *Cannabis* growth. Often infected plants that appeared healthy during the vegetative phase begin to show more severe symptoms a few weeks into flower.

If plants are showing yellowing leaves, wilting or poor growth with no clear environmental cause a *Fusarium* infection should be considered as a potential culprit.

Origin

Fusarium is primarily a soil pathogen. The most likely point of entry in a *Cannabis* facility is due to introduction of infected plant material or within unsterilized growing medium. Because *Fusarium* is ubiquitous in the environment, spores from soil and plant material outside of the facility can also hitch a ride on the shoes of visitors and employees.

Spread

Fusarium is a soil-borne organism favoured by warm temperatures and excessive soil moisture. Once introduced in a facility, *Fusarium* can spread on contaminated tools and equipment, on unsterilized pots or in recycled growing medium. The fungus can also spread in irrigation systems if the water is recirculated or runoff from infected plants contacts nearby healthy plants. If the fungus sporulates, spores can spread throughout the facility in the air or on employee clothing. *Fusarium* spores can also invade *Cannabis* inflorescences and lead to product failure.

Fusarium spores are extremely stable and can survive in soil, plant debris, tools and containers for years. Careful sanitation of surfaces and equipment that encounter infected plant debris is critical to limit spread.

Infection

While *Fusarium* can infect all tissues of a plant, it is primarily a root pathogen. The fungus enters the plant through root tips or wounds in the root tissue. Once inside the plant, *Fusarium* advances intracellularly toward the vascular tissue until it reaches the xylem, where it clogs the vascular system reducing water transport in the plant leading to wilting. Eventually it reaches the surface where it sporulates profusely, spreading the fungus to nearby plants.

Fusarium is a hemibiotroph, meaning that during the initial stages of infection, it acts as a parasite living within the plant, but not killing it. Once infection is established, *Fusarium* transitions into a more aggressive stage feeding itself from dead tissue (necrotroph). This stage of infection leads to rapid decline and plant death. Because of this two-part life cycle, active *Fusarium* infections often go unnoticed until the fungus is well established within the plant and begins to destroy tissue.

Misdiagnosis

Because *Fusarium* infections hinder the function of the root system, initial symptoms can be confused with nutrient and water deficiencies. If plants are showing unexplained signs of nutrient deficiencies, or appear wilted even though they are not dry, *Fusarium* should be evaluated as a possible cause. *Fusarium* symptoms also overlap with other root infecting pathogens such as *Pythium*. A co-infection with both *Fusarium* and *Pythium* can be common due to plant stress and weakened defences.

Prevention

The best way to keep your facility safe from *Fusarium* is effective prevention through reduction of conditions that favour infection, strict sanitation protocols, and periodic screening to catch potential infections before significant spread occurs.

1. Avoid entry of *Fusarium* into the facility

- Start with clean, tested cuts. The most common way for *Fusarium* to enter a facility is through infected cuts, which can be avoided by testing new plant material prior exposing your facility.
- *Fusarium* spores can also be present on seed coats. Surface sterilize seeds using 10% bleach for one minute followed by rinsing in clean water prior planting.
- Limit entry of insects. Many insects can spread fungal pathogens or damage root systems making the plant vulnerable to infection.
- *Fusarium* is extremely common in the soil outdoors. Request visitors and employees entering the facility dip their shoes in sanitizing foot baths, wear disposable foot coverings or replace street shoes with a shoes used exclusively in the cultivation facility.
- Ensure that filters in air purifiers are replaced regularly and the water sanitation protocol utilized effectively kills fungal spores.
- Coco growing medium can contain contamination from many plant pathogens including *Fusarium*. Confirm with your supplier that the coco has been sterilized. Coco can be chemically sterilized by soaking in 5% bleach for 30 minutes.

