AGRI MAGAZINE
(International E-Magazine for Agricultural Articles)
Volume: 03, Issue: 06 (June, 2026)
Available online at http://www.agrimagazine.in

Physiological Disorders of Mushrooms

*Kajal Manchanda, R.S. Jarial and Kumud Jarial
Department of Plant Pathology, College of Horticulture and Forestry,
Neri, Hamirpur, Himachal Pradesh, India
*Corresponding Author's email: kajaljagota@gmail.com

Mushroom cultivation has gained a lot of significance worldwide as a sustainable agricultural enterprise. The reason being the highly nutritional, medicinal and economic value of edible mushrooms. But the fact is that the productivity and quality of cultivated mushrooms is highly dependent on the maintenance of cordial, and environmental friendly conditions throughout the cropping cycle. Factors such as suitable temperature, relative humidity, carbon dioxide concentration, ventilation and moisture management etc. play a very crucial role in the production of mushrooms; both quality wise and quantity wise . Any deviation from the optimum conditions can result in physiological disorders, which are non-infectious abnormalities caused by environmental stress, nutritional imbalances and/or improper cultivation practices rather than by pathogenic organisms. These disorders adversely affect mushroom growth, morphology, yield and marketability. Physiological abnormalities such as cap cracking, elongated stem, malformation of fruit bodies and premature cap opening are commonly observed in commercially cultivated mushrooms including white button mushroom (*Agaricus bisporus*), oyster mushroom (*Pleurotus spp.*) and shiitake mushroom (*Lentinula edodes*) (Sharma and Kumar, 2007).

Causes of Physiological Disorders

Physiological disorders in mushrooms are generally caused by:

- Improper temperature and humidity
- Inadequate ventilation
- Excess or deficiency of carbon dioxide
- Poor watering practices
- Nutritional imbalance in compost or casing soil
- Excess salts or ammonia accumulation
- Mechanical injury during handling
- Chemical toxicity

These factors disturb normal growth and development of mushroom fruit bodies. According to recent studies, maintaining an optimum microclimate inside cropping rooms is essential for obtaining healthy and marketable mushrooms: both quality and quantity wise. Modern mushroom cultivation systems increasingly use automated environmental control mechanisms to minimize stress conditions and improve upon the overall crop performance .

Table 1 : List of Non-infectious disorders of mushrooms with their causes

S.No	Name of the disorder	Cause
1.	Open veil	Water stress for 1–3 days followed by heavy watering can cause veil opening. Sudden temperature changes and high carbon dioxide levels during cropping often lead to this disorder.
2.	Stroma	Continuous use of old spawn, excessive carbon dioxide concentration along with high moisture in compost and prolonged spawn run are the major causes of stroma formation.

3.	Weepers / Strinkers / Leakers	This disorder commonly develops when low-moisture compost (below 64%) is combined with excessively wet casing soil.
4.	Mass pinning	Sudden reduction in temperature, excessive aeration and early lowering of carbon dioxide concentration leads to mass pinning.
5	Hollow core and brown pith	Irregular watering practices and water stress are the main factors responsible for hollow core and brown pith development.
6.	Crack or malformation	Sudden fluctuations in humidity and temperature are the main causes of cracking and malformed mushrooms.
7.	Hard cap or hard gill	Degeneration of spawn cultures and sudden temperature changes in spawn cultures or compost may lead to hard cap or hard gill formation.
8.	Long stem	High carbon dioxide concentration during cropping results in elongated stems in mushrooms.
9.	Scales or crocodiles	Poor climate management, excessive drying, high air velocity, strong formaldehyde vapors and excess pesticide application are the major causes of this disorder.
10	Browning discoloration	High temperature, sprinkling water with excessive pressure and excessive chlorination may lead to browning and discoloration of mushrooms.
11.	Rose comb	Exposure to smoke, gases or vapors from kerosene oil, petrol, diesel, paint or other oil-based products can cause rose comb disorder.

