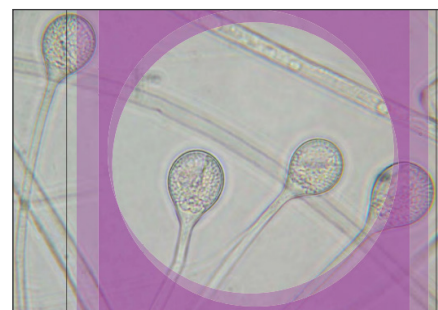




# Fungal Facts

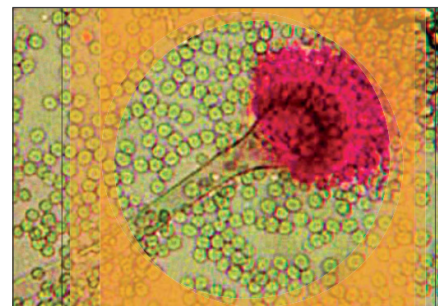
## **Absidia**

**Natural Habitats:** Soil • Decaying vegetation  
**Suitable Substrates in the Indoor Environment:** Often found in stored grains • Other foods  
**Water Activity:** Unknown  
**Mode of Dissemination:** Wind  
**Allergenic Potential:** Recognized as an allergen  
**Potential Opportunist or Pathogen:** In immunocompromised patients pulmonary invasions, the meninges (brain or spinal chord), and kidney infections can result from *Absidia* exposure • *Absidia* may also cause zygomycosis in immunocompromised patients (AIDS)  
**Industrial Uses:** Unknown  
**Potential Toxins Produced:** Unknown  
**Other Comments:** *Absidia* often causes food spoilage



## **Aspergillus**

**Natural Habitats:** Soil • Plant debris • Indoor air environment  
**Suitable Substrates in the Indoor Environment:** Grows on a wide range of substrates indoors • Prevalent in water damaged buildings  
**Water Activity:** Aw=0.75-0.82  
**Mode of Dissemination:** Wind  
**Allergenic Potential:** Allergic bronchopulmonary aspergillosis (ABPA) which is common in asthmatic and cystic fibrosis patients • *Aspergillus* sinusitis • Invasive aspergillosis in immunocompromised patients  
**Potential Opportunist or Pathogen:** Aspergilloma and chronic pulmonary aspergillosis in people with lung disease  
**Industrial Uses:** *A. oryzae* is used in soy sauce production • *A. terreus* produces mevinnin which is able to reduce blood cholesterol • *A. niger* produces enzymes used to make some breads and beers and is also used in plastic decomposition. • *A. niger* and *A. ochraceus* are used in cortisone production.  
**Potential Toxins Produced:** Secalonic acid D • Aflatoxin B • Aflatoxin G • Aflatoxin M1 • Aflatrem (alkaloid) • Aflatrem (indole alkaloid) • Aspertoxin • Brevianamide A • Citreoviridin, • Citrinin • Cyclopiazonic acid • Fumagillin • Fumigaclavine • Fumitremorgin A • Gliotoxin • Helvolic acid • 3-Nitropropionic acid • Ochratoxin A • Ochratoxin B • Ochratoxin C • Penicillic acid • Phthioic acid • Patulin • Sphingofungins • Sterigmatocystin • Terrein • Terreic acid • Terretinin • Territrem A • Versicolorin A • Verruculogen • Viomellein  
**Other Comments:** It is the second most common opportunistic pathogen following *Candida*.





## ***Aureobasidium***

Natural Habitats: Soils • Plant leaf and stem tissue • Wood • Fresh Water • Plant Debris  
Suitable Substrates in the Indoor Environment: Damp areas including kitchens, bathrooms, grout, and shower curtains • Painted interior surfaces and textiles • Skin and nails of people

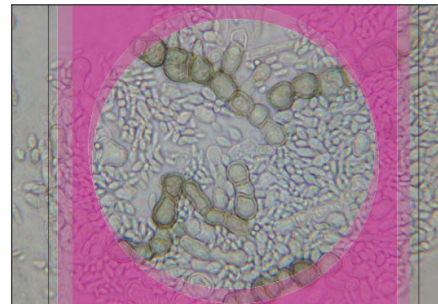
Water Activity: Grows well where moisture accumulates (88.5 RH on woodchip wallpaper)