2. Avoid conditions that encourage *Fusarium* growth

- Water-saturated, oxygen-deficient, and highly saline conditions in growing medium stress plants and make them prone to attack by pathogens. Excessive moisture around the root ball encourages fungal growth and creates anaerobic conditions that damage roots, providing a point of entry for a *Fusarium* infection.
- *Fusarium* is an opportunistic infection so stressed plants are more susceptible to infection. Avoid high salt and excessive nutrients. Over fertilization can reduce root growth and increase access of the root system to pathogen entry.
- Avoid damaging roots when transplanting to limit access of root tissue to a *Fusarium* invasion.
- Excessively dense plant populations should be avoided. High density plantings create more favorable environment for growth of *Fusarium* because aeration and drying within the canopy is reduced.
- Ensure that filters in air purifiers are replaced regularly and the water sanitation protocol utilized effectively kills fungal spores.
- Excessive humidity encourages *Fusarium* growth and spread.
- Be sure to maintain effective air circulation in the canopy.

3. Careful sanitation to avoid *Fusarium* spread

- *Fusarium* spores can survive for years in contaminated soil/growing medium, plant debris, and on equipment such as pots and tools. All materials coming into the contact with plants or growing medium should be thoroughly sanitized before reuse.
- Prior to sanitizing the containers or trays, wash off the clinging soil and plant parts. The washed containers can then be sanitized by soaking them for at least 30 minutes in a commercial bleach (5.25%) solution that is diluted to 10% (one part 5.25% bleach to nine parts water). Other affective chemical treatments include quaternary ammonia based compounds.
- Surfaces including floors and tabletops should also be thoroughly cleaned before moving new plants into that space.
- All cutting tools should be sterilized between each plant to limit spread from sick plants to healthy plants.
- Hands should be thoroughly washed with soap and water before handling the planting equipment, containers, or plants. Gloves should be used when trimming plants and can be sanitized using a 10% bleach spray when moving from plant to plant.
- All cleaning operations should be away from transplant and production areas to avoid contamination of healthy plants with fungal spores.
- Any sick plants should be promptly and carefully removed from the facility to limit infection spread.
- Do not reuse soil or growing medium from infected plants and do not compost plants with fungal infections.

4. Preventative testing

Molds and fungi that attack root systems can often go unnoticed until the upper portion of the plant begins to show signs of root dysfunction. Preventive testing is critical to identify pathogenic molds and fungi before they become a serious threat. Because *Fusarium* is very common in the environment, periodic testing of critical genetics and mother stock plants regardless of symptoms or obvious exposure is recommend so infected plants can be removed before infection spread.



Healthy plant (far left) compared to plant infected with *Fusarium* (middle to far right).



Sources: *Fusarium* Wilt, Utah State University and FUSARIUM MOLD: A FUNGUS FATAL TO CANNABIS. IS THERE A CURE?, Herbies

Treatment

If *Fusarium* is identified or suspected the two most critical steps in effective mitigation is removal all infected plant material and identification of the origin of infection.

Reduction of *Fusarium* infections in your facility requires identification of the route of entry of the pathogen and limiting mechanisms of potential spread. While the most common route of entry for *Fusarium* is though intake of infected plant material, once introduced *Fusarium* can colonize and spread through irrigation systems, reused potting medium, water run-off and debris from infected plant material.

If *Fusarium* is identified, samples from the main water tank and along multiple points within the water system should be taken to determine if the pathogen is present in the water supply. If *Fusarium* is detected in the water, all tanks, lines and joints should be thoroughly sanitized. Work with the supplier of your water sterilization system to confirm that fungus and molds are effectively eliminated.

Everything that comes into contact with plant material should be carefully sanitized. *Fusarium* can survive in dead plant tissue, so any plant debris should be disposed of promptly in a closed container. Sweeping of dried plant debris can encourage spores to become airborne. Be sure to wet dried material prior to sweeping to limit movement of spores. Before sweeping, dampen any dried material to limit the spread of spores.

If plants are showing signs of *Fusarium* infection (i.e. yellow, wilted leaves, crown rot, damping off) they should be removed as quickly as possible. Avoid spreading soil or growing medium from infested areas. Carefully remove disease plants to avoid leaving behind residual plant tissue. Sick plants should be bagged and placed in a covered trash container. All surfaces, tools and equipment should be carefully cleaned with a 10% bleach solution.

Once sick plants are removed and the point of entry determined, screening for *Fusarium* in your plants and the water system regularly to immediately detect any re-emergence of the pathogen and minimize potential loss.