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Integrated cultural management practices for controlling black thrips infestation in Chilli

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Abstract

Chilli (*Capsicum annum* L.) is an economically significant crop cultivated worldwide, valued for its culinary, medicinal, and ornamental properties. As a member of the Solanaceae family, it thrives in diverse agro-climatic conditions, contributing approximately 40% to global production, with India being a primary contributor. However, the productivity of chilli is adversely affected by various biotic and abiotic stresses, notably pest infestations, among which thrips pose a significant threat. Historically dominated by *Scirtothrips dorsalis*, the invasive species *Thrips parvispinus* has emerged as a major pest, leading to substantial losses in yield and crop quality, particularly in southern Indian states. This paper reviews the impact of black thrips on chilli cultivation and highlights effective management strategies, including cultural practices, biological control, and chemical interventions. By implementing comprehensive management approaches, farmers can mitigate the adverse effects of thrips infestations, ensuring sustainable chilli production and maintaining the economic viability of this vital crop.

Keywords: Black thrips, Sustainable agriculture, Biotic stress, cultural and chemical control

Introduction

Chilli (*Capsicum annum* L.) is an economically significant and widely cultivated crop globally, renowned for its culinary, medicinal, and ornamental value (Bosland & Votava, 2012; Sharma *et al.*, 2021) ^[1, 22]. Belonging to the Solanaceae family, chilli is cultivated in various agro-climatic regions, making it a versatile and adaptable crop (Kang & Goto, 2010; Patel *et al.*, 2022) ^[5, 16]. Beyond its culinary applications, chilli possesses medicinal properties attributed to its bioactive compounds, including capsaicin, vitamins, and antioxidants (Materska & Perucka, 2005; Kim *et al.*, 2023) ^[10, 6]. These compounds have been studied for their potential health benefits, such as anti-inflammatory, analgesic and antioxidant properties, making chilli a subject of interest in pharmaceutical and nutraceutical industries (Surh, 2002; Zhang & Wang, 2023) ^[27, 30]. India is known for its diverse hub of chilli peppers due to its diverse variability present. Hence it is also described as a secondary centre of origin and India contributes approximately 40% of the world's production. In India, green and dry chilli has an extensive annual production of 3851,000 MT in 364,000 ha acreage and 1702,000 MT in 683,000 ha respectively (NHB, 2021) ^[12].

The chilli crop in India is ascribed to many biotic and abiotic stresses resulting in low productivity of the crop. Among the sucking pests, thrips are one of the major ones causing severe yield losses in chilli due to reduced production. Earlier, *Scirtothrips dorsalis* (Hood), was predominant, but in the recent past the invasive species *Thrips parvispinus* (Karny), has caused colossal loss to chilli growers in Andhra Pradesh, Telangana and Karnataka (Prasannakumar *et al.*, 2021, Reddy *et al.*, 2023) ^[17, 20]. Black thrips feed on Chilli plants, causing damage to leaves, flowers, and fruits, which can lead to yield losses and reduced crop quality (Kumar & Meena, 2022) ^[9]. Effective management strategies are essential to mitigate the impact of black thrips infestation and ensure optimal Chilli production. In this article, we explore various methods for controlling black thrips infestation in Chilli plants, ranging from cultural practices to chemical control measures (Choudhary *et al.*, 2021) ^[2].

Thrips

Thrips are one of the major sucking pests affecting chilli crop globally. It belongs to the taxonomic order Thysanoptera and this order was introduced by Haliday, an Irish Entomologist in 1836 [3], encompassing 41 species and 11 genera of thrips (Haliday, 1836) [3]. The nomenclature of the order derives from the fusion of two terms, "*Thysanos*" denoting "fringe" and "*pteron*" signifying "wing," owing to the characteristic fringed wings exhibited by thrips. The Indian thrips taxonomy encompasses a total of 739 species across 259 genera, with suborder Terebrantia accounting for 309 species within 116 genera, and suborder Tubulifera comprising 430 species in 143 genera, as documented by Tyagi and Kumar (2016) [28]. An additional 44 species, representing novel distributional records, have been identified across diverse geographical regions within India, as reported by Rachana and Varatharajan (2017) [18]. Notably, the invasive *Thrips parvispinus* (Karny) falls within the

Thrips orientalis group, as categorized by (Mound, 2000) [11].

Indian Scenario

In India, the initial occurrence of *T. parvispinus* was documented in the year 2014 on *Carica papaya* L. (Caricaceae) in Bangalore, followed by its subsequent identification on *Brugmansia* sp. (Solanaceae) and *Dahlia rosea* Cav. (Asteraceae) in 2018 (Kumar & Thomas, 2019) [8]. This polyphagous pest exhibits a wide host range, affecting crops such as beans, eggplant, papaya, pepper, potato, shallot, and strawberry, as noted by NPPO (2022). [141] Notably, it inflicted substantial damage on chilli fields in the southern states of Andhra Pradesh, Karnataka, and Telangana in October 2021, leading to extensive surveys and host record compilation (Reddy *et al.*, 2022) [19]. The study encompassed the examination of 1257 specimens collected from these aforementioned states (Patel & Singh, 2023) [15].

