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Efficacy of selected insecticides against chilli thrips *Scirtothrips dorsalis* (Hood.) on chilli (*Capsicum annum* L.)

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Abstract
Context: A field experiment was carried out at a farmer's field in Mahabubabad district, Telangana, during *Kharif* season 2020-21 to evaluate the efficacy of selected insecticides against chilli thrips, *Scirtothrips dorsalis* (Hood.), a major pest causing significant yield losses in chilli (*Capsicum annuum* L.).
Objective: To evaluate the in-situ efficacy of selected insecticides against thrips in chilli and to calculate the cost-benefit ratio of the treatments.
Methodology: Seven insecticidal treatments, namely Fipronil 5% SC (T1), Acetamiprid 20 SP (T2), Imidacloprid 17.8 SL (T3), Dimethoate 30 EC (T4), Fenazaquin 10 EC (T5), Emamectin benzoate 5 SG (T6), and Indoxacarb 14.5% SC (T7), were evaluated against chilli thrips under field conditions. An untreated control (T0) was maintained for comparison. Observations on thrips incidence and yield performance were recorded and analyzed to determine treatment efficacy.
Results and Discussion: The results indicated significant variation among treatments in suppressing thrips population. Indoxacarb 14.5% SC (T7) recorded the lowest thrips incidence (0.83%), followed by Emamectin benzoate 5 SG (T6) (1.27%), Imidacloprid 17.8 SL (T3) (1.33%), and Acetamiprid 20 SP (T2) (1.63%). Fipronil 5% SC (T1) (1.77%) and Dimethoate 30 EC (T4) (1.89%) showed moderate effectiveness, whereas Fenazaquin 10 EC (T5) recorded the highest thrips incidence (2.21%), indicating comparatively lower effectiveness. Yield performance followed a similar trend, with Indoxacarb 14.5% SC (T7) producing the highest yield (117.5 q/ha), followed by Emamectin benzoate 5 SG (T6) (110 q/ha) and Imidacloprid 17.8 SL (T3) (105 q/ha). The untreated control (T0) recorded the lowest yield (65 q/ha), confirming the importance of chemical intervention in thrips management.
Significance: The study highlights that Indoxacarb 14.5% SC and Emamectin benzoate 5 SG were highly effective in managing chilli thrips and enhancing yield. These insecticides can be recommended as suitable options for effective thrips control and improved productivity in chilli cultivation under Telangana conditions.

Keywords: Capsicum annuum, cost–benefit ratio, efficacy, insecticides, Scirtothrips dorsalis

Introduction
Chilli (*Capsicum annuum* L.), commonly referred to as "Mirch" in Hindi, is an important spice and vegetable crop belonging to the family Solanaceae. The crop originated in the Latin American region and is presently cultivated worldwide due to its high culinary and economic value. Chilli was introduced into India by the Portuguese during the 16th century, after which it rapidly spread across diverse agro-climatic regions of the country. Since ancient times, chillies have been widely used not only as a spice and food ingredient but also in traditional household remedies. Biologically, the pungency of chilli is considered a natural defense mechanism to deter herbivores and fungal pathogens. The term *Capsicum* is derived from the Greek word "Kapsimo," meaning "to bite," reflecting its pungent nature. The therapeutic properties of chilli are mainly attributed to capsaicin along with other constituents such as proteins, fixed oils, thiamine, and ascorbic acid. Owing to its distinct flavour and pungency, chilli holds a prominent position among vegetable and spice crops (Patil *et al*., 2017) [22]. In India, chilli cultivation is largely concentrated in states such as Andhra Pradesh, Karnataka, Maharashtra, and Tamil Nadu, which together account for a major share of the total area under chilli cultivation. India is also a leading exporter of chillies, with major importing countries including Sri Lanka, the USA, Nepal, Mexico, and Bangladesh (Jagtap *et al*., 2012) [17].

The pest complex of chilli is highly diverse, with more than 293 insect and mite species reported to infest the crop both under field and storage conditions. The most destructive sucking pests include yellow mite (*Polyphagotarsonemus latus* Banks), chilli thrips (*Scirtothrips dorsalis* Hood), and aphids such as *Myzus persicae* (Sulzer) and *Aphis gossypii* (Glover) (Sandeep Kumar *et al*., 2017) [33]. Yield losses caused by sucking pests have been estimated to range between 30 and 50 per cent (Hemanth Swami *et al*., 2018) [15].

