Alternaria





- Alternaria is one of the most common and widely distributed molds on the planet (2). The reproductive spores become airborne easily and are prolific in the atmosphere worldwide.
- Growth Rate: Rapid Mature with 0.5 to 8 days (34)
- Water activity: 0.85-0.88 (1)
- Outdoors: In the outdoor environment, Alternaria is found in soil, water and plant material- it plays an important role in vegetable matter decomposition (1). Airborne Alternaria spore counts are often higher around farming and agricultural operations, particularly during harvesting processes when spores are released into the air in large numbers. (3) It is well studied as a plant pathogen having saprophytic effects on a wide variety of vegetation and is often the source of early blights in crops (2). It reaches peak concentrations during late summer and fall (2).
- Indoors: Alternaria can be found growing indoors on textiles, dust, wood, carpeting, flooring, drywall or gypsum board, wall paper, furniture, and other cellulose materials. It can be found in humidifiers, heating and air conditioning units, inside of ductwork, and surrounding damp areas i.e. sinks, showers, and windows(1).

Health Effects

- Allergenic
 - Considered by some to be among the most common mold allergens in the US (1).
 - Alternaria can cause allergy symptoms following ingestion, inhalation, injection or direct contact.
 - Alternaria spores are airborne allergens (1). Reactions due to inhalation may increase during peak concentration times in late summer and early fall.
 - Inhalation of high concentrations by sensitive individuals may manifest in Type I and Type III hypersensitivity reactions. These include allergic asthma, conjunctivitis (redness of the eye), rhinitis (hay fever), anaphylaxis, angioedema (dermal swelling), urticarial (hives) or hypersensitivity pneumonitis (Type III).
 - Pathogen
 - Invasion is rare but can occur, particularly in immunocompromised individuals. Cases of onychomycosis (nail infection), sinusitis, ulcerated cutaneous infections, keratitis, phaeohyphomycosis, as well as osteomyelitis and peritonitis in patients undergoing peritoneal dialysis have been reported (1,4).
 - Can occasionally cause phaeohyphomycosis (fungal infection), usually in subcutaneous tissue (6).
 - Toxins/ Metabolites
 - Alternariol (antifungal uses), AME (alternariol monomethylether), tenuazonic acid, & altertoxins (1)

Newton Microbial Laboratory©2016

Ascospores



Growth and Distribution

Ascospores refers to spores produced in a sac-like structure known as an ascus (plural asci). These spores are specific to fungi of the phylum Ascomycota. Ascomycota is a broad division containing a large number of genera and individual species. Identification of the genus and/or species based on spore morphology alone is not always possible, therefore these spores are often given the more general classification of "Ascospores" in microscopic analysis.

- Ascospores are found worldwide with prevalence and distribution depending on particular genus and species.
- Outdoors: Ascospores are found ubiquitously in outdoor environments; often found on dead and decaying plant material. Many types are known to have pathogenic or parasitic properties in plants.
- Indoors: Common substrates include damp building materials such as gypsum or lumber, carpeting, dust, and other organic materials.

- Allergen
 - Ascospores can be allergenic to sensitive individuals, most often producing Type I or Type III hypersensitivity reactions. These include allergic asthma, conjunctivitis (redness of the eye), rhinitis (hay fever), anaphylaxis, angioedema (dermal swelling), urticarial (hives) or hypersensitivity pneumonitis (Type III). (5)
 - Reactions due to spore inhalation may increase following rain or high humidity. (5)
 - Unlike some fungi which rely on air currents for spore dispersal, ascomycetes are capable of a more active form of spore dispersal that utilizes water droplets to catapult their spores into the air. Various species of Ascospores are known to use this method to liberate spores every single day, regardless of air flow. Subsequently, exposure to ascospores may be more consistent from day to day than exposure to other spores which are only dispersed with adequate air currents. For this reason these spores may be of particular interest in cases of chronic respiratory disease such as asthma and rhinitis (5).
- Pathogen
 - Some types can be pathogenic; dependent upon genus and species.
- Toxins\Metabolites
 - Vary greatly depending on genus and species.

