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An Overview of *Thrips parvispinus* (Karny) and Its Economic Importance

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Thrips parvispinus (Karny) (Thysanoptera: Thripidae), commonly referred to as the pepper thrips or tobacco thrips, has emerged as one of the most threatening invasive insect pests of the twenty-first century. Originally endemic to the tropical belt of Southeast Asia, this polyphagous species has steadily extended its geographical reach to encompass parts of Africa, Oceania, Europe, and, more recently, North America. Its rapid proliferation is underpinned by a compressed developmental cycle of approximately 13–14 days, wide host adaptability across nearly 100 plant species from 39 families, and a cryptic feeding behaviour that allows populations to reach damaging densities before detection. In India, catastrophic outbreaks have been documented across chilli-growing districts of Andhra Pradesh, Telangana, and Karnataka, with crop losses frequently exceeding 70–100%. Economically significant damage has also been recorded on papaya, cucurbits, ornamental plants, and several export-oriented vegetables. The present article reviews the taxonomy, morphology, biology, global distribution, host range, nature of crop damage, and economic significance of *T. parvispinus*, while also summarising current knowledge on integrated pest management (IPM) strategies. An understanding of this pest's ecological versatility is indispensable for the formulation of effective and sustainable control frameworks.

Introduction

Among the order Thysanoptera, the family Thripidae harbours numerous species of considerable phytosanitary importance, yet few have attracted as much global concern in recent years as *Thrips parvispinus* (Karny, 1922). Known variously as the pepper thrips, tobacco thrips, and South East Asian thrips, this species was historically confined to the humid tropics of Southeast Asia, where it ranked among the primary constraints on chilli cultivation. Over the past two decades, however, a series of incursions into previously unaffected continents has radically transformed its status from a regional agricultural nuisance to a globally significant invasive pest.

India's first documented encounter with *T. parvispinus* on papaya (*Carica papaya* L.) predates the more dramatic episodes that followed. The country's chilli-growing heartland principally the states of Andhra Pradesh, Telangana, and Karnataka witnessed an unprecedented infestation during the northeast monsoon season of 2020–2021. Surveys conducted across these states revealed thrips populations colonising the reproductive structures of chilli plants with an intensity rarely seen with endemic thrips species such as *Scirtothrips dorsalis* Hood, resulting in yield damage of 70–100% in severely affected plots. The outbreak galvanised the scientific community, leading to rapid morphological and molecular confirmation of the species identity through cytochrome oxidase I (CO-I) barcoding. Simultaneously, comparable invasions were being reported in Florida (USA) as early as 2020, followed by spread to multiple American states and Canadian provinces by 2022–2023.

What renders *T. parvispinus* particularly formidable is the convergence of several biological traits: a short generation time that facilitates rapid population build-up, a remarkably wide host range spanning food crops and ornamentals alike, and a behavioural predisposition to shelter within the rolled and unexpanded leaves and floral structures where conventional insecticide applications fail to penetrate effectively. This review consolidates current scientific understanding of the pest's taxonomic position, life history parameters, global distribution, economic impact, and the state of management knowledge, with the objective of providing postgraduate students and agricultural researchers with a comprehensive reference on this emerging threat.

Taxonomy and Morphology

Taxonomically, *Thrips parvispinus* belongs to the order Thysanoptera, family Thripidae, and was first described by Karny in 1922. The species epithet 'parvispinus' refers to the characteristically small dorsal spines on the abdominal tergites. The adult female, measuring approximately 1.0 mm in body length, displays a strikingly two-toned coloration: the head and thorax are pale brown to light amber, while the abdomen is dark mahogany to blackish-brown a diagnostic feature that distinguishes *T. parvispinus* from the morphologically similar chilli thrips, *Scirtothrips dorsalis* Hood, which is uniformly pale yellow. The adult male is considerably smaller at approximately 0.6 mm and uniformly yellow in colour, closely resembling male *S. dorsalis*.

Microscopically, the antenna comprises seven segments furnished with fork-shaped sensory organs on the third and fourth segments. The compound eyes are large and pigmented but not elongated. The first pair of ocellar setae is absent, while the second pair is distinctly shorter than the third a key character for slide-mount identification. The wings, when present, are strap-like with fringed margins, a hallmark of the order. Scanning electron microscopic studies have revealed intricate reticulation patterns on the head and a strongly developed thorax, features that contribute to the robustness of this species under adverse environmental conditions.

