Bio. Res. Today 2024, 6(1):12-14

Biotica Research Today

e-ISSN: 2582-6654

January, 2024

Article ID: RT1536

Popular Article

Integrated Pest Management in Mushroom Cultivation

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Conflict of interests: The author has declared that no conflict of interest exists.

How to cite this article?

Meena and Prasad, 2024. Integrated Pest Management in Mushroom Cultivation. *Biotica Research Today* 6(1), 12-14.

Abstract

Mushroom is an edible fungus which humans have been using as food and medicine since time immemorial. Cultivation of eatable mushrooms can often be affected by several insect pests, mites and nematodes which often cause production losses. The market value of mushrooms also reduces due to infestation and contamination. There is not much evidence related to integrated pest management in mushroom cultivation. The updated article presents a practical list of insect pests related to mushroom cultivation and their integrated management, which will provide useful information to mushroom growers and also help them for controlling of the insect pests and nematodes.

Keywords: Insect-pests, Integrated Pest Management, Mushroom, Phorids

Introduction

In addition to having specific therapeutic benefits, mushrooms, commonly named "white vegetables" or "boneless vegetarian meat," are affluent in proteins, minerals and fibre (Thakur and Singh, 2013). On a dry weight basis, mushrooms have 19-35% protein, whereas rice only has 7.3%. Milk contains 25.2% and wheat contains 13.2% (Chang and Miles, 1988). Because of their nutritional and therapeutic qualities, mushrooms are becoming increasingly popular and they are currently grown commercially in more than 100 nations worldwide. Mushrooms like wood ear (*Auricularia auricula*), winter (*Flammulina velutipes*), shiitake (*Lentinula edodes*), oyster (*Pleurotus* spp.) and straw (*Volvariella volvacea*) mushroom are the next most often farmed mushrooms globally. Four types of mushrooms have traditionally been grown year-round in India: *Agaricus bisporus*, *Pleurotus* spp., *Volvariella* spp. and *Calocybe indica*. The Indian subcontinent is well-known around the world for having a wide range of agro-climatic zones and habitats that support a high biodiversity of mushrooms (Thakur *et al.*, 2011). In the process of growing mushrooms, pest infestation of various kinds poses a major risk to the mushrooms. According to Fasidi *et al.* (2008), mushrooms are more vulnerable to several insect pests (Figure 1) including sciarids, phorids, cecids, mites and nematodes that might result in substantial crop loss. The article covers the key insect pests of mushrooms, the damages caused by them and their integrated management.

Figure 1: Oyster and Button mushrooms infested with insect-pests

1. Sciarid Fly (*Lycoriella mali*)

Sciarids are tiny, fragile, black gnat-like flies that are 3-6 mm long. They have long, thread-like antennae that are held erect and huge compound eyes. The female fly has a bigger abdomen than the male. Another crucial attribute for sciarid identification is the distinctive Y venation found on their iridescent wings. When fully grown, the whitish, legless and reasonably active larvae can reach a length of

Article History

RECEIVED on 30th December 2023 RECEIVED in revised form 12th January 2024 ACCEPTED in final form 13th January 2024

6 to 12 mm. The distinctive huge head, which is shiny and black and has massive, strong biting mouthparts, is the primary identifying characteristic. When the mushrooms are harvested, the key infestation done by sciarid larvae is hollowing out in the stems. Damage can be significant when larvae eat on developing buttons and pinheads. The pin-heads can get brown and leathery when the mycelial attachments are broken off.

2. Phorids (*Megaselia halterata*)

Phorids are tiny, hump-backed (2-3 mm) flies with barely noticeable antennae. They are brown-black, have a stouter overall appearance than sciarids and resemble little house flies. The male and female flies appear to be identical, but upon closer inspection, the male gut terminates in a black capsule, while the female gut is typically whiter having a piercing tip. Another distinguishing aspect is the venation on the wings. The larvae are creamy-white, maggots without leg that are 1-6 millimeter in length. They have a blunt back tip and a pointy, non-black head end. They spend the first two-thirds of their juvenile existence as a 2-3 mm long, immobile, non-feeding pupa, which changes complexion from creamy white to brown as the fly within grows. The only food source for phorids' larvae is mushroom mycelium, which allows them to reduce yield. It is rare to see the larvae because they develop largely in the compost rather than burrowing into mushrooms. The flies are the most noticeable and they are typically in large numbers throughout the summer and late fall. They can cause pickers a great deal of inconvenience since they are highly active around lights.

3. Cecids (*Heteropeza pygmaea* and *Mycophila speyeri*)

The larvae of phorids can decrease yield because they have only access to the mycelium of mushrooms as sustenance. Because the larvae mostly develop in the compost instead of burrowing into mushrooms, it is uncommon to see them. The most conspicuous are the flies, which are usually abundant in late summer and early fall. Because they are so busy around lights, they can be a huge nuisance to pickers. The larvae cause infestation on the surface of the stipe or in the joint area of the gills and stalks. Spoilage is the main cause of marketable yield loss. Should there be larvae found in commercially packaged mushrooms, the entire product may be rejected, causing significant financial loss.

4. Mites

Mites from the families Acaridae, Pyemotidae, Eupodidae, Ascidae, Digamsellidae, Scutacardiae, Tydeidae and Macrochelidae typically infest cultivated mushrooms. The two main mites that harm mushrooms are *Tarsonemus* spp. and *Histiostoma* spp. These small, invisible mites can be found in large quantities in crops and their feeding causes the base of the stem to become discoloured and a reddish-brown colour. The first signs are webs that develop where fungi and bacteria can enter between the fruit body, mycelium and cultivation shelves. Mites consume fruiting bodies and mycelia, which lowers the yield and lowers the quality of the mushrooms.