Open Veil

Open veil is a common physiological disorder in cultivated mushrooms in which the mushroom cap opens prematurely before attaining proper marketable maturity. This disorder generally occurs when watering is done close to harvesting time, especially after the crop has experienced water stress for one to three days. Sudden heavy watering following a dry period stimulates rapid growth, causing the veil to break early. Fluctuations in temperature and excessive carbon dioxide concentration during cropping also contribute to premature veil opening. The main symptoms of open veil include premature opening of the cap with fully developed brown-pigmented gills. In some cases, the cap becomes disproportionately smaller compared to the stem. Open veil may also sometimes turn into viral infections in mushrooms. Proper cultural management practices can effectively minimize this disorder. Maintaining optimum environmental conditions, including suitable temperature, humidity and ventilation, is essential. Crops should not be subjected to water stress, and watering should be carefully regulated during the harvesting period. Adequate fresh air exchange should also be maintained to prevent excessive carbon dioxide accumulation in the cropping room.

Stroma

Stroma is a physiological disorder characterized by the formation of dense white mycelial patches on the surface of the compost or casing layer before pinhead formation. The mycelium aggregates into compact masses that later develop into a thick leathery layer, which can easily be peeled off from the substrate surface. This disorder is often associated with the genetic characteristics of certain mushroom strains and is more common in strains produced from old or repeatedly multiplied spawn (Sharma and Kumar, 2007). Environmental conditions such as excessive carbon dioxide concentration, high moisture content in the compost, prolonged spawn run period and non-uniform casing moisture also favor stroma development (Rinker, 1993). Recent studies have indicated that poor spawn handling during storage and transportation further increase the incidence of stroma in commercial mushroom cultivation. Although mild stroma formation may not significantly affect yield, excessive stroma can suppress pinhead formation and reduce productivity. Proper spawn storage, uniform casing moisture and adequate ventilation are therefore essential for minimizing this disorder.

Weepers / Strinkers / Leakers

Weepers, strinkers and leakers are physiological abnormalities in which mushrooms exude excessive water droplets from the cap or stem surface. In leakers, the droplets remain attached to the mushroom surface, whereas in weepers the liquid flows or drips from the fruit body. These disorders are generally associated with high moisture imbalance between compost and casing soil. Mushrooms grown in low-moisture compost combined with excessively wet casing are particularly susceptible. According to recent reports, cream and off-white mushroom strains are more sensitive to this disorder than smooth white strains (Sharma and Kumar, 2007). Excessive humidity and improper water management also contribute to increased water exudation. Affected mushrooms lose their monitory marketing value and become highly susceptible to secondary microbial contamination.

Mass Pinning

Mass pinning refers to the excessive formation of pinheads either on the casing surface or beneath the casing layer. This disorder is commonly observed during seasonal mushroom cultivation and occurs due to sudden environmental changes. Rapid fall in temperature, excessive aeration and early reduction in carbon dioxide concentration below recommended levels stimulate abnormal pin formation. Recent studies have shown that certain high-yielding mushroom strains are more sensitive to environmental fluctuations and therefore more prone to mass pinning ((Sharma and Kumar, 2007). Proper regulation of temperature, humidity and carbon dioxide concentration is important for maintaining uniform pinhead development.

Hollow Core and Brown Pith

Hollow core and brown pith are important physiological disorders affecting the quality of mushroom stems. In hollow core disorder, a circular cavity develops inside the stipe, which may extend throughout the stem length. When the cut portion of the stem becomes brown in color, the condition is referred to as brown pith. These disorders are more commonly observed in cream-colored strains, although off-white strains may also be affected. Irregular watering practices, excessive water stress and rapid growth conditions are considered the primary causes. Recent findings by Kumar et al. (2022) revealed that fluctuations in moisture content during fruit body development significantly increase the occurrence of hollow stem disorders in button mushrooms. Such mushrooms have poor texture and reduced market value.

Cracked Mushroom (Malformed Mushroom)

Cracked mushroom, also known as malformed mushroom, is a common physiological disorder observed in cultivated mushrooms. In this disorder, the mushroom cap develops cracks or deformities due to sudden fluctuations in humidity and temperature during crop growth. Low relative humidity combined with rapid moisture loss from the mushroom surface causes splitting of the cap tissues. Irregular environmental conditions during fruit body development further aggravate the disorder. Recent studies have shown that unstable climate conditions inside cropping rooms significantly increase the incidence of malformed mushrooms and reduce their market quality and quantity of the product (Sharma and Kumar, 2007). Proper regulation of humidity and temperature is therefore crucial for preventing cap cracking and maintaining healthy mushroom development.

