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Field Evaluation of Integrated Pest Management Strategies against Chilli Black Thrips *Thrips parvispinus* (Karny), in the Srikakulam District

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Chilli (*Capsicum annum* L) is an important spice crop grown extensively in India for both domestic and export markets. Invasive black thrips *Thrips parvispinus* has been causing destructive damage to chilli crop in India leading to indiscriminate use of insecticidal sprays. On-farm trials were conducted during *Kharif* and *Rabi* 2022-23 & 2023-24 to evaluate Integrated Pest Management practices against black thrips with emphasis on minimal pesticidal sprays with different mode of actions so that pests may not develop resistance which will reduce the residues on the produce in the farmer's fields of Srikakulam district of Andhra Pradesh. IPM adopted fields *i.e.* seed treatment, marigold as trap crop, erection of blue sticky traps, *Beauveria bassiana* spray and Neem oil and

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Fipronil 5 SC spray at 30 DAT; Imidacloprid+Fipronil 40%WG spray at 50 DAT; have shown 40 to 85 per cent reduction in black thrips infestation over farmers practice during all the seasons of both the years. This resulted in a higher average mean yield of 57 q/ha, average net returns of Rs. 4,96,000 per hectare with cost benefit ratio of 3.29 in IPM fields over farmer's practice depicting that the adoption of IPM practices helped in reducing the pest incidence and increase in yield, net returns.

Keywords: Chilli; black thrips; IPM; yield; net income.

ABBREVIATIONS

IPM : Integrated Pest Management
DAT : Days After Transplanting

1. INTRODUCTION

Chillies *i.e. Capsicum annum* L., and *Capsicum frutescens* L. commonly used spice in green as well as dried form. India is a major producer, exporter and consumer of chillies in the world with an annual production of 601,084 million tonnes of value Rs.1,249,248.45 Lakhs from an area of about 10 lakh ha. Chillies contribute about 39.03% of Indian spice exports in quantity, and about 33.80 % in value [1]. Pests and diseases, and pesticidal sprays poses a greater threat to the export potential by reducing the crop productivity and increasing the residues. It has been reported that the crop is infested with more than 21 insects and non-insect pests [2]. Recently, *Thrips parvispinus* (Karny) (Thysanoptera: Terebrantia: Thripidae) has become a major threat to chilli growing regions in India, due to which chilli farmers have been facing great economic losses.

The invasive thrips, *T. parvispinus* is native to Thailand and has widespread occurrence in other South East Asian countries [3]. It sucks the sap from leaves, feeds on pollen, flowers and fruits of chillies resulting in upward curling of leaves, flower drop, curled-mis shaped fruits in chillies, capsicum, and other crops. In India, it was first reported by Tyagi et al*.* [4], followed by, Rachana et al*.* [5], Roselin et al*.* [6] and Verghese [7] in papaya, *Dalhia rosea*, *Brugmansia sp*. and chilli respectively. Nagaraj et al*.* [8] and Rachana et al*.* [9] reported other hosts *i.e.* cotton, bitter gourd, chrysanthemum, watermelon, mango, tamarind and marigold. It is reported that 23% of crop loss was recorded in Indonesia due to *T. parvispinus* [10]. These thrips can feed and breed in diverse ago-ecosystems. Diagnostic field survey's conducted by Rachana and Shylesha [11] from Andhra Pradesh, Chattisghar, Karnataka and Tamil Nadu revealed that black thrips incidence was in alarming proportions in flowers i.e 90-95% flowers were badly damaged and recorded 18.20 thrips/flower leading to shedding of flowers, malformation of fruits and fruit drop and severe yield loss in chillies.

The farmers always prefer chemical sprays to protect against the damage to high-value crops caused by insect pests and others. The indiscriminate use of huge amounts of pesticides to protect the crop without proper management practices results in resurgence of the pests, phytotoxicity on fruits, destruction of earthworms, infertility/low fruit setting due to killing of pollinators and the presence of high amounts of pesticidal residue on harvested fruits. In this context, Integrated Pest Management practices were tested to create awareness on eco-friendly management among chilli farmers for sustainable production of the crop.

