



A Recent Report on Occurrence of Mites on Commercial Mushrooms in Western Himalayas

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

A large number of mites infest mushroom fruiting body and compost. These mites cause enormous damage to the fruiting body. An effort was made to identify different acarid mites and was undertaken at Department of Entomology and Mushroom Research and Training Centre, Faculty of Horticulture, Sher-e-Kashmir University of Agricultural Sciences and Technology, Shalimar under temperate conditions of Kashmir. During the present study four acarid mites were found in the mushroom culture. The mites were collected, reared in the laboratory on fruiting bodies of mushroom till the emergence of adult. The specimens were preserved in Oudemans fluid and send for identification. The samples were identified as *Tyrophagus putrescentiae*, *Acarus siro*,

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Pygmephorus sellnicki and *Rhizoglyphus robini*. These mites usually develop on rotting plant remains permeated by fungal hyphae and cause significant damage to mushroom fruiting bodies. This was the first report of mite infestation on commercial mushrooms in Kashmir.

Keywords: Mushroom; mould mite; grain mite; red pepper mite; bulb mite; infestation.

1. INTRODUCTION

Cultivation of Mushroom has been in trend for about 300 years. However, commercial cultivation of mushrooms in India has started few years back and is gaining popularity as the enterprise that will transform the agricultural wastes into high healthy nutritional food. Mushroom growing is one of the fastest and technologically sophisticated agricultural industries in the world. In India mushroom is cultivated in Uttar Pradesh, Haryana, Rajasthan, Himachal Pradesh and J&K. Mushrooms are spore producing fruiting bodies and are important component for sustenance of ecosystem. They are of great importance as they are used as edible food and some are of medicinal values. Those that are edible mushrooms are rich in protein, sugar, glycogen, lipid, vitamins, amino acids, and minerals. Mushrooms are subjected to a wide range of diseases and pests which cause serious crop loss [1]. Sciarid fly, phorid fly, spring tails and mites are important arthropod pests of cultivated mushrooms in India. Mites are among the creepiest creatures in the animal kingdom. Around 64 species, 51 genera, 28 families, 3 orders have been reported on edible mushrooms [2]. Some directly damage the fruiting bodies while others are of predaceous nature and feeds on other small mites, some may attach to mycelium, fly eggs, nematodes and bacteria. Mycelium eating mites cause high yield loss. Mites rarely occur in mushroom houses where good pasteurized compost is used, they are commonly found in poor hygienic conditions. *Acarus siro* Linn, *Tarsonemus myceliophagus* Hussey, *Tyrophagus lantneri* Osb, *Pygmephorus sellnicki* Krezal, *Caloglyphus mycophagus* (Megnin), *Tyrophagus putrescentiae* Schrank are considered economically important pests [3,4,5]. Very little study has been conducted regarding occurrence of mites on these mushrooms. Aishwarya et al. [6] reported some mites on mushroom from Kerala. These mites are tiny arachnids that are difficult to see and often go undetected until their numbers are significant.

2. MATERIALS AND METHODS

The studies were undertaken during 2020 to 2022. Mushrooms were cultivated in scientifically

designed mushroom houses by adopting the standard package of practices [7]. Fruiting bodies of mushroom were obtained twice a week from the mushroom house and were examined for the presence of mites in any of their developmental stages i.e. egg, larva, protonymph, tritonymph and adult stages. The number of mites were counted, separated and recorded. The immature stages were reared in the laboratory up to the adult and the number of each species in damaged fruiting bodies was recorded. Moreover, all harvested mushrooms (both the damaged and healthy) and the mushroom beds were checked frequently for the infestation of any other mite pest. The entire mushroom houses were also inspected on a frequent basis for the occurrence of any mite species. The samples were also collected from different mushroom houses of Kashmir and examined under a stereo zoom microscope (Make: Model Nikon SMZ800). Mites were picked up with a fine camel hair brush, moistened and stored in oudemans fluid. Some mites were washed from mushrooms or shaken directly into jars filled with oudemans fluid [8]. The identity of the specimens was further confirmed by the experts and available literature. Mite species that were found associated with mushrooms are discussed below:

3. RESULTS

The identification of the collected material of mites revealed the occurrence of a total of 04 species of mites under one (01) order and four (4) families. Out of these, 03 species under 4 families were damage causing mites and 01 reported to change the aesthetic value of commercial mushrooms.