Aspergillus/Penicillium

Growth & Distribution (7):

Aspergillus & Penicillium are incredibly adaptive and abundant organisms. Their distribution is world-wide with many species possessing abilities to tolerate environmental conditions that challenge other molds (i.e. extreme temperatures & pH levels, restricted water availability and exposure to radiation). Colony growth rates are rapid for many species. Mature colonies are capable of quickly producing large numbers of spores. Because of the morphological similarity of the spores, the two genera are typically grouped together as "Aspergillus-Penicillium."

Newton ••

Microbial Laboratory

- **Growth Rate:** Usually Rapid Mature within 3-4 days; however, some species are slower(6).
- Water Activity: Aspergillus: 0.93-0.97 & Penicillium: 0.88 0.99 (33, 35)
- **Outdoors**: Both can be found outdoors on a variety of substrates- particularly plant materials such as cereals, grains, decaying wood, and soil (7).
- Indoors: Found indoors on organic materials such as wood, textiles, cellulose materials, carpeting, painted surfaces, and food stuffs such as cheeses, butter/margarine meats, breads, fruits and vegetables. Halotolerant species may be found growing on refrigerated foods (7). Penicillium is used in cheese production and is responsible for the veins in blue cheese.

Health Effects

- Allergen:
 - Because these spores are so abundant, daily exposure to Aspergillus/Penicillium is very common in both indoor and outdoor environments. Often this exposure occurs without any noticeable reaction or symptoms. However, sensitivities may develop in some instances- especially with prolonged exposure to high spore concentrations. This can result in allergic responses.
 - Spores may progress further into the respiratory system than other common spores due to their small aerodynamic diameter.
 - Penicillium is the mold from which the antibiotic Penicillin was first derived. Penicillin is now made synthetically. It does not contain the mold Penicillium. Allergy to one does not necessarily imply allergy to the other.

Pathogen (6,7):

- There are approximately 175 species of Aspergillus, only about 20 of which are known to cause disease in humans.
- Diseases caused by Aspergillus are known as aspergillosis and include invasive infection, colonization, & toxicosis.
- Certain species of Penicillium are considered pathogens. Infection may occur in skin, blood, bone marrow, internal organs or lymph nodes. (6). In the immunocompromised (particularly HIV patients or those who have recently been in Southeast Asia) I *P. marnefei* can cause severe infection capable of affecting respiratory, lymphatic, and nervous systems.
- Toxins/Metabolites:
 - Different species of Aspergillus/Penicillium are associate with an array of mycotoxins and metabolites, some of which are medically significant in humans. The importance of these toxins can vary from species to species and depends largely on the prevalence of that species.

Basidiospores



Growth & Distribution:

- Basidiospores are spores produced by the division of Fungi known as Basidiomycota. These spores are unique for lacking septation, containing bilateral symmetry, and often having a visible pore at the site of detachment from the basidium (7). This is a large group of organisms consisting of a large number of individual genera & species. Distribution is world-wide with the prevalence in any given area varying for each genus and species. Like ascospores, basidiospores disperse using water droplets. Therefore, airborne spore concentrations are often higher following rain or high humidity. This division includes edible mushrooms.
- Outdoors: Basidiospores are found growing on plant material, organic debris, and soil. Many species of basidiospores are known to be plant pathogens.
- Indoors: Basidiospores may be found growing on damp materials. Colonies may grow given sufficient access to water (leaks, flooding, high humidity, or surrounding plumbing, heating/air conditioning components, appliances, house plants, etc.).

Health Effects:

- Allergenic:
 - Exposure to these spores is commonplace in both indoor and outdoor environments. Nonetheless they are also potentially allergenic. Allergic responses may occur following inhalation, ingestion, or direct contact. Reactions due to inhalation may be increased following rain or high humidity when spore concentrations are often elevated.
 - In sensitive individuals, typically manifest Type I or Type III hypersensitivity reactions. These include allergic asthma, conjunctivitis (redness of the eye), rhinitis (hay fever), anaphylaxis, angioedema (dermal swelling), urticarial (hives) or hypersensitivity pneumonitis & allergic sinusitis (Type III). (5)
- Pathogenic:
 - Invasion is not typical but can occur, particularly in the immunocompromised or immunosuppressed. These infections can includes sinitus, keratitis, phaeohyphomycosis, & peritonitist.
- Toxins\Metabolites:
 - Mycotoxins vary depending on genus and species. They are especially relevant in edible fungi of this division such as mushrooms.
 - Common sources of mushroom poisoning include Amnita, Lepiota, Coprinus, & Psilocybe

