

CONTROL AND MANAGEMENT OF POISONOUS MUSHROOMS IN THE LANDSCAPE

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A mushroom is the large and fleshy reproductive structure, or fruiting body, of certain fungi. Its purpose is the production and dispersal of spores. Generally, mushrooms have a cap, stalk, and some kind of spore-bearing surface, such as gills or pores, on their underside. The stalk keeps the fertile surface out of dirt and up in the air for spore dispersal; the cap protects the spores as they mature. The shape, texture, color and other features of the cap, the position and shape of the stalk, and the arrangement and attachment of the gills are important characteristics used in the identification of mushrooms.

The bulk of the body of a mushroom is underground or within wood, and therefore unknown to most people. It grows by microscopic tubes, call hyphae, that are many times smaller than the diameter of a human hair. Unlike the mushroom, which lives for just hours or a few days, hyphae continue to grow and branch throughout the substrate (its food source) as long as it can obtain nutrients and environmental conditions remain favorable. Most people have seen networks of hyphae on moist wood, leaf litter, moldy bread, or rotting vegetables. When a mushroom is carefully lifted from damp and loose soil, the hyphae are visible as fine strands attached to the base of the stalk. Despite their small size, the network of hyphae may live for many years, sometimes growing to gigantic sizes. In fact, one of the largest organisms on earth today may be a fungus hidden underground in the roots of trees in Malheur National Forest in eastern Oregon. Known as the Honey Mushroom, or *Armillaria ostoyae*, a single individual fungus over three miles across with a weight greater than the largest whale has been identified. Above ground, the only evidence of its presence is the periodic and ephemeral fruiting of mushrooms. Researchers have estimated its age at somewhere between 2,000 and 8,500 years.

Unlike plants, fungi are unable to produce their own food. Instead, they get their nourishment from living and dead plant and animal matter. If fungi obtain food by colonizing dead organic matter (leaves, twigs, fallen trees, etc.), they are called saprophytes. Saprophytic fungi play important ecological roles in nutrient recycling by breaking down their food into simpler products, which eventually return to the soil as simple organic compounds, minerals, and humus.

There is another group of mushroom-forming fungi that are equally critical to the health of trees but for an entirely different reason. These fungi form beneficial symbiotic associations with plants and help in their growth. Most oak and pine trees live in association with these fungi, which grow within and outside the plant's roots, actually functioning as additional roots of the tree. The fungi obtain sugars from the tree while the hyphae absorb minerals from the soil, making them available to the host plant. The mutual beneficial partnership between the fungus and the plant is called a mycorrhiza. Many mushrooms form mycorrhizal relationships with trees, and this is one of the reasons why mushrooms are often abundant in forests or forested landscapes.

Amanita phalloides, the Death Cap, accounts for 95% of fatal mushroom poisoning. It is a common and sometimes abundant part of the flora in forests and forested landscapes along the central California coast. It is often large and an attractive shade of green, belying the deadly toxins within. Recently, its origin was traced to Europe (meaning that it is sort of an introduced weed).

The Death Cap, Destroying Angel (*Amanita virosa*), the Fool's Mushroom (*A. verna*) and several of their relatives, along with the Autumn Skullcap (*Galerina autumnalis*) contain the same deadly toxin, called amatoxin. These toxins inhibit protein synthesis, resulting in general cell destruction and eventually organ failure, especially the intestine, liver, and kidney. However, discomfort is not immediate, which makes treatment of the toxin difficult since the victim does not make the connection between eating mushrooms and the onset of symptoms. After this latent period (6-15 hours), the victim will experience diarrhea, profuse vomiting, and

abdominal pains for several days. The symptoms then subside and the victim may appear to recover for a short time, but this period generally will be followed by a rapid and severe loss of strength. Kidney and liver function may then fail, causing the victim to collapse into a coma. If the victim survives, recovery generally requires at least a month and is accompanied by enlargement of the liver.

Certain species of False Morel (*Gyromitra esculenta* and *G. gigas*) contain gyromitrin, a volatile hydrazine derivative. Poisoning by this toxin resembles *Amanita* poisoning but is less severe. After a latent period of 6 to 10 hours after ingestion, the victim will suffer from abdominal pains, vomiting, and sometimes diarrhea. The incidence of mortality is low.

Some mushrooms contain neurotoxins that cause profuse sweating, convulsions, hallucinations, excitement, and depression. Ingestion of many *Inocybe* or *Clitocybe* species results in profuse sweating about 20 minutes after consumption. This effect is caused by the presence of high levels of muscarine. With large doses, these symptoms may be followed by abdominal pain, severe nausea, diarrhea, blurred vision, and labored breathing. Deaths are rare, but may result from cardiac or respiratory failure in severe cases.

The Fly Agaric (*Amanita muscaria*) and relatives produce ibotenic acid and muscimol. Symptoms generally occur within 1 to 2 hours after ingestion of the mushrooms. An initial abdominal discomfort may be present or absent, but the chief symptoms are drowsiness and dizziness (sometimes accompanied by sleep), followed by a period of hyperactivity. The victim may also exhibit symptoms of alcohol intoxication. Nausea and vomiting may also occur if too many mushrooms have been consumed. Symptoms generally fade within a few hours.

Numerous mushrooms, including members of many of the most abundant genera (for example, *Agaricus*, *Boletus*, *Lactarius*, *Russula*, *Tricholoma*, *Coprinus*, *Pluteus*, and others), contain toxins that can cause gastrointestinal distress (nausea, vomiting, diarrhea, and abdominal cramps). Symptoms start 30-90 minutes after consumption and may be initially similar to those caused by amatoxins. The diagnostic difference is that poisonings caused by these mushrooms have a rapid onset rather than the delayed start by amatoxin poisonings. Symptoms usually subside by the next day. The chemistry of the toxins responsible for gastrointestinal distress is unknown.

The Inky Cap Mushroom (*Coprinus atramentarius*) and some relatives can cause disulfiram-like (Antabuse) poisoning. Symptoms include nausea and vomiting but only if the mushrooms are consumed with a drink containing alcohol within 72 hours of eating them. Otherwise, the mushroom can be eaten with no ill effects. Another group of mushrooms contains psilocybin, a toxin that belongs to the LSD family of compounds. A number of mushrooms in the genera *Psilocybe*, *Panaeolus*, *Gymnopilus*, and *Conocybe* produce a syndrome similar to alcohol intoxication (sometimes accompanied by hallucinations). Onset of symptoms is usually rapid and the effects generally subside within two hours.

Because mushrooms are merely the fruiting bodies of fungi, removing them does not kill the underground mycelia from which they are growing. Furthermore, spores may be carried in the wind long distances, so picking the mushrooms does not eliminate reproductive spores in the landscape. Since the most dangerous mushrooms are mycorrhizal (e.g., the Death Cap), removing the host tree may be necessary to eliminate any chance of the mushroom fruiting. Fungicides are probably not practical; multiple applications and proper timing over a long period of time would be necessary. If a mushroom is growing on buried wood from old construction lumber or dead tree roots or stumps, these sources of organic matter may have to be removed by replacing the soil and sod to a depth of one foot or more and at least one foot beyond the outside edge of the substrate. Mushrooms that form unsightly fairy rings in lawns can be managed, at least superficially, by increasing fertilizer and irrigation in order to mask the symptoms of the fungus in the lawn. Physically breaking the mat of hyphae, which can become so dense that water doesn't penetrate the ground, is necessary in some cases. A soil aerator is usually used in such cases.