3.1 Mould Mite, *Tyrophagus putrescentiae* (Sarcoptiformes: Acaridae) Schrank

T. putrescentiae also called storage mite, copra mite or cheese mite is a cosmopolitan pest of high protein foods and have significant economic importance. It is an important pest of edible fungi and accounts to the destruction of more than one million ton of fungi annually [9]. It is an astigmatic mite, widely distributed throughout the world and

has been found in association with *Rhizoglyphus robini* and *Acarus siro*. Their small size makes early infestation difficult to detect. They are slow moving, translucent mite species having long hairs on their body. This mite feeds on the mycelium and damage the mushroom culture affecting its growth and development. The susceptibility of mushrooms to mite attack depends on high humidity, softness and high nutritive value at optimum temperature. The life cycle consists of egg, larva, protonymph, deutonymph and adult stage. The larvae having three pair of legs; protonymph, deutonymph and adult with four pair of legs. These mites have a hypopus stage which is resistant to adverse condition and occur when the substrate becomes polluted. The mites are oval in shape with creamish and translucent body. Eggs are laid for a period of 10-15 days on mushrooms, female lives for 2 to 3 days after egg laying. After emerging from egg, larvae take 5 to 6 days to change into protonymph. The active phase of the protonymphal and deutonymphal period is of 7 to 8 and 9 to 10 days respectively. The developmental time from egg to adult is of 46-49

days, total longevity of male is of 22-25 days. The males had a narrow body with a distinctly pointed abdomen when compared to females with longevity of 22-24 days. The average longevity of female varies from 27 to 30 days. The life cycle of *T. putrescentiae* decreased significantly with an increase in temperature. The length of life cycle was shortest and longest as of 10 and 27 days respectively (Table 1). *T. putrescentiae* feeds on mycelium and sporophores resulting in small irregular pits on stalk and caps. These pits thereafter suffer from bacterial attack leading to decomposition which breaks down tissues just below the surface and result in the skin collapsing leaving an open pit. Besides the injury to the mycelium, mushroom mites also cause damage to the fruiting bodies by eating into them, distorting or destroying the young growth. In more mature mushrooms the mites may be found clustered in groups consisting of individuals of many sizes, usually hidden in the folds between the gills, where they burrow into the tissue, causing the caps to break down (Fig. 1). Affected mushroom become brownish in colour.

