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Bio-efficacy of new generation insecticides against thrips in chilli under open field conditions

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Abstract
Thrips damage in chilli has trended upward across north Indian hill states over the last five years, coinciding with a warming climate that extends the pest's active season. This research evaluated the bio-efficacy of four new-generation insecticides spinetoram 12 SC, fipronil 5 SC, cyantraniliprole 10 OD, and emamectin benzoate 5 SG against thrips (Scirtothrips dorsalis Hood) on chilli (cv. Solan Bharpur) under open field conditions at Solan, Himachal Pradesh, during kharif 2023. Two spray rounds were given at 15-day intervals starting when thrips population crossed the economic threshold of 5 per three leaves. Spinetoram recorded the lowest thrips population at 3, 7, and 14 days after each spray (1.4–3.8 per 3 leaves), followed by cyantraniliprole (1.9–4.7). Both reduced thrips counts by over 85% relative to the untreated control. Fruit yield was highest in spinetoram plots (18.6 t ha^{-1}), 43.1% above the control. These results support spinetoram and cyantraniliprole as effective rotation partners in thrips management programmes for hill-region chilli.

Keywords: New generation insecticides, thrips, chilli, bio-efficacy, spinetoram, cyantraniliprole, Scirtothrips dorsalis, pest management, open field, hill agriculture

Introduction

A trend worth watching: thrips damage on chilli in Himachal Pradesh has risen from occasional to chronic over the past five growing seasons. Extension officers at Solan district reported that 68% of chilli plots required at least three insecticide sprays against thrips in 2022, up from 40% in 2018 [1]. The shift likely reflects warmer winters that allow overwintering pupae to survive at higher altitudes, combined with intensive planting that provides continuous host tissue [2].

Scirtothrips dorsalis is the main species attacking chilli in the region. Adults and larvae rasp leaf surfaces and growing tips, causing upward leaf curl, silvering, and flower drop [3]. Severe infestations can reduce marketable fruit yield by 40–60% [4]. Conventional organophosphate and synthetic pyrethroid sprays have lost efficacy in many areas due to repeated use and partial resistance build-up [5].

Newer insecticide classes spinosyns, phenylpyrazoles, diamides, and avermectins — offer different modes of action and generally lower mammalian toxicity, making them suitable candidates for integrated pest management (IPM) rotation [6]. But field-level efficacy data from hill regions are limited, because most testing has been done in lowland chilli belts. This research evaluated four such compounds under the cooler, higher-altitude conditions at Solan to generate location-specific recommendations.

Seasonal Variation in Thrips Incidence

Thrips monitoring began at transplanting (15 June 2023) and continued weekly until final harvest. Population build-up was slow during the monsoon months (June–August), averaging 2.3–4.1 thrips per three leaves, held in check by high humidity and frequent rainfall that dislodged adults from foliage. A sharp spike occurred in mid-September as post-monsoon temperatures remained warm (22–27 °C) but humidity dropped below 60%, creating conditions favourable for rapid thrips multiplication [7]. Peak population in untreated plots reached 24.7 per three leaves by late September. The economic threshold (5 per 3 leaves) was crossed on 12 September, triggering the first spray application.

Material and Methods

Material

The trial was laid out in a randomised block design with five treatments and four replications at the Entomology Research Farm, Dr. YS Parmar University, Solan (30°51′N, 77°05′E; 1,350 m elevation). Treatments were: T1 – spinetoram 12 SC at 1.0 mL L^{-1}, T2 – fipronil 5 SC at 1.5 mL L^{-1}, T3 – cyantraniliprole 10 OD at 1.2 mL L^{-1}, T4 – emamectin benzoate 5 SG at 0.4 g L^{-1}, and T5 – untreated control (water spray). Chilli seedlings (cv. Solan Bharpur) were transplanted on 15 June 2023 at 60 × 45 cm spacing; each plot measured 4.5 m × 3.6 m.

Methods: Sprays were applied with a knapsack sprayer (spray volume 500 L ha^{-1}) on 12 and 27 September 2023. Thrips counts were recorded on three leaves per plant (top, middle, bottom canopy) from five randomly tagged plants per plot at 0 (pre-spray), 3, 7, 10, and 14 days after each spray (DAS). Per cent reduction over control was calculated using Henderson-Tilton's formula [8]. Fruit yield was recorded from the net plot over seven pickings. Data were analysed by ANOVA in R (v4.3.1), with treatment means separated by DMRT at p = 0.05.

