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THE DISEASES OF WHITE BUTTON MUSHROOM: A CLOSER LOOK

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ABSTRACT

The white button mushroom (Agaricus bisporus) constitutes 31% of global mushroom production, with India contributing 85% of its total mushroom yield. Despite its industrial significance, the productivity of A. bisporus in India is hindered by various diseases and environmental factors. Key fungal diseases such as Wet Bubble, Dry Bubble, Cobweb, Green Mould, Brown Plaster Mould, and Bacterial Blotch significantly impact yield. Effective disease management practices include maintaining hygiene, proper composting and pasteurization, and targeted chemical treatments. Genetic diversity within A. bisporus strains remains limited, increasing susceptibility to pathogens and posing challenges for disease resistance.

KEYWORDS: Bacterial diseases, Disease management, Genetic diversity, Fungal diseases

INTRODUCTION

As per current estimates, 1.5 million types of fungi are considered to exist on Earth.16000 species of mushroom were found globally under natural habitat. However, about 31 genera of mushrooms were known to us based on their edibility. Among the various types of well-known mushrooms, the cultivation of Button mushroom (Agaricus bisporus), Oyster mushrooms (Pleurotus spp.), Paddy Straw mushroom (Volvariella volvaceae), Milky mushroom (Calocybe indica), Shiitake mushroom (Lentinula edodes) etc. reached to a enthusiastic industrial status. According to data, about 48.3 million tonnes of grown mushrooms will be produced worldwide (FAO Stat, 2022). In connection with mushroom production, China is the global principle producer subsequently succeeded by the US, Netherlands, Poland, and Spain. As per the estimate given by FAO in 2023, India ranks 5th in terms of global mushroom production 2.0 million tonnes. In comparison to developed nations like the US, Netherlands, Poland, Spain and other European countries, India's response to the rise in mushroom productivity in recent years has been trailing behind on several parameters.

The white button mushroom (Agaricus bisporus), overall contributes 31 percent of global production while, India's share of white button mushrooms comprised of 85 per cent of total mushroom production. Amongst the main reason for significantly less yield and productivity of button mushrooms in India, is insect infestation, disease, and environmental fluctuations such as PH, CO2 accumulation, excessively hot as well as low temperature, low moisture etc. Although, among the different diseases of mushrooms, at the core mainly fungal, bacterial and viral pathogens caused a devastating losses. The most prevalent and important disease of A. bisporus includes Dry Bubble, Wet Bubble, Cobweb, Green Mould, False truffle, Olive green mould, Brown plaster mould and Bacterial blotch. Furthermore, the aggressiveness of all these disease-inciting agents generally lies on healthiness of the compost, casing and spawns. Moreover, A. bisporus strains lack genetic diversity that is underlying challenge supports limited parent strain crossing and increases susceptibility of mushrooms toward various pathogenic diseases (Savoie et al., 2013).

FUNGAL DISEASE OF WHITE BUTTON MUSHROOM

WET BUBBLE (*Mycogone perniciosa*)

Wet bubble disease of white button mushrooms is also recognized as La mole, white mould, bubble, or Mycogone disease.

Symptoms: Malformed mushrooms have swollen stipes. The cap of mushroom loose its original shape and size due to formation of white and fluffy cottony growth of fungal mycelium on emerging young pinheads well as primordia and mature fruiting flush. The yellowish droplets appear on unpleasant odour stinking infected tissue which have a size sometimes similar to grapefruit (Sharma et al., 2007).

Disease spread and transmission: The dissemination of fungus spores to surrounding environment take place by factors including mechanical means, soil, water, flies as mites etc. The fungus survives even for long durations inside spent mushroom debris as well as soil in form of resting structures such as chlymdosopres. However, unhygienic conditions maintained in growing room, use of contaminated water at time of irrigation and spores mixed with casing attributed to infection in fruiting bodies.

Management: The infection of wet bubble during cropping period will be minimized by following using directions of good agriculture practice. Broadly, these practices include firstly maintenance of proper hygiene inside crop growing room. The infection aggravated due to mechanical means should be restricted by implementing complete checks on entry as well as exits of growing room. However, if disease persists in form of patches, have to be isolated and simultaneously treat the patches with (2.0 %)

formalin swab. The pasteurization of casing soil for 4-6 hours at 65 °C also attributed to neutralizes the inoculum completely. As important, spray of benomyl at rate of 0.1 per cent after application of casing on compost minimizes the inoculum. The regular spray of benzimedazole fungicides viz. Carbendazim and Thiabendazole at the rate of 0.62 g/m2 also proved effective in control of disease.

DRY BUBBLE (*Verticillium fungicola* / *Lecanicillium fungicola*)

Symptoms: This disease is recognized by its peculiar symptoms like appearance of irregular mass of undifferentiated tissues as well as wart like growth of soft tissues during early stage of infection on emerging young pin heads. Which is followed by drying as well as breaking stipes. While, during advancement of disease in fully formed mushrooms leads to formation slight brown sunken lesion leading to dryness of and browning of cap (Sharma et al., 2007).