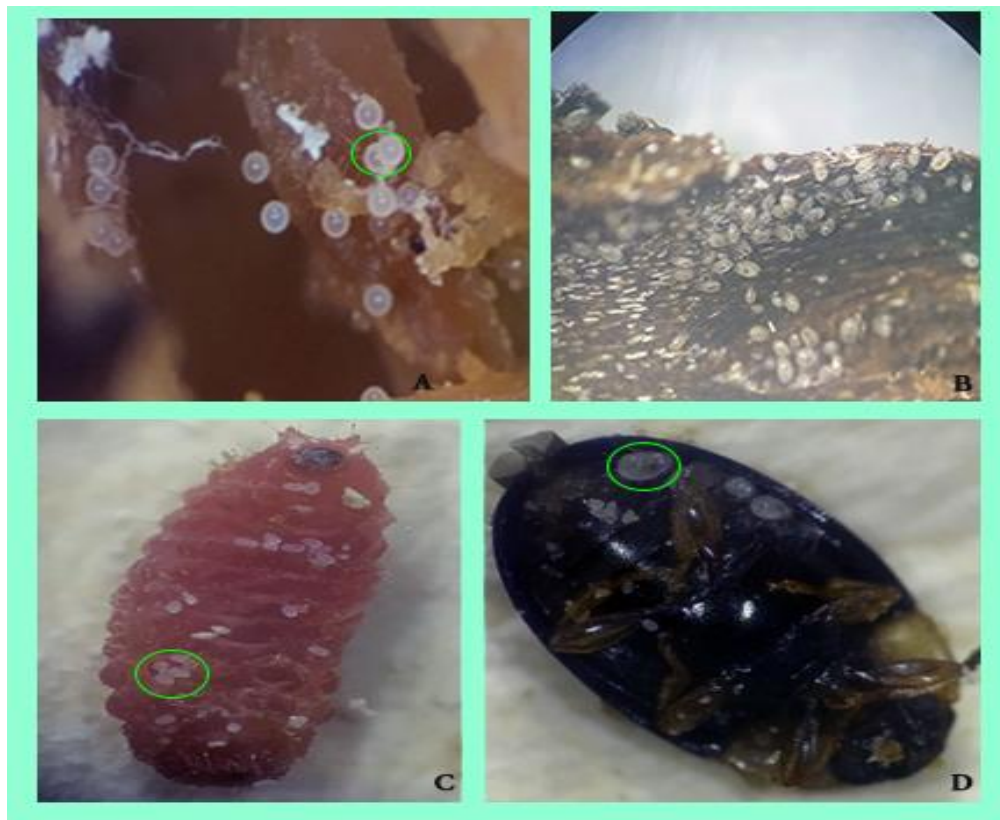


Fig. 1. *Tyrophagus putrescentiae* Schrank (Sarcoptiformes: Acaridae) A: Egg B: Adult C: Adult in association with larvae of pleasing beetle D: Adult in association with pleasing beetle

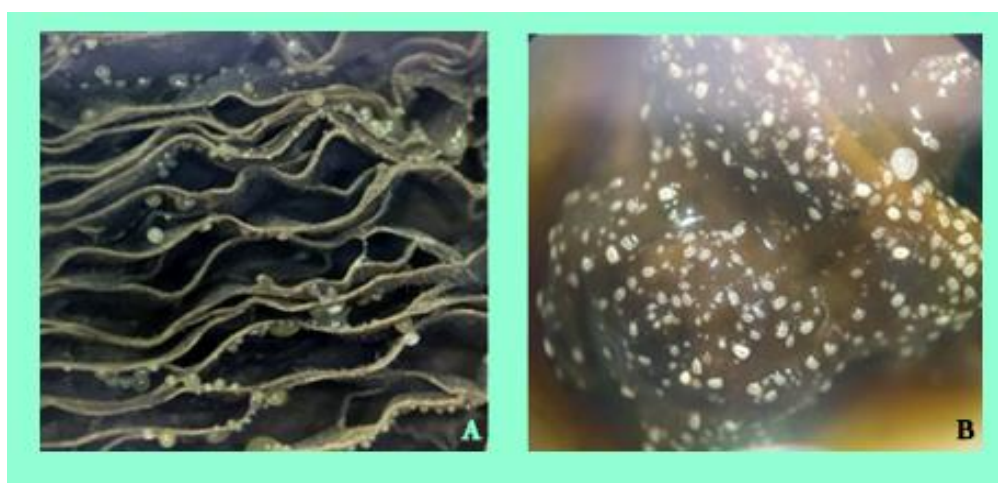


Fig. 2. *Acarus siro* Linn (Acarina: Acaridae): A: Egg B: Adult

3.2 Grain mite, *Acarus siro* Linn (Acarina: Acaridae)

A. siro also named as grain mite or flour mite formerly called *Tyroglyphus farinate* is cosmopolitan in distribution. This storage mite is very common in mushrooms and has been found to damage the mushrooms by turning them from light brown to deep brown in colour. It contaminates the mushrooms which acquire unpleasant musty smell and making them unusable for human consumption. The development of this pest takes place in mushrooms with high moisture content. The female is about 0.3 to 0.6 mm long whitish; legs are yellow in colour. Females lay around 50 to 150 eggs in their lifetime and can tolerate several months at low temperature. Around 5 to 6 eggs are laid by female in a day. Oviposition period varies from 9 to 10 days. The egg takes around 4 to 5 days to change to larvae, 5 to 6 and 2 to 4 days to change into protonymph and tritonymph respectively. The total development from egg to adults may take around 33-34 days (Table 1). There is a resting stage after protonymph that lasts for around 2 days. The longevity of male and female is about 14 to 20 and 12 to 20 days respectively (Fig. 2). The survival of the pest is best at 20 to 25°C.