Surveys conducted by AVRDC (The World Vegetable Center) across Asian countries indicated that thrips, mites, and aphids are among the most serious sucking pests affecting chilli. Among them, *Scirtothrips dorsalis* is particularly damaging due to its rapid multiplication under dry weather conditions. In South India, the pest has been reported to cause yield losses of 30 to 50 per cent, particularly during dry spells (Varadharajan, 1995) [45]. Several studies have documented the significance of *S. dorsalis* as a key pest of chilli. Nearly 25 insect species have been recorded attacking chilli foliage and fruits, but chilli thrips (*Scirtothrips dorsalis* Hood; Thripidae: Thysanoptera) is regarded as one of the most destructive pests in India

(Ananthakrishnan, 1971 [2]; Butani, 1976; Krishna Kumar, 1995; Krishna Kumar *et al*., 1996). Feeding injury by thrips results in typical leaf curl symptoms, locally referred to as "Kokadava" in Gujarat (Amin, 1979). Yield losses due to thrips infestation in green chilli have been reported in the range of 60.5 to 74.3 per cent.

Chilli thrips is a highly polyphagous pest, causing serious damage not only to chilli but also to several vegetable, ornamental, and fruit crops in southern and eastern Asia. The pest generally appears in chilli fields within a few weeks after transplanting, with peak infestation often observed during early winter. Both nymphs and adults feed by sucking sap from the lower surface of leaves, leading to characteristic upward curling. Under severe infestation, tender leaves and buds become brittle and dry, often resulting in partial or complete defoliation and significant yield reduction (Sandeep Kumar *et al*., 2017) [33]. Additionally, *S. dorsalis* causes indirect losses by transmitting tospoviruses, thereby intensifying crop damage. Yield losses due to thrips in chilli have been reported to range from 50 to 90 per cent depending on pest severity and climatic conditions. Quantitative yield losses have been estimated between 11 and 32 per cent, while qualitative losses may reach up to 88 per cent (Venugopal *et al*., 2018) [46].

The occurrence of *S. dorsalis* in India was first documented by Hood (1919) [16], who collected the species from castor and chilli crops in Coimbatore. Subsequent reports by Ayyar (1928) and Ayyar *et al*. (1935) [3, 5] recorded severe thrips infestation in the chilli-growing tracts of Guntur (Andhra Pradesh) and Periyakulam (Tamil Nadu). These studies observed that thrips populations were relatively low during rainy periods, but infestation increased during drier phases, with seasonal variation influenced by monsoon patterns.

Ramakrishna Ayyar initially collected thrips specimens from chilli shoots and fruits in Coimbatore during 1916, which were later described by Hood (1919) [16] as a new species, *Scirtothrips dorsalis*. Since then, the nomenclature of this pest has remained unchanged. The pest is also known by various common names such as dreaded chilli thrips, Assam thrips, tea thrips, and grape scab thrips, reflecting its wide host range and regional importance.

In recent years, chilli farmers have increasingly depended on repeated insecticidal applications due to severe thrips outbreaks. The frequency of pesticide sprays has steadily increased, resulting in higher cultivation costs and reduced profitability. Excessive chemical use has also contributed to serious ecological concerns, including insecticide resistance, pest resurgence, secondary pest outbreaks, pesticide residues in produce, and harmful impacts on beneficial natural enemies (David, 1978) [11]. Chilli leaf curl syndrome, considered one of the most damaging disorders affecting crop growth and yield, is often associated with thrips feeding injury. Thrips infestation results in upward curling of leaves with a boat-shaped appearance, along with puckering, deformation, twisting, and brittleness of leaves and fruits. Severe infestation at flowering stage may also affect floral development and reduce fruit set.

To manage thrips, farmers in many chilli-growing regions reportedly apply 25–30 rounds of pesticide sprays during a single season. Such indiscriminate usage not only increases production costs but also poses risks such as environmental contamination, groundwater pollution, adverse effects on human health, and destruction of non-target organisms including natural enemies (Vishwakarma *et al*., 2019) [47]. Therefore, identifying effective insecticides with better pest suppression and yield enhancement remains essential for sustainable chilli production.

In view of the increasing severity of chilli thrips and its economic importance, the present study entitled "Efficacy of selected insecticides against thrips *Scirtothrips dorsalis* (Hood.) on chilli (*Capsicum annuum* L.)" was undertaken at a local farm in Mahabubabad, Telangana, during the *Kharif* season of 2020–2021.

Materials and Methods

The field trial was carried out during the *kharif* season of 2020–2021 at a farmer's field in Narsimhulapet village, Mahabubabad district, Telangana, the experimental farm is situated alongside the Warangal–Khammam highway at latitude 17°N and longitude 79°E, approximately 202 m above mean sea level. The soil type was uniform black cotton soil with good drainage, moderate available phosphorus and potash content, low available nitrogen, and a pH range of 7.2–8.5. Mahabubabad district falls within the sub-tropical agro-climatic belt of south-eastern Telangana. The region experiences hot summers (maximum temperature 35–40°C) and moderately cold winters (minimum ~15°C). Relative humidity ranged between 20–40%, and mean annual rainfall averaged 700–900 mm. Meteorological data including monthly rainfall, maximum and minimum temperatures, and relative humidity were recorded throughout the experimental period of 2020–21. The trial includes eight treatments along with an untreated control, and each treatment was replicated thrice. The chilli variety "Tejaswini" was selected, seed rate: 1–1.5 kg/ha, and the crop was grown according to recommended agronomic practices to ensure uniform and healthy plant stand.