Table 1: Host range of *Thrips parvispinus* across the world

Host Reported	Reference
Papaya	Tyagi <i>et al.</i> , 2015 [29]
Papaya, peppers, potatoes, egg plants, beans, shallots, crotalaria, cucumber, coffee, tobacco	Hutasoit <i>et al.</i> , 2017 [4]
Anthurium, chrysanthemum, dahlia, gardenia, ficus	NPPO, 2022 [14]
Chilli, weed species of Parthenium, <i>Amaranthus</i> sp, <i>Axonopus</i> sp, <i>Ageratum</i> sp, <i>Alternanthera</i> sp. <i>Thunbergia</i> sp, foliage of neem and pongamia	Nagaraju <i>et al.</i> , 2021 [13]
Chilli, capsicum, mango, cotton, drumstick, cucumber, beans, bottle gourd, bitter gourd, marigold, chrysanthemum, watermelon, coccinea, brinjal, etc.	Sridhar <i>et al.</i> , 2021 [26]
Chilli, tomato, okra, squash, and various ornamental plants	Patel <i>et al.</i> , 2022 [16]
Peppers, eggplant, sunflower, and herbs	Singh & Verma, 2023 [23]
Foliage of leafy vegetables and fruit crops	Kumar & Reddy, 2022 [7]

Level of damage

Chilli thrips in India (Andhra Pradesh, Karnataka and Telangana) caused up to 70- 100 per cent damage irrespective of the chilli cultivars grown by the farmers. Export of 6, 01,500 tonnes worth 8,430 crores was affected (Reddy *et al.*, 2022) [19].

Thrips species reported on pepper in India

Before the introduction of *Thrips parvispinus* to India, several thrips' species were reported on pepper (*Capsicum* spp.). These included *Thrips tabaci*, *Frankliniella schultzei*, *Scirtothrips dorsalis* and others. *Scirtothrips dorsalis* was one of the predominant species affecting pepper crops. Following the entry of *Thrips parvispinus*, this invasive species gained prominence as a significant pest of pepper due to its rapid establishment, wide host range, and potential to cause severe damage to pepper plants (Singh & Verma, 2023) [23]. The transition from indigenous thrips species to the invasion of *Thrips parvispinus* has necessitated enhanced pest management strategies to effectively mitigate the economic impact on pepper cultivation in India (Patel *et al.*, 2022) [16].

Life cycle

The life cycle of *Thrips parvispinus* includes several distinct stages. Adult females lay eggs on plant tissues, which hatch into first instar nymphs. Nymphs progress through two more instar stages, followed by a prepupal phase characterized by reduced mobility and colour changes. This is succeeded by the pupal stage, where metamorphosis occurs within pupal cases. The duration of each stage varies with temperature, typically ranging from 15 to 30 days (Kumar & Reddy, 2022) [7]. Female thrips generally live longer than males, surviving for about 8 to 10 days. They lay numerous eggs, which are small and oval-shaped

(Tyagi *et al.*, 2015) [29].

Symptoms

Damage symptoms on the flowers include scraping causing reddish streaks, it also feeds on pollen impeding pollination (Kumar & Reddy, 2022) [7]. Severe infestation results in the drying and withering of flowers. Direct feeding of larvae and adults on buds and fruits affects the fruit set and fruits attain abnormal shape (Reddy, Kumar, & Priya, 2023) [20]. They are found colonizing the underside of leaves and are found to prefer sucking the sap from the adjacent portion of the veins on leaves. Infested leaves show a yellowish and blotchy appearance. Necrotic regions and yellow streaks are found on the leaf lamina (Singh, Patel, & Verma, 2022) [24]. Unlike the *Scirtothrips dorsalis* which is a severe pest of chilli that infests the foliage, Fig 1. and Fig 2. *T. parvispinus* infests the floral parts and fruits as well (Prasannakumar, Rao, & Desai, 2021; Tyagi & Kumar, 2016) [17, 28].

Demographic characters: Why difficult to manage?

The management of *Thrips parvispinus* is fraught with complexities due to its unique demographic attributes. It exhibits high fecundity, with females capable of prolific egg-laying within a short temporal window (Reddy, Kumar, & Priya, 2023) [20]. This compressed life cycle augments population proliferation, fostering swift infestation establishment (Kumar & Reddy, 2022) [7]. Moreover, the species displays polyphagous tendencies, rendering it capable of feeding on a diverse range of plant species, thereby complicating management strategies (Singh, Patel, & Verma, 2022) [24]. The propensity of *Thrips parvispinus* to develop resistance against chemical insecticides exacerbates control challenges (Tyagi & Kumar, 2016) [28]. Its

cryptic behaviour, often concealed within plant substrates, further obstructs timely detection and control efforts (Prasannakumar, Rao, & Desai, 2021) ^[17]. Notably, the absence of potent natural predators in specific ecosystems accentuates the intricacy of maintaining *Thrips parvispinus* populations in equilibrium (Hutasoit *et al.*, 2017) ^[4]. Collectively, these demographic attributes accentuate the requisite for comprehensive, adaptive management approaches to effectively curtail *Thrips parvispinus* infestations in agricultural systems (Rachana & Varatharajan, 2017) ^[18].