Mode of Dissemination: Water droplets, rain • Wind when spores become dry

Allergenic Potential: Type I (asthma and hay fever) • Type III (hypersensitivity) • Skin irritant causing dermatitis

Potential Opportunist or Pathogen: Keratomycosis • Phaeohyphomycosis • Pulmonary mycosis with sepsis

Industrial Uses: *A. pullulans* produces pullulan which is used for packaging food and drugs.  
Potential Toxins Produced: Unknown



## ***Botrytis***

Natural Habitats: Plant pathogen responsible for causing

Suitable Substrates in the Indoor Environment: Houseplants • Fruits • Vegetables

Water Activity: Unknown

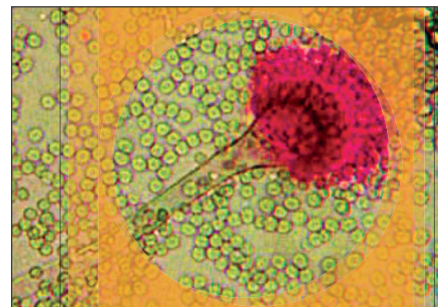
Mode of Dissemination: Wind

Allergenic Potential: Type I (asthma and hay fever)

Potential Opportunist or Pathogen: Hyalohyphomycosis

Industrial Uses: Biocontrol agent of insects

Potential Toxins Produced: Unknown



## ***Chaetomium***

Natural Habitats: Dung • Seeds • Soil • Straw

Suitable Substrates in the Indoor Environment: Paper • Sheetrock • Wallpaper

Water Activity: Aw>0.90

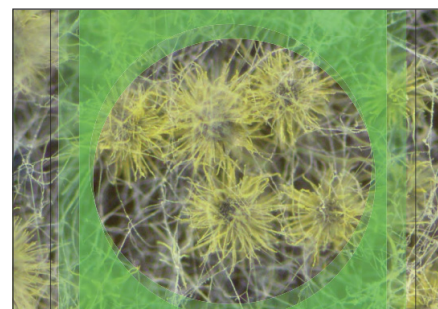
Mode of Dissemination: Wind • Insects • Water splash

Allergenic Potential: Type I (asthma and hay fever)

Potential Opportunist or Pathogen: Onychomycosis

Industrial Uses: Cellulase production • Textile testing

Potential Toxins Produced: Chaetomin • Chaetoglobosins are produced by *Chaetomium globosum* • Sterigmatocystin is produced by rare species



## ***Cladosporium***

Natural Habitats: Dead plant matter • Straw • Soil • Woody plants

Suitable Substrates in the Indoor Environment: Fiberglass duct liner • Paint • Textiles  
• Found in high concentration in water-damaged building materials

Water Activity: Aw 0.84-0.88

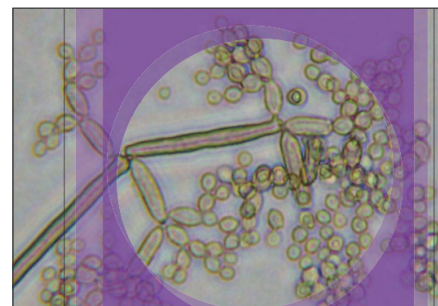
Mode of Dissemination: Air

Allergenic Potential: Type I (asthma and hay fever)

Potential Opportunist or Pathogen: Edema • Keratitis • Onychomycosis • Pulmonary Infections • Sinusitis

Industrial Uses: Produces 10 antigens

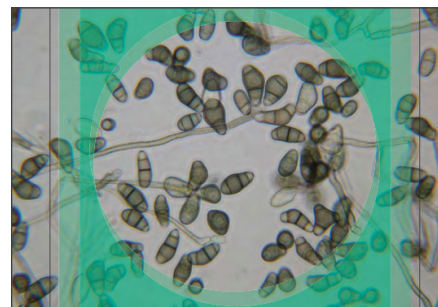
Potential Toxins Produced: Cladosporin • Emodin





