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Field efficacy of novel insecticide molecules against the thrips complex in grapevine cv. Bangalore blue

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ABSTRACT: Field evaluation of new-generation insecticides against grape thrips on cv. Bangalore Blue was conducted during 2025 at Budigere (Devanahalli taluk) and Konaghatta (Doddaballapur taluk). Among the insecticides tested, broflanilide 30 SC exhibited the highest efficacy, resulting in the greatest reduction in thrips population and the lowest berry damage. Spinetoram 11.70 SC and spinosad 45 SC were also highly effective and provided significantly better control than the untreated check, whereas fluxametamide 10 EC and dimpropyridaz 120 g/L SL showed moderate efficacy. Economic analysis revealed that broflanilide 30 SC recorded the highest incremental cost-benefit ratio (ICBR) of 25.22, followed by spinosad 45 SC (17.32). The results indicate that broflanilide 30 SC is a promising option for the effective and economical management of grape thrips in Bangalore Blue vineyards.

Keywords: Bio-efficacy, *Vitis vinifera*, *Scirtothrips dorsalis*, Broflanilide, Bangalore Blue.

INTRODUCTION

Grape (*Vitis vinifera* L.) is considered one of the most significant fruit crops in temperate zones and has been successfully cultivated in the tropical and subtropical climates of the Indian subcontinent (Bose *et al*., 1999). In India, grapes are cultivated on roughly 1.63 lakh ha, producing 34.01 lakh tonnes annually (Patel *et al.,* 2024). Karnataka ranks among the leading grape-producing states, where varieties like 'Bangalore Blue' are popular for their juice and wine potential. The berries are typically medium in size, with a bluish black to dark purple hue. They are seeded, spherical in shape and contain a juicy pulp. The pulp is green and succulent, while the juice exhibits a rich purple colour with a distinct foxy flavour. It has total soluble solids ranging from 16-18% and an acidity level of approximately 0.8-1.0% (Winkler and Cook, 1974).

However, the climatic conditions conducive to grape growing also support the rapid multiplication of insect pests. Among these, thrips (*Scirtothrips dorsalis* Hood, *Thrips parvispinus* (Karny), *Thrips palmi* Karny, *Thrips florum* Schmutz and *Megalurothrips typicus* Bagnall have been identified as major contributors to both qualitative and quantitative yield reductions (Abhijna, 2025). Thrips damage results in whitish discoloration of leaves, corky surfaces on berries (scab formation), and reduced market appeal (Kulkarni, 2020).

Infestation by thrips, particularly *Rhipiphorothrips cruentatus* Hood, results in distinct damage to grape leaves. Affected leaves develop a whitish discoloration, appear withered, and eventually turn brown. As the infestation progresses, the leaves curl and fall off prematurely. Such affected vines often fail to bear fruit, or the developing fruits drop off before maturity. Even when fruits reach maturity, their quality remains substandard. Another species, *Scirtothrips dorsalis* Hood, causes damage by lacerating and sucking sap from grape berries at all developmental stages. This feeding activity results in corky surface on the berries, leading to scab formation (Reddy, 1957). These symptoms significantly reduce the fruit's market appeal and export quality. In recent years, thrips-related damage has been increasingly observed, with particularly severe effects noted on the Bangalore Blue cultivar.

In recent years, thrips-related damage has been increasingly observed on the Bangalore Blue cultivar and the foregoing review has provided ample evidence that the occurrence, abundance and diversity of thrips infesting grapes differ across regions, cultivars and growth stages. Further, it was also found that the performance of different insecticides and biorationals evaluated under varied vineyard conditions has also been inconsistent. Since chemical control remains a primary method for pest management, identifying molecules with high efficacy and economic returns is crucial. Thus, efficacy trials were conducted to know the relative bio-efficacy of different new generation chemicals against grape thrips.

MATERIALS AND METHODS

The efficacy trials were conducted against grape thrips in farmers' orchards at Budigere and Konaghatta of Devanahalli and Doddaballapur taluks, respectively during 2025. Two field trials were conducted during 2025 in a Randomized Block Design (RBD) with eight treatments, *viz*., cyantraniliprole 10.26 OD @ 1.4 ml/ L, fluxametamide 10 EC @ 0.8 ml/ L, spinetoram 11.70 SC @ 0.6 ml/ L, spinosad 45 SC @ 0.25 ml/ L, dimpropyridaz 120 g/L SL @ 1.0 ml/ L, broflanilide 30 SC @ 0.08 ml/ L, lambda-cyhalothrin 4.9 CS @ 0.5 ml/ L, and an untreated control. Each treatment was replicated thrice, and each vine was considered one replication. The treatments included chemicals selected based on their safety and efficacy profile on the basis of earlier literature. Inclusion of lambda-cyhalothrin as a standard check was based on farmers feedback and usage. The study evaluated the efficacy of broflanilide, dimpropyridaz, and fluxametamide against grape thrips to explore their potential as novel management options. This investigation was particularly relevant as grape growers often resort to insecticide applications at intervals of 3-4 days during the flowering and berry formation stages due to severe thrips infestation.