Newton Microbial Laboratory©2016

Bipolaris/Drechslera



Growth & Distribution:

- Bipolaris, Drechslera, Exserohilum, & Helminthosporium are dematiaceous fungi, producing spores which are elongate, cylindrical, often with numerous septations or cells. These genera are grouped together due to spore similarity. These spores are common in both indoor and outdoor environments. They are found world wide with some species being exceptionally tolerant of dry environments (6).
- Growth Rate: Rapid Mature within 5 days (6)
- Water Activity: 0.80 (this is a generalized number for common molds) (26)
- Outdoors: These molds are most commonly found on grasses, grains and other plant materials. Bipolaris can be a plant pathogen causing spots, blights, rots, and other symptoms in staple crops like rice, wheat, and sorghum. In the past, plant disease caused by Bipolaris invasion has caused starvation of large human populations. In 1943-1944 the Bengal famine in India was caused by *Bipolaris oryzae* disease in rice. In the 1970s, *Bipolaris maydis* was responsible for a devastating leaf blight resulting in huge losses of corn crops in the USA & UK. (11)
- **Indoors:** These mold may be found on water damaged materials, food stuffs, houseplants, and other organic materials.

- Allergenic:
 - These molds are highly common in both indoor and outdoor environments; most people have some level of exposure on a daily basis.
 - In sensitive individuals can manifest Type I or Type III hypersensitivity reactions. These include allergic asthma, conjunctivitis (redness of the eye), rhinitis (hay fever), anaphylaxis, angioedema (dermal swelling), urticarial (hives) or hypersensitivity pneumonitis & allergic sinusitis (Type III). (5)
 - Pathogenic:
 - Bipolaris (rapid growth mature within 5 days) can be pathogenic in rare instances, particularly in immunocompromised. May invade bone, cornea (keratomycosis), skin, aorta, lung, central nervous system or cause brain lesions (6).
 - Exserohilum (rapid growth mature within 5 days) can cause phaeohyphomycosis (infection of mycelia/hyphae of dematiaceous fungi), most commonly in nasal sinuses, skin, subcutaneous tissue, and cornea. Rare reports of fatal disseminated infection (6).
- Mycotoxins/Metabolites:
 - Cytochalasin, sporidesmin, sterigmatocystin (7)

Chaetomium



Growth & Distribution

- Chaetomium is a common mold with worldwide distribution; however, airborne spore concentrations are generally low in outdoor air (1). Identification is usually successful due to unique spore morphology with spores exhibiting a distinctive lemon-shape & olive-brown color. (7) There are approximately 80-150 species described; taxonomic data varies greatly for the genus (1). Some species are thermotolerant or thermophilic (able to tolerate or thrive in high heat). Spores themselves can be highly resistant to dry circumstances and UV radiation (7).
- Growth Rate: Rapid Mature within 5 days (6)
- Water Activity: 0.91-0.94 (1)
- Outdoors: These molds are found commonly in soil, on plant remains, and on softwood and hardwood timber (where it is known as "soft- rot fungus")(7).
- Indoors: These molds are often found on water damaged cellulosic materials such as wood, sheetrock paper, cardboard, wall paper, & textiles. Like many molds, Chaetomium is cellulolytic- it degrades cellulose materials. Growth may result in damage to building materials, paper documents, textiles, etc. (4)

- Allergen:
 - Spores of these molds are somewhat less common in the air in but are considered to be allergenic (1).
 - In sensitive individuals, typically manifest Type I or Type III hypersensitivity reactions. These include allergic asthma, conjunctivitis (redness of the eye), rhinitis (hay fever), anaphylaxis, angioedema (dermal swelling), urticarial (hives) or hypersensitivity pneumonitis & allergic sinusitis (Type III)(5).
- Pathogen:
 - Very occasionally pathogenic in humans- mostly in the immunocompromised. Reportedly the cause of systemic and cutaneous phaeohyphomycosis (6), onychomycosis (nail infection), peritonitis, cutaneous lesions (2) and extremely rare cases of fatal disseminated cerebral disease in the immunocompromised and intravenous drug users (1).
 - Very rare cases of toenail or fingernail infection in people with normal immunity (2).
- Toxins/Metabolites:
 - Include chaetoglobosin, chetomin, chaetochromin, chaetosin, cochliodinol, sterigmatocystin (potentially carcinogenic) (12)
 - Several species do produce mycotoxins when growing on water damaged building materials in specific growth conditions (1).
 - Mycotoxicosis in humans is poorly studied; however, some animals studies have shown contaminated cereals to be toxic and even fatal in animals following ingestion of contaminated feed (1).
 - Toxicosis has been seen in mice spleen, liver, and kidney.(1)