Table 1: Details of treatments evaluated against chilli thrips Scirtothrips dorsalis (Hood.) on chilli [Capsicum annuum L.], Kharif 2020–21

Treatment	Chemical formulation	Dose (ml or g lit^{-1} / kg ha^{-1})	Reference
T1	Fipronil 5 SC	1 ml lit^{-1}	Samota *et al.* (2017) [29]
T2	Acetamiprid 20 SP	0.4 ml lit^{-1}	Deole and Yadu (2018) [39]
T3	Imidacloprid 17.8 SL	0.3 ml lit^{-1}	Patel *et al.* (2008)
T4	Dimethoate 30 EC	1 ml lit^{-1}	Shinde *et al.* (2018) [36]
T5	Fenazaquin 10 EC	2 ml lit^{-1}	Patil *et al.* (2017) [22]
T6	Emamectin benzoate 5 SG	0.4 g lit^{-1}	Sujay *et al.* (2015) [41]
T7	Indoxacarb 14.5% SC	0.65 ml lit^{-1}	Vanisree *et al.* (2017) [44]
T0	Control (untreated check)		

SC = Suspension concentrate; SP = Soluble powder; SL = Soluble liquid; EC = Emulsifiable concentrate; SG = Soluble granule.

Statistical analysis

All data collected were subjected to appropriate statistical transformations prior to analysis. The experimental data were analysed following the standard statistical procedures for agricultural research as outlined by Gomez and Gomez (1976). Treatment means were compared using the *F*-test to determine the significance of differences among treatments, and critical differences (CD) were calculated at the 5% probability level ($p \leq 0.05$) for pairwise comparison of treatment means. Analysed data were tabulated and interpreted in accordance with the objectives of the investigation.

Results and discussion

All observational data were compiled, subjected to appropriate statistical analysis, and presented as treatment means in the following sections. Results are discussed objective-wise as outlined below.

Field efficacy of selected insecticides against chilli Thrips, *Scirtothrips dorsalis* (Hood.) on Chilli

Baseline thrips populations across all treatments were recorded one day prior to the first spray application to ensure comparability among treatments. The pre-spray population data are presented in Table 2.

Per cent mean population of *Scirtothrips dorsalis* after first spray application

The comparative efficacy of the seven insecticidal treatments against *S. dorsalis* based on per cent population reduction over the untreated control (T0) is presented in Table 2 and discussed at each observation interval below.

Three days after first spray (3 DAS_1): The per cent mean population of *S. dorsalis* was recorded at three days after the first spray application is presented in Table 2. All insecticidal treatments exhibited statistically significant superiority over the untreated control at this interval. T7-Indoxacarb 14.5% SC @ 0.65 ml lit^{-1} registered the highest population reduction (0.86%), differing significantly from all other treatments. This was followed, in descending order of efficacy, by T6-Emamectin benzoate 5 SG @ 0.4 g lit^{-1} (1.26%), T3-Imidacloprid 17.8 SL @ 0.3 ml lit^{-1} (1.40%), T2-Acetamiprid 20 SP @ 0.4 ml lit^{-1} (1.66%), T1-Fipronil 5 SC @ 1 ml lit^{-1} (1.80%), and T4-Dimethoate 30 EC @ 1 ml lit^{-1} (1.86%). T5-Fenazaquin 10 EC @ 2 ml lit^{-1} recorded the lowest per cent population reduction (2.46%) among all the insecticidal treatments at this observation interval.

Seven days after first spray (7 DAS_1): The per cent mean population of *S. dorsalis* at seven days after the first spray application is presented in Table 2. All treatments continued to demonstrate statistically significant superiority over the untreated control. T7-Indoxacarb 14.5% SC @ 0.65 ml lit^{-1} again recorded the highest thrips population reduction (1.06%), maintaining its position as the most efficacious treatment. The efficacy ranking at this interval followed a similar trend: T6-Emamectin benzoate 5 SG @ 0.4 g lit^{-1} (1.46%), T3-Imidacloprid 17.8 SL @ 0.3 ml lit^{-1} (1.60%), T2-Acetamiprid 20 SP @ 0.4 ml lit^{-1} (1.86%), T1-Fipronil 5 SC @ 1 ml lit^{-1} (2.00%), and T4 - Dimethoate 30 EC @ 1 ml lit^{-1} (2.06%). T5 - Fenazaquin 10 EC @ 2 ml lit^{-1} (2.60%) continued to exhibit the least efficacy among the treated plots.

