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Sustainable management of black thrips (*Thrips parvispinus* Karny) in chilli through integrated pest management

Lakshmi Narayanamma V and K Sathish

Professor Jayashankar Telangana Agricultural University, Rajendranagar, Telangana, India

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Corresponding Author: Lakshmi Narayanamma V

Abstract

Black thrips (*Thrips parvispinus* Karny) is a serious sucking pest of chilli, causing flower drop, fruit deformation, and significant yield losses. Field demonstrations and on-farm trials were conducted during *Rabi* 2023-24 and 2024-25 in irrigated medium black soils of Telangana to evaluate the effectiveness of integrated pest management (IPM) modules. Experiments were designed A Randomized Block Design (RBD) with three replications. Results showed that the complete IPM module (T_4) significantly reduced thrips populations, increased fruit yield (65.98 q/ha) compared to farmers' practice (57.64 q/ha) and improved net returns (Rs. 99,250/ha vs Rs. 80,150/ha). Farmer feedback indicated good adoption potential. The study demonstrates that the complete IPM module is a sustainable and economically viable approach for managing black thrips in chilli under southern Indian conditions.

Keywords: Chilli, *Thrips parvispinus*, integrated pest management module, economics and field demonstrations

Introduction

Chilli (*Capsicum annuum* L.) is one of the most important spice and vegetable crops cultivated globally, owing to its high economic value, diverse uses, and export potential. India is the largest producer, consumer, and exporter of chillies in the world, contributing significantly to global production (FAO, 2022). According to national horticultural statistics, chilli is cultivated over a substantial area in India with consistently increasing production. Among Indian states, Andhra Pradesh and Telangana are major chilli-producing states, together accounting for a significant share of national production. Andhra Pradesh ranks first in chilli production with high productivity levels, while Telangana is an important contributor with expanding area under irrigated conditions (DES-AP, 2023; DES-Telangana, 2023). However, productivity remains highly variable across regions due to biotic and abiotic constraints (NHB, 2023; Horticulture Statistics at a Glance, 2024). Chilli productivity in these states is frequently reduced by severe pest pressure, particularly from sucking insect pests.

In recent years, black thrips (*Thrips parvispinus* Karny), an invasive species of Southeast Asian origin, has emerged as a serious and economically destructive pest of chilli in southern India. The pest was first reported in India during 2015-16, initially on papaya and subsequently expanded its host range to several horticultural crops, including chilli (Tyagi *et al*., 2015; Kumar *et al*., 2019) [9, 20]. Since its introduction, *T. parvispinus* has rapidly established and frequent outbreaks and resurgence have been reported under intensive cultivation systems (Reddy *et al*., 2020; Seal *et al*., 2020) [15, 16]. In Andhra Pradesh its establishment in chilli ecosystems was first documented in January 2021 in Guntur district, followed by widespread outbreaks across chilli-growing areas of Andhra Pradesh and Telangana during the 2021-22 season due to largely depend on repeated and unselective application of insecticides. Moreover, an indiscriminate use of synthetic pyrethroids and organophosphates, which has led to reduced field efficacy, pest resurgence, resistance development, and adverse environmental effects (Reddy *et al*., 2018; Gupta and Dikshit, 2021) [6, 14]. Such practices increase production costs while compromising ecological sustainability.

Integrated Pest Management (IPM) is globally recognized as a sustainable and eco-friendly, approach that integrates cultural, mechanical, biological, and judicious chemical methods to maintain pest populations below economic threshold levels (Kogan, 1998; FAO, 2019) [8]. IPM components such as sticky traps, neem-based botanicals, entomopathogenic fungi, balanced nutrient management, and rotation of selective insecticides have been reported to effectively manage thrips in chilli while improving yield and profitability (Sundar *et al*., 2020; Lakshmi *et al*., 2022) [10, 18]. In this context, an investigation was undertaken to evaluate and demonstrate an IPM module for the management of black thrips in chilli through On-Farm Trials (OFT) during 2023-24 and Front-Line Demonstrations (FLD) during 2024-25 under irrigated medium black soil conditions of Telangana. The study aimed to assess the impact of IPM practices over farmers' conventional practices in terms of pest incidence, yield, and economic returns, thereby supporting sustainable chilli production in major chilli-growing regions.