Cladosporium

Newton Microbial Laboratory

Growth & Distribution:

- Cladosporium are found in air and soil worldwide. Cladosporium are among the most common airborne fungi (4). Spores are
 produced in abundance and easily disperse through the air. Extremely common on decaying organic matter. These mold are
 common plant pathogens. Molds of this genus are dematiaceous with over 40 named species (1).
- Growth Rate: Moderately Rapid Mature within 7 days. (6)
- Water Activity: 0.85-0.88 (1)
- Outdoors: Cladosporium can be found on food sources such as cereals, fruit, vegetables. Commonly found on dead plants and shrubs in temperate regions. Halotolerant (salt tolerant) species exist. (7) The most common species isolated from plant materials & soils (*C. cladosporiodides*) experiences peak airborne spore concentrations between June/July and September/October in temperate climates (2).
- Indoors: Cladosporium can be found on water damaged materials (i.e. plaster, paint, textiles, gypsum, wall paper, wood, moist window sills). May affect food sources such as cheeses, butter/margarine, vegetables, fruits and vegetables(7). Often found on the surface of fiberglass duct liners, in bathroom showers, and on basement walls (2). Some studies have reported Cladosporium in 70% of homes examined in the US & 100% of homes examined in Canada (1).

- Allergen:
 - Allergic reaction to airborne spores are of particular importance because these spores exist in in such high concentrations in the air. Symptoms may increase during peak concentrations from June-October. Sensitization may occur. (1)
 - In sensitive individuals typically manifest Type I or Type III hypersensitivity reactions. These include allergic asthma, conjunctivitis (redness of the eye), rhinitis (hay fever), anaphylaxis, angioedema (dermal swelling), urticarial (hives) or hypersensitivity pneumonitis & allergic sinusitis (Type III). (5)
- Pathogen:
 - Is pathogenic in humans very rarely, reported cases include skin lesions, keratitis, onychomycosis, sinusitis, pulmonary infections (1).
- Mycotoxins/Metabolites:
 - Cladosporic acid (12)
 - Gibberellin (hormone influencing developmental processes in plants) & ergosterol (precursor to vitamin D2 which may have anti-tumor properties). (1)
 - Toxic effects have been seen in animals (chicken embryos & horses) but not known to be reported in humans to date (1,2).

Curvularia





Growth & Distribution

- Curvularia is found world-wide with a particular preference for the tropics and warmer climates (7). Spores usually have a unique curved shape caused by an enlarged central cell (2). Airborne spores are common in both indoor and outdoor environments worldwide.
- Growth Rate: Moderately rapid 4 to 12 days (32)
- Water activity: 0.80 (this is a generalized number for common molds) (26)
- **Outdoors:** Curvularia is typically seen growing on plant material. They are weakly pathogenic to plants and are the cause of leaf spots, seedling blight, and failing of seedling germination (2).
- **Indoors:** Curvularia may be found growing on materials containing cellulose such as woods and grains. Growth is less frequent indoors but may be seen on food.(7)