Fourteen days after first spray (14 DAS_1): The per cent mean population of *S. dorsalis* at fourteen days after the first spray application is presented in Table 2. All insecticidal treatments remained significantly superior over the untreated control at this interval. T7 - Indoxacarb 14.5% SC @ 0.65 ml lit^{-1} retained the highest efficacy with a mean thrips count of 1.26%, followed by T6 - Emamectin benzoate 5 SG @ 0.4 g lit^{-1} (1.73%), T3 - Imidacloprid 17.8 SL @ 0.3 ml lit^{-1} (1.80%), T2 - Acetamiprid 20 SP @ 0.4 ml lit^{-1} (2.06%), T1 - Fipronil 5 SC @ 1 ml lit^{-1} (2.06%), and T4 - Dimethoate 30 EC @ 1 ml lit^{-1} (2.26%). T5 - Fenazaquin 10 EC @ 2 ml lit^{-1} (2.66%) recorded the lowest efficacy among all treatments at this observation point.

Table 2: Field efficacy of selected insecticides against chilli Thrips, *Scirtothrips dorsalis* (Hood.) on Chilli: Mean percent population of *Scirtothrips dorsalis*, after 1st spray

Treatment	Insecticide formulation	Thrips per 3 leaves (mean count)				
		1 DBS	3 DAS	7 DAS	14 DAS	Mean
T1	Fipronil 5 SC @ 1 ml lit^{-1}	9.13	1.80	2.00	2.06	1.95
T2	Acetamiprid 20 SP @ 0.4 ml lit^{-1}	9.40	1.66	1.86	2.06	1.86
T3	Imidacloprid 17.8 SL @ 0.3 ml lit^{-1}	7.80	1.40	1.60	1.80	1.60
T4	Dimethoate 30 EC @ 1 ml lit^{-1}	8.43	1.86	2.06	2.26	2.06
T5	Fenazaquin 10 EC @ 2 ml lit^{-1}	8.06	2.46	2.60	2.66	2.57
T6	Emamectin benzoate 5 SG @ 0.4 g lit^{-1}	8.66	1.26	1.46	1.73	1.48
T7	Indoxacarb 14.5% SC @ 0.65 ml lit^{-1}	8.86	0.86	1.06	1.26	1.06
T0	Untreated check (control)	7.60	7.93	8.13	9.33	8.46
F-test		*NS*	*S*	*S*	*S*	*S*
S.Ed. (±)		0.64	0.38	0.28	0.24	0.18
C.D. ($p = 0.05$)		1.33	0.78	0.57	0.49	0.37

DBS = Days before spray; DAS = Days after spray; S = Significant; NS = Non-significant.
S.Ed. = Standard error of difference; C.D. = Critical difference at $p \leq 0.05$.
Figures are means of three replications.

Pooled mean (3, 7, and 14 DAS_1): First spray

The pooled mean of *S. dorsalis* population across the three post-spray observation intervals (3, 7, and 14 DAS_1) is presented in Table 2. Pooled analysis confirmed that all insecticidal treatments were significantly superior over the untreated control throughout the post-spray period. T7 - Indoxacarb 14.5% SC @ 0.65 ml lit^{-1} - recorded the highest pooled mean population reduction (1.06%), followed by T6 - Emamectin benzoate 5 SG @ 0.4 g lit^{-1} (1.48%), T3 - Imidacloprid 17.8 SL @ 0.3 ml lit^{-1} (1.60%), T2 - Acetamiprid 20 SP @ 0.4 ml lit^{-1} (1.86%), T1 - Fipronil 5 SC @ 1 ml lit^{-1} (1.95%), and T4 - Dimethoate 30 EC @ 1 ml lit^{-1} (2.06%). T5 - Fenazaquin 10 EC @ 2 ml lit^{-1} (2.57%) was the least effective treatment across the entire first spray observation period.