Management

Cultural Practices

Cultural practices are pivotal in managing black thrips in chilli plants. Crop rotation disrupts thrips' life cycle, while weed control limits their habitat (Kumar & Reddy, 2022) ^[7]. Sanitation, like removing crop residues, prevents overwintering sites (Prasannakumar, Rao, & Desai, 2021) ^[17]. Physical barriers, such as plant borders using crops like maize, prevent thrips dispersal (Singh, Patel, & Verma, 2022) ^[24], while the adoption of blue/white sticky traps at a density of 65-75 traps/ha at canopy height aids in mass trapping (Tyagi & Kumar, 2016) ^[28]. Reflective (silver-colored) plastic mulch covers deter thrips movement (Hutasoit *et al.*, 2017) ^[4]. These integrated practices effectively control thrips infestation in chilli plants.

Biological Control

Biological control methods offer sustainable and environmentally friendly solutions for managing black thrips infestations in chilli plants. Predatory insects, such as predatory mites and parasitic wasps, serve as natural enemies of thrips and help regulate their populations (Kumar & Reddy, 2022; Shankar *et al.*, 2023) ^[7, 21]. Enriching compost or farmyard manure with beneficial organisms like *Metarhizium anisopliae* or *Pseudomonas fluorescens* can also aid in controlling thrips (Tyagi & Kumar, 2016; Sharma & Ghosh, 2021) ^[28, 22].

Implementation of biological control measures includes using *Steinernema carpocapsae* (EPN) formulation with a wetting agent and applying *Beauveria bassiana* or *Lecanicillium lecanii* fungi. These fungi infect and kill thrips, providing an effective means of reducing infestation in chilli plants (Prasannakumar, Rao, & Desai, 2021; Singh *et al.*, 2020) ^[17, 25]. Additionally, botanical extracts like neem seed kernel extract (NSKE), neem oil, *Pongamia* oil, or *Vitex negundo* extract, along with Azadirachtin 3000 PPM, have proven to be effective in controlling thrips infestations (Hutasoit *et al.*, 2017; Reddy *et al.*, 2022) ^[4, 19].

Chemical Control

Chemical control measures are often used to manage black thrips infestation in Chilli plants, especially in cases of severe infestation. Insecticides labeled for thrips control, such as neonicotinoids, spinosad, or pyrethroids, can be applied to Chilli plants to target thrips directly. Treating seedlings with Imidacloprid 17.8% SL through root dip for 30 minutes is found to be effective controlling thrips. Sequential sprays of chemical insecticides, such as fipronil 80% WG, cyantraniliprole, acetamiprid, or spinosad at specified intervals, further enhance the management strategy for chilli black thrips. It is important to follow recommended application rates and safety precautions when using insecticides to minimize environmental impact and ensure human safety. Additionally, systemic insecticides can be applied to Chilli plants to target thrips feeding on foliage and flowers. These insecticides are absorbed by the plant and

translocated throughout its tissues, providing long-lasting protection against thrips infestation. (NPPO, 2022) ^[14].

Table 2: Recommended insecticide dosages for managing thrips infestation in chilli plants

Technical name	Trade name	Dosage
Cyantraniliprole	Benevia	240 ml/acre
Broflanilide	Exponus	34 ml/acre
Fluxametamide	Gracia	160 ml/acre
Spinetoram	Delegate	180 ml/acre
Fibronil	Regeant	400 ml/acre

Monitoring and Early Detection

Regular monitoring and early detection of black thrips infestation are crucial for effective management. Growers should conduct routine scouting of chilli fields to detect thrips infestations early, focusing on leaf undersides, flowers, and fruits where thrips are commonly found (Nagaraju *et al.*, 2021; Reddy *et al.*, 2023) ^[13, 20]. Sticky traps can be installed in chilli fields to monitor thrips populations and assess the effectiveness of control measures. White or blue sticky traps attract thrips, which become trapped on the sticky surface, providing growers with valuable information about thrips activity and population dynamics (Kumar & Meena, 2022; Prasannakumar, Rao, & Desai, 2021) ^[9, 17].



Fig 1: Thrips infestation on chilli plants



Fig 2: Infestation of thrips on chilli leaves and flower

Conclusion

Controlling black thrips infestation in Chilli plants requires an integrated approach that combines cultural, biological, and chemical control methods. By implementing these strategies, Chilli growers can effectively manage thrips infestation and minimize damage to their crops. Proactive monitoring, early detection, and timely intervention are essential for successful thrips management and ensuring optimal Chilli production. By adopting sustainable and environmentally friendly management practices, growers can protect their crops from thrips damage and ensure a bountiful harvest.

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