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Research Article

Mortality response of new chemistry insecticides against *Thrips orientalis* (Thysanoptera: Thripidae) on jasmine under field conditions

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ABSTRACT

Thrips orientalis is an important sap-sucking insect pest affecting various crops, including Jasmine. Chemical control is one of the most commonly employed methods for its management. The efficacy of several insecticides at their recommended field dosage on Jasmine plants against *T. orientalis* was evaluated. After 240 h, mortality was the highest with fipronil (96%) followed by emamectin benzoate (94%) for the first spray. Following second spray application, mortality with fipronil was 96.8% followed by emamectin benzoate as 94.9% with similar trend as for the first spray application. Out of nine insecticides tested, pyriproxyfen was least effective with 71.1% and 71.9% 240 h after first and second application, respectively. Means of both applications showed fipronil with the highest mortality rate (96.5%) followed by emamectin benzoate (94.5%) which are recommended for effective field management of *T. orientalis* on Jasmine plants.

Keywords: *Thrips orientalis*; field application; insecticides; mortality.

INTRODUCTION

Plants possessing attractive floral characteristics like Orchid, Jasmine, Tulip and Bougainvillea have been subject to extensive trade as ornamental specimens (Rusdiyanto et al., 2020). Across human history, tradition of utilizing flowering plants with therapeutic attributes has been recorded like biological activity in different constituents of Jasmine as crude extracts and fractions derived from its leaf, bark, root, seed and oil to exhibit medicinal uses (Jayaprakasha & Rao, 2011; Mandal et al., 1998). Jasmine plant parts have anti-oxidative, anti-carcinogenic, anti-diabetic, anti-microbial and anti-inflammatory properties (Prakkash et al., 2019). Their antifungal activities were observed against *Aspergillus niger*, *Penicillium* and *Aspergillus flavus* (Hussain et al., 2013; Voon et al., 2012). Like other plants, Jasmine has *Thrips orientalis*, as major sucking insect pest affecting its aesthetic value (Cao et al., 2017). *T. orientalis* is a polyphagous pest belonging to the order Thysanoptera and family Thripidae (Mound et al., 2022). These insects are minute, slender-bodied, and typically range from 1 to 3 mm in length (Reynaud, 2010). The adults are characterized by their fringed wings, piercing-sucking mouthparts, and distinctive feeding behaviour, which causes damage by puncturing plant cells and extracting their contents (Ghosh et al., 2017). Adult *T. orientalis* are pale yellow to brown, with feathery wings (Muhammad, 2017). They exhibit a short life cycle, completing development from egg to adult in 15–20 days under favourable conditions (Yadav & Chang, 2012). The pest thrives in warm, humid climates and reproduces rapidly, laying eggs within plant tissue (Abbot & Chapman, 2017).

