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Integrated Pest Management Strategies for Sustainable Management of Black Thrips, *Thrips parvispinus* (Karny) in Chrysanthemum Cultivation

Sake Manideep*, M. Muthuswami, P. S. Shanmugam, Aswini R, Chirasani Nagarani, Talapala Sai Kumar, Bacham Anil Kumar, Tulasi B

Department of Agricultural Entomology, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, 641003, India

ABSTRACT

Chrysanthemum (Dendranthema grandiflora L.), a prominent ornamental flower in the Asteraceae family, is widely cultivated for its aesthetic and medicinal value. However, the increasing prevalence of the invasive pest, Thrips parvispinus (Karny) poses a significant threat, causing substantial qualitative and quantitative losses. Despite its economic importance, studies on effective integrated pest management (IPM) strategies targeting T. parvispinus remains limited. This study aimed to evaluate the the potential of combining cultural, mechanical, biorational, and chemical strategies for sustainable pest management. Field experiments were conducted in Dasarapalli, Krishnagiri district, Tamil Nadu during 2022-2023 to assess efficacy of four IPM modules against T. parvispinus in chrysanthemum cultivation. Four IPM modules were tested in Dasarapalli, Krishnagiri district, during 2022–2023. Among the tested modules, Module I comprising a seedling root dip, mulching, blue sticky traps, and the application of Pongamia soap (5 g/L) alongside need-based chemical insecticides, specifically Spinosad 45% SC at 0.2 mL/L proved most effective. It recorded a mean thrips incidence of 18.85 per flower and the highest yield of 19.76 tonnes per hectare, demonstrating superior pest control and enhanced crop productivity. Challenges such as environmental variations and the complex behavior of T. parvispinus highlighted the need for adaptive IPM strategies. While other IPM modules showed moderate effectiveness, complementary evaluations of individual treatments revealed that Pongamia soap (5 g/L) achieved a 74.90% reduction in thrips incidence, making it the most effective biorational. Among chemical insecticides, Spinosad 45% SC (0.2 mL/L) demonstrated the highest efficacy, reducing the thrips population by 80.2%. These findings underscore the importance of integrating environmentally friendly biorationals with targeted chemical applications and cultural practices. The superior performance of Module I illustrates the potential for sustainable and eco-friendly chrysanthemum cultivation by minimizing chemical dependence. This study provides valuable insights for developing practical IPM strategies to address the challenges posed by invasive thrips species.

Keywords: *Thrips parvispinus, chrysanthemum, IPM Modules, Biorationals, Chemical insecticides, Eco-friendly pest management, Pongamia soap, Spinosad*

1. Introduction

Chrysanthemum (*Dendranthema grandiflora* L.), a flower crop belonging to the Asteraceae family (Compositae), is often referred to as the "Queen of the East" and is also known as India's Autumn Flower. Initially cultivated in China as early as the 15th century BC, chrysanthemums have become one of the most widely grown flower species globally, with over 20,000 varieties, including 1,000 cultivars found in India [1,2]. In India, chrysanthemums are commercially cultivated primarily in Tamil Nadu, Karnataka, and Maharashtra, where they hold significant importance in religious ceremonies, garland-making, and ornamental applications.

Intensive chrysanthemum cultivation, involving extensive use of synthetic fertilizers and pesticides, has disrupted the crop-pest equilibrium. Invasive insect pests pose a constant threat to commercial crop growers by expanding their host range and causing significant damage in areas where natural control measures are absent.

*Corresponding Author: ***Sake Manideep***

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Among these, the invasive pest *Thrips parvispinus* presents a serious challenge to chrysanthemum cultivation. Initially reported in India on papaya [3], this pest has since expanded its host range to include various ornamental and agricultural crops. It causes both qualitative and quantitative losses, particularly impacting cut flowers, and is notoriously difficult to manage due to its small size and cryptic behavior [4]. The widespread and indiscriminate use of insecticides has further exacerbated the problem, leading to thrips resurgence in southern states and causing damage levels of 70–100% in chilli crops [5].

To address this challenge, Integrated Pest Management (IPM) strategies are crucial for the sustainable management of *T. parvispinus*. These strategies combine cultural practices, biological control measures, and judicious insecticide application to achieve effective pest suppression while minimizing economic losses and environmental impacts.

2. Materials and Methods

The study was conducted in a farmer's field in Dasarapalli (12°41'51.7"N 77°46'38.4"E) village, Krishnagiri district, Tamil Nadu to compare the effectiveness of IPM modules against *T. parvispinus* in chrysanthemum. The IPM modules were compared with farmer practices and untreated control. Each module was imposed in 40 x 10m^2 area in a randomized block design and replicated five times.

The IPM module was formulated including seedling root dip, mulching, blue sticky traps, and effective biorational and insecticides as components. The development of the IPM module was based on the findings of the field evaluation of biorationals and chemical insecticides. The details of the two IPM modules are given in Table 1.