Disease spread and transmission: The fungus requires high humidity, poor ventilation and temperature of 28°C for its optimum growth. The spores of Verticillium spp. are generally sticky in nature which disseminated by mean of anemochory, hydrochory as well as improper hygienic conditions maintained in growing room. The spores of fungus also move and infects the casing through dust as well as sciarid and phorid flies.

Management of Dry Bubble: The disease is managed by implementing proper sanitation practices at growing room. The bubble or wart like structures on infected pinheads should be isolated and removed as early followed by treatment with 2.0 percent formalin and salt. The casing material have to be completely pasteurized for 4-6 hours at 65 °C. However, the infestation of flies/insect in the cropping room to be controlled by spray application of insecticides. The spray of preventive fungicide like chlorothalonil or zineb at the rate of 0.5 g/m2 also proved effective in control of disease.

COBWEB (*Cladobotryum dendroides*)

Symptoms: The irregular cottony ball of mycelium in form of cobweb appeared over casing soil. The mycelium covers the fruiting pin heads, which leads to discoloration of mushroom fruiting bodies as well as and causes soft rot. However, often development of brown irregular spots also becomes visible on fruiting structures. Moreover, with the advancement of infection cob web produce granular irregular structure of mycelium having powdery masses of spores (Sharma et al., 2007).

Disease spread and transmission: The main source of infection is infected casing soil. At time of maturity of cobweb, white powdery mass of spores were dislodged by windblown through vents, water splashes as

well as spore carried through dust and debris inside the growing room. High humidity maintained inside the growing room also favours the cob web development over casing soil.

Management of Cobweb: The casing soil should be completely pasteurized for 4-6 hours at 65 °C. The identification of early symptoms like formation of spots of cobweb are very important. Such infections spot to be immiditltly treated with alcohol. Treat the infected patch by covering with salt. Avoid to use casing soil that is embedded with heavy peat. The control strategies include lowering humidity and increasing air circulation. Increase hygiene of the harvesting and watering department. The spray of preventive fungicide like chlorothalonil or zineb at the rate of 0.5 g/m2 also proved effective in control of disease

GREEN MOULD (*Trichoderma viride*, *Penicillium cyclopium*, *Aspergillus* spp.)

Initially dense growth of white mycelia mat becomes visible over the casing soil and sometimes on compost also. The green colour of sporulation also found on the casing as the name indicates green mould. In case of heavy infestation, the symptoms are similar to dry bubble disease. Later the fungus creeps at the casing layer and infect the young mushroom primordia. This disease leads to formation of malformed and distorted cap as well as stipes.

Epidemiology: Disease spread and transmission Green mould most appears over compost which were rich in carbohydrate and having deficiency of nitrogen. The compactness of compost during its preparation also leads induce the disease due to improper pasteurization. Excessive level of humidity, low pH in the casing soil and regular use of 2.0 per cent formalin are the factors leads to disease development. The dispersal of pathogen spores were takes place by dust particles, contaminated clothing's, and animal vectors especially the mite.

Management: Maintain of good hygienic conditions at growing room will minimize the disease outbreak. The use of completely pasteurized compost is necessary. Sterilization of equipment's inside cropping room is important. The sprays of mancozeb (0.2%) or bavistin (0.1%) or treatment with zineb dust at weekly interval gives effective control of the disease.

BROWN PLASTER MOULD (*Papulaspora byssina*)

*Symptoms:*The disease is attributed due to formation of white mycelial growth in form of patches on the compost, casing soil as well as on the side of polybags due to accumulation of water due to process of condensation. However, with the advancement of disease the size of patches increases and changes colour to tan brown colour. This disease lead to no production of mycelium of mushroom (Sharma et al., 2007).

Epidemiology: The poorly prepared compost and casing soil cause primary infection. Highly wet compost prepared from poor quality of straw as well as addition of poor quality of gypsum and high temperature ranges between 28 -32 0C at the time of spawning induce the disease development.

*Management:*Composting should be done thoroughly, using adequate gypsum without adding excessive water. The compost ought not to become extremely wet prior or following optimum heating/pasteurization. Localized treatment of affected patches with 2 percent formalin treatment.

INK CAPS (*Coprinus* spp.)

Symptoms: This disease is usually encountered on mushroom beds throughout the spawn flow, that appears especially in North India. It mainly appears on compost bed during spawn run and even on newly cased beds, even outside the manure piles during fermentation. Ink caps are generally conical bell-shaped mushrooms. The fruiting structure of ink caps are initially appearing creamy white in colour which later turns blue to blackish in colour even covered with dry white scales. The stem of such fruiting structures becomes strong and rigid usually grows in clusters which grows deep inside the compost layer. However, this disease leads to decaying of ink caps and formation of slimy black mass on the beds due to process of auto digestion (Sharma et al., 2007).

Epidemiology: The disease usually spreads through unpasteurized or poorly pasteurized manure or casing soil. The abundance of a high level of nitrogen in compost, in addition to the usage of an excessive quantity of chicken manure throughout the process of composting, leads to the development of ink caps. Appearance of ink caps are meant as general indicator of accumulation of ammonia in manure. Use of poor quantity of gypsum as well as maintaining of too low temperature during composting even excessive wetness in compost favours the disease spread. The large mass of spores is usually released from such cluster of fruiting structures and infects fresh beds of compost.