2. MATERIALS AND METHODS

An On-Farm Trial on Integrated Pest Management (IPM) in Chilli against black thrips was conducted by KVK, Amadalavalasa in Srikakulam District for two consecutive years from 2022-23 to 2023-24 during *Kharif* and *Rabi* seasons. On Farm Trials were conducted in 3 villages in every season in selected farmer's fields *viz*., Patharlapalli (Ranasthalam), Chintada (Amadalavalsa), Veerayyavalasa (Etcherla), Polaki, Gantapeta (Polaki), Kesavarayapuram (Laveru) to evaluate the integrated pest management practices with major emphasis on minimal pesticidal sprays and to popularise IPM technology among farmer's community. The soil of the trials was sandy loam in texture with medium fertility status. The F_1 private hybrid seedlings were raised in the shade net nursery and 25 days old seedlings were transplanted in the main field with 75 cm x 45 cm spacing. Standard agronomic practices were followed to grow the crop.

2.1 Details of the Treatments

Treatment 1: IPM

- Deep summer Ploughing
- application of Neem cake @200kg per acre.
- Soil application of Azospirillum, Phoshobacteria, and Potash mobilizing bacteria @ 5 Kg/ha
- Seed treatment with Imidachloprid 8g/kg
- Two rows of maize/jowar as boarder crop/ Marigold as trap crop
- Installation of Yellow & blue sticky traps- for sucking pest management (20 per acre)
- Removal and destruction of virus affected pants
- Spraying of microbial-based insecticides like *Beauveria bassiana* and *Paecilomyces lilacinus* @ at 5 g or ml/L (spore load - 1x108 cfu/g or ml)
- Neem oil 10,000 ppm @ 2ml/L alternating with the chemical sprays. Fipronil – 40 to 50 g/acre.
- Imidacloprid 40% + Fiprnil 40%WG – 40 to 50 g/acre.
- Cyantraniliprole - 240 ml/ acre & Acetamiprid – 40 to50 g/acre

Treatment 2: (Farmers practice)

- Mixed Chemical spraying at 2-3 days intervals
- Acephate, Imidacloprid, Acetamiprid and fipronil

Each treatment was imposed in 0.4 ha. Neem cake was applied @ 200 kg per acre during summer ploughing. Seed treatment with Imidacloprid @ 8g/kg seed was imposed. Two rows of maize crop are sown around the main crop to avoid migration of pests and Yellow and blue sticky traps were erected @ 20 per acre during the season to attract whitefly and thrips respectively to monitor and mass trapping of sucking pests. Marigold crop was sown to attract natural enemies and sucking pests as a trap crop. *Beauveria bassiana* @ 5 g or ml/L (spore load - $1x10^8$ cfu/g or ml) has sprayed as and when thrips were observed in the sticky traps to reduce the pest load on the crop. Neem oil and fipronil @ 40g per acre was sprayed at 30 DAT and Imidacloprid 40% + Fiprnil 40%WG (Police) @ 40 to 50 g/acre at 50 DAT when thrips population crossed the ETL.

The observations were recorded from five randomly selected plants in each field. Observations were recorded at 30 DAT and 50 DAT. The number of flowers / leaves affected by thrips was recorded on every selected plant and later the percentage damage to plants was worked out by using the formula

> Per cent infestation = Number of affected plants / no of total plants observed x 100

First plucking of fruits was made at 65 DAT and successive plucking was done at an interval of 15 days. Fruit yield per plant was calculated from each harvesting and cumulated fruit yield per hectare from all harvestings of field. The fruit yield was recorded and computed to quintals per hectare. The benefit - cost ratio (BC Ratio) of the treatments was calculated by estimating cost of cultivation and return from fruit yield after converting them to one hectare of land. The economics were calculated using the following formula:

1. Gross return = Yield x Market price
2. Net Returns = Gross Return - Total Cost of cultivation
3. B: C ratio = Gross Return / Total Cost

3. RESULTS AND DISCUSSION

A Perusal of Table 1 revealed that black thrips per cent infestation was reduced in IPM plots during *Kharif* and *Rabi* of both years 2022 and 2023 when compared to Farmer's practice *i.e.* mixed insecticidal sprays at weekly intervals. In *Kharif* and *Rabi* for the year 2022-23 IPM plots recorded 68.57, 75.00 per cent reduction in black thrips infestation at 30 Days after Transplanting (DAT) and 85.00, 84.00 per cent reduction in black thrips infestation at 50 DAT respectively when compared to farmers practice. Similarly, during *Kharif* and *Rabi* 2023-24 IPM fields recorded 40, 66.66 per cent reduction in black thrips infestation was observed at 30 DAT and 66.66, 85.00 per cent reduction in black thrips infestation at 50 DAT respectively when compared to farmers practice.