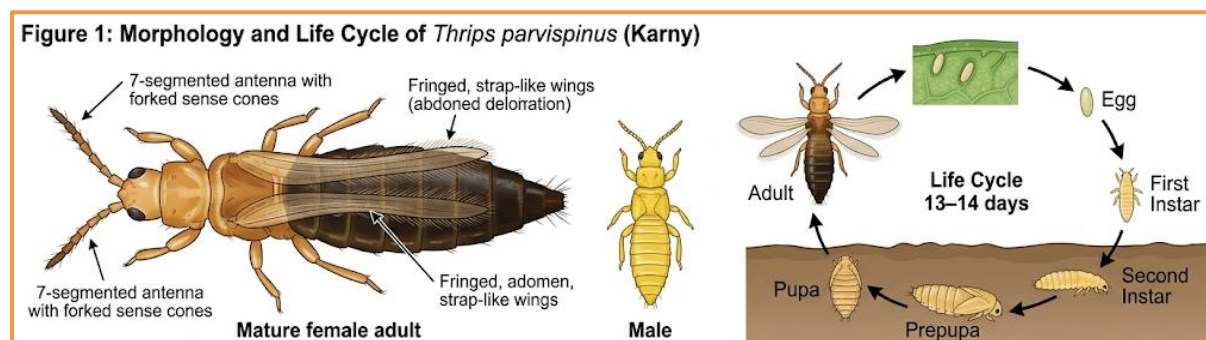
Biology and Life Cycle

The developmental biology of *T. parvispinus* has been studied both in the laboratory and greenhouse settings, with chilli (*Capsicum annum* L.) serving as the preferred host in most experimental investigations. The life cycle encompasses six discrete stages egg, first-instar larva, second-instar larva, prepupa, pupa, and adult with total development from egg to adult completed in approximately 13–14 days under optimal conditions of 25–28°C and moderate humidity. Table 1 summarized the duration and key attributes of each developmental stage.

Table 1. Developmental stages of *Thrips parvispinus* (Karny) on chilli under laboratory conditions (25–28°C)

Life Stage	Duration (days)	Key Characteristics	Location on Plant/Soil
Egg	4–6	Bean-shaped, shiny white; 0.23 × 0.13 mm	Embedded in leaf tissue
First Instar Larva	2–3	Translucent white; rasping-sucking feeding	Leaf surface, buds
Second Instar Larva	2–3	Pale yellow; increased feeding activity	Leaf surface, flowers
Prepupa	1	Non-feeding; immobile stage	Soil or leaf axils
Pupa	2–3	Wing buds visible; non-feeding	Soil/litter
Adult	~20–30	Females: ~1 mm, dark brown; Males: ~0.6 mm, yellow	Foliage, flowers, fruits

Source: Keerthi M.C. et al. (unpublished); Hutasoit et al. (2017); Revynthi et al. (2024). EPN = entomopathogenic nematode.

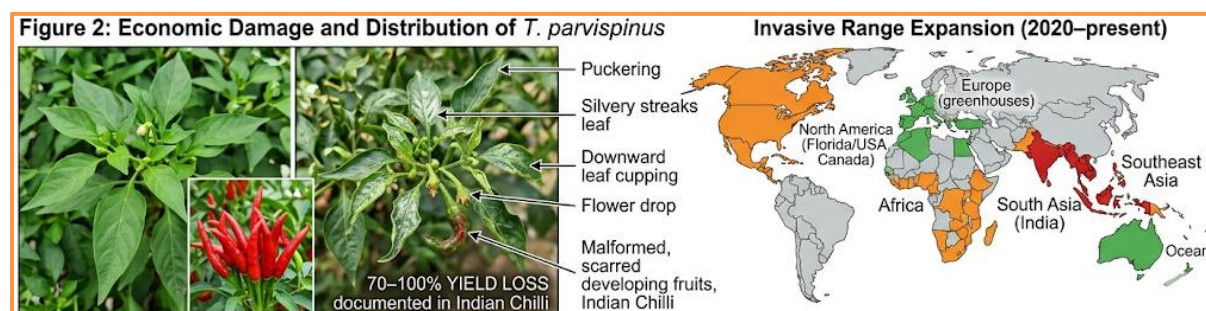


Female thrips deposit their eggs individually within leaf tissue through a specialised saw-like ovipositor (endophytic oviposition), rendering the eggs largely inaccessible to contact insecticides and natural enemies. Newly hatched first-instar larvae are translucent white and immediately begin scraping and feeding on epidermal cells. The second instar is pale yellow and considerably more mobile. After completing two larval instars within four to five days, the larvae drop to the soil or seek sheltered leaf axils to undergo the non-feeding prepupal and pupal stages. Under warm, tropical conditions, multiple overlapping generations accumulate rapidly, allowing populations to escalate from sub-economic to catastrophic levels within a single cropping season.