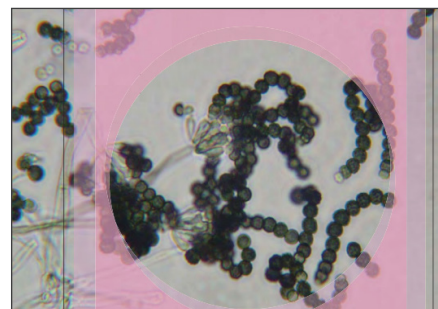
## ***Curvularia***

**Natural Habitats:** Plant saprobe and pathogen to cereal plants • Soil  
**Suitable Substrates in the Indoor Environment:** Paper • Wood products  
**Water Activity:** Unknown  
**Mode of Dissemination:** Wind  
**Allergenic Potential:** Type I (asthma and hay fever) • A relatively common cause of allergic fungal sinusitis  
**Potential Opportunist or Pathogen:** In immunocompromised patients: Cerebral abscess • Endocarditis • Mycetoma • Ocular keratitis • onychomycosis • pneumonia • sinusitis  
**Industrial Uses:** Unknown  
**Potential Toxins Produced:** Cytochalasin B



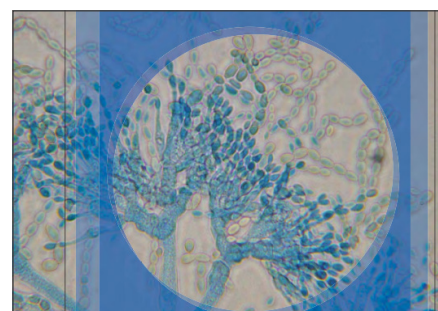
## ***Memnoniella***

**Natural Habitats:** Plant materials • Soil  
**Suitable Substrates in the Indoor Environment:** Paper • Sheetrock • Wood  
**Water Activity:** Suspected to be above 0.90 Aw  
**Mode of Dissemination:** Wind  
**Allergenic Potential:** Unknown  
**Potential Opportunist or Pathogen:** Unknown  
**Industrial Uses:** Dechloro griseofulvin Epidechloro griseofulvin • Griseofulvins • Memnopeptide A • Trichodermol • Trichodermin  
**Potential Toxins Produced:** Unknown  
**Other Comments:** Griseofulvin used an anti-dermatophyte drug and is commercially available.



## ***Paecilomyces***

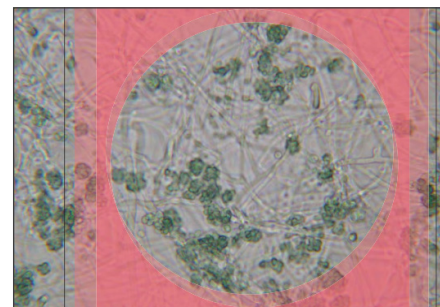
**Natural Habitats:** Decaying plant matter • Insects • Soils  
**Suitable Substrates in the Indoor Environment:** Optical Lenses • Leather • Paper • PVC • Jute Fibers • Tobacco  
**Water Activity:** Aw=0.79  
**Mode of Dissemination:** Wind  
**Allergenic Potential:** Type I (hay fever, asthma) • Type III (hypersensitivity)  
**Potential Opportunist or Pathogen:** *P. variotii* causes paecilomycosis (symptoms include keratitis, cellulitis, and alveolitis). • Corneal ulcers, keratitis, and endophthalmitis can occur after extended contact lens use or eye surgery due to *Paecilomyces* infection  
**Industrial Uses:** *Paecilomyces fumosoroseus* is currently marketed as a biocontrol insecticide  
**Potential Toxins Produced:** Byssochlamic acid • Ferrirubin • Fusigen • Indole-3-acetic acid • Paecilotoxins • Patulin • Variotin • Viriditoxin  
**Other Comments:** *P. crustaceus* and *P. variotii* can grow well at temperatures as high as 50°C