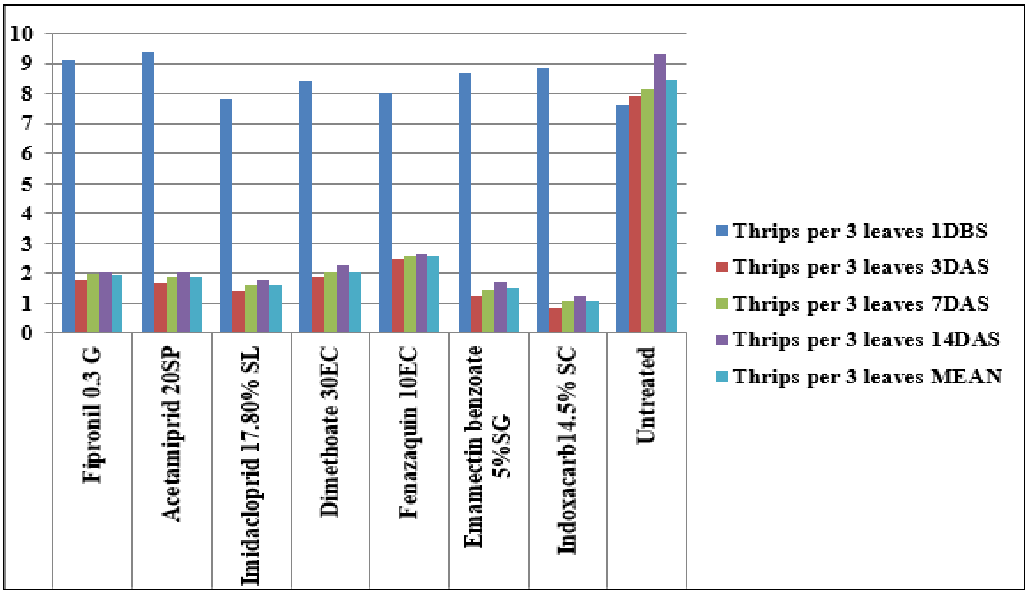

Fig 1: Graphical representation of field efficacy of selected insecticides against chilli Thrips, *Scirtothrips dorsalis* (Hood.) on Chilli: Mean percent population of *Scirtothrips dorsalis*, after 1st spray

Mean per cent population of *Scirtothrips dorsalis* after Second spray application

Treatment means were compared with the Critical Difference (CD) at the 5% probability level ($p \leq 0.05$). The efficacy rankings following the second spray application across all observation intervals are presented below.

Three days after Second spray (3 DAS$_2$): The per cent mean population of *S. dorsalis* recorded at three days after the second spray application is presented in Table 3. All insecticidal treatments were significantly superior over the untreated control. T7 - Indoxacarb 14.5% SC @ 0.65 ml lit^{-1} recorded the highest population reduction (0.40%), followed in descending order of efficacy by T6 - Emamectin benzoate 5 SG @ 0.4 g lit^{-1} (0.86%), T3 - Imidacloprid 17.8 SL @ 0.3 ml lit^{-1} (0.86%), T2 - Acetamiprid 20 SP @ 0.4 ml lit^{-1} (1.20%), T1 - Fipronil 5 SC @ 1 ml lit^{-1} (1.40%), and T4 - Dimethoate 30 EC @ 1 ml lit^{-1} (1.53%). T5 - Fenazaquin 10 EC @ 2 ml lit^{-1} (1.66%) was the least efficacious treatment at this interval.

Seven days after Second spray (7 DAS$_2$): The per cent mean population of *S. dorsalis* at seven days after the second spray application is presented in Table 3. All treatments remained significantly superior over the untreated control. T7 - Indoxacarb 14.5% SC @ 0.65 ml lit^{-1} again exhibited the highest efficacy with a population reduction of 0.60%, followed by T6 - Emamectin benzoate 5 SG @ 0.4 g lit^{-1} (1.06%), T3 - Imidacloprid 17.8 SL @ 0.3 ml lit^{-1} (1.06%), T2 - Acetamiprid 20 SP @ 0.4 ml lit^{-1} (1.40%), T1 - Fipronil 5 SC @ 1 ml lit^{-1} (1.60%), and T4 - Dimethoate 30 EC @ 1 ml lit^{-1} (1.73%). T5 - Fenazaquin 10 EC @ 2 ml lit^{-1} (1.86%) remained the least effective treatment at this observation point.

Fourteen days after Second spray (14 DAS$_2$): The per cent mean population of *S. dorsalis* at fourteen days after the second spray application is presented in Table 3. All insecticidal treatments were significantly superior over the untreated control at this interval. T7 - Indoxacarb 14.5% SC @ 0.65 ml lit^{-1} recorded the highest population reduction (0.80%), followed by T6 - Emamectin benzoate 5 SG @ 0.4 g lit^{-1} (1.26%), T3 - Imidacloprid 17.8 SL @ 0.3 ml lit^{-1} (1.26%), T2 - Acetamiprid 20 SP @ 0.4 ml lit^{-1} (1.60%), T1 - Fipronil 5 SC @ 1 ml lit^{-1} (1.80%), and T4 - Dimethoate 30 EC @ 1 ml lit^{-1} (1.93%). T5 - Fenazaquin 10 EC @ 2 ml lit^{-1} (2.06%) continued to record the least population reduction among all insecticidal treatments.