- Allergen:
 - Poorly studied but believed to be an allergen and irritant (13).
 - In sensitive individuals typically manifest Type I or Type III hypersensitivity reactions. These include allergic asthma, conjunctivitis (redness of the eye), rhinitis (hay fever), anaphylaxis, angioedema (dermal swelling), urticarial (hives) or hypersensitivity pneumonitis & allergic sinusitis (Type III). (5)
- Pathogen:
 - Believed to cause corneal infections in the immunocompromised (14)
 - Opportunistic infections of cornea and sinuses, nails, subcutaneous tissue, and systemic organs. Dissemination to the brain can occur rarely. (6)
 - Can be causal agent in <u>mycetoma</u> (6):
 - Infections of subcutaneous tissue and skin. Untreated, chronic infections may progress to involve muscle, fascia & bone. Typically seen on the lower leg or foot, rarely disseminated.
 - Fungi enters the skin via wound, a nodule slowly develops into a tumor or abnormal tissue mass beneath the skin, cavities are formed within the mass and discharge occurs.
 - This is a rare condition which is not contagious. (6) Most infections occur in immunocompromised hosts. (2)
 - Toxins/Metabolites:
 - Some toxins produced- mainly studied in plants.

Epicoccum



Growth & Distribution

- Epicoccum is found worldwide. Spores are large with distinctive, highly septate morphology and dark brown color (7). Spores
 are dispersed easily by the wind. Airborne concentrations are generally higher on dry, windy days with higher counts occurring
 later in the day (1). Spores are common in both outdoor and indoor air.
- Growth Rate: Moderately Rapid Mature within 7 days (6)
- Water Activity: 0.86-0.90 (1)
- Outdoors: Epicoccum is most often found on aging or decaying plants. It is known to invade various parts of dead plants such as the seeds of corn, barley, oats, & wheat as wells as beans and surrounding soil. Can also invade insects. (7)
- Indoors: Found on cellulose materials (e.g. gypsum boards, floors, paper, woods, cardboard) and other organic materials (e.g. house plants, dust, and occasionally human skin and sputum(7)).

Health Effects:

- Allergen:
 - Believed to be an important spore in inducing fungi-related respiratory allergy disorders. Increases in outdoor spore concentrations may exacerbate asthma attacks in children.(1)
 - In sensitive individuals, typically manifests Type I or Type III hypersensitivity reactions. These include allergic asthma, conjunctivitis (redness of the eye), rhinitis (hay fever), anaphylaxis, angioedema (dermal swelling), urticarial (hives) or hypersensitivity pneumonitis & allergic sinusitis (Type III). (5)

– Pathogen:

- Not believed to be infectious in humans (1).
 - 1 reported case of fatal haematogenous mycosis in a severely immunosuppressed allogenenic hematopoietic stem cell transplant recipient possibly attributed to Epicoccum (1).
- Toxins/Metabolites:
 - No toxins or metabolite reported to be harmful to humans.
 - Produces secondary metabolites and mycotoxins which may be useful as biocontrol agents against bacteria, fungi, & viruses (1).
 - E.g. *E nigrum* against *Monilinia* spp. on fruit (7).

Fusarium





- Worldwide distribution. Spores are sickle-shaped and contain numerous cells. Spores are common in both indoor and outdoor air.
- **Growth Rate:** Rapid Mature within 4 days (6)
- Water Activity: 0.86-0.91 (4)
- **Outdoors:** Fusarium is common on plant materials (particularly cereals such as grain) and in soil. Many species are pathogenic in plants and may cause root rot, stem rot, vascular wilt, or fruit rot (4). Can also cause rot and mycotoxin contamination of stored crops and grains (4). Spore concentrations are typically higher around water sources, agricultural areas, and during summer (1).
- **Indoors:** Fusarium spores are commonly found indoors as a result of normal air exchange from the outdoor environment. However, growth of Fusarium colonies indoors is rare & is typically a sign of high moisture. This mold may be found on water damaged cellulose, in heating & air conditioning units or ductwork, in stagnant dehumidifier water, in or around appliances such as dishwashers or washing machines, and in bathrooms or kitchens. (4)

