



## MUSHROOM DISEASES

The most common diseases of mushroom includes: Bacterial blotch, Green mould, die-back disease, dry bubble disease and wet bubble disease.

### Bacterial blotch (*Pseudomonas tolaasi*)

The main source of bacterial blotch in the mushroom farm is the casing soil. The disease is favoured by dampness [high humidity (over RH 85%), high temperatures (over 20°C) and poor ventilation in the growing houses]. It can be spread by the workers' hands, irrigation water and on the inventory. Mushroom flies and mites also spread the disease. The first disease symptoms appear in areas of caps that have been moist for a longest time and areas where mushroom caps touch. Symptoms include spots that darken becoming chocolate-brown in colour and slimy. It can also cause distortion and splitting of the stipes. When the infection is severe, spots spread throughout the whole mushroom surface. Seriously diseased mushrooms can become deformed and the caps can decay giving a foul (unpleasant) odour. Young pins affected by the disease become brown and do not further develop.

What to do:

- Maintain strict hygiene and sanitation in mushroom facilities
- Use properly prepared substrate and casing soil that have been adequately pasteurized
- Avoid excessive humidity, high temperatures and poor ventilation in growing rooms
- Avoid fluctuation of temperatures in the growing rooms which may cause water condensation on mushroom caps
- Remove diseased mushrooms which can be a source of the disease
- Control mushroom flies and mites which can spread the bacteria
- Water mushrooms with chlorinated water (125 ml 10% chlorine solution for 100 l of water per 100 m<sup>2</sup>. Use calcium hypochlorite

products since sodium hypochlorite may burn caps) before first break when the pin size is 4-5 mm

- Remove spent substrate from the farm. It can be used as manure for other crops

### Green mould (*Trichoderma aggressivum* var. *aggressivum*)

This fungus is soil-borne. There are many species of the fungus but *Trichoderma aggressivum* var. *aggressivum* (*Trichoderma harzianum* biotype 4 (Th4)) is a major problem particularly to button mushrooms. It gains entry to growing rooms primarily through contaminated personnel and equipment. Other sources include poorly composted substrate or carryover in rooms that were not sufficiently steamed off. Once introduced, it rapidly spreads into large disease areas from infection source. Infection of casing soil can result in serious losses. Green mold is characterized by dense white mycelial growth followed by extensive green patches on casing/compost or mushroom caps. The spores of the fungus are sticky and can easily be spread by flies, mites and workers to previously uninfected area. Red pepper mites are often associated with the disease.

What to do:

- Maintain hygienic conditions at all stages of production
- Use properly prepared substrate and casing soil that have been adequately pasteurized
- Remove contaminated substrate as soon as possible from the farm and dispose of it at a considerable distance nor less than 100 metres
- Control flies and mites
- Spread table salt on the compost in affected areas when green mold is first recognized.
- Filter air to prevent colonization of sterilized compost
- Disinfest all structures and equipment (including clothing) associated with



spawning (use immediately after disinfestation or store where air is filtered).

- Grow tropical mushroom (*Agaricus bitorquis*). It is resistant to the virus

### Die-back disease (Virus)

It causes spots in the casing soil where no mycelial growth occurs. Around these spots, mushrooms of low quality appear with long stems and dirty caps. Sometimes the only indication of a virus infection is low yield. In severe cases, a few deformed mushrooms are produced. The disease can be introduced to the farm by infected spawn. It is spread by spores and mycelium from infected mushrooms. Mushrooms affected with the virus open fast, releasing infected spores. Sometimes, mushrooms that were formed inside the casing layer come out already open. Spores from infected mushrooms are easily carried by wind, insects, on implement, clothes and hands of personnel.

What to do:

- Maintain good sanitation and hygiene in growing rooms
- Use well prepared and pasteurized substrate (compost)
- Control flies and mites
- Workers should dip their shoes in a disinfecting solution (sodium hypochlorite) (household bleach) before entering the growing rooms
- Remove spent substrate from the farm. This can be used as manure for other crops

What to do:

- Observe sanitation and hygiene during growing cycle
- Cover the beds after spawning with a paper, which must be sprinkled with 2% formalin solution every 3-4 days in order to kill all settling spores
- Harvest mushrooms in proper time, not allowing them to open
- Clean and disinfect growing rooms after growth cycle

### Wet bubble (*Mycogone perniciosa*)

This disease like dry bubble is soil-borne. Infested soil may be primary source of infection. Infection usually occurs at casing. The disease is spread within a house mainly by water splash, on clothing, equipment, flies or mites. Cross-contamination between houses can also take place. Young pin heads infected by *Mycogone* grow into shapeless lumps cauliflower-like which have a velvety appearance initially and eventually break down producing small amber droplets of liquid on the surface. It can also appear as gray fuzzy growth on gills (a series of radially arranged (from the center) flat surfaces located on the underside of the cap on which spores are formed)

What to do:

- As for dry bubble disease.



## MUSHROOM PESTS

The most common pests includes: Mites , Mushroom flies, Mycophytic nematodes, phorid fly, sciarid fly.

### Mites

Mites belong to the spider family. They are eight-legged compared to insects which are six-legged. They are very small and are usually not noticed until large numbers are present. Many different kinds of mites are encountered during mushroom cultivation process. Some mites feed on fungi and bacteria that exist in great amounts in decaying organic materials used as a substrate in mushroom production. Other members of mites are predators that mainly feed on nematodes and smaller mites. Only a few of them are considered as mushroom pests. These include mushroom mites or tarsonemid mites (*Tarsonemus myceliophagus*) and red pepper mites (*Pygmephorus sellnicki*). The mushroom mites are so small, that they are not seen with a naked eye. They are shiny, light brown in colour feeding on the mushroom mycelium and mycelium of many other competing fungi present in the substrate. They gnaw the bases of mushroom stipes (stalks of mushroom) which in result become rounded and obtain a reddish-brown shade. The amount of damage they bring to the growing crop will depend on the time and degree of infestation. If a large population of mites enters the batch at spawning, the damage can be significant.