Table 3: Field efficacy of selected insecticides against chilli Thrips, *Scirtothrips dorsalis* (Hood.) on Chilli: Mean percent population of *Scirtothrips dorsalis* after 2nd Spray

Treatment	Insecticide formulation	Thrips per 3 leaves (mean count)				
		1 DBS	3 DAS	7 DAS	14 DAS	Mean
T1	Fipronil 5 SC @ 1 ml lit^{-1}	7.93	1.40	1.60	1.80	1.60
T2	Acetamiprid 20 SP @ 0.4 ml lit^{-1}	8.13	1.20	1.40	1.60	1.40
T3	Imidacloprid 17.8 SL @ 0.3 ml lit^{-1}	8.06	0.86	1.06	1.26	1.06
T4	Dimethoate 30 EC @ 1 ml lit^{-1}	8.13	1.53	1.73	1.93	1.73
T5	Fenazaquin 10 EC @ 2 ml lit^{-1}	8.66	1.66	1.86	2.06	1.86
T6	Emamectin benzoate 5 SG @ 0.4 g lit^{-1}	7.73	0.86	1.06	1.26	1.06
T7	Indoxacarb 14.5% SC @ 0.65 ml lit^{-1}	8.20	0.40	0.60	0.80	0.60
T0	Untreated check (control)	10.33	15.00	16.66	17.66	16.44
F-test		*NS*	*S*	*S*	*S*	*S*
S.Ed. (±)		0.72	0.39	0.32	0.31	0.33
C.D. (p = 0.05)		1.50	0.81	0.67	0.64	0.68

DBS = Days before spray; DAS = Days after spray; S = Significant; NS = Non-significant.
S.Ed. = Standard error of difference; C.D. = Critical difference at p ≤ 0.05.
Figures are means of three replications.

Pooled mean (3, 7, and 14 DAS₂): Second spray

The pooled mean per cent population of *S. dorsalis* across the three post-spray observation intervals following the second application is presented in Table 3. All insecticidal treatments were significantly superior over the untreated control throughout the observation period. T7 - Indoxacarb 14.5% SC @ 0.65 ml lit^{-1} recorded the highest pooled mean population reduction (0.60%), followed by T6 - Emamectin benzoate 5 SG @ 0.4 g lit^{-1} (1.06%), T3 - Imidacloprid 17.8 SL @ 0.3 ml lit^{-1} (1.06%), T2 - Acetamiprid 20 SP @ 0.4 ml lit^{-1} (1.40%), T1 - Fipronil 5 SC @ 1 ml lit^{-1} (1.60%), and T4 - Dimethoate 30 EC @ 1 ml lit^{-1} (1.73%). T5 - Fenazaquin 10 EC @ 2 ml lit^{-1} (1.86%) was the least effective treatment across all observation intervals of the second spray period.

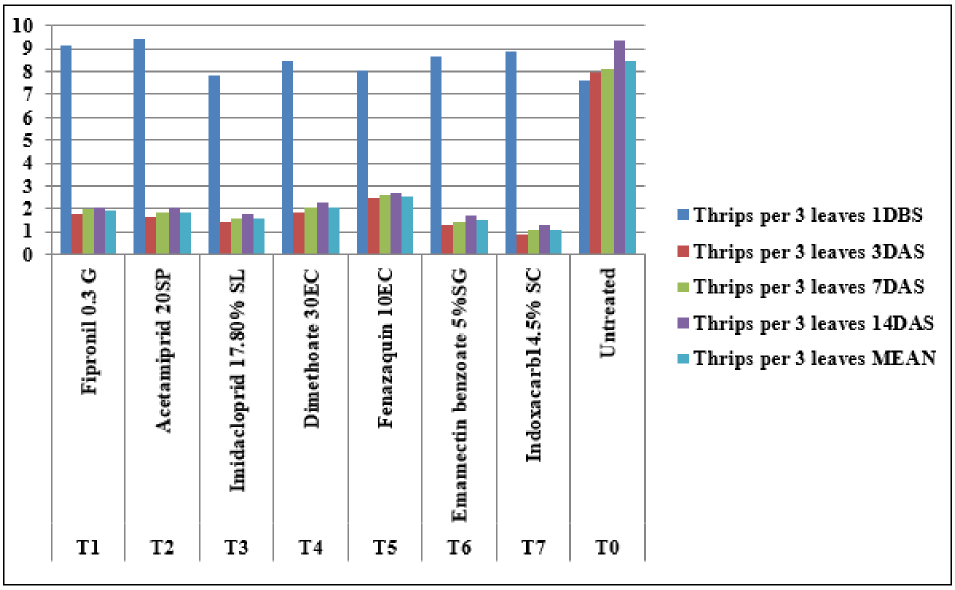

Fig 2: Graphical representation of field efficacy of selected insecticides against chilli Thrips, *Scirtothrips dorsalis* (Hood.) on Chilli: Mean percent population of *Scirtothrips dorsalis* population after 2nd spray