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Feeding leads to cell destruction, resulting in discoloration, distortion, and reduced photosynthesis (Jamian et al., 2024). *T. orientalis* has a significant impact on jasmine, a valuable ornamental and aromatic plant (Ashrith & Hegde, 2020). The pest damages flower buds, leading to discoloration, malformed blooms, and reduced yield and quality of flowers (Chauhan & Veer, 2014). Severe infestations can cause flower abortion, hindering economic gains for farmers and the ornamental plant industry. Silvering of leaves, browning of flower petals, and curling of young leaves. A study noted yield losses of 25–50% in jasmine crops under high infestation conditions (Sridhar et al., 2022).
Imidacloprid a systemic and contact action provides effective control. Results from a study revealed a 70–85% reduction in thrips population after 3–5 days of application (Yesuf et al., 2022). Spinosad have showed over 90% efficacy in controlling thrips on jasmine flowers within 48 hours (Romero, 2011). This thrips is also capable to transmit impatiens necrotic spot virus (INSV) and tomato spotted wilt virus (TSWV) in its host plants (Persley et al., 2010). To achieve its optimal management, it is imperative to implement a proactive approach targeting pest population, safeguarding indigenous beneficial insects and nurturing robust botanical development (Gentz et al., 2010). For quick and effective control, insecticides are the most common tool in pest management (Martins et al., 2012). Their notable effectiveness and rapid response against a wide range of pest species has demonstrated a correlation with the augmentation of both quantity and monetary worth of significant economic benefits for farmers (Karar et al., 2022). Insecticides from the Spinosyn family, specifically spinosad and spinetoram, has become common for thrips management (Gao et al., 2012). A bio-efficacy and phytotoxicity assessment was conducted in the field to determine the effects of afidopyropen 5.0% + abamectin 2.5% DC on leafhoppers and thrips in *Bt* cotton. Among the chemicals evaluated, afidopyropen 5.0% + abamectin 2.5% DC @ 56.26 g/ha demonstrated the highest recorded yields of 22.39 q/ha and 30.94 q/ha, respectively (Chandaragi et al., 2023). Thrips was a significant problem for pomegranate crops, but there are effective treatments available. Spinosad 45 SC, cyantraniliprole, and fipronil 5 SC have proven to be the most successful insecticides in reducing the occurrence of thrips on pomegranate plants (Khandare et al., 2020). After conducting tests on the toxicity of various insecticides, it was found that fipronil, in both WG and SC formulations, emerged as one of the most effective options for controlling *Thrips orientalis* (Herron & James, 2005). In terms of controlling thrips, fipronil had a greater impact than formetanate and acrinathrin. Following a 13-hour exposure to fipronil, a mortality rate of over 95% was observed (Garzo et al., 2000). Due to the size and complexity of the ornamental industry, precise data on its global value is difficult to ascertain, however, an annual global estimate places it at over 5 billion US dollars (Lodovica & Wardlow, 2002). While the benefits of insecticides in field production agriculture are widely acknowledged, the advantages of using insecticides in the production of ornamental crops are often overlooked or not highlighted for consumers or homeowners. This is intriguing, as homeowners commonly utilize or apply insecticides to protect ornamental plants from arthropod pests, with the aim of upholding aesthetic quality and preserving property values (Crane et al., 2006). Unfortunately, many consumers/homeowners lack knowledge about the processes involved in cultivating ornamental plants, which leads to a lack of awareness regarding the immediate advantages of insecticide use (Ravlin & Robinson, 1985). The demanding nature of production and the need for high aesthetic standards in cultivating ornamental plants necessitates the use of insecticides to control arthropod pests. The use of insecticides is crucial for the ornamental industry to effectively control arthropod pests and ensure the production of high-quality plant material for consumers and homeowners (Hudson et al., 1996).
Even in the most technologically sophisticated nations, the expenditure on toxic chemicals and their application amounts to approximately three percent of the market value of agricultural commodities. In contrast, Pakistan imports pesticides worth over 10 billion rupees (Arif et al., 2018). The tolerance for thrips on horticulture crops is extremely low. Ongoing testing of new chemistry insecticides is necessary for effective control and efficient management. Testing new chemistry insecticides in the field can help identify the most effective options for controlling thrips. The current study focuses on examining the impact of different new chemistry insecticides on Jasmine plants in field conditions. The research acknowledges the importance of chemical control in effectively managing *Thrips orientalis*. A thorough research study was conducted to assess the effectiveness of various insecticides on controlling the horticultural insect pest. The study focuses on the mortality rate of *T. orientalis* populations on infested Jasmine plants. In addition, the utilization of insecticides enables ornamental producers to effectively compete in both national and international markets. This paper aims to highlight the significance of insecticides in the ornamental industry.

MATERIALS AND METHODS

Field experimentation was conducted at the Horticulture research area of Pir Mehr Ali Shah, Arid Agriculture University Rawalpindi to evaluate the efficacy of novel chemistry insecticides against Jasmine thrips, *T. orientalis*. Nine insecticides were procured from a local market. Chlorfenapyr 36%SC, Diafenthiuron 50%SC, Clothianidin 20%SC, Afidopyropen 5%DC, Imidacloprid 20%SL, Acetamiprid 20SL, Pyriproxyfen 10.8% EC, Emamectin benzoate 1.9% EC and Fipronil 5%SC were tested. A comprehensive breakdown of each insecticide is provided (Table 1).

Field Trials

Insecticides were applied as foliar application with rechargeable handheld atomizer (Model: TMD-16C, Company: AgriPro) with a spraying capacity of 1 liter. This sprayer was battery-operated and ensured uniform application of insecticides on the Jasmine plants against *Thrips orientalis*. For control treatment, only distilled water was applied. Tested insecticides solutions were prepared in distilled water at the recommended field dose. An examination was conducted into the effects of nine different insecticide treatments along with a control plant on a designated line of Jasmine plants. Every treatment was administered to a distinct set of Jasmine plants. To enhance the reliability of observations, three branches from each treated plant was marked as replication and ten flowers from each replication were taken for observation of thrips population. The flowers function as the central subject of examination for nymphs and adults of *T. orientalis* population both prior to and subsequent to the administration of the corresponding insecticides. The field trials were administered twice, and observations were recorded before and at five different time intervals from 24, 48, 72, 168 and 240 hours after being sprayed. The utilization of this experimental design facilitates a thorough evaluation of the effectiveness of every treatment in thrips infestation control on the Jasmine plants, thereby making a significant contribution to the domain of horticultural pest management.