Materials and Methods

Experimental Site

The present study was conducted during the *Rabi* seasons of 2023-24 and 2024-25 in different locations of the different farmer fields under irrigated medium black soil (Vertisols) conditions of Bhadradri Kothagudem district, Telangana, India. The area receives an average annual rainfall of 1100 to 1200 mm and the climate is semi-arid, suitable for chilli cultivation.

Experimental Design

The experiments evaluated four treatments for the management of black thrips (*Thrips parvispinus* Karny) under different farmers' fields of Kothagudem district. A Randomized Block Design (RBD) with three replications were planned. Each plot measured 10 m × 10 m, with recommended crop spacing and agronomic practices maintained uniformly across all plots.

Table1: Treatment details and pest management components evaluated against *Thrips parvispinus* in chilli

Treatment	Components / Practices	Dose / Application	Application schedule	Rationale
T_1 - Farmers' Practice (Control)	Indiscriminate chemical sprays	Synthetic pyrethroids, OPs, chlorpyriphos, monocrotophos, diafenthiuron (2 g L^{-1}), spinosad (0.3 ml L^{-1})	Applied after pest appearance	Represents existing farmer practice
T_2 - Botanical + Traps	Sticky traps + neem-based spray	50 yellow & blue traps $acre^{-1}$; Azadirachtin 10,000 ppm @ 3 ml L^{-1} + sticker 0.5 ml L^{-1}	Traps at early stage; sprays based on monitoring	Evaluates non-chemical IPM components
T_3 - Biocontrol + Selective Chemicals	Entomopathogenic fungi + selective insecticides	Beauveria bassiana @ 5 g L^{-1}; fipronil 80 WG (0.2 g L^{-1}), cyantraniliprole (1.2 ml L^{-1}), acetamiprid (0.2 g L^{-1})	Fungi at 7-10 day intervals; chemicals rotated at ETL	Assesses biocontrol with minimal chemical use
T_4 - Full IPM Module	Traps + botanicals + biocontrol + selective chemicals + nutrient & cultural practices	Traps (50 $acre^{-1}$); Azadirachtin (3 ml L^{-1}); B. bassiana (5 g L^{-1}); selective insecticides; N & K in 5 splits; micronutrients 2.5-3 g L^{-1}	Integrated application throughout crop growth	Evaluates comprehensive IPM strategy

Data Collection

Observations were recorded at 15th day intervals from 30 days after transplanting (DAT) until harvest. Parameters recorded included. Count the thrips population per 5 randomly tagged plants per plot. Percent damaged flowers/fruits per plot. Fruit yield-expressed as q/ha at harvest. Economic returns-total cost of inputs, net returns (Rs. /ha), and Benefit: Cost (B:C) ratio.

Statistical Analysis

All graphical representations were generated using the ggploT$_2$ package in R software to visualize treatment effects on thrips population, yield, and economic returns. Data were subjected to ANOVA, and mean comparisons were performed using Duncan's Multiple Range Test (DMRT) at $p < 0.05$.

Results and Discussion

Effect of Different Pest Management Modules on Black Thrips Incidence: The incidence of black thrips (*Thrips parvispinus* Karny) varied significantly among different pest management treatments across observation periods. Farmers' practice (T_1), characterized by indiscriminate use of chemical insecticides, consistently recorded the highest thrips population, indicating poor and unsustainable pest suppression. Frequent application of broad-spectrum insecticides under T_1 possibly resulted in resistance development and pest resurgence, a phenomenon well documented in chilli thrips management (Seal *et al*., 2020) [16]. The botanical and trap-based treatment (T_2) significantly reduced thrips population compared to T_1. Installation of yellow and blue sticky traps combined with azadirachtin sprays effectively suppressed early-stage infestations. Botanical insecticides are known to deter feeding and oviposition while conserving natural enemies, thereby contributing to reduced pest pressure (Kumar *et al*., 2019) [9]. Treatment T_3 (biocontrol with minimal chemical intervention) recorded further reduction in thrips incidence. Regular application of Beauveria bassiana and *Lecanicillium lecanii*, supplemented with selective insecticides applied on need basis, effectively controlled thrips populations. Entomopathogenic fungi infect thrips through cuticular penetration and are particularly effective under humid conditions prevalent during the chilli-growing season (Lalitha Priya *et al*., 2022) [11]. The lowest thrips population was consistently recorded under the full IPM module (T_4). The combined use of sticky traps, botanicals, biocontrol agents, selective insecticides, and balanced nutrient and cultural practices resulted in synergistic pest suppression. Similar findings have been reported where integration of multiple IPM components minimized pest outbreaks and delayed resistance development.

