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

**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 mitesand was undertaken at Department of Entomology and MushroomResearch 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. Themites werecollected, 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*Tyrophagusputrescentiae*, *Acarussiro,Pygmephorussellnicki and Rhizoglyphusrobini*.Thesemites 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

**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.Mushroomsare 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. Thosethat 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 (Jenita *et al.,* 2021). 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. Around64 species, 51 genera, 28 families, 3 orders have been reported on edible mushrooms (Praveen and Gupta, 2019). 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. Mitesrarely occurin mushroom houses where good pasteurized compost is used, they are commonly found in poor hygienic conditions. *Acarussiro* Linn, *Tarsonemusmyceliophagus* Hussey, *Tyrophaguslantneri*Osb, *Pygmephorussellnicki*Krezal, *Caloglyphusmycophagus* (Megnin), *Tyrophagusputrescentiae*Schrankare considered economically important pests(Kumar *et al.*, 2004, Rana, 2008, Fletcher and Gaze, 2008). Very little study has been conducted regarding occurrence of mites on these mushrooms. Aishwarya*et.al.*, (2018) 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.

**Materials and Methods**

The studies were undertakenduring 2020 to 2022. Mushrooms were cultivated in scientifically designed mushroom houses by adopting the standard package of practices (Baiswar*et al.*, 2016). 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, tritonymphand 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 Kashmirand examined under a stereozoom 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 (Zachardaet *al.*, 1998). The identity of the specimens was further confirmed by the experts and available literature. Mite species thatwere found associated with mushrooms are discussedbelow:

**Results**

The identification of the collected material of mites revealed the occurrence of a total of 04 species of mites under one (01) order andfour (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.

**1. Mould mite,*Tyrophagusputrescentiae*Schrank (Sarcoptiformes:Acaridae)**

*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 (Hubert *et al*., 2004).It is an astigmaticmite, widely distributed throughout the world and has been found in association with *Rhizoglyphusrobini*and *Acarussiro*. 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,deutonymphand adult stage. The larvae havingthree pair of legs;protonymph, deutonymphand 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.Themites are oval in shape with creamishand translucent body .Eggs are laid for a period of 10-15 days on mushrooms, female livesfor 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 protonymphaland deutonymphalperiod is of 7 to 8 and9 to 10 days respectively. The developmental time from egg to adult isof 46-49 days, totallongevity of male isof 22-25days.The males had a narrow body with a distinctly pointed abdomen when compared to females with longevityof 22-24 days. Theaverage longevity of femalevaries 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 longestas of 10and27 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.

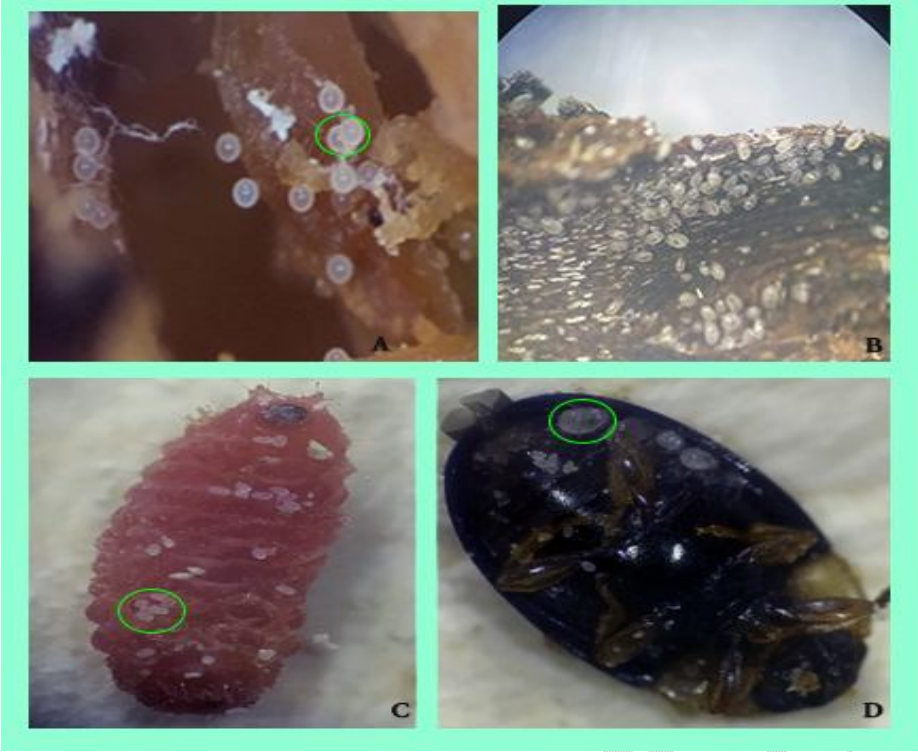


**Fig 1.** ***Tyrophagusputrescentiae*****Schrank (Sarcoptiformes:Acaridae) A: Egg B: Adult C: Adult in association with larvae of pleasing beetle D: Adult in association with pleasing beetle.**