Management: Use correctly pasteurized compost and casing soil. Avoid overwatering. To prevent the undesirable mushroom from spreading further, eradicate its young fruit bodies. Prepare compost with fresh straw. During spawning, the level of ammonia in the compost need to be less than 10 ppm, indicating that there is no ammonia smell.

BACTERIAL DISEASE OF WHITE BUTTON MUSHROOM

BACTERIAL BLOTCH AND BACTERIAL OF WHITE BUTTON MUSHROOM (*Pseudomonas tolaasii*)

This disease is also named as brown blotch and bacterial spot.

Symptoms: This disease is identified by appearance of circular to irregular pale yellow spots develops on the surface of the piles later coalesce to form sunken chocolate brown blotches. The most conspicuous symptoms appear as formation of dark area of blotches on the surface of caps which later turns dark brown in colour. The disease in severe instances leads to splitting of caps as well as misshapen of mushroom fruiting bodies. The tissue comprises the fruiting structures generally appear water soaked and grey. Blotches appear in early button stage, appear on any age - even on harvested refrigerated mushrooms. Sometimes covering entire cap (Sharma et al., 2007).

*Epidemiology:*Casing material mixture and air-borne dust are primary source of infection of bacterial blotch. Besides gram negative bacterial population found to be more in caps in comparison to casing. The pathogen mostly survives in mushroom spent or debris under the presence of moisture. However, the secondary spread of disease took place by contaminated farm tools, cloths, water splashes, sciarids and mites.

Management: Lowering of temperature not more than 20 C and humidity not more than 85 per cent will be helpful in minimizing the disease incidence. Additionally, spraying of Pseudomonas fluorescens over the casing also lowers the infection. Under the chemical application, spraying of terramycin, streptomycin at the dose of 200 ppm and oxytetracycline at the dose of 300 ppm fond effective in managing of disease.

MUMMY DISEASE OF MUSHROOM (Pseudomonas spp)

Symptoms: The name of disease resembles with visible symptoms appeared on fruiting body of button mushroom. In this disease, early symptoms appeared as swollen base of stipe which usually covered with fibrous mat of white mycelial growth. However, structure of stipes becomes leathery brown in texture as well as colour. The advancement of infection leads to curving of caps to one side while, inner tissue of fruiting structure becomes spongy in nature sometime even caused breaking of veils. Whenever, such mushroom cut in to two parts longitudinally inner tissues appeared reddish brown in colour (Sharma et al., 2007).

Epidemology: The disease mostly spreads to healthy one due to dispersal of contaminated causing as well as compost. The bacteria usually colonize and invade the hyphae of Agricus by means of entry through cell wall. The disease is mostly aggravated due to presence of high humidity, warm temperature, poor ventilation inside growing room

Management: Isolation of infected mushroom is important and disinfect the infected patch from where disease portion have been removed to be treat with 2.0 % formalin or salt solution. Infectivity of

inoculum is rendered to extent by steaming of compost at the temperature of 70C for one hour. The use of streptocycline and oxytetracycline is proved effective to reduce disease.

COMMON VIRAL DISEASE OF WHITE BUTTON MUSHROOM

La France disease was known as one of important disease which is caused by dsRNA virus particle. The disease derived its name because it was first identified and diagnosed by La France brothers of America in 1948. This disease also known to its one more name as X disease because for long period the cause of disease was unknown to us.

Symptoms: The symptoms of diseases attributed by opening of veils before maturity of fruiting structures, brownish colour of mushroom caps which gradually accompanied by reduction in yield of crop. Symptoms of disease mostly appeared after casing the compost then the symptoms appeared on fruiting bodies. The sporophore inhibition also takes place due to infestation of disease. However sometimes after application of casing mycelia fails to convert in to reproductive structures or appears in close dense clusters. Development of musty smell in addition to dwarfing are common structures.

Epidemology: The transmission of viral disease commonly took place by movement of spores as well as viable mycelium to healthy mushroom beds. Additionally, vectors like phorid fly and mites also helps in transmission of disease.

Management: Maintain of proper hygienic condition in cropping room will reduce movement of viable mycelium or spores will reduce disease spreads. the use of heat therapy will be helpful to check the disease. The use of high yielding resistant and immune strains of mushroom will be helpful. The control of virus vectors should be done through using spray of dimethoate or malathion

CONCLUSION

The cultivation of white button mushrooms in India is critically affected by a range of diseases, predominantly fungal and bacterial in origin. The industry's growth is hampered by the susceptibility of A. bisporus to pathogens due to limited genetic diversity. Effective disease management strategies, including stringent hygiene practices, proper composting, pasteurization, and the use of fungicides and bactericides, are essential. Addressing these challenges is vital for enhancing productivity and sustaining the growth of the mushroom industry in India. Increased research into developing disease-resistant strains and improving cultivation practices will be crucial for the future.

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