3.3 Red Pepper Mite, *Pygmephorus sellnicki* Krezal (Pyemotidae: Acaridae)

P. sellnicki are also named as pyemotid or pigmy mite as they got their name by the outward appearance of the reddish accumulations moving

on the mushroom caps. These mites are found in mushroom beds but are not regarded as primary pest of mushroom or harmful to crop, their presence indicates that the quality of organic matter used in mushroom production is poor. The colour of the mite is yellowish-brown to reddish brown with flattened looks. Red pepper mites are the secondary pests of mushroom and are usually related to trichoderma or green moulds upon which they feed and promote the spreading in infected rooms. Their presences in large number worsen the mushrooms and bring unpleasant sensations. If they are numerous, they can be the cause for crop rejection, due to their bright colour. These mites disperse on poorly sterilized surfaces, on clothes of workers by clinging on scairid flies. Basically, they do not feed on mushrooms but damage them by spreading the spores of trichoderma between the bags and makes the mushrooms unfit for consumption. Female red pepper mites have high fecundity rate and are capable to multiply at a rapid rate. They lay large numbers of eggs, a single female can lay 100-150 eggs and within 4-5 days, they hatch into larvae which develop to adults through two nymphal and a quiescent resting stage of 4 to 5, 3 to 4 and 2 days respectively; the whole cycle is usually completed in 26-27 days. The longevity of male and female is about 14 to 15 and 12 to 16 days respectively (Table 1). Adults are wedge-shaped, 0.25 mm long and stout-legged; the legs and body bear feathery setae (Fig. 3). Populations increase rapidly under suitable conditions and, soon after casing, the mites swarm over the beds and developing sporophores in reddish-brown masses with decline in population.

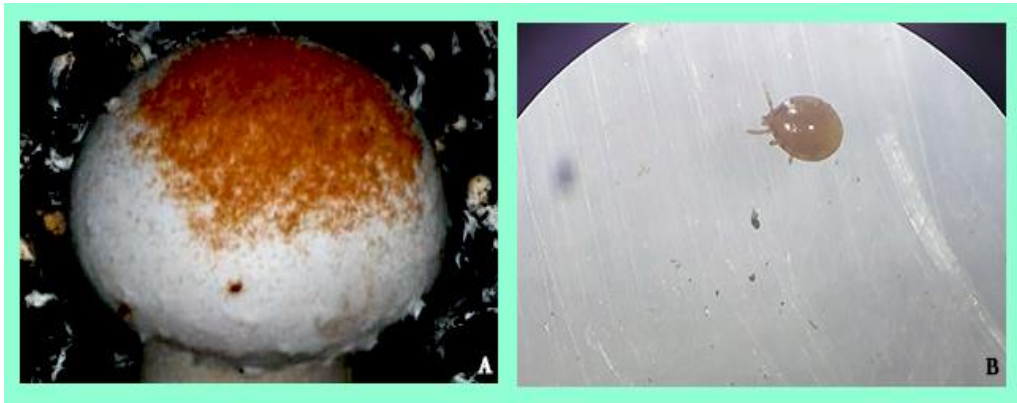


Fig. 3. *Pygmephorus sellnicki* Krezal (Pyemotidae: Acaridae). A: Infestation of red pepper mite on mushroom B: Adult under magnification



Fig. 4. Bulb mite, *Rhizoglyphus robini* claprade (Astigmata: Acaridae)

Table 1. Time taken (in days \pm SD) by different mites for the completion of development