Effect on Fruit Yield: Significant differences in fruit yield were observed among treatments. The lowest yields were recorded under T_1, likely due to sustained pest damage, flower drop, and fruit deformation caused by high thrips infestation. Repeated chemical sprays without monitoring failed to provide long-term protection. Treatment T_2 showed moderate yield improvement over farmers' practice, indicating the role of botanicals and traps in reducing pest pressure during early crop stages. However, botanical-only approaches may not be sufficient under high pest pressure conditions. T_3 recorded substantially higher yields due to effective suppression of thrips by biocontrol agents and judicious chemical use. These results confirm earlier reports that selective insecticides combined with biological agents improve crop productivity while reducing pesticide load (Thakur *et al*., 2021) [19]. The highest fruit yield was obtained under T_4 (full IPM), demonstrating the importance of integrating pest, nutrient, and cultural management practices. Balanced fertilization and micronutrient sprays improved plant vigor, enabling plants to tolerate minor pest injury and recover faster. Similar yield advantages under IPM modules have been reported in chilli and other vegetable crops (Devare *et al*., 2024) [3].

Table 2: IPM (T_4) produced higher fruit yields than T_1

Year	T_1 (q/ha)	T_2 (q/ha)	T_3 (q/ha)	T_4 (q/ha)
2023-24	58.65	60.14	62.75	63.98
2024-25	57.64	59.47	61.44	65.98

Economic Analysis: Economic evaluation revealed clear superiority of IPM-based treatments over farmers' practice. Although the cost of cultivation was slightly higher under T_3 and T_4 due to additional inputs, net returns were significantly higher, owing to increased yield and better fruit quality. Farmers' practice recorded comparatively lower net returns despite frequent pesticide sprays, highlighting inefficiency and higher input wastage. The full IPM module (T_4) recorded the highest net returns and favourable benefit-cost ratio, confirming its economic viability. These findings align with previous studies emphasizing that IPM not only improves yield but also enhances profitability by optimizing input use (Kogan, 1998; Reddy *et al*., 2020) [8, 15].

Table 3: Net returns and B:C ratios were consistently higher under IPM

Year	T_1(Rs. /ha)	T_2(Rs. /ha)	T_3(Rs. /ha)	T_4(Rs. /ha)	T_1 B:C	T_2 B:C	T_3 B:C	T_4 B:C
2023-24	76,525	79,151	82,103	92,800	2.84:1	2.57:1	2.31:1	2.13:1
2024-25	80,150	83,574	88,748	99,250	2.95:1	2.70:1	2.54:1	2.15:1

Farmers' Perception and Field Applicability: Farmers expressed positive feedback towards IPM treatments, particularly the use of sticky traps, neem-based formulations, and reduced chemical sprays. Improved crop appearance, reduced pesticide exposure, and ease of adoption enhanced farmer confidence in IPM strategies. Demonstration-based learning through OFTs and FLDs played a crucial role in improving awareness and adoption, as reported earlier by extension studies in chilli ecosystems (Singh *et al*., 2022) [17].

Conclusion
The study demonstrates that IPM strategies are superior to conventional chemical-based practices for managing *Thrips parvispinus* in chilli. Among treatments, the full IPM module (T_4) was most effective at suppressing thrips, increasing yield and economic returns. Reliance on indiscriminate chemical use fails to provide sustainable control and promotes pest resurgence. In contrast, integrating botanicals, biocontrol agents, selective insecticides and agronomic practices offers a sustainable, economically viable, and eco-friendly approach. Adoption of IPM modules is strongly recommended for chilli cultivation in Andhra Pradesh, Telangana and similar agro-ecological regions. Large-scale promotion through extension programs and field demonstrations will be essential for long-term pest management and sustainable production.

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