- Allergen:
 - One of the most common positive dermal tests in mold allergen panels (1).
 - Studies have shown that Fusarium can cause eye irritation and erythema (skin redness) (1).
 - In sensitive individuals, typically manifests Type I or Type III hypersensitivity reactions. These include allergic asthma, conjunctivitis (redness of the eye), rhinitis (hay fever), anaphylaxis, angioedema (dermal swelling), urticarial (hives) or hypersensitivity pneumonitis & allergic sinusitis (Type III). (5)
 - Reactions due to spore inhalation may be increased with proximity to agricultural/farming operations or during peak concentration in summer seasons.
- Pathogen:
 - Numerous species of Fusarium can cause infections including mycetoma, eye infections, sinusitis, septic arthritis, and nail infections (6). Typically seen in the immunocompromised.
 - Cause of disseminated systemic infections in severely neutropenic (neutrophil deficient) hosts (6). Unfortunately fatality rates in these instances are high, with the prognosis depending on the immune status of the host (1).
 - Agent of Hyalohyphomycoses (formation a colorless, septate hyphae in tissue; can cause acute inflammation & necrosis or invasion of blood vessels resulting in thrombosis & infarction)(6).
- Toxins/Metabolites:
 - Fumonisin, fusaric acid, fusarin, fusarochromanone, moniliformin, trichothecenes (deoxynivalinol, T2 toxin), zearlenol, Zearalenone (12)
 - Ingesting food prepared from grain contaminated with toxigenic species can result in disease (6) Possible cytotoxic, nephrotoxic, tremorgenic, immunosuppressive, & carcinogenic effects in humans and animals (1).

Memnoniella



Growth & Distribution

- Memnoniella is also known as Stachybotry echinata. Memnoniella and Stachybotrys are similar genera, some suggesting they are indeed synonymous (17). Memnoniella has been reported in Europe, the Middle East, and North America (7).
- Water Activity: >0.90 (19) Does not grow well with low water activity (7)
- Outdoors
 - Found on plant materials and in soil (7). Spore concentrations in outdoor air are typically low.
- Indoors
 - Found on damp cardboard, paper, textile, wood, and other water damaged materials (7).

Health Effects:

- Allergen:
 - These spores are not common in the outdoor air. However, indoor spore concentrations can cause reactions in sensitive individuals.
 - In sensitive individuals, typically manifests Type I or Type III hypersensitivity reactions. These include allergic asthma, conjunctivitis (redness of the eye), rhinitis (hay fever), anaphylaxis, angioedema (dermal swelling), urticarial (hives) or hypersensitivity pneumonitis & allergic sinusitis (Type III). (5)

Pathogen:

- Unknown
- Toxins/Metabolites:
 - One study found moderately cytotoxic isolates of *M. Echinata*. These isolates were also found to produce significant amounts of decholorogriseofulvins which are anti-fungal compounds typically found only in *Penicillium* species (18)
 - This study also suggested that *M. echinata* should be considered potentially hazardous in indoor air as it produces many of the same toxins as *Stachybotrys chatarum* and may be capable of progressing further into the respiratory system due to its smaller aerodynamic diameter (18).
 - Griseofulvin, spirocyclic drimanes, trichodermin, trichodermol, phenylspirodrimane (7).

Myxomycetes



Growth & Distribution

- Myxomycetes is a large class with approximately 500 individual species and worldwide distribution (25). Interestingly, these organisms are no longer considered to be true fungi like other molds, but have been reclassified as protozoans. These organisms belong to group commonly called "slime molds" that exhibit an amoeba-like stage. Spores are common in both indoor and outdoor environments worldwide (15). Spores can be dispersed by air, arthropods and other animals due to their small size (4 20 µm)(25).
- Growth Rate: Generally Rapid Mature within 2 to 4 day; however, specific growth rate does depend on species (24).
- Water Activity: 0.80 (this is a generalized number for common molds)(26).
- Outdoors
 - Found in soil, decaying plant material (especially damp wood), and dung. Species of Myxomycetes are not as geographically constricted as most organisms; most Myxomycetes species can be found world wide. (15)
- Indoors
 - Can be found growing indoors on damp building materials such as cardboard, wallpaper, gypsum board, wood, etc.

- Allergen:
 - These spores are very common in both indoor and outdoor air. They are small, foreign particles which may be inhaled
 deep into the respiratory system and may cause allergic responses.
 - In sensitive individuals, typically manifests Type I or Type III hypersensitivity reactions. These include allergic asthma, conjunctivitis (redness of the eye), rhinitis (hay fever), anaphylaxis, angioedema (dermal swelling), urticarial (hives) or hypersensitivity pneumonitis & allergic sinusitis (Type III). (5)
- Pathogen:
 - Unknown
- Toxins/Metabolites:
 - Unknown

Pithomyces





Growth & Distribution:

The colonies grow fairly fast, usually dark (grey to black) in color, while occasionally being yellowish white in color, suede- like to downy, with multicellular conidia (phragmo- or dictyoconidia) forming on peg- like extensions. The conidia extensions are oblong, segmented, verrucose and light brown in color. (4, 29) These spores can be distributed by light winds, rain, and by grazing sheep (27).