Data Analysis

Rate of mortality and live insects was achieved through application of Sun-Shepard's formula (1981), as per the principles of the Randomized Complete Block Design.

$$Corrected\ \% = \frac{Mortality\ \%\ in\ Treated\ plot\ \pm Change\ \%\ in\ Control\ Plot}{100 \pm Change\ \%\ in\ Conrol\ Plot} x\ 100$$

A probability of 5% was deduced for the comparison of means through the utilization of Tukey's Honest Significant Difference test employing the statistical package Statistix 8.1. Imidacloprid was used as standard insecticide for comparative analysis owing to its substantial well-documented track record of effectiveness (Bambhaniya et al., 2018).

Table 1. Listing the insecticides used in the present study, along with their trade names, common names, groups, and doses.

Sr. No.	Trade Name	Active Ingredient	Group	Company	Dose ml/Acre	Dose ml/Litre
T1	Pirate	Chlorfenapyr 36%SC	Pyrroles	Swat Agro Chemicals	100	1
T2	Doomtrex	Diafenthiuron 50%SC	Thiourea	ICI Pesticides	240	2.4
T3	Telsta	Clothiandin 20%SC	Neonicotinoid	FMC	250	2.5
T4	Sefina	Afidopyropen 5%DC	TRP	Engro	200	2
T5	Acelan	Acetamiprid 20SL	Neonicotinoid	FMC	250	2.5
T6	Confidor	Imidacloprid 20%SL	Neonicotinoid	Bayer	250	2.5
T7	Pyriproxyfen	Pyriproxyfen 10.8%EC	IGR (Juvenile Hormone)	Syngenta	250	2.5
T8	Chemdoot	Emamectin benzoate 1.9%EC	Avermectin	FMC	200	2
T9	Regent	Fipronil 5%SC,	Phenylpyrazole	Bayer	300	3

RESULTS AND DISCUSSION

Mortality Response of Insecticides After 1st Field Trial

Following a 24-hour application period (F = 10.7; P = 0.0000), fipronil and emamectin benzoate demonstrated the highest levels of efficacy against thrips, with mortality rates of 44% and 40%, respectively, with no statistically significant distinction between the two. On the other hand, the efficacy of the remaining insecticides was comparatively lower, resulting in thrips mortalities varying from 25% to 30%. These mortality rates were statistically distinct from those of fipronil and emamectin benzoate. At the 72-hour mark (F = 18.4; P = 0.0000), the majority of insecticides exhibited a general upward trend in thrips mortality rates, with the majority falling within the 60% range. However, fipronil and emamectin benzoate maintained their superiority with 76% and 74% mortalities, with statistically insignificant differences. The trend continued for 168 hours (F = 26.1; P = 0.0000), with a marginal increase of 10-12% in mortalities attributed to the majority of insecticides. Significantly, fipronil demonstrated the maximum thrips mortality rate of 96% after 240 hours (F = 31.8; P = 0.0000), which was statistically indistinguishable from emamectin benzoate's 94% mortality rate. On the contrary, pyriproxyfen exhibited the lowest efficacy, as evidenced by its maximal mortality rate of 71%. In brief, fipronil and emamectin benzoate exhibited superior performance compared to alternative insecticides on a consistent basis. Furthermore, their similar effectiveness throughout different time periods underscores their statistical insignificance.

Table 2. Mean percent mortality of *Thrips orientalis* under field conditions after different intervals of 1st insecticides application.