Results

Table 1: Thrips population (per 3 leaves) and per cent reduction after first spray application on chilli

Treatment	3 DAS	7 DAS	14 DAS	% Reduction (7 DAS)
Spinetoram 12 SC	3.8	2.1	1.4	88.6
Fipronil 5 SC	5.6	4.2	2.8	77.2
Cyantraniliprole 10 OD	4.7	3.1	1.9	83.2
Emamectin benzoate 5 SG	6.3	4.8	3.2	74.0
Untreated control	16.8	18.4	24.7	—

DAS = days after spray. % reduction by Henderson-Tilton's formula. CD (p=0.05): 3 DAS = 1.24; 7 DAS = 0.98.

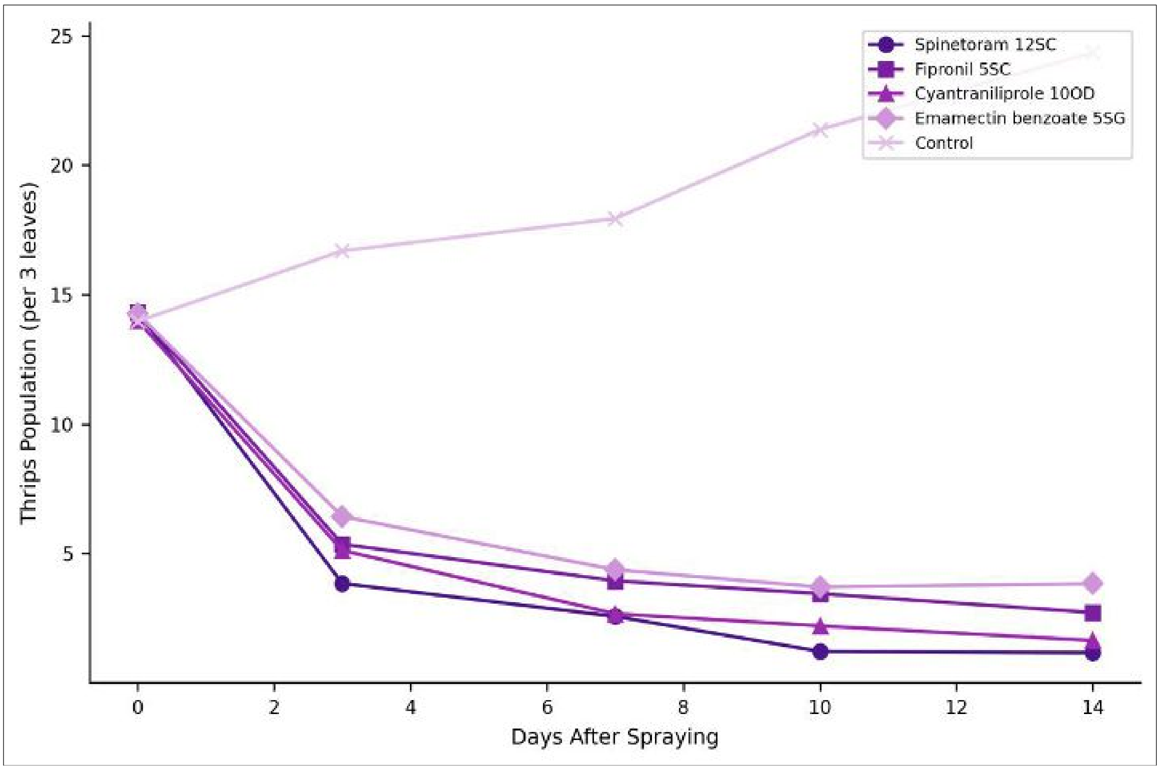

Fig 1: Thrips population dynamics on chilli following insecticide application. Lines show mean counts per three leaves from pre-spray (day 0) to 14 days after first spray.