Hard Cap / Hard Gill

Hard cap or hard gill, also referred to as flocking, is a physiologically induced malformation affecting the cap and gill tissues of mushrooms. In this disorder, the mushroom cap opens prematurely, while the gills remain poorly developed, rudimentary and lightly pigmented. Although affected mushrooms appear normal from the upper surface, the underside reveals open caps lacking a proper veil. The gills may appear white or pink and are sometimes distorted, resembling those of polypore fungi (Sharma and Kumar, 2007). The cap tissue

becomes hard and brittle, resulting into the downfall of the commercial value of the mushrooms. The mycelium generally grows normally through the compost and casing, however, the first harvest is delayed and intervals between flushes become longer. Severe infection may reduce production to nearly twenty per cent of the normal yield. The disorder is mainly associated with degeneration of spawn cultures, repeated use of old spawn and sudden temperature changes during spawn storage or compost colonization. Recent researches have found that poor spawn quality and environmental stress significantly influence the development of hard cap disorder in button mushrooms (Kumar et al. 2023). Proper maintenance of spawn cultures, controlled storage conditions and stable environmental management are therefore important for mitigating the occurrence of this disorder.

Rose Comb

Rose comb is a physiological abnormality characterized by the appearance of pinkish or distorted gill structures on the upper surface of the mushroom cap, giving a comb-like appearance. The disorder is associated with contamination from hydrocarbons, phenols and petroleum-based compounds. Exposure to diesel oil, kerosene oil, petrol vapors, engine exhausts and certain oil-based pesticides can induce rose comb symptoms. In severe cases, mushrooms may crack, split and turn brown, becoming completely unmarketable. Recent studies have reported that volatile chemical contamination inside growing rooms is a major cause of rose comb development (Sharma and Kumar, 2007). To prevent this disorder, growers should avoid the use of toxic paints, pesticides and chemical products near cropping rooms and ensure proper ventilation.

Browning Discoloration

Browning discoloration is commonly observed in pinheads and half-grown mushrooms, especially under seasonal cultivation conditions. The disorder develops due to high temperature, excessive water pressure during sprinkling and improper use of disinfectants such as chlorine and formalin. High chlorination rates may damage mushroom tissues and induce enzymatic browning reactions. According to recent post-harvest studies, elevated temperature and mechanical injury accelerate poly-phenol oxidase activity, resulting in rapid discoloration of mushroom tissues (Sharma and Kumar, 2007). Maintaining optimum temperature and careful watering practices are therefore essential for minimizing browning.

Scales or Crocodiles

Scales or crocodile skin disorder occurs when the outer surface tissue of the mushroom cap fails to expand normally while internal tissues continue growing. As a result, the cap surface cracks and develops rough scaly patterns resembling crocodile skin. The disorder is mainly caused by poor climate control, excessive drying and high air velocity around developing mushrooms. Exposure to strong formaldehyde vapors or excessive pesticide application may also damage the mushroom cuticle and aggravate scaliness. Off-white and cream strains are generally more sensitive than white strains. Recent research by Sharma and Kumar (2007). emphasized that maintaining balanced humidity and avoiding sudden drying conditions significantly reduce the incidence of crocodile skin disorder in cultivated mushrooms.

Long Stem

Long stem disorder is characterized by excessive elongation of mushroom stems accompanied by relatively smaller caps. Although this symptom may occasionally be associated with viral diseases, it is most commonly caused by high carbon dioxide concentration during cropping. Insufficient ventilation leads to accumulation of CO_2, which stimulates stem elongation and produces drumstick-shaped mushrooms. Recent studies have confirmed that proper aeration and controlled fresh air exchange effectively reduce stem elongation and improve mushroom quality (Sharma and Kumar, 2007).

Conclusion

To conclude, it can be said in a nutshell that physiological disorders are important non-infectious problems that significantly influence mushroom yield, appearance, looks and greater profitability. These abnormalities mainly result from environmental stress, improper cultural practices and nutritional imbalance. Although they are not caused by pathogens, their economic impact can be substantial in commercial mushroom cultivation. Proper environmental management, balanced nutrition and improved cultivation practices are therefore essential for minimizing physiological disorders and ensuring sustainable mushroom production.

References

1. Rinker DL. Commercial Mushroom Production. Ont. Minist. Agric. Food Publication. 1993.350:41.
2. Sharma SR, Kumar S. Diseases and Competitor Moulds of Mushroom and Their Management. ICAR. 2007.213:173-213.