- **Growth Rate:** Rapid Mature within 5 days (6)
- Water Activity: 0.80 0.89 (28)
- Outdoors
 - Can be found on soil and litter (4). During sheep grazing can be found on herbage due to dry litter. (27)
- Indoors
 - Can be found on paper (30).

- Allergen:
 - In sensitive individuals, typically manifests Type I or Type III hypersensitivity reactions. These include allergic asthma, conjunctivitis (redness of the eye), rhinitis (hay fever), anaphylaxis, angioedema (dermal swelling), urticarial (hives) or hypersensitivity pneumonitis & allergic sinusitis (Type III). (5)
- Pathogen:
 - Can very rarely cause infection in the immunocompromised (6).
 - Can cause onychomycosis (29).
 - One case of peritonitis reported in a patient with vulvar cancer. (29)
- Toxins/Metabolites:
 - Sporidesmin (a mycotoxin which causes facial eczema in sheep)(31).

Stachybotrys





- Stachybotrys is found worldwide. One species in particular, *Stachybotrys chatarum* (sometimes called "black mold" or "toxic mold"), has gained attention recently following concerns about indoor air quality and mold contamination.
- **Growth Rate**: Moderately Rapid Usually mature with 7 days. Growth may be slower on medias that are not high in cellulose.
- Water Activity: Minimal 0.94; Optimal >0.98 (1)
- Outdoors
 - Found on decaying plant material and in soil. May contaminate grains, tobacco, wood pulp, and other plant debris. Spore concentrations are generally low in outside air.
- Indoors
 - Typically found growing indoors on materials containing cellulose with high water content. This can include water damaged building materials such as wood, gypsum board, wall paper, textiles, carpeting, and cardboard. Stachybotrys does not generally grow without prolonged access to moisture, usually lasting days or weeks. It is also not well suited for competition against other molds. Spores do not become airborne easily and generally settle out of the air quickly. For this reason, airborne spores are often the result of recent physical disturbance of colonies. (1)

- Allergen:
 - In sensitive individuals, typically manifests Type I or Type III hypersensitivity reactions. These include allergic asthma, conjunctivitis (redness of the eye), rhinitis (hay fever), anaphylaxis, angioedema (dermal swelling), urticarial (hives) or hypersensitivity pneumonitis & allergic sinusitis (Type III). (5)
- Pathogen:
 - No reported cases of human or animal infection (1).
- Toxins/Metabolites:
 - May be associated with pulmonary hemorrhage & hemosiderosis in infants (6).
 - Has frequently been suggested as a contributing agent in a variety of illnesses reported by occupants of water damaged buildings; however, establishing a firm causal relationship requires further study (6).
 - The species *S. chartarum* produces several mycotoxins that may affect humans and animals after ingestion, inhalation, or absorption (1).
 - Griseofulvin, trichothecenes (isosatratoxin, roridin, satratoxin, trichodermol, trichoverrol (12)

Stemphylium

- Growth & Distribution
 - Found worldwide. Spores are common in both indoor and outdoor air.
- Growth Rate: Rapid Mature within 5 days (6)
- Water Activity: Minimum of 0.90 (23)
- Outdoors
 - Found on plant materials (such as tomato, pomaceous & stone fruit, pear and cherry)(7).
- Indoors
 - Can be found growing on cellulosic materials such as paper, cardboard, gypsum, wood, food stuffs, etc. Spores may be found indoors as a result of normal exchange with outside air. Growth may occur near windows and door ways, especially with elevated moisture.