Table 1. Details of per cent infestation of black thrips in chillies during Kharif & Rabi of 2022-23 and 2023-24

Treatments	Per cent infestation of thrips							
	30 DAT				50 DAT			
	Kharif 2022	Rabi 2022	Kharif 2023	Rabi 2023	Kharif 2022	Rabi 2022	Kharif 2023	Rabi 2023
T1: IPM	11	10	15	10	06	08	10	06
T2: Control	35	40	25	30	40	50	30	40
% increase/ decrease	-68.57	-75.00	-40.00	-66.66	-85.00	-84.00	-66.66	-85.00

Table 2. Details of Yield and Economic parameters of Chilli cultivation during Kharif & Rabi of 2022-23 and 2023-24

Season	Mean Yield (q/ha)		Cost of Plant protection (Rs/ha)		Cost of cultivation (Rs/ha)		Gross returns (Rs/ha)		Net returns (Rs./ha)		BC Ratio	
	T1 IPM	T2 Control	T1 IPM	T2 Control	T1 IPM	T2 Control	T1 IPM	T2 Control	T1 IPM	T2 Control	T1 IPM	T2 Control
Kharif 2022	55	45	12000	5000	212500	205500	660000	540000	447500	334500	3.10	2.62
Rabi 2022	60	50	12000	5000	220000	213000	720000	600000	500000	387000	3.27	2.82
Kharif 2023	54	46	12500	7500	212500	207500	702000	598000	489500	390500	3.30	2.88
Rabi 2023	59	48	12500	9000	220000	216500	767000	624000	547000	407500	3.48	2.88
Mean	57	47.25	12250	6625	216250	210625	712250	590500	496000	379875	3.29	2.80

The details of yield, cost of plant protection, cost of cultivation, gross returns, net returns and cost-benefit ratio's each year, each season was presented in the Table 2 revealing that adoption of IPM practices resulted in higher yields, net returns and cost-benefit ratio when compared to farmers practice. In *Kharif & Rabi* 2022, the mean yield was higher 55 q/ha and 60 q/ha in IPM plots over farmer's fields *i.e* 45q/ha and 50 q/ha respectively. However, the cost of cultivation for IPM plots was higher than the farmer's practice (due to seed treatment, neem cake, microbial pesticides, botanical pesticides and new chemicals). IPM fields resulted in increased net returns *i.e* Rs.4,47,500 and Rs.5,00,000 when compared to farmers fields *i.e.* Rs.3,34,500 and Rs.3,87,000 during *Kharif* and *Rabi* 2022 respectively. Cost Benefit ratio was also higher in IPM plots i.e. 3.10 and 3.27 during *Kharif* and *Rabi* 2022 respectively.

Similarly, during *Kharif* and *Rabi* 2023, the mean yield was higher *i.e.* 54 q/ha and 59 q/ha in IPM fields when compared to farmers fields *i.e.* 46 q/ha and 48 q/ha respectively. IPM plots recorded higher net returns *i.e.* Rs.4,89,500 and Rs.5,47,000; cost-benefit ratio's 3.30 and 3.48 during *Kharif* and *Rabi* respectively when compared to farmers practice.

3.1 Discussion

The findings are in collaboration with the earlier works of Vani [12] and Akshata [13] that the farmers realised increased yield and net returns in practising IPM practices rather than indiscriminate spraying of chemical insecticides for pest control. Ferers [14] also reported that a border crop taller than the main crop will reduce the sucking pest incidence. Similarly, Smitha and Giraddi [15] reported that maize as border crop to chilli, and marigold as an intercrop, neem cake application @ 500 kg/ha and *Lecanicillium lecanii* enhanced the natural enemy's population and reduced the incidence of chilli thrips, mites and percent fruit damage. Ghatak et al. [16] reported that *Verticillium lecanii* caused a high percentage reduction of the thrips population. Need-based chemical sprays with imidacloprid [17,18] and acetamiprid [19], fipronil [20] resulted in higher chilli yields and less thrips incidence [21].

4. CONCLUSION

The overall data from two consecutive years reveals that there was a 40 to 85 percentage reduction in thrips infestation in IPM plots when compared to farmers practice. This study suggests that implementing Integrated Pest Management (IPM) strategies could effectively reduce black thrips incidence and yield loss in chillies.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

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.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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