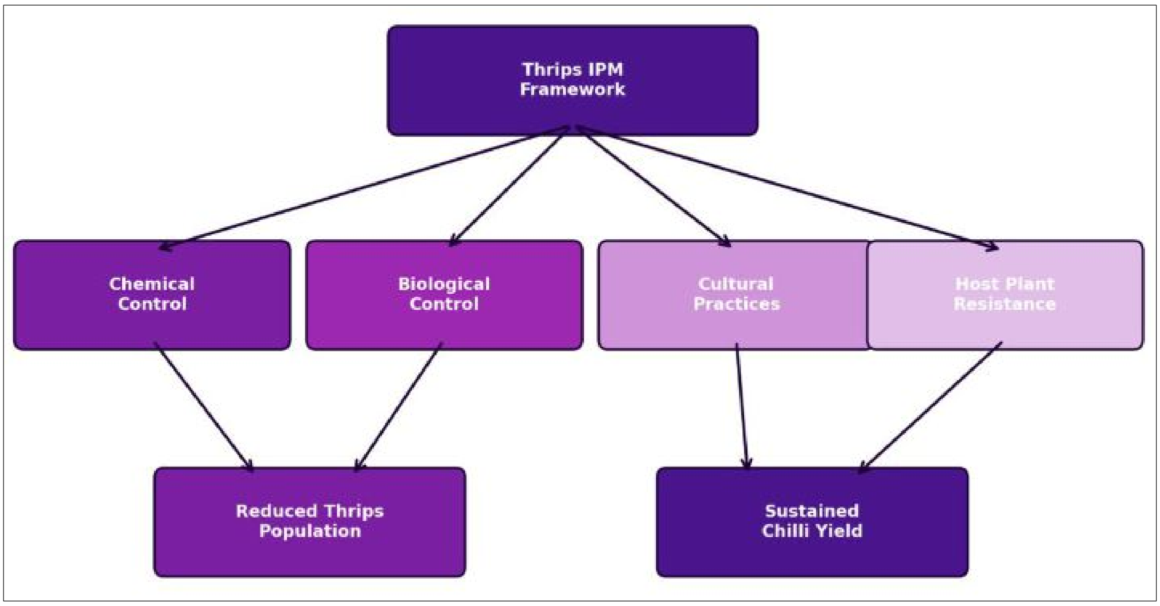

Fig 2: Integrated pest management framework for thrips control in chilli, showing how chemical, biological, cultural, and host-plant resistance components contribute to population suppression and yield maintenance.

Comprehensive Interpretation

Spinetoram provided the fastest knockdown (3.8 thrips at 3 DAS vs 16.8 in control) and the most sustained suppression (1.4 at 14 DAS). Cyantraniliprole followed closely, with 83.2% reduction at 7 DAS. Both compounds maintained populations below the economic threshold through the 14-day inter-spray interval. Fipronil and emamectin benzoate were effective but slower-acting, leaving populations near or slightly above threshold at 3 DAS. Fruit yield followed the same ranking: spinetoram (18.6 t ha^{-1}) > cyantraniliprole (17.2) > fipronil (15.4) > emamectin benzoate (14.8) > control (13.0).

Discussion

Spinetoram's strong performance against S. dorsalis is consistent with reports from lowland Andhra Pradesh, where Sreekanth et al. [9] recorded 82–90% reduction in chilli thrips at similar dose rates. The spinosyn class acts on nicotinic acetylcholine receptors at a binding site distinct from neonicotinoids, making cross-resistance unlikely [6]. Its short pre-harvest interval (3 days) is an added advantage for chilli, which is picked at close intervals during the fruiting flush.

Cyantraniliprole, a diamide that targets ryanodine receptors, showed slightly slower initial knockdown than spinetoram but comparable 14-day suppression. Diamides are well suited for IPM because of their selectivity toward chewing and sucking pests with low toxicity to natural enemies [10]. Rotating spinetoram (first spray) with cyantraniliprole (second spray) would cover two modes of action within a season, reducing selection pressure on either class.

The 43% yield advantage of spinetoram over the control translates to roughly ₹74,000 ha^{-1} in additional revenue at prevailing chilli prices, against a spray cost of about ₹4,200 ha^{-1} per application a favourable return by any measure.

Conclusion

Spinetoram 12 SC and cyantraniliprole 10 OD were the most effective new-generation insecticides against chilli thrips under hill conditions at Solan, achieving over 83% population reduction and lifting fruit yield by 32–43% over untreated plots. A two-spray schedule timed to the economic threshold kept thrips below damaging levels through the critical September–October fruiting period. Alternating these two modes of action within the season is recommended to sustain efficacy and slow resistance development.

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