Insecticides	Thrips population after spray (% Mortality)				
	24 Hours	48 Hours	72 Hours	168 Hours	240 Hours
Chlorfenapyr	(5) 30.2b	(7.8) 47.6b	(10.4) 63.1b	(12.5) 75.9b	(14.1) 85.6b
Diafenthiuron	(4.9) 27.5b	(8.8) 48.8b	(11.3) 62.8b	(13.4) 74.1b	(15.2) 83.9b
Clothianidin	(4.8) 28.6b	(8.2) 48.9b	(10.7) 63.4b	(12.9) 76.4b	(14.6) 86.5b
Afidopyropen	(5.1) 29.2b	(8.1) 46.4b	(10.7) 61.7b	(12.8) 73.7b	(14.7) 84.4b
Acetamiprid	(3.9) 26.3b	(7.3) 48.8b	(9.8) 64.9b	(11.4) 76.1b	(13.2) 87.5b
Imidacloprid	(4) 25.58b	(7.3) 45.9c	(9.6) 60.9b	(11.4) 72.1b	(13.1) 82.7b
Pyriproxyfen	(4.4) 25.2b	(6.7) 37.9c	(9) 50.7c	(10.8) 61.2c	(12.6) 71.1c
Emamectin benzoate	(6.3) 40.5a	(9.5) 60.4a	(11.6) 74.2a	(13.3) 84.7a	(14.8) 94.1a
Fipronil	(7.9) 44.7a	(11.1) 63.2a	(13.4) 76.1a	(15.4) 87.4a	(16.9) 96a

Values shown in braces are the mean % population. Means sharing same letters in column are insignificantly different (Tukey's HSD test, P < 0.05).

Mortality Response of Insecticides After 2nd Field Trial

Thrips mortality rates were measured at various time periods (24 hours, 48 hrs, 72 hrs, 168 hrs, and 240 hrs) after 2nd insecticides application. The thrips mortality rates after 24 hours (F = 10.8; P = 0.0000), were 52% for fipronil and 48% for emamectin benzoate, which were statistically insignificant but nevertheless rather high. Statistically distinct from fipronil and emamectin benzoate, the other insecticides showed lower mortality rates, ranging from 32.827% to 37%. The majority of insecticides showed thrips mortalities in the 60% range after 72 hours (F = 18.4; P = 0.0000), while fipronil showed 79% mortality and emamectin benzoate 77% mortality revealed statistically insignificantly high mortalities. At 168 hours (F = 26.1; P = 0.0000), this pattern had continued, and the overall rise in fatalities was 9-13%. At 240 hours, thrips mortality was 96% with fipronil and 94% with emamectin benzoate however, there was no statistical significance between the two. The lowest mortality rate was seen once again with pyriproxyfen at 71%.

Overall, after 240 hours (F = 31.8; P = 0.0000), the most effective insecticides were fipronil and emamectin benzoate, and they continued to be effective over time. In contrast, other insecticides tested had lower and more variable mortality rates.

Table 3. Mean percent mortality of *Thrips orientalis* under field conditions after different intervals of 2nd insecticides application.

Insecticides	Thrips population after spray (% Mortality)				
	24 Hours	48 Hours	72 Hours	168 Hours	240 Hours
chlorfenapyr	(6.9) 37.8b	(9.6) 52.2b	(12.3) 66.6b	(14.4) 78.53b	(15.9) 86.4b
diafenthiuron	(6.2) 35.1b	(9.4) 53.4b	(11.7) 66.4b	(13.5) 76.73b	(15.03) 84.8b
clothianidin	(5.9) 36.2b	(8.8) 53.5b	(11.06) 66.9b	(13.05) 79b	(14.4) 87.3b
afidopyropen	(6.6) 36.8b	(9.1) 51.03b	(11.7) 65.3b	(13.6) 76.3b	(15.2) 85.2b
acetamiprid	(5.6) 33.9b	(8.8) 53.3b	(11.3) 68.5b	(13.09) 78.72b	(14.6) 88.3b
imidacloprid	(5.1) 32.8b	(7.9) 50.4bc	(10.1) 64.5b	(11.7) 74.7b	(13.1) 83.5b
pyriproxyfen	(5.1) 33.2b	(6.5) 42.5c	(8.3) 54.2c	(9.8) 63.8c	(11.1) 71.9b
emamectin benzoate	(8.3) 48.2a	(11.2) 65a	(13.4) 77.7a	(15.1) 87.353a	(16.4) 94.9a
fipronil	(9.8) 52.4a	(12.7) 67.8a	(15.03) 79.6a	(16.9) 90a	(18.1) 96.8a

Values shown in braces are the mean % population. Means sharing same letters in column are insignificantly different (Tukey's HSD test, $P < 0.05$).