Table 1. IPM modules used in the experiment

Module I	Seedling dip method, mulching, blue sticky trap, pongamia soap @5g/lit+Spinosad 45% SC @0.2ml/lit
Module II	Seedling dip method, mulching, blue sticky trap, neem soap @5g/lit+ spinetoram 11.7%SC @0.2ml/lit
Module III	Farmer's practice (Diafenthiuron 25% + pyriproxyfen 5% SE combi product, spraying of Monokem 36% SL, @ 2ml/l)
Module IV	Untreated control

The variety, sent yellow with recommended agronomic practices was cultivated in drip cum fertigation. The treatments in the IPM modules were imposed based on the incidence of black thrips.

Blue sticky traps at the rate of 20/acre were installed at canopy level (20 cm above the ground) thirty days after sowing. Observations of the number of thrips (nymphs and adults) collected in sticky traps were taken weekly.

3.6.2. Post-harvest observations

a) Yield

The chrysanthemum yield in each IPM module was collected at each harvest and then calculated on a hectare basis to assess the impact of IPM modules on the output.

b) Yield and cost economics

The cost of cultivation and economic aspects were determined by considering the price of the input (in rupees) during its usage and the market price of the chrysanthemum during the sale.

i) Cost of cultivation

The total cost of production (in Rs/ha) for each treatment was computed based on the overall expenses associated with chrysanthemum cultivation.

ii) Gross return

The gross return was determined by adding up the earnings generated from selling the entire yield. Here is the formula used to calculate it.

Gross return (Rs/ ha)	=	Yield (q/ha)	x	Price (Rs/t)

iii) Net return

The net return (in Rs/ha) was calculated by deducting the cultivation costs (in Rs/ha) from the gross return.

Net return (Rs /ha) = Gross return q/ha – Cost of cultivation (Rs/ha)

vi) Incremental Benefit: Cost ratio

The gross return to production cost ratio was determined for each treatment and used to compare the performance of various treatments as a benefit: cost ratio (B: C).

$$\text{B: C Ratio} = \frac{\text{Net return (Rs/ha)}}{\text{Cost of cultivation (Rs/ha)}}$$

3.7. Data analysis

The thrips population data were transformed into a square root (Angular) transformation, and the modified data were subsequently analyzed using an analysis of variance (ANOVA). The LSD (Least Significant Difference) test was employed to distinguish between the means of treatment. The significance level was fixed at $\alpha = 0.05$. All of these steps were performed using SPSS software version 16.0 and GRAPES software version 1.0. The percent reduction over untreated control was worked using modified Abbot's formula given below,

$$P = \frac{(100 \times 1 - T_a \times C_b)}{(T_b \times c_a)}$$

Where, P = Percent population reduction over control

Ta = Population in treatment after spray

Ca = Population in control after spray

Tb = Population in treatment before spray

Cb = Population in control before spray [6]

Results and discussion

The field experiment conducted in a farmer's field at Dasarapalli village 2023, Krishnagiri district, assessed the efficacy of various Integrated Pest Management (IPM) modules in reducing thrips infestations in chrysanthemum cultivation. Among the tested modules, Module I, which integrated seedling dip treatment, mulching, blue sticky traps, biorational Pongamia soap (5 g/lit), and Spinosad 45% SC (0.2 ml/lit), emerged as the most effective, achieving a 53.25% reduction in thrips populations compared to the control(Table 2). The mean thrips population in Module I across 30, 45, 60, 75, and 90 days after treatment (DAT) was 4.28, 9.10, 17.86, 33.73, and 29.30, respectively. Notably, the thrips population increased across all modules after 60 DAT, reflecting the pest's life cycle dynamics.

Module II, which utilized neem soap (5 g/lit) and Spinetoram 11.7% SC (0.2 ml/lit) alongside cultural practices, was the second most effective, reducing thrips populations by 41.00 percent reduction over control. In comparison, Module III (farmer practices) showed limited efficacy, achieving only a 28.49 percent reduction over control. By 90 DAT, the average thrips damage levels in Module I, Module II, Module III, and the untreated control were 18.85%, 23.90%, 28.49%, and 40.58%, respectively (Figure1).