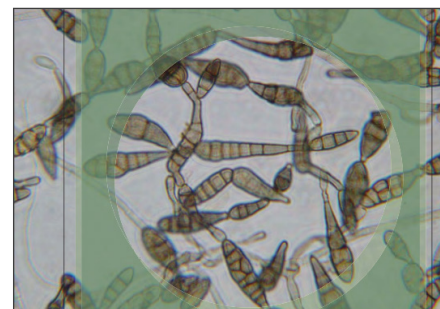
## Trichoderma

**Natural Habitats:** Decaying wood • Dead leaves • Soil  
**Suitable Substrates in the Indoor Environment:** Paper • Textiles • Wood (wet)  
**Mode of Dissemination:** Insects • Water splash • Wind  
**Allergenic Potential:** Type I allergies (hay fever, asthma) • Type III (hypersensitivity)  
**Potential Opportunist or Pathogen:** Has occasionally been associated with disease in immunocompromised individuals  
**Industrial Uses:** Biocontrol agent against a variety of plant pathogens • Biproducts of *T. viride* are used to make beer and wine  
**Potential Toxins Produced:** Gliotoxin • Isocyanides • Trichothecene • Trichodermin • T-2 toxin



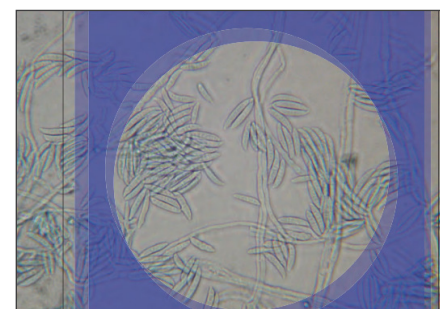
## Alternaria

**Natural Habitats:** Common saprobe and pathogen of plants. Typically found on plant tissue, decaying wood, and foods. • Soil • Air outdoors  
**Suitable Substrates in the Indoor Environment:** Indoors near condensation (window frames, showers) • House dust (in carpets and air) • Also colonizes building supplies, computer disks, cosmetics, leather, optical instruments, paper, sewage, stone monuments, textiles, wood pulp, and jet fuel  
**Water Activity:** Aw = 0.85-0.88  
**Mode of Dissemination:** Wind  
**Allergenic Potential:** Type I allergies (hay fever, asthma) • Type III (hypersensitivity pneumonitis)  
**Potential Opportunist or Pathogen:** Phaeohyphomycosis {causing cystic granulomas in the skin and subcutaneous tissue} • In immunocompetent patients, *Alternaria* colonizes the paranasal sinuses, leading to chronic hypertrophic sinusitis  
**Industrial Uses:** Biocontrol of weed plants • Biocontrol of fungal plant pathogens  
**Potential Toxins Produced:** Alternariol (AOH) • Alternariol monomethylether (AME) • Tenuazonic acid (TeA) • Altenuene (ALT) • Altertoxins (ATX)  
**Other Comments:** *Alternaria* spores are one of the most common and potent indoor and outdoor airborne allergens. Additionally, *Alternaria* sensitization has been determined to be one of the most important factors in the onset of childhood asthma. Synergy with *Cladosporium* or *Ulocladium* may increase the severity of symptoms



## Fusarium

**Natural Habitats:** Soil • Plant pathogen causing root rot, stem rot, and wilt of many ornamental and crop plants.  
**Suitable Substrates in the Indoor Environment:** Often found in humidifiers • Wet, cellulose-based building materials  
**Water Activity:** Aw=0.86-0.91  
**Mode of Dissemination:** Insects • Water droplets, rain • Wind when spores become dry  
**Allergenic Potential:** Type I allergies (hay fever, asthma)  
**Potential Opportunist or Pathogen:** Esophageal cancer is believed to happen after consumption of *F. moniliforme* infected corn • Keratitis • Endophthalmitis • Onychomycosis • Cutaneous infections • Mycetoma • Sinusitis • Pulmonary infections • Endocarditis • Peritonitis • Central venous catheter infections • Septic arthritis • Neurological disease in horses after consumption of *F. moniliforme* infected corn • Respiratory disease in pigs after consumption of *F. moniliforme* infected corn  
**Industrial Uses:** Biological Weapon  
**Potential Toxins Produced:** Trichothecenes • Zearalenone • Fumonisin  
**Other Comments:** Major plant pathogen