5. Nematodes

The most harmful pest of mushrooms is nematodes, whose presence causes severely low yields or complete crop failures. The gill knots are home to nematodes, which deposit numerous eggs there. The mushroom is being impacted by three different kinds of nematodes: *Ditylenchus myceliophagus*, *Aphelenchus avenae* and *Aphelenchoides composticola*. Using their stylet, the parasitic nematodes puncture the mycelial cell and introduce digestive fluids. An obvious sign of a nematode infestation is soggy, sour-smelling and depressed compost.

6. Minor Pests

The production of edible mushrooms can be impacted by beetles as early as fruiting. When these insects hatch, they can consume the nutrients found in the mushroom where they lay their eggs. Because many grow-room constructions are composed of wood, termites pose a persistent threat during the growing season. Because they are fed mushrooms at the start of shaping, mollusks including slugs, snails and conch can be pests in mushroom production. Rats consume mushrooms directly.

Integrated Pest Management

Preventive Measures

• A preferable choice for protecting crops against insect, mite and nematode pests may be to implement preventive methods, given the limitations of pest management in the production of mushrooms. In order to effectively manage insect, mite and nematode pests during the mushroom-growing process, the following methods, if implemented, may be helpful.

• To prevent insect pest entrance, cultivate mushrooms in well-ventilated rooms with windows and doors that have wire nets of 14-16 mesh cm^{-1}.

• The most crucial preventive measures for pest management are stringent cleanliness and sanitation; without these, effective pest control would never be possible. The goal of any practice should be to exclude and eradicate pests.

• It is important to guarantee basic facilities like irrigation, sewage disposal and pure irrigation water.

• To prevent compost from coming into direct touch with infected soil, the floor used for compost preparation should be cemented.

• Keep the production unit's surroundings, inside and outside tidy. After each stacking, the composting yard needs to be properly cleaned with a disinfectant (5% formalin, hot water, *etc*.).

• The cropping rooms should not be close to the composting platform.

• Asking employees and guests to immerse their feet in a disinfectant made with 5% formalin will help them get rid of the infestation. Employees should routinely wash their hands and clothing.

• The best place to grow mushrooms is somewhere devoid of hazardous gasses and vapors, as well as chemical industry waste.

• The ideal compost for use should have a pH of 7.2 and

70% moisture content.

• Proper pasteurization is essential, as improper pasteurization can lead to numerous insect issues.

• All tools and equipment used in the process of making sprout must be cleaned and sanitized and it must be fresh and devoid of any impurities.

• Using previously cleaned tools and wearing clean boots and gloves to preserve general hygiene are crucial factors to take into account.

• Reusing polythene bags is not advised and previously used trays should be sanitized.

• It is best to begin picking younger, cleaner crops before moving on to older ones.

• Maintaining the best possible environmental conditions in operating rooms is important and trash from different procedures needs to be gathered and disposed of every day.

• Control nematode and insect pests early on to prevent the pathogens they carry from spreading.

• To stop pests from spreading to subsequent crops in the growth rooms, cook them out for twelve hours at 70 degrees centigrade.

• Spent mushroom compost needs to be removed as far as possible from the cropping area, deposited in a hole and then covered with dirt.

• Before and after running the crop, the mushroom farm needs to be thoroughly cleaned with water and then treated with a disinfectant.

Curative Measures

• Applying 10 g a.i. kg^{-1} of permethrin dust will kill flies without leaving any residue behind.

• Diflubenzuron, often known as Dimilin, is an insect growth regulator that is widely accepted as safe and advised for use in mushroom cultivation. It is also possible to administer a prescribed amount of deltamethrin as a soak treatment.

• Diflubenzuron (0.005%) at 10 mg kg^{-1} and malathion (0.01%) of straw diluted in water are mixed well during the final rotation to treat the compost. Hundred kilograms of prepared casing material is thoroughly mixed with 35 mg kg^{-1} of Diflubenzuron (0.01%) diluted in water, provided that flies are observed before casing.

• In cropping rooms, if mushroom flies are observed, use 30 ml of Nuvan 76 EC at a rate of 22.5 g a.i./ 100 m^3. Shut off the ventilators and doors for two hours after spraying. Don't spray directly onto mushroom beds. Note the 48-hour gap between mushroom spraying and harvesting.

• Application of 2-3 g malathion or 0.5-1 g diazinon m^{-2} between the flushes.

• Application Diazinon 20 EC @ 0.15% in the compost, spraying Dicofol @ 0.1% on the beds and drenching mushroom units and surrounding areas with Diazinon are effective in control of mites.

• The only widely used disinfectant that works well for cleaning floors is sudol (4%) which is efficient against cecid fly larvae.

Conclusion

Important pests of farmed mushrooms include worms, mites, phorids, sciarids and cecids. Nevertheless, integrated pest management, which combines cultural, biological, physical, mechanical and chemical methods, is thought to be the most effective and efficient tool for managing pests. As such, IPM helps to provide natural and environmentally friendly pest management tools for mushroom cultivation. It is best to employ fewer chemical techniques of pest management because overuse of chemicals can have detrimental long-term consequences on the natural ecosystem as well as detrimental effects on humans and beneficial living organisms.

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