Tabel 2: Validation of IPM modules against black thrips, T. parvispinus in chrysanthemum at Dasarapalli, Krishnagiri Dt, Tamil Nadu

Module	Thrips population (Nos./flowers)						
	30 DAS	45 DAS	60 DAS	75 DAS	90 DAS	Mean	PRC
Module I (IPM - I): Seedling dip method, mulching, blue sticky trap, pongamia soap @5gm/lit+Spinosad 45 SC @0.2ml/lit	4.28 (2.07) a	9.105 (3.01) a	17.86 (4.22) a	33.73 (5.80) a	29.30 (5.41) a	18.855	53.25
Module II (IPM- II): Seedling dip method, mulching, blue sticky trap, neem soap @5gm/lit+ spinetoram 11.7%SC @0.2ml/lit	5.364 (2.31) b	13.70 (3.70) b	29.42 (5.42) b	38.36 (6.19) b	32.81 (5.71) b	23.908	41.00
Module III (Farmer's practice) Farmers practice (Insecticides spray 5 rounds) @ fortnight intervals starting from 65 days after sowing	6.782 (2.60) c	16.31 (4.03) c	35.06 (5.92) c	44.5 (6.67) c	39.82 (6.31) c	28.49	27.906
M4 -Untreated control	9.182 (3.03) d	19.5 (4.41) d	45.01 (6.70) d	61.8 (7.86) d	67.45 (8.21) d	40.58	
SE(d)	0.0328	0.0369	0.0592	0.0750	0.0766		
LSD (0.05)	0.0715	0.0804	0.129	0.1634	0.1669		
Significant	**	**	**	**	**		

*DAS – days after spraying. *Figures in parentheses are $\sqrt{n+1}$ transformed values.Treatment means with a same letter are on par with each other by the LSD at a 5% level of significance. PRC = percent reduction over control, NS = non-significant and ** = highly significant*

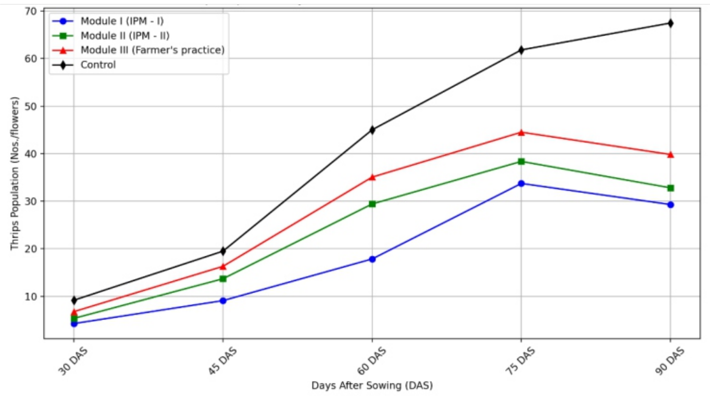

Figure 1. Thrips population dynamics across different treatment IPM modules

The economics of IPM modules and farmers' practices are presented in Heat MAP (Fig 1). Darker blue shades indicate higher values, making it easy to identify the most effective treatment (Module I) and the least effective (Module IV).The average flower yield across the modules and untreated control ranged from 14.82 to 19.76 t/ha. The net returns were highest in Module I (Rs. 1753700/ha) and in Module II (Rs. 1683500). The benefit-cost ratios in M I, M II, and farmers' practice were 2.84, 2.71, and 2.26 respectively.

Figure 2. Comparative Analysis of different treatment IPM modules for flower yield and economic parameters

These findings align with earlier studies demonstrating the effectiveness of IPM strategies in reducing thrips infestations. For instance, a significant 87.08% increase in chili yield was achieved using a module that combined mulching, blue sticky traps, and sequential insecticide applications [7]. Similarly, the integration of sticky traps and insecticides proved beneficial in managing thrips in mungbean [8], while organic-based IPM modules were found effective in fennel [9]. In onion cultivation, the use of border crops, seed treatments, and insecticides was emphasized for controlling thrips and improving both yield and quality [10, 11].

The study highlights the economic and ecological advantages of IPM strategies over traditional practices. Module I demonstrated the highest efficacy and economic viability, significantly reducing chemical dependence and promoting eco-friendly chrysanthemum cultivation. By integrating cultural, biological, and selective chemical controls, IPM strategies enhance pest management efficiency while minimizing environmental impacts and the risks of pesticide resistance. For instance, incorporating trap crops, seed treatments, and biocontrol agents such as *Beauveria bassiana* in IPM modules resulted in a 40–85% reduction in black thrips infestation, along with substantial economic returns [12].

Incorporating such IPM strategies into chrysanthemum cultivation could effectively manage *T. parvispinus* and other thrips species at a lower cost while ensuring sustainable production. Future studies should explore the long-term impact of these strategies on pest dynamics and assess their adaptability across diverse agro-climatic conditions.

Conclusions

The results highlight the importance of integrating various pest control measures into a cohesive strategy. The superior performance of Module I underscores the potential of combining environmentally friendly biorationals with targeted chemical applications and cultural practices for the effective management of *T. parvispinus*. This integrated approach not only reduces chemical reliance but also supports sustainable and eco-friendly chrysanthemum cultivation. These findings offer valuable insights for developing practical IPM strategies to address the challenges posed by invasive thrips species in floriculture.

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