Stage	Mould mite	Grain mite	Red pepper mite	Bulb mite
Egg	2.65 \pm 0.51	9.58 \pm 1.43	4.11 \pm 1.62	4.11 \pm 1.92
Larva	5.52 \pm 0.97	4.85 \pm 0.76	4.36 \pm 1.52	3.58 \pm 1.84
Protonymph	7.40 \pm 0.21	5.14 \pm 0.21	3.70 \pm 1.48	6.79 \pm 0.80
Deutonymph	9.25 \pm 0.22	2.65 \pm 0.44	2.11 \pm 1.68	7.69 \pm 1.95
Male	23.33 \pm 0.99	14.23 \pm 0.41	14.44 \pm 0.99	25.77 \pm 2.41
Female	27.11 \pm 1.02	12.78 \pm 0.85	12.77 \pm 0.66	23.22 \pm 6.43
Longevity	49.55 \pm 1.21	34.65 \pm 0.32	27.47 \pm 0.98	44.67 \pm 7.06

3.4 Bulb Mite, *Rhizoglyphus robini* Claprade (Astigmata:Acaridae)

R. robini is a cosmopolitan pest of many agricultural, ornamental, field, and storage crops including commercially grown edible fungi. *R. robini* is capable of ingesting fungal material and passing it through the digestive tract in a viable state. The body is smooth and colorless, the appendages are reddish brown. The

propodosomal plate is rectangular, posterior setae are smooth. The life cycle consists of egg, larvae, protonymph, deutonymph and adult. The hypopial stage is also found when the substrate becomes polluted. Around 15 to 20 eggs are laid by each female. The hatching period is of 4 to 10 days. A six-legged larva emerged from the egg and the lived in this condition for 3 to 7 days. After hatching the larvae measures 0.15 to 0.2 mm long, ovoid in shape with three pair of legs

and lack genital suckers. The larvae molt into another stage in around 5.0 days. The protonymph measures around 0.5 mm and is of 6 to 7 days respectively. This stage can be distinguished from the tritonymph by having two genital suckers, whereas the tritonymph have three or four suckers. Hypopal stage or heteromorphic deutonymph is another quiescent stage which appears when there is overcrowding or the substrate becomes too polluted by decay. This stage is milky white measuring 0.5 to 0.6 mm in length with four pair of legs. This stage lasted for 7 to 9 days (Table 1). In this stage abdomen is observed to be same as in the adult but the genitalia are undeveloped. The mites are bigger and bulged in size as compared to deutonymph. Mature bulb mites are 0.6 to 0.9 mm long with four pairs of legs. The mean number of eggs laid by females ranged from 100 to 120 eggs. The male adult is of 0.50-0.60 mm long and lives for 22 to 28 and female adult measures about 0.45 to 0.95 mm long lasted 22 to 24 days (Fig. 4). The total life cycle from egg to adult is approximately 44 to 46 days.

4. DISCUSSION

There were few reports available regarding infestation of acarid mites on mushroom from the country. During the present study four acarid mites were found feeding on the mushrooms and were identified as *Tyrophagus putrescentiae*, *Acarus siro*, *Pygmephorus sellnicki* and *Rhizoglyphus robini*. These findings are in confirmation with the findings of Praveen and Gupta, [2]. They reported some species of acarid mites feeding on the mushrooms. Sriparna and Gupta, [10] also reported 28 species of mites occurring on the wild and edible mushrooms. Malik et al. [11] reported *Tyrophagus putrescentiae* as an important pest of stored grains. Gurney and Hussy, [12] reported three species of *pygmephorus* on mushroom beds and compost.

5. CONCLUSION

There was no record of these species on mushroom from Jammu & Kashmir. During the present study these species were reported for the first time on mushrooms from Jammu & Kashmir. The specimens were preserved in Oudemans fluid and send for identification. The samples were identified as *Tyrophagus putrescentiae*, *Acarus siro*, *Pygmephorus sellnicki* and *Rhizoglyphus robini*.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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