**2.Grain mite,*Acarussiro*Linn (Acarina: Acaridae)**

*A.siro* also named as grain mite or flour mite formerly called *Tyroglyphusfarinate* iscosmopolitan in distribution.This storage mite is very common in mushroomsand has been found to damage the mushrooms by turning themfrom 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 withhigh 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 lifetimeand 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 protonymphand tritonymphrespectively. Thetotal development from egg to adults may take around 33-34days (Table 1). There is a resting stage after protonymph that lasts for around 2 days.The longevity of male and female is about 14 to20 and 12 to 20 days respectively (Fig 2).The survival of the pest is best at 20 to 25ºC.

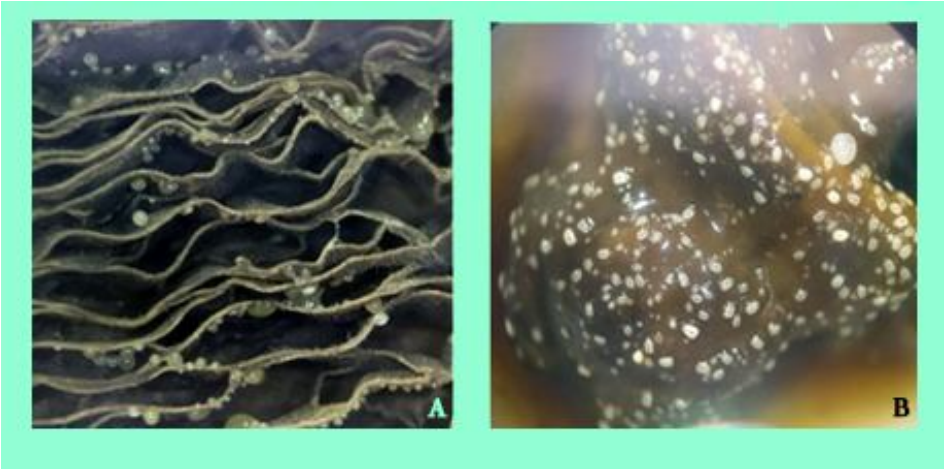


**Fig 2. *Acarussiro* Linn (Acarina: Acaridae): A: Egg B: Adult**

**3. Red pepper mite,*Pygmephorussellnicki*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. Thesemites are found in mushroom beds but are not regarded as primary pest of mushroom or harmful tocrop, theirpresence indicates that the quality of organic matter used in mushroom production ispoor. Thecolour 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 orgreen mouldsupon which they feed and promote the spreading in infected rooms.Theirpresences 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 multiplicate at a rapid rate. Theylay large numbers of eggs, asingle 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 to15 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.

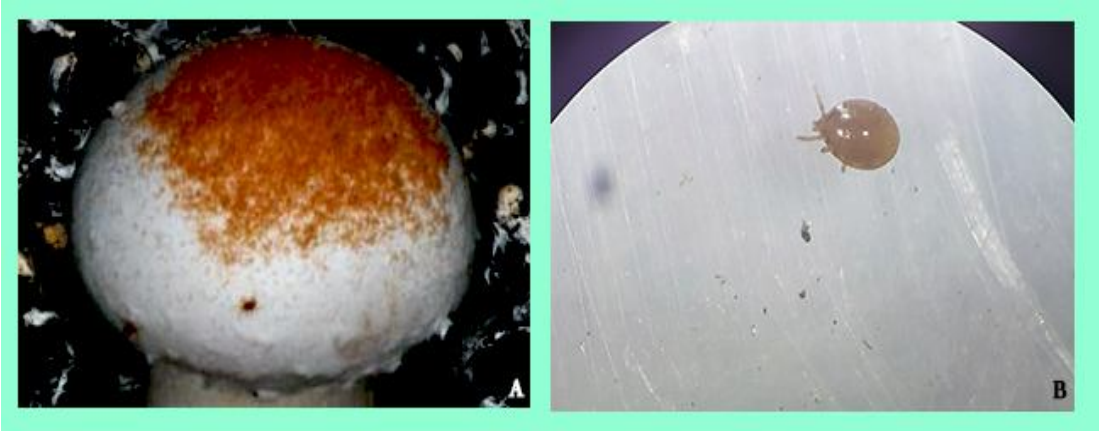


**Fig 3.*Pygmephorussellnicki*Krezal (Pyemotidae: Acaridae). A: Infestation of red pepper mite on mushroom B: Adult under magnification**

**4. Bulb mite, *Rhizoglyphusrobini*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. Thebody is smooth and colorless, the appendages are reddish brown. Thepropodosomal 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 becomespolluted. 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 around5.0days. The protonymph measures around 0.5 mmand 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 anotherquiescent 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 46days.