## Graphium

Natural Habitats: Dung • Seeds • Soils • Woody plant tissue

Suitable Substrates in the Indoor Environment: Unknown

Water Activity: Unknown

Mode of Dissemination: Beetles when mitosporic state of *Ophiostoma ulmi*

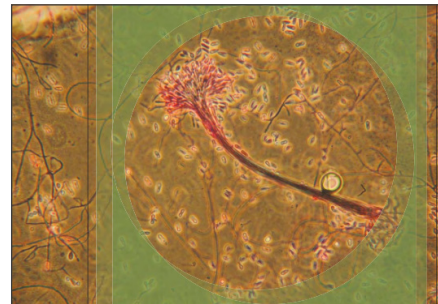
Allergenic Potential: Unknown

Potential Opportunist or Pathogen: Unknown

Industrial Uses: R135402, a compound with antifungal activity against *Candida albicans* and *Cryptococcus neoformans*, has been isolated from a fermentation broth of *Graphium putredinis*

Potential Toxins Produced: Unknown

Other Comments: There have not been any reports of human infections with *Graphium* species, however, it is a mitosporic state of *Pseudoallescheria boydii* which causes subcutaneous mycoses in man



## Nigrospora

Natural Habitats: Common on live or dead grass • Seeds • Soil

Suitable Substrates in the Indoor Environment: Unknown

Water Activity: Unknown

Mode of Dissemination: Forcibly ejected

Allergenic Potential: Type I allergies (hay fever, asthma)

Potential Opportunist or Pathogen: Keratitis • Skin lesions

Industrial Uses: Unknown

Potential Toxins Produced: Unknown metabolite reported with some toxic properties



## Penicillium

Natural Habitats: Soil • Seed • Cereal crops

Suitable Substrates in the Indoor Environment: Foods (blue mold on cereals, fruits, vegetables, dried foods) • House dust • Fabrics • Leather • Wallpaper • Wallpaper glue

Water Activity: Aw=0.78-0.86

Mode of Dissemination: Wind • Insects

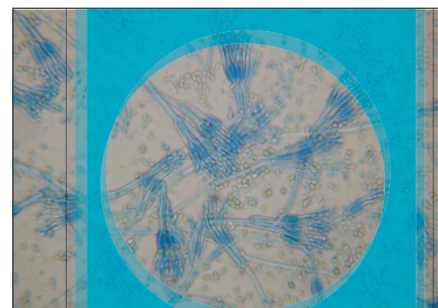
Allergenic Potential: Type I (hay fever, asthma) • Type III (hypersensitivity)

Potential Opportunist or Pathogen: Penicilliosis

Industrial Uses: Uses *P. chrysogenum* for the antibiotic penicillin • *P. griseofulvum* for the antibiotic griseofulvin • *P. roquefortii* for Roquefort cheese • *P. camemberti* for Camembert cheese • Brie, Gorgonzola, and Danish Blue cheese are also the products of *Penicillium* • Used to cure ham and salami • Production of organic acids such as fumaric, oxalic, gluconic, and gallic

Potential Toxins Produced: Citrinin • Citreoviridin • Cyclopiazonic acid • Fumitremorgen B • Grisiofulvin • Janthitrems • Mycophenolic acid • Paxilline • Penitrem A • Penicillic acid • Ochratoxins • Roquefortine C • Secalonic acid D • Verruculogen • Verrucosidin • Viomellein • Viridicatumtoxin • Xanthomegnin

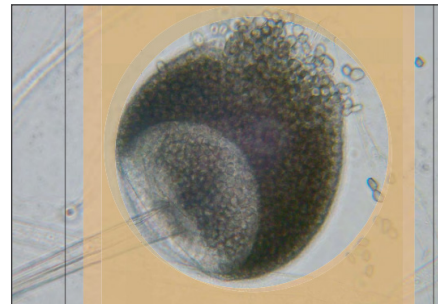
Other Comments: *Penicillium* is one of the most common genera of fungi





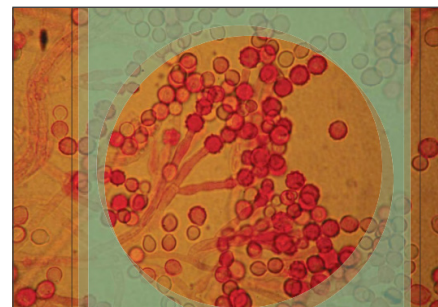
## Rhizopus

**Natural Habitats:** Dung • Fruits- causing rhizopus rot on stone fruits and strawberries • Soils • Vegetables  
**Suitable Substrates in the Indoor Environment:** Stored fruits and vegetables  
**Water Activity:** Aw=0.93  
**Mode of Dissemination:** Wind  
**Allergenic Potential:** Type I (hay fever, asthma) • Type III (hypersensitivity)  
**Potential Opportunist or Pathogen:** Causal agent of zygomycosis in immunocompromised, malnourished or severely burned people  
**Industrial Uses:** Used to ferment rice into miso • Used to ferment soybeans to tempeh and sufu  
**Potential Toxins Produced:** *Rhizopus oryzae* produces agroclavine (an ergot alkaloid toxic to mammals)