Pooled Analysis of Mortality Response of Insecticides After 1st and 2nd Field Trials Under Field Conditions

Statistical analysis comparing the efficacy of the initial and subsequent insecticide applications over a 24-hour duration ($F = 11.2$; $P = 0.0000$), indicates that fipronil and emamectin benzoate were the most successful, causing thrips mortalities of 51% and 48%, respectively. As opposed to fipronil and emamectin benzoate, the remaining insecticides demonstrated comparatively lower levels of toxicity, as evidenced by thrips mortalities varying from 32% to 37%. Notably, these values were all statistically distinct. At the 72-hour mark ($F = 19.7$; $P = 0.0000$), the majority of insecticides continued to induce thrips mortalities in the range of 60%. Nevertheless, fipronil and emamectin failed to achieve statistical significance, as evidenced by mortality rates that varied from 79% to 77% higher. As the duration of observation was prolonged to one week (168 hours), a steady pattern emerged wherein nearly all insecticides exhibited an additional 10–12% mortality ($F = 27.2$; $P = 0.0000$). Ten days (240 hours) of efficacy analysis revealed fipronil to be the most effective, causing 96% mortality of thrips, which was statistically insignificant compared to 94% for emamectin benzoate ($F = 34.2$; $P = 0.0000$). It is worth mentioning that pyriproxyfen exhibited the most minimal mortality rates, peaking at 72%.

Table 4. The pooled percentage of field mortality observed in *Thrips orientalis* subsequent to the first and second applications of insecticides.

Insecticides	Thrips population after spray (% Mortality)				
	24 Hours	48 Hours	72 Hours	168 Hours	240 Hours
Chlorfenapyr	(13.1) 37.7±3.159b	(18.5) 53.07±1.7041b	(23.3) 66.5±1.022b	(27.1) 78.4±0.816b	(30.2) 86.4±0.634b
Diafenthiuron	(12.1) 33.9±3.0b	(19.1) 53.5±1.397b	(23.5) 65.8±1.16b	(27.3) 76.3±0.957b	(30.3) 84.7±0.674b
Clothianidin	(11.9) 35.8±2.233b	(18.1) 54.1±1.35b	(22.3) 66.7±1.331b	(26.3) 78.8±0.968b	(29.1) 87.1±0.883b
Afidopyropen	(12.7) 36.03±1.61b	(18.2) 51.3±1.489b	(23.04) 64.±1.457b	(26.9) 76.02±1.126b	(30.2) 85.1±0.82b
Acetamiprid	(10.9) 34.6±2.377b	(17.3) 54.7±1.562b	(21.8) 68.8±1.283b	(25.04) 78.9±0.925b	(27.8) 87.9±0.782b
Imidacloprid	(10.3) 32.7±1.986b	(16.2) 51.3±1.337b	(20.3) 64.5±1.006b	(23.6) 74.7±1.05b	(26.5) 83.9±0.752b
Pyriproxyfen	(10.6) 32.1±1.548b	(14.1) 42.7±1.128c	(17.8) 53.7±0.861c	(21.08) 63.4±0.847c	(24.1) 72.7±0.745c
Emamectin benzoate	(15.9)	(21.7)	(25.7)	(28.8)	(31.2)

Fipronil	48.2±2.177a (18.7) 51.4±1.978a	65.9±1.528a (24.8) 68.06±1.056a	77.8±1.055a (28.9) 79.2±1.008a	87.3±0.61a (32.7) 89.6±0.486a	94.5±0.438a (35.2) 96.5±0.29a

Values shown in braces are the mean % population. Means sharing same letters in column are insignificantly different (Tukey's HSD test, $P < 0.05$).