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

**Table: 1.Time taken (in days ± SD) by different mitesfor the completion of development.**

| Stage | Mould mite | Grain mite | Red pepper mite | Bulb mite |
|---|---|---|---|---|
| **Egg** | 2.65 ±0.51 | 9.58 ± 1.43 | 4.11 ± 1.62 | 4.11 ±1.92 |
| **Larva** | 5.52 ± 0.97 | 4.85 ± 0.76 | 4.36 ± 1.52 | 3.58 ±1.84 |
| **Protonymph** | 7.40 ±0.21 | 5.14 ± 0.21 | 3. 70±1.48 | 6.79 ±0.80 |
| **Deutonymph** | 9.25 ±0.22 | 2.65 ± 0.44 | 2.11 ±1.68 | 7.69 ±1.95 |
| **Male** | 23.33 ± 0.99 | 14.23 ± 0.41 | 14.44 ± 0.99 | 25.77 ± 2.41 |
| **Female** | 27.11 ± 1.02 | 12.78 ± 0.85 | 12.77 ± 0.66 | 23.22 ± 6.43 |
| **Longevity** | 49.55 ± 1.21 | 34.65 ± 0.32 | 27.47 ± 0.98 | 44.67 ± 7.06 |

**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 *Tyrophagusputrescentiae,Acarussiro,Pygmephorussellnicki*and *Rhizoglyphusrobini*.These findings are in confirmation withthe findings of Praveenand Gupta, 2019. Theyreported some species of acarid mites feeding on the mushrooms.Sriparna and Gupta, 2022 alsoreported 28 species of mites occurring on the wild and edible mushrooms.Malik *et al*., 2018 reported *Tyrophagusputrescentiae* as an important pest of stored grains.Gurney and Hussy, 1967 reported three species of *pygmephorus* on mushroom beds and compost.

**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 *Tyrophagusputrescentiae, Acarussiro, Pygmephorussellnicki and Rhizoglyphusrobini*.

**Disclaimer (Artificial intelligence)**

Option 1:

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.

Option 2:

Author(s) hereby declare that generative AI technologies such as Large Language Models, etc have been used during writing or editing of manuscripts. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the generative AI technology

Details of the AI usage are given below:

1.

2.

3.



## References

Aishwarya, M., S.K. Gupta & S.P. James. 2018. A preliminary report on Acari inhabiting in different mushrooms of Western Ghats, Calicut, Kerala. Uttar Pradesh *J. Zool*. 38(1): 15-19.

Baiswar P, Ngachan SV, Chandra S, Das A, H Rymbai 2016. Mushroom cultivation and spawn production, published by ICAR RC for NEH region, Umiam, Meghalaya, 31.

Fletcher, J. T., and Gaze, R. H. 2008. Mushroom pest and disease control. London: Manson Publishing.

Gurney, B. and N. W. Hussey. 1967. *Pygmephorusspp* (acarina :pyemotidae) associated with cultivatedmushrooms.*Acarologia*.http://www1.montpellier.inra.fr/CBGP/acarologia/ acarologia-xxx@supagro.fr.

Hubert, J., Jaroší ķ V., Mourek, J., Kubatova, A. &Zdarkova, E. 2004. Astigmatid mite growth and fungi preference (Acari: Acaridida): comparisons in laboratory experiments. *Pedobiologia*, 48(3), 205–214.

JenitaNongthombam, Adesh Kumar, Sumeet Patidar:2021.A review on study of growth and cultivation of oyster mushroom.*Plant Cell Biotechnology and Molecular Biology* 22(5&6):55-65.

Kumar, S., Gautam, Y. and Sharma, S.R. 2004. Mushroom mites and their management. *Mushroom Research*, 13(2): 46-52.

Malik, Arvind, Rachna Gulati, Komal Duhan and Asha Poonia. 2018.*Tyrophagus putrescentiae* (Schrank) (Acari: Acaridae) as a pest of grains: A review *Journal of Entomology and Zoology Studies* : 6(2): 2543-2550

Praveen, R. & S.K. Gupta. 2019. Some new records of mites occurring in mushroom in South Bengal. *Int. J. Zool. Studies* 4 (5): 8-12.

Rana, M.2008. Studies on abundance and damaging potential of Acarine species on mushroom. *M.Sc. Thesis*, CCS Haryana Agriculture University, Hisar.

Sriparna Pakira and Salil Kumar Gupta2022.On a collection of mites and insects occurring on edible and wild mushrooms from Mini Sundarbans-Hasnabad areas of North 24 Parganas (West Bengal). *Journal of Entomology and Zoology Studies;* 10(3): 119-121.

Zacharda M., Pultar O. and Muska J. 1998. Washing techniques for monitoring mites in apple orchards. *Experimental and Applied Acarology*, 5: 181–183