Red pepper mites got their names from their reddish-brown colour and are often found moving on the mushroom caps or the casing surface. These mites are not regarded as primary pests, their presence is usually an indicator that *Trichoderma* (green mould) is present in the compost. These mites feed on various weed moulds but not mushrooms, thus their presence indicates that the compost is unsatisfactory. They are yellowish-brown in colour, 0.25 mm in length and have a flattened appearance. They spread spores of *Trichoderma* from bag to bag. They feed on competing fungi and that is why their presence indicates poorly prepared compost and possible presence of *Trichoderma*. They reproduce

very fast one female can lay up to 160 eggs within 5 days. They cause browning of mushroom heads and promote the spreading of green molds not only in the infected room, but also in the whole farm. When their population is high, they cause discomfort and even allergy to mushroom pickers at work.

### What to do:

- Maintain strict hygiene in the mushroom houses. This includes thorough cleaning of all machinery, equipment and rooms that were used during the spawning process, steaming the rooms in the end of the cultivation cycle at necessary temperature, and using disinfectants such as household bleach (sodium hypochlorite) (e.g. Teepol®) to clean all working surfaces and implements. Workers should wear clean clothes and dip their shoes in a disinfecting solution (sodium hypochlorite) before entering the growing rooms
- Keep straw and manure away from mushroom growing houses
- Use properly pasteurized substrate (compost)
- Control mushroom flies
- Remove spent compost from the farm. It can be used as manure for other crops

### Mushroom flies

Sciarid flies (*Lycoriella* spp.) and phorid flies (*Megaselia* spp.) can be a major problem in mushroom production. Adult flies enter mushroom houses through openings and cracks. They are attracted by the smell of substrate (compost) and growing mushrooms. They lay eggs in the substrate, casing layer and mushrooms. Each female can lay up to 170 eggs. At a temperature of 24.5°C development from egg to adult takes about 21 days. Emerging larvae (maggots) feed on the substrate, mushroom mycelium and developing mushrooms. Damaged mycelium results in the formation of pins brown in colour and having a leathery surface. Developing pins and young mushrooms may not survive after larval attack. Infested young mushrooms become hollow



and shrink, and may eventually die. Larvae may also tunnel ripe mushrooms forming many passage ways and holes, which makes the mushrooms unsuitable for human consumption. The affected substrate areas turn into swampy masses with a foul odour in which mushroom mycelium will not be able to grow. Adult flies are known to spread mushroom diseases and mites. They are also a nuisance to workers.

What to do:

- All windows or ventilating vents should be covered with insect proof net
- Use yellow sticky traps (yellow polythene sheets coated with vegetable oil) to detect and monitor presence of flies in the growing house
- In India, yellow coloured bulbs of 15 W and yellow polythene sheets coated with vegetable oil (e.g. mustard oil) have been widely adopted and proven very effective in management of mushroom flies without use of synthetic pesticides
- Remove from growing houses and farm all used substrate (compost). The spent substrate can be used as compost manure for other crops
- Disinfect growing rooms with household bleach (sodium hypochlorite) (e.g. Teepol®) after harvesting (end of cultivation cycle)
- Remove weeds and rotting materials near mushroom growing facilities

### **Mycophytic nematodes (*Aphelenchoides composticola* and *Ditylenchus myceliophagus*)**

These nematodes (eelworms) are common inhabitants of most agricultural soils. They feed on mushroom mycelium. They gain access to growing rooms in substrate and casing soil. They are spread by insects, personnel and implements. Affected areas become unpleasantly wet and soft with a foul odour because of anaerobic (not needing oxygen to live) bacteria activities. Nematodes affect yield and quality. The degree of crop losses depends on the time and level of the initial infection. Infection at spawning time can have an effect on mycelial growth

and thus making cultivation unprofitable. Infection occurring later causes only minor crop losses and goes unnoticed by the mushroom grower. The presence of nematodes on mushroom beds indicates bad cultivation conditions, that is, poor substrate and casing soil preparation and non-observance of sanitation and hygiene.

### **Mushroom abnormalities**

#### 1. The formation of scales or "crocodile skin"

These are caused by:

- Very dry air
- Strong air movement with low relative humidity
- Shortcomings in the air supply and distribution system
- Tendency of the strain to form scales
- Damage done by pesticides.

#### 2. The formation of stroma (dense layer of mycelium without fruiting on casing soil) which is

Caused by:

- Low-quality degenerating mushroom strain
- Mycelial growth in a poorly ventilated casing layer, with a high concentration of carbon dioxide, high temperature and low humidity, and a high volume of evaporation
- Overly long period of mycelial growth in the casing layer
- Petroleum-based fumes or chemicals.

#### 3. Rosecomb (misshapen cap with gills on the cap) which is caused by:

- Casing layer contaminated by mineral oils
- Contamination by petroleum-based materials.

#### 4. Outgrowths on mushroom caps - "cock's comb" which is caused by:

- An overdose of pesticides
- Casing layer contaminated with chemicals



- Effect of exhaust gases, heating appliances, diesel oil, formalin vapors, dissolvers, paint

5. Thick stipes, small caps which is caused by:

- Excessively high carbon dioxide level on the initial stage of growth.

6. A small cap on a normal stipe which is caused by:

- Improper climatic conditions for specific strains
- Susceptibility of some strains