Before the treatment imposition, the vines were selected for the experiment carefully and labelled. Each vine representing single replication of each treatment was tagged properly for taking observations on thrips and totally three vines were selected from each treatment. From each labelled vine, five shoots were randomly selected and tagged. Later the number of thrips present before spray was taken as pre-count. The treatments were imposed by using high volume knapsack sprayer. Sprays were imposed at the inflorescence and fruit setting stages at an interval of 10 days. Observations were recorded on the number of thrips per shoot (using the tapping method) and berry damage on five randomly selected bunches per vine. The observations on number of thrips per tap were recorded at pre-treatment and at 3, 7 and 10 days after spraying (DAS). Later the values were square root transformed and subjected to Two way Analysis of Variance (ANOVA).

Per cent bunch damage

The percentage of bunch damage was estimated by recording the number bunches damaged by thrips per vine and total number of bunches per vine in each treatment. Each vine is represented as one replication. The observations were used to calculate the extent of bunch damage based on the proportion of damaged bunches to the total number of bunches per vine, using the following formula:

$$\text{Bunch damage (\%)} = \frac{\text{Number of damaged bunches}}{\text{Total number of bunches per vine}} \text{X100}$$

Per cent berries damage

The percentage of berry damage was assessed by randomly selecting five bunches from each individual vine in all replications of each treatment. The number of healthy and damaged berries in each selected bunch was recorded and the extent of berry damage was calculated as the proportion of damaged berries to the total number of berries observed, using the following formula:

$$\text{Berry damage (\%)} = \frac{\text{Number of damaged berries}}{\text{Total number of berries observed}} \text{X100}$$

RESULTS AND DISCUSSION

Budigere (Trial I)

The data on the efficacy of selected insecticides against thrips on grapes cv. Bangalore Blue are presented in Table 1. The pre-treatment population count of thrips were taken one day prior to the imposition of the treatments and the count ranged from 9.89 to 11.56 thrips per shoot, with no significant variation among treatments, confirming uniform initial infestation. These pre-count values were used to work out the per cent reduction in the thrips damage after imposition of treatments. The observations were recorded at three, seven and ten days after spraying.

At three days after treatment, broflanilide 30 SC recorded the lowest thrips population (4.00 thrips/shoot per shoot) and was significantly superior to all other treatments. This was followed by spinetoram 11.70 SC and spinosad 45 SC, which recorded 5.33 and 5.56 thrips per shoot, respectively, and were statistically on par with each other. Fluxametamide 10 EC and dimpropyridaz 120 g/L SL provided moderate control, recording

6.89 and 7.56 thrips per shoot, respectively, and did not differ significantly from one another. In contrast, cyantraniliprole 10.26 OD and lambda-cyhalothrin 4.9 CS were comparatively less effective in reducing thrips populations three days after treatment application.

The observations recorded at seven days post-treatment, the least thrips incidence was observed in broflanilide 30 SC (2.44 thrips per shoot), which was significantly superior to all other treatments. It was followed by spinetoram 11.70 SC (3.33) and spinosad 45 SC (3.56 thrips per shoot), which were statistically on par. Fluxametamide 10 EC (5.44) and dimpropyridaz 120 g/L SL (5.56 thrips per shoot) showed moderate reduction in thrips population, whereas cyantraniliprole 10.26 OD (6.44 thrips per shoot) and lambda-cyhalothrin 4.9 CS (6.56 thrips per shoot) were found least effective among the chemical treatments. The untreated control recorded the highest thrips population (13.67 thrips per shoot).

At ten days after the first spray, broflanilide 30 SC recorded the lowest thrips population (2.33 thrips per shoot) and was significantly superior to all other treatments. Spinetoram 11.70 SC and spinosad 45 SC were the next most effective treatments, recording 3.22 and 3.44 thrips thrips per shoot, respectively, and were statistically on par with each other. Fluxametamide 10 EC (5.33 thrips per shoot) and dimpropyridaz 120 g/L SL (5.44 thrips per shoot) exhibited moderate efficacy in suppressing thrips populations. In contrast, cyantraniliprole 10.26 OD (6.33 thrips per shoot) and lambda-cyhalothrin 4.9 CS (6.67 thrips per shoot) were comparatively less effective among the insecticidal treatments. The untreated control harboured the highest thrips population, with 13.89 thrips per shoot.

