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Monthly e-Magazine on Agriculture and Interdisciplinary Sciences
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ISSN: 3139-6488

The Hidden Enemy of Rice: From Panicle Rice Mite Infestation to Integrated Pest Management

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Article ID: 21007

Abstract

The panicle rice mite, *Steneotarsonemus spinki* Smiley (Acari: Tarsonemidae), is a minute and cryptic pest of rice that can cause substantial yield and grain-quality losses. The mite predominantly inhabits the inner leaf sheath and may subsequently colonize developing panicles, where feeding can cause sterility, poor grain filling and malformed grains. Its importance is further increased by its association with sheath rot caused by *Sarocladium oryzae* and bacterial panicle blight associated with *Burkholderia glumae*. Parthenogenetic reproduction, temperature-dependent development, continuous rice cultivation, ratoon and volunteer rice, crop residues and movement of contaminated machinery can favour population persistence and spread. Its concealed habit also makes early detection and conventional contact control difficult. Sustainable management therefore requires an integrated approach combining early detection, sanitation, crop rotation, management of ratoon and volunteer rice, host plant resistance, conservation of natural enemies and judicious use of registered acaricides. This review summarizes the biology, ecology, distribution, damage and integrated management of *S. spinki*, with emphasis on early detection and preventive suppression.

Keywords: *Steneotarsonemus spinki*, panicle rice mite, rice tarsonemid mite.

Introduction

Rice (*Oryza sativa* L.) is a major cereal crop and is attacked by numerous insect and mite pests. Among them, the panicle rice mite, *Steneotarsonemus spinki* Smiley (Acari: Tarsonemidae), is an important pest in several tropical and subtropical rice-growing regions. The mite is exceptionally small and primarily inhabits the protected space between the leaf sheath and stem, making early detection difficult. As populations increase, mites may move towards developing panicles, causing poor grain development, sterility and malformed grains. Infestations have also been associated with sheath rot caused by *S. oryzae* and bacterial panicle blight associated with *B. glumae*, increasing the complexity and potential severity of damage.

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Identification

Adults of *S. spinki* are approximately 250 µm long and are not readily visible to the unaided eye. They are transparent to straw-coloured; females are ovoid, whereas males are active and possess elongated hind legs with prominent spines. Because of their minute size and concealed habit, detection requires magnification and examination of the inner leaf sheath.

Biology and Life History

S. spinki exhibits facultative parthenogenesis. Virgin females can produce male progeny, allowing establishment from a small founding population; following mating, females produce additional offspring. A female may produce approximately 55 eggs, although fecundity varies with temperature and experimental conditions.

Development is strongly temperature-dependent, with warm conditions favouring faster multiplication. The mite can also persist between rice crops in stubbles and ratoon rice, allowing populations to bridge successive cropping cycles.

Conditions favouring population increase

- Warm temperatures
- Relatively dry periods
- Continuous rice cultivation
- Ratoon and volunteer rice
- Infested crop residues
- Repeated rice cultivation without rotation
- Movement of contaminated farm machinery

Distribution and Host Association

S. spinki is recognized as a pest of rice in tropical Asia, Central America and the Caribbean. Major outbreaks have been documented in Central America and the Caribbean, and its detection in the United States demonstrated its occurrence beyond historically recognized pest regions.Rice is the principal cultivated host. The mite has also been reported from wild and weedy plants associated with rice production, including *Oryza latifolia* and other grasses and sedges. Such alternate hosts may provide refuges between rice crops and contribute to off-season persistence.

From Infestation to Damage

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The mite initially colonizes the inner leaf sheath, where feeding produces brown to chocolate-coloured discoloration. As the plant develops, populations may move through successive sheaths towards the developing panicle. Because colonies remain concealed, external inspection may underestimate infestation.

During reproductive development, feeding can result in:

- Spikelet sterility and partial panicle infertility
- Poor grain filling
- Grain discoloration
- Chaffy and malformed grains
- Reduced grain quality and yield

The severity of damage varies with mite density, crop stage, cultivar and environmental conditions. Reported yield losses differ considerably among regions, partly because mite damage may occur together with associated pathogens.