Geographic Distribution and Host Range

Native to Thailand and the tropical lowlands of Southeast Asia, *T. parvispinus* has progressively colonised an expansive geographic range. Its current distribution encompasses South Asia (India, Bangladesh, Sri Lanka), East and Southeast Asia (Japan, Korea, Malaysia, Indonesia, Philippines), parts of sub-Saharan Africa (Ghana, Uganda), Oceania (Hawaii, Australia), Europe (Spain primarily in greenhouse crops), and North America, where it was first confirmed in Florida in 2020 and has since been intercepted in Georgia, North and South Carolina, Colorado, Ohio, Pennsylvania, and California by 2025. Molecular studies using the mitochondrial CO-I gene have demonstrated that global invasive populations are largely genetically homogeneous, traceable to a single dominant haplotype a finding with significant implications for predicting future range expansion.

Regarding host range, *T. parvispinus* is highly polyphagous, having been documented on at least 100 plant species from 39 families worldwide. Key agricultural hosts include chilli and pepper (*Capsicum annum* L.), papaya (*Carica papaya* L.), cucumber (*Cucumis sativus* L.), eggplant (*Solanum melongena* L.), watermelon (*Citrullus lanatus* (Thunb.) Matsum. & Nakai), and potato (*Solanum tuberosum* L.). Ornamental hosts include gardenia (*Gardenia jasminoides* J. Ellis), mandevilla (*Mandevilla spp.*), anthurium (*Anthurium andraeanum* Lind.), chrysanthemum (*Chrysanthemum spp.*), and hibiscus (*Hibiscus rosa-sinensis* L.). In India, the species has additionally been collected from coriander (*Coriandrum sativum* L.), mango (*Mangifera indica* L.), cotton (*Gossypium hirsutum* L.), and bitter melon (*Momordica charantia* L.), underscoring its capacity to exploit a vast array of cultivated and wild hosts.



Nature of Crop Damage and Economic Importance

Both adults and larvae of *T. parvispinus* inflict injury by employing asymmetric, rasping-sucking mouthparts to rupture epidermal cells and extract their liquid contents. This feeding modality produces characteristic silvery-white streaks or scars on expanded leaf surfaces,

with more severe deformation observed in young, tightly rolled leaves where populations tend to concentrate. Infested terminal growth exhibits a characteristic puckering, crumpling, and downward cupping of leaves, a symptom readily confusable with broad mite (*Polyphagotarsonemus latus* Banks) damage but distinguishable upon microscopic examination. Floral infestation particularly prominent in chilli results in premature flower drop, fruit set failure, and scarring of developing fruits, directly translating into commercial yield losses.

Indirect damage of particular ecological note involves the stimulation of saprophytic fungal growth in feeding wounds. In Malaysia, feeding by *T. parvispinus* on papaya has been documented to attract *Cladosporium oxysporum* Berk. & M.A. Curtis, inducing the 'bunchy top' malformation syndrome a condition severely diminishing papaya marketability. Unlike the closely related *Frankliniella occidentalis* (Pergande), *T. parvispinus* has not yet been confirmed as a vector of any plant-pathogenic tospovirus, though surveillance continues given the potential for new associations as the pest enters novel agroecosystems. The economic impact of *T. parvispinus* has risen sharply wherever it has established. Table 2 provides a comparative summary of yield losses reported across affected countries.

Table 2. Economic losses caused by Thrips parvispinus (Karny) in different countries and host crops

Country/Region	Primary Host Crop	Reported Yield Loss (%)
India (Andhra Pradesh, Telangana, Karnataka)	Chilli (<i>Capsicum annuum</i>)	70–100
Indonesia	Chilli (<i>Capsicum annuum</i>)	Up to 23
Malaysia	Papaya (<i>Carica papaya</i>)	Severe (bunchy top)
USA (Florida)	Pepper, ornamentals	Millions USD (2022)
Ghana	Ridge Gourd (<i>Luffa acutangula</i>)	Significant export losses

Source: Compiled from Veeranna et al. (2022), Vos (1994), Amouzou et al. (2022), FFAR (2023). USD = United States Dollar.

Management Strategies

The management of *T. parvispinus* presents several challenges not encountered with more familiar thrips pests. Its preferred feeding sites within rolled leaves and floral structures create a physical barrier to contact insecticides, while its short generation time accelerates the selection of resistance alleles under repeated chemical exposure. The species' small body size near 1 mm for females further complicates early detection and field monitoring. Given these constraints, an integrated pest management (IPM) approach drawing upon chemical, biological, and cultural tools is strongly advocated.