Field efficacy of selected insecticides against *Scirtothrips dorsalis* (Hood.) on chilli, overall mean of first and second spray

The observations on the overall mean percent population of *Scirtothrips dorsalis* after the first and second sprays indicated that all insecticidal treatments were significantly more effective than the untreated control. Among the evaluated treatments, T7 Indoxacarb (0.65 ml/L) recorded the maximum reduction in chilli thrips population **(**0.83%**)** and was significantly superior to the control. This was followed by T6 Emamectin benzoate (0.4 g/L) **(**1.27%**),** T3 Imidacloprid (0.3 ml/L) **(**1.33%**),** T2 Acetamiprid (0.4 ml/L) **(**1.63%**),** T1 Fipronil (1 ml/L) **(**1.78%**),** and T4 Dimethoate (1 ml/L) **(**1.90%**).** T5 Fenazaquin (2 ml/L) was found to be the least effective treatment, showing the lowest reduction **(**2.22%**)** among all the treatments.

Among the selected treatments, Indoxacarb was identified as the most effective insecticide, with efficacy values of 1.06% and 0.60% after the first and second sprays, respectively. These results are in similar with the findings of Vanisree *et al.* (2017) [44]**.** Similarly, Emamectin benzoate exhibited high efficacy, recording 1.48% and 1.06% after the first and second sprays, respectively, which is supported by the observations of Shinde *et al.* (2018) [36]. Imidacloprid was the next best treatment, showing efficacy values of 1.60% and 1.06% during the first and second sprays, respectively. These findings corroborate the results reported by Sangle *et al.* (2017) [31]. This was followed by Acetamiprid and Fipronil, which recorded efficacy values of 1.86% and 1.40%, and 1.95% and 1.60% after the first and second sprays, respectively. Similar results were also reported by Samota *et al.* (2017) [29]. The least effective treatments were Dimethoate (1.89%) and Fenazaquin (2.21%)**,** and these findings are supported by Shinde *et al.* (2018) and Patil *et al.* (2017) [22, 36], respectively.

Table 4: Field efficacy of selected insecticides against Scirtothrips dorsalis (Hood.) on chilli, overall mean of first and second spray applications, Kharif 2020–21

Treatment	Insecticide formulation	First spray					Second spray					Overall mean
		Thrips per 3 leaves					Thrips per 3 leaves					
		1 DBS	3 DAS	7 DAS	14 DAS	Mean	1 DBS	3 DAS	7 DAS	10 DAS	Mean	
T1	Fipronil 5 SC @ 1 ml lit^{-1}	9.13	1.80	2.00	2.06	1.95	7.93	1.40	1.60	1.80	1.60	1.78
T2	Acetamiprid 20 SP @ 0.4 ml lit^{-1}	9.40	1.66	1.86	2.06	1.86	8.13	1.20	1.40	1.60	1.40	1.63
T3	Imidacloprid 17.8 SL @ 0.3 ml lit^{-1}	7.80	1.40	1.60	1.80	1.60	8.06	0.86	1.06	1.26	1.06	1.33
T4	Dimethoate 30 EC @ 1 ml lit^{-1}	8.43	1.86	2.06	2.26	2.06	8.13	1.53	1.73	1.93	1.73	1.90
T5	Fenazaquin 10 EC @ 2 ml lit^{-1}	8.06	2.46	2.60	2.66	2.57	8.66	1.66	1.86	2.06	1.86	2.22
T6	Emamectin benzoate 5 SG @ 0.4 g lit^{-1}	8.66	1.26	1.46	1.73	1.48	7.73	0.86	1.06	1.26	1.06	1.27
T7	Indoxacarb 14.5% SC @ 0.65 ml lit-^{1}	8.86	0.86	1.06	1.26	1.06	8.20	0.40	0.60	0.80	0.60	0.83
T0	Untreated check (control)	7.60	7.93	8.13	9.33	8.46	10.33	15.00	16.66	17.66	16.44	12.45
F-test		NS	S	S	S	S	NS	S	S	S	S	S

S.Ed. (±)	0.64	0.38	0.28	0.24	0.18	0.72	0.39	0.32	0.31	0.33	0.27
C.D. (p = 0.05)	1.33	0.78	0.57	0.49	0.37	1.50	0.81	0.67	0.64	0.68	0.55

DBS = Days before spray; DAS = Days after spray; S = Significant; NS = Non-significant; S.Ed. = Standard error of difference; C.D. = Critical difference.

Overall mean = average of first and second spray pooled means. Combined S.Ed. = $\sqrt{[(S.Ed._1^2 + S.Ed._2^2) \div 2]}$; Combined C.D. = $\sqrt{[(C.D._1^2 + C.D._2^2) \div 2]}$.