Panicle Rice mite and damaging symptoms (Source- google web)

The Mite-Disease Complex

The economic importance of *S. spinki* extends beyond direct feeding. The mite is frequently associated with *Sarocladium oryzae*, the causal agent of sheath rot, and *Burkholderia glumae*, associated with bacterial panicle blight. Feeding injury can damage plant tissues and may facilitate pathogen invasion. The mite has also been associated with the carriage of fungal propagules. Consequently, diagnosis of affected fields should consider both mite infestation and associated diseases rather than attributing all symptoms to a single causal factor.

Why Management Is Difficult

Management is complicated by three interacting characteristics of the pest: microscopic size, rapid multiplication and a protected feeding site. Parthenogenetic reproduction and

favourable temperatures can accelerate population growth, while the position beneath the leaf sheath limits exposure to contact acaricides. Therefore, management should begin before severe panicle symptoms become evident, making early detection the critical intervention point.

From Detection to Management

Surveillance and Early Detection

Fields should be monitored particularly during booting and reproductive stages. Suspected plants should be examined by carefully removing the outer leaf sheath and inspecting the inner surface with a hand lens or stereomicroscope. A useful surveillance programme should record mite presence, infestation frequency, location within the plant, sheath symptoms, panicle and grain symptoms, cultivar, crop stage and field history. Reliable sampling procedures and economic thresholds remain important research needs because concealed populations are difficult to estimate through visual scouting alone.

Cultural Management

Management should target population carry-over between crops through:

- Removal or management of ratoon and volunteer rice
- Appropriate management of infested crop residues
- Crop rotation with suitable non-host crops
- Avoidance of unnecessary continuous rice cultivation
- Cleaning of machinery before movement from infested to uninfested fields
- Management of alternate hosts where they contribute to pest persistence

These practices reduce refuges and interrupt population continuity between cropping cycles.

Biological Control

Predatory mites and fungal pathogens may contribute to natural suppression of *S. spinki*. Their practical value, however, depends on field efficacy, predator-prey relationships, environmental compatibility and compatibility with other management practices. Conservation of naturally occurring predatory mites should therefore be encouraged through avoidance of unnecessary broad-spectrum pesticide use.

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Natural enemy	Type / group	Feeding or role	Importance in rice ecosystem
Spiders	Generalist predators	Actively prey on small, soft-bodied arthropods, including mites and other insect pests	Help naturally suppress pest populations in paddy fields
Predatory mites	Acari;mainly Phytoseiidae	Feed directly on plant-feeding mites and their immature stages	Potentially useful biological control agents; their use in rice is less developed than in orchard systems
Amblyseius spp.	Predatory mites; Phytoseiidae	Hunt and consume phytophagous mites and other small arthropods	Important group of predatory mites with potential for mite management
Endoparasitoid wasps	Hymenoptera	Develop inside suitable insect hosts and contribute to suppression of pest populations	May contribute to overall biological control within the crop canopy, although they are not specific predators of rice mites

Chemical Management

Chemical control should be used judiciously when mite populations reach economically important levels. At this stage, any one of the recommended acaricides should be applied at the appropriate label-recommended dose:

S. no.	Insecticides/ formulation	Dose/L
1	Spiromesifen 22.9% w/w SC	1.0 ml
2	Propargite 57% EC	1.0 ml
3	Fenpyroximate 5% EC	1.0 ml
4	Ethion 50% EC	3.0 ml
5	Diafenthiuron 50% WP + Propiconazole 25% EC	1.5 g + 1.0 ml
6	Propargite 57% EC + Propiconazole 25% EC	1.5 ml + 1.0 ml
7	Profenofos 50% EC + Propiconazole 25% EC	2.0 ml + 1.0 ml

Integrated Pest Management Strategy

An effective IPM programme can be organized around four sequential steps: This approach shifts management from responding to visible damage towards preventing population establishment and limiting carry-over.

Detect: Inspect inner leaf sheaths and monitor susceptible crop stages.

Disrupt: Manage ratoon and volunteer rice, crop residues and alternate hosts; clean farm machinery.

Reduce: Use suitable cultivars, crop rotation and conservation of natural enemies.

Intervene: Where damaging infestation is confirmed, apply an effective, locally registered acaricide as part of an integrated programme.

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