Newton

Microbial OC Laboratory

- Health Effects:
 - Allergen:
 - Considered by some to be among the most common mold allergens in the US (1).
 - In sensitive individuals, typically manifests Type I or Type III hypersensitivity reactions. These include allergic asthma, conjunctivitis (redness of the eye), rhinitis (hay fever), anaphylaxis, angioedema (dermal swelling), urticarial (hives) or hypersensitivity pneumonitis & allergic sinusitis (Type III). (5)
 - Pathogen:
 - Not known to be pathogenic (6)
 - Toxins/Metabolites:
 - Unknown

Torula





- Torula is a common mold with worldwide distribution. At least one species is thermophilic (thrives in high heat) (22).
- Water Activity: 0.80 (this is a generalized number for common molds)(26).
- Outdoors
 - Found in soil and dead or decaying plant matter (grasses, grains, woods, root vegetables). Can be pathogenic in plants (7).
- Indoors
 - Spores can be found indoors as a result of normal air exchange with the outdoor environment. Growth indoors is not common but can occur on damp, cellulosic materials such as wood, paper, and cardboard.
- Health Effects:
 - Allergen:
 - In sensitive individuals, typically manifests Type I or Type III hypersensitivity reactions. These include allergic asthma, conjunctivitis (redness of the eye), rhinitis (hay fever), anaphylaxis, angioedema (dermal swelling), urticarial (hives) or hypersensitivity pneumonitis & allergic sinusitis (Type III). (5)
 - Pathogen:
 - No known reports in humans
 - Toxins/Metabolites:
 - Cytotoxin (12)

Trichoderma





Growth & Distribution

- Found worldwide. Various Trichoderma species are highly adaptive and respond quickly to environmental changes. These species are often used in the study of gene expression (20). During World War II the US Army discovered a species of Trichoderma that produces enzymes useful in breaking down cellulose called cellulases. These have applications in many industries including production of biofuels, textiles, food/animal feed, brewing, and paper (20).
- Growth Rate: Rapid Mature within 5 days (6)
- Water Activity: Minimum 0.91 (23)
- Outdoors
 - Found in soil and plant materials, especially wood and trees. Also found on grains, nuts, and fruits (7). Commonly colonize plant roots, often protecting the plant from other fungi & toxins and facilitating root growth (20).
- Indoors
 - Indoors Trichoderma is typically found growing on water damaged materials, especially those high in cellulose. It may be
 isolated from wood, paper, textiles, and heating and air conditioning systems.

- Allergen:
 - In sensitive individuals, typically manifests Type I or Type III hypersensitivity reactions. These include allergic asthma, conjunctivitis (redness of the eye), rhinitis (hay fever), anaphylaxis, angioedema (dermal swelling), urticarial (hives) or hypersensitivity pneumonitis & allergic sinusitis (Type III). (5)
- Pathogen:
 - Rare reports of infection in the immunocompromised (7) or patients having recently undergone major surgery (7).
 - Rare cases of peritonitis in people undergoing peritoneal dialysis (6).
- Toxins/Metabolites:
 - Gliotoxin, koninginin, trichodermin (12)
 - T. brevicompactum may produce trichotecenes (7).
 - Biocontrol agents against other fungi, particularly plant pathogens (20).

Ulocladium





Growth & Distribution

- Found worldwide. Generally has high water requirements for growth but can survive short dry periods (1).
- Growth Rate: Rapid Mature within 5 days (6)
- Water Activity: 0.89-0.90 (1)
- Outdoors
 - Found in soil and decaying plants. Some species are pathogenic in plants such as nuts, beans, and cereals. (1)
 - Indoors
 - Can be found on wood, paper, textiles, mattress dust, and in heating and air conditioning units and ductwork. Is often found in association with water damage or high humidity (1).

- Allergen:
 - May induce irritation or inflammation (1).
 - Considered by some to be among the most common mold allergens in the US (1).
 - In sensitive individuals, typically manifests Type I or Type III hypersensitivity reactions. These include allergic asthma, conjunctivitis (redness of the eye), rhinitis (hay fever), anaphylaxis, angioedema (dermal swelling), urticarial (hives) or hypersensitivity pneumonitis & allergic sinusitis (Type III). (5)
- Pathogen:
 - Very occasionally involved in phaeohyphomycosis (infection of mycelia of dematiaceous fungi) in the immunocompromised (6)
- Toxins/Metabolites (1):
 - Can produce strong endometabolites that may be have a negative impact on indoor air quality.
 - No toxins known to be hazardous to humans.
 - Some metabolites that are active against fungi and plants.