Chemical Management

Laboratory and greenhouse evaluations conducted by identified chlorfenapyr, sulfoxaflor combined with spinetoram, and spinosad as the most efficacious conventional insecticides, delivering high mortality across all developmental stages in both direct contact and residue-based bioassays. Abamectin, acetamiprid, cyantraniliprole, and tolfenpyrad displayed moderate activity and are considered candidates for rotational use. Importantly, insecticide rotation is a critical component of resistance management, as *T. parvispinus* populations subjected to repeated application of the same active ingredient show early signs of reduced susceptibility. Applications should be targeted to the pre-flowering and early flowering stages when thrips populations are ascending but before extensive reproductive damage has occurred.

Biological Control

Promising biological control options for *T. parvispinus* have recently emerged from both greenhouse trials and field studies. The generalist predatory bug *Orius insidiosus* (Say) achieved approximately 86% reduction in adult thrips populations in controlled cage

experiments, while the predatory mite *Anystis baccharum* (L.) delivered an even higher efficacy of approximately 91%. Entomopathogenic nematodes (EPNs) specifically *Steinernema riobrave* Cabanillas, Poinar & Raulston and *Steinernema carpocapsae* (Weiser) reduced pupal-stage recovery by up to 60% in greenhouse trials when applied to the soil substrate under warm, moist conditions. These biocontrol agents are particularly promising in ornamental greenhouse production, where chemical residue restrictions on marketable plants demand low-input alternatives.

Cultural and Phytosanitary Measures

Since *T. parvispinus* spreads most effectively through the movement of infested propagating material (cuttings, transplants, and ornamental pot plants), phytosanitary measures represent a foundational layer of management. Dip treatments of plant cuttings in registered insecticide solutions before transshipment have been validated as effective at intercepting early-stage infestations. On-farm cultural practices including the timely removal of infested plant debris, maintenance of weed-free field borders (weeds serve as alternative hosts and population reservoirs), and the use of reflective silver mulches to disorient migrating adults reduce initial population establishment and slow the build-up of thrips to economically damaging levels. Crop monitoring through weekly tap sampling or the use of blue sticky traps, to which *T. parvispinus* adults are preferentially attracted, provides early warning for timely intervention.

Table 3. Summary of integrated pest management strategies for Thrips parvispinus (Karny)

Management Category	Recommended Approach / Agent	Efficacy / Remarks
Chemical (conventional)	Chlorfenapyr, spinosad, sulfoxaflor + spinetoram	High mortality across all stages (Ataide et al., 2024)
Biorational	Azadirachtin, insect growth regulators (IGRs), spirotetramat	Moderate; suitable for resistance rotation
Biological control	<i>Orius insidiosus</i> , <i>Anystis baccharum</i> (predatory mites); <i>Steinernema riobrave</i> , <i>S. carpocapsae</i> (EPNs)	<i>O. insidiosus</i> : 86% adult reduction; <i>A. baccharum</i> : 91% control (Buitenhuis & Jandricic, 2024)
Cultural	Removal of infested plant material; weed management; crop rotation; reflective mulches	Reduces initial populations; slows reinfestation
Phytosanitary / Regulatory	Dip treatments for cuttings; quarantine compliance	Prevents movement of infested propagating material (Ataide et al., 2024b)

Source: Compiled from Ataide et al. (2024); Buitenhuis and Jandricic (2024); Saito and Buitenhuis (2025). EPN = entomopathogenic nematode; IPM = integrated pest management.

Conclusion

Thrips parvispinus (Karny) has transitioned from a localised agricultural problem in Southeast Asian chilli production to a globally significant invasive threat with documented impacts across five continents. Its formidable combination of biological traits abbreviated developmental cycle, endophytic oviposition, cryptic shelter-seeking behaviour, and expansive host adaptability makes it one of the most challenging phytophagous insects to monitor and control in contemporary agroecosystems. The economic losses inflicted on chilli, papaya, pepper, and ornamental industries across Asia, Africa, and the Americas underscore the urgency of deepening our scientific understanding of this species.

The evidence reviewed here points firmly toward the necessity of an integrated pest management framework that couples judicious rotational use of insecticides (prioritising spinosad, chlorfenapyr, and spinetoram-based products) with the deployment of effective natural enemies such as *Orius insidiosus*, *Anystis baccharum*, and entomopathogenic nematodes. These biological tools must be supported by robust cultural practices especially

strict phytosanitary protocols governing the movement of plant material and regular population monitoring using standardised sampling methods. Continued research into host plant resistance, particularly the identification and breeding of thrips tolerant Capsicum accessions, represents a high-value long-term investment. With climate change models projecting the expansion of thermally suitable habitat for *T. parvispinus* into presently marginal regions, the window for proactive management preparedness is narrow, and interdisciplinary collaboration between entomologists, plant pathologists, extension agencies, and regulatory bodies is essential to prevent further establishment and crop losses.

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