Mean comparison for nine different insecticides after 24 hours of exposure indicated significant differences in their efficacy against *Thrips orientalis*. Fipronil and emamectin benzoate consistently showed high mortality from 24 to 240 hours after first application of nine insecticides. Fipronil had mortality rates of 44.7% to 96.07% and emamectin benzoate 40.59% to 94.1% (Table 2). The present findings are also in conformity with the findings of (Kandil et al., 2020) that fipronil and emamectin benzoate are effective insecticides for controlling cotton leafworm, *Spodoptera littoralis* and thrips. Fipronil functions as a non-competitive antagonist, impeding the flow of chloride ions within central nervous system through its interaction with gamma amino butyric acid receptor (GABAR), which serves as the primary target for this particular compound (Gong et al., 2015). In the current research, significant disparity was noted during the comparative analysis of various new chemistry insecticides. The efficacy of fipronil at the recommended field dose is observed to be the highest among the tested insecticides with a mortality rates of 96% after 240 hours' time span, whereas the remaining insecticides displayed varying levels of effectiveness. Thrips mortality rates increased with chlorfenapyr, diafenthiuron, clothianidin, afidopyropen, acetamiprid, and imidacloprid, showing cumulative effects. Although effective, pyriproxyfen gives mortality rates from 25.2% to 71.1% (Table 2). The present finding is in accordance with the report from (Kumar & Pandey, 2022) conducted on sugarcane, which is not an ornamental plant but shares some pests with them, found that fipronil 40% + imidacloprid 40% WG applied @ 300 g a.i./ha was effective for the management of white grub and thrips without causing any harm to natural enemies. Emamectin benzoate is a macrocyclic lactone insecticide as it targets insect nerve cells, leading to paralysis and death (Stavrakaki et al., 2022). In the current study it stands out with second highest efficacy, achieving 74.2% mortality at 72 hours and 94.1% by 240 hours after fipronil (Table 2). This finding is in the accordance with (Sarkar et al., 2015) found out the effectiveness of pre-mix formulation fipronil 15% + emamectin benzoate 5% WdG against thrips and fruit borer *Helicoverpa armigera* of chilli that the treatment at higher dosages (500, 750 and 1000 ml/ ha) followed by lower dose 400 ml/ha was superior over standard check treatments fipronil 5% SC and emamectin benzoate 5% SG. The showcased effectiveness of fipronil and emamectin benzoate, highlights thie remarkable potency as an insecticide, underscoring its potential as a valuable asset in integrated pest management approaches. The findings further emphasize the importance of assessing dose response relationships in order to optimize insecticide applications, thereby achieving effective control over *T. orientalis* while minimizing potential environmental consequences. Time intervals after the second application of insecticides showed that emamectin benzoate and fipronil were effective. Over 240 hours, these insecticides had mortality rates of 94.9% and 96.8% (Table 3). The variation in effectiveness emphasizes the importance of carefully selecting insecticides by classification and timing to control *T. orientalis* infestations in agricultural settings. After 240 hours, chlorfenapyr, diafenthiuron, clothianidin, afidopyropen, and acetamiprid show an increasing mortality rate from 84.82% to 88.3% (Table 3). A study conducted by (Natikar & Balikai, 2022) evaluated the efficacy of various insecticides against major insect pests in the potato ecosystem. Among the treatments, cyantraniliprole, spinosad 45% SC, emamectin benzoate 5% SG, diafenthiuron 70% WP, and chlorfenapyr 10% SC were effective in suppressing the insect pests of potato and resulted in higher tuber yield and economic returns. Chlorfenapyr is known for its low interactive resistance to carbamate, organophosphorus, and pyrethroid insecticides (Huang et al., 2023). It acts as an uncoupler in mitochondrial oxidative phosphorylation, obstructing the conversion of ADP to ATP, ultimately causing insect mortality. Imidacloprid mortality rose steadily to 83.5% after 240 hours. Pyriproxyfen's unique reaction, reaching 71.9% effectiveness after 240 hours of second application, suggests a novel mode of action compared to other insecticides (Table 3). Pyriproxyfen of juvenile hormone mimic negatively affect immature stages of insects (Boina et al., 2010). Efficacy of pyriproxyfen at a mortality rate of 71.9%, was notably less when compared to the effectiveness exhibited by the other insecticides. (Swami et al., 2018) evaluated the insecticide pyriproxyfen 10% EC for controlling *Thrips tabaci*, and *Amrasca biguttula*, infesting chilli crops. Among the treatments, Pyriproxyfen 10% EC @ 1250 ml/ha followed by Imidacloprid 17.8% SL 50 g @ 250 ml/ha was most effective in reducing the thrips population in chilli during both years, Kharif 2016 and 2017. But in the current findings pyriproxyfen standout the least significant as compared to all the other tested insecticides.