Bold values indicate the most efficacious treatment (T7 — Indoxacarb 14.5% SC). Figures are means of three replications.

Crop yield and Cost-Benefit ratio of selected insecticidal treatments

Marketable yield

Significant differences in marketable chilli yield (q ha^{-1}) were observed among the insecticidal treatments evaluated, with all treated plots recording substantially higher yields compared to the untreated check. The yield data clearly reflected the direct influence of thrips population suppression on crop productivity; wherein more efficacious treatments consistently corresponded to higher marketable yields. T7 - Indoxacarb 14.5% SC @ 0.65 ml lit^{-1} produced the highest marketable yield of 117.5 q ha^{-1}, followed in descending order by T6 - Emamectin benzoate 5 SG @ 0.4 g lit^{-1} (110.0 q ha^{-1}), T3 - Imidacloprid 17.8 SL @ 0.3 ml lit^{-1} (105.0 q ha^{-1}), T2 - Acetamiprid 20 SP @ 0.4 ml lit^{-1} (100.0 q ha^{-1}), T1 - Fipronil 5 SC @ 1 ml lit^{-1} (95.0 q ha^{-1}), T4 - Dimethoate 30 EC @ 1 ml lit^{-1} (90.0 q ha^{-1}), and T5 - Fenazaquin 10 EC @ 2 ml lit^{-1} (85.0 q ha^{-1}). The untreated check (T0) recorded the lowest yield of 65.0 q ha^{-1}, which was significantly inferior to all insecticidal treatments, underscoring the adverse impact of uncontrolled *S. dorsalis* infestation on chilli productivity. The yield advantage observed in treated plots is attributable to reduced thrips feeding damage, which otherwise results in flower drop, fruit malformation leading to substantial crop loss.

Economics of the treatments (Cost-Benefit ratio)

Economic analysis of the insecticidal treatments revealed noteworthy differences in cost-effectiveness across the treatments studied. The benefit–cost ratio (BCR) was computed for each treatment by dividing the gross return per hectare by the total cost of production including plant protection charges. T7 - Indoxacarb 14.5% SC @ 0.65 ml lit^{-1} yielded the most favourable BCR of 1:8.3, indicating that every one rupee invested in this treatment returned ₹8.3 in gross value, making it not only the most biologically efficacious but also the most economically viable treatment among those evaluated. This was followed by T6 - Emamectin benzoate 5 SG @ 0.4 g lit^{-1} (BCR 1:7.7), T3 - Imidacloprid 17.8 SL @ 0.3 ml lit^{-1} (1:7.5), T2 - Acetamiprid 20 SP @ 0.4 ml lit^{-1} (1:7.1), T1 - Fipronil 5 SC @ 1 ml lit^{-1} (1:6.7), T4 - Dimethoate 30 EC @ 1 ml lit^{-1} (1:6.3), and T5 - Fenazaquin 10 EC @ 2 ml lit^{-1} (1:5.9). The untreated check (T0) recorded the lowest BCR of 1:4.4, reflecting the significant economic loss incurred due to unrestricted thrips infestation in the absence of any chemical intervention.

The convergence of biological efficacy, marketable yield, and economic returns unequivocally identifies T7 - Indoxacarb 14.5% SC @ 0.65 ml lit^{-1} as the most suitable insecticidal treatment for the integrated management of *Scirtothrips dorsalis* on chilli under the agro-climatic conditions prevailing in Mahabubabad district during *Kharif* 2020–21. The strong positive correlation between per cent thrips population reduction and marketable yield across all treatments further validates the economic significance of timely and effective chemical management of this pest in commercial chilli cultivation.

Conclusion

Based on the critical analysis of the results obtained in the present study on the efficacy of selected insecticides against chilli thrips, *Scirtothrips dorsalis* (Hood), it can be concluded that Indoxacarb @ 0.65 ml/L was the most effective treatment in reducing thrips infestation. This was followed by Emamectin benzoate @ 0.4 g/L, Imidacloprid @ 0.3 ml/L, Acetamiprid @ 0.4 ml/L, Fipronil @ 1 ml/L, Dimethoate @ 1 ml/L, and Fenazaquin @ 2 ml/L, which also demonstrated appreciable effectiveness in managing the thrips population. These insecticides may be suitably incorporated into an Integrated Pest Management (IPM) programme for effective thrips control in chilli cultivation. The economic analysis further revealed that Indoxacarb was the most profitable treatment, recording the highest cost–benefit ratio (1:8.3), followed by Emamectin benzoate (1:7.7). However, further multi-location and multi-season trials are recommended to validate the consistency of these findings under varied agro-climatic conditions. Such studies would provide stronger scientific evidence and help in developing sustainable, farmer-friendly pest management strategies to minimize yield losses caused by thrips infestation in chilli.

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