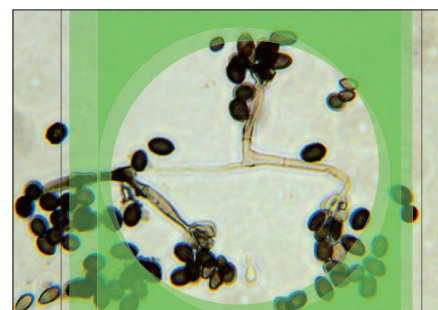
## Scopulariopsis

**Natural Habitats:** Soil  
**Suitable Substrates in the Indoor Environment:** Dairy products • Fruit • Grain • Meat • Paper • Wood  
**Mode of Dissemination:** Wind  
**Allergenic Potential:** Type III (hypersensitivity)  
**Potential Opportunist or Pathogen:** Onychomycosis in toe nails • Skin lesions • Mycetoma • Keratitis • Endophthalmitis, invasive sinusitis, pulmonary infections, endocarditis, and brain abscess typically only afflict immunocompromised patients  
**Industrial Uses:** Unknown  
**Potential Toxins Produced:** *Scopulariopsis brevicaulis* produces arsine gas from arsenate dyes found in wallpaper covered with Paris Green



## Stachybotrys

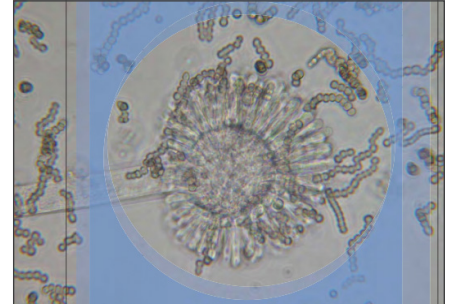
**Natural Habitats:** Decaying plant materials • Soil  
**Suitable Substrates in the Indoor Environment:** Water damaged building materials such as: ceiling tiles, gypsum board, insulation backing, sheet rock, and wall paper • Paper • Textiles  
**Water Activity:** Aw=0.94  
**Mode of Dissemination:** Insects • Water • Wind  
**Allergenic Potential:** Type I (hay fever, asthma)  
**Potential Opportunist or Pathogen:** Unknown  
**Industrial Uses:** Unknown  
**Potential Toxins Produced:** Cyclosporins • Macrocyclic trichothecenes: roridin E, satratoxin F, G & H, sporidesmin G, trichoverrol, verrucarins J • Stachybotryolactone  
**Other Comments:** *Stachybotrys* may play a role in the development of sick building syndrome. The presence of this fungus can be significant due to its ability to produce mycotoxins. Exposure to the toxins can occur through inhalation, ingestion, or skin exposure





## ***Syncephalastrum***

Natural Habitats: Dung • Soil  
Suitable Substrates in the Indoor Environment: Unknown  
Water Activity: Unknown  
Mode of Dissemination: Unknown  
Allergenic Potential: Unknown  
Potential Opportunist or Pathogen: Cutaneous infections reported  
Industrial Uses: Unknown  
Potential Toxins Produced: Unknown



## ***Ulocladium***

Natural Habitats: Soil • Plant materials • Soil, dung, paint, grasses, fibers, wood, decaying plant material, paper, and textiles  
Suitable Substrates in the Indoor Environment: Gypsum board • Jute • Paper • Rotten wood • Textiles • Wood  
Water Activity: Aw=0.89  
Mode of Dissemination: Wind  
Allergenic Potential: Type I (hay fever, asthma)  
Potential Opportunist or Pathogen: Unknown  
Industrial Uses: Unknown  
Potential Toxins Produced: Unknown  
Other Comments: *Alternaria* sensitive allergy sufferers have a multiplied reaction when *Ulocladium* and *Alternaria* are present together