Following the comprehensive analysis of the combined mortality data obtained from the application of both the first and second insecticides application, it has been observed that chlorfenapyr exhibited an initial efficacy of 37.7% after a duration of 24 hours (Table 4). This efficacy further increased to 86.4% after a period of 240 hours. Diafenthiuron demonstrated a comparable pattern, commencing at a concentration of 33.9% and progressively escalating to 84.7%. The compound known as clothianidin exhibited a moderate level of initial efficacy, measuring at approximately 35.8% after 24 hours. However, over a period of 240 hours, this efficacy significantly increased to approximately 87.1%. Afidopyropen, acetamiprid, and imidacloprid exhibited a gradual increase in mortality rates, ranging from 85.1% to 87.9% after 240 hours (Table 4). The present findings are also in conformity with the findings of (Das, 2013) conducted an experiment to evaluate the efficacy of imidacloprid (Rally 20 SL) against chilli aphids *Myzus persicae*. Three doses of Rally 20 SL imidacloprid were evaluated against nymphs and adult's infestation at the flowering and fruiting stage of chilli. The highest mortality was observed from 3 ml/L, both in the leaf and twigs, followed by 2 ml/L and 1 ml/L concentrations. Imidacloprid had a good knockdown effect on aphid populations, significantly reducing them just 1 day after insecticide spray. The action of imidacloprid persisted for at least up to the 10th day after application. For controlling chilli aphids, Rally 20 SL with a dose of 2 ml/L was effective. In the current study pyriproxyfen displayed a discernible trend characterized by an initial mortality rate of 32.1%, which subsequently intensified to 72.7% after a duration of 240 hours after the pooled analysis of both applications. Fipronil and emamectin benzoate exhibited significant initial efficacies of 51.4% and, 48.2% respectively, ultimately resulting in mortality rates approaching optimal levels at 96.5% and 94.5% after a duration of 240 hours (Table 4). The present result is in accordance with the report from (Siddesha et al., 2021) studied the bio-efficacy of insecticides and selected biorationals against chilli thrips *Scirtothrips dorsalis* and chilli mites *Polyphagotarsonemus latus* during summer and Rabi seasons. Among different insecticides, spirotetramat + imidacloprid 240 SC was the most effective against thrips, resulting in a 90.73% reduction in population. Fipronil 5 SC (86.22%) and ethion 50 EC (81.60%) were also effective. For mites, spirotetramat + imidacloprid 240 SC (86.80%) and spiromesifen 22.9 SC (82.89%) were effective. Among biorationals, nimbecidine showed the highest reduction in thrips and mites, followed by silicon 1000 ppm. The highest incremental cost-benefit ratio was observed for spirotetramat + imidacloprid 240 SC, followed by fipronil 5 SC. In the current research, the cumulative mortality data for thrips indicate that fipronil and emamectin benzoate are the most efficacious insecticides, with efficacy rates exceeding 90%. With the exception of pyriproxyfen, the remaining insecticides exhibited commendable performance.

From a practical standpoint, it is evident that these discoveries emphasize the utmost importance of carefully selecting insecticides and considering the duration of exposure in order to achieve efficient management of thrips. Fipronil and emamectin benzoate, due to their remarkable efficacy, exhibit considerable potential as fundamental constituents within integrated pest management approaches targeting *T. orientalis*. Nevertheless, it is imperative to engage in meticulous deliberation regarding various factors, including the precise pest species under scrutiny, the techniques employed for application, and the surrounding environmental conditions. This approach is crucial for maximizing the effectiveness of pest control measures within agricultural contexts. The dataset provided can be utilized by agricultural practitioners and scientists to further refine and optimize pest management methodologies, thereby making significant contributions towards the development of sustainable and efficient agricultural practices.

CONCLUSION

In contrast, alternative insecticides such as chlorfenapyr, diafenthiuron, clothianidin, afidopyropen, and acetamiprid demonstrated significant efficacy in thrips management, albeit with slightly lower average values compared to fipronil and emamectin benzoate. In summary, the empirical observations suggest that the choice of insecticidal agent and the duration of exposure play crucial roles in determining the effectiveness of thrips control. The observed elevated mean values associated with fipronil and emamectin benzoate indicate their significant potential as effective tools in integrated pest management strategies for *T. orientalis*. Nevertheless, it is imperative to meticulously contemplate the meticulous assortment of an insecticidal agent, considering a multitude of variables including but not limited to the precise pest species under scrutiny, the modality of application implemented, and the diverse array of environmental factors that necessitate thorough consideration. The dataset, in its entirety, provides invaluable insights for agricultural practitioners and scientists who aim to optimize the effectiveness of pest management strategies in farming environments.

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