A similar efficacy trend was also observed after the second spray. On the third day after the second spray, broflanilide 30 SC recorded the lowest mean number of population (1.33 thrips per shoot), followed by spinetoram 11.70 SC (2.89) and spinosad 45 SC (3.11). Fluxametamide 10 EC (5.00) and dimpropyridaz 120 g/L SL (5.11) maintained moderate suppression, whereas cyantraniliprole 10.26 OD (5.89) and lambda-cyhalothrin 4.9 CS (5.44) were found less effective. The untreated control recorded the highest mean number of population (13.78 thrips per shoot).

On the seventh day after the second spray, broflanilide 30 SC continued to record the lowest thrips population (0.89 thrips per shoot). This was followed by spinetoram 11.70 SC (1.67) and spinosad 45 SC (1.78) and found statistically on par with each other. Fluxametamide 10 EC (3.44) and dimpropyridaz 120 g/L SL (3.89) recorded moderate counts, while cyantraniliprole 10.26 OD (4.22) and lambda-cyhalothrin 4.9 CS (4.78) recorded relatively higher mean number of thrips per shoot among chemical treatments. The untreated control showed the maximum mean number of thrips per shoot (13.22).

At the tenth day after the second spray, broflanilide 30 SC recorded the lowest mean number of thrips per shoot (0.22) with the highest per cent reduction (98.11%) over untreated control, followed by spinetoram 11.70 SC and spinosad 45 SC, which were recorded 0.56 and 0.67 thrips per shoot, achieving 95.19% and 94.31% reduction over untreated control, respectively. Fluxametamide 10 EC and dimpropyridaz 120 g/L SL recorded moderate reductions of 78.92% and 75.54%, respectively. Whereas cyantraniliprole 10.26 OD and lambda-cyhalothrin 4.9 CS were least effective with 67.72% and 66.82% reduction, respectively.

With respect to bunch damage at harvest, broflanilide 30 SC proved most effective treatment with least per cent bunch damage (4.43% per vine) and was statistically on par with spinetoram 11.70 SC (5.09%). This was followed by spinosad 45 SC (7.90%). Moderately high per cent bunch damage was observed with fluxametamide 10 EC (11.68%) and dimpropyridaz 120 g/L SL (12.60%) treatments. Whereas lambda-cyhalothrin 4.9 CS (19.78%) and cyantraniliprole 10.26 OD (25.37%) were found least effective in reducing per cent bunch damage among chemical treatments. The untreated control recorded the maximum per cent bunch damage (42.55%).

A similar trend was observed with respect to berry damage, the lowest per cent berry damage was recorded in broflanilide 30 SC (7.97%), which was statistically on par with spinetoram 11.70 SC (10.75%) and spinosad 45 SC (12.27%). Moderately high per cent berry damage was observed in fluxametamide 10 EC (20.36%) and dimpropyridaz 120 g/L SL (27.97%). Cyantraniliprole 10.26 OD (47.05%) and lambda-cyhalothrin 4.9 CS (44.56%) treatments recorded relatively high per cent berry damage with 47.05% and 44.56%, respectively. The maximum per cent berry damage was observed in the untreated control (52.49%).

Overall, the results clearly revealed that broflanilide 30 SC, spinetoram 11.70 SC, and spinosad 45 SC

Table 1: Efficacy of insecticides against thrips on cv. Bangalore Blue grapes (Budigere)

Treatments	Dosage formulation ml/L	Pre-count	Mean number of thrips per shoot*						Reduction over control (%)	Bunch damage (%)**	Berry damage (%)**
			First spray			Second spray					
			3 DAS	7 DAS	10 DAS	3 DAS	7 DAS	10 DAS			
Cyantraniliprole 10.26 OD	1.4	9.89 (3.22)	8.44 (2.99)^{d}	6.44 (2.64)^{d}	6.33 (2.61)^{d}	5.89 (2.53)^{d}	4.22 (2.17)^{d}	3.56 (2.01)^{d}	67.72	25.37 (30.25)^{e}	47.05 (43.31)^{d}
Fluxametamide 10 w/w EC	0.8	10.89 (3.37)	6.89 (2.72)^{c}	5.44 (2.44)^{c}	5.33 (2.42)^{c}	5.00 (2.35)^{c}	3.44 (1.98)^{c}	2.56 (1.75)^{c}	78.92	11.68 (19.99)^{c}	20.36 (26.82)^{b}
Spinetoram 11.70 SC	0.6	10.44 (3.31)	5.33 (2.41)^{b}	3.33 (1.96)^{b}	3.22 (1.93)^{b}	2.89 (1.84)^{b}	1.67 (1.47)^{b}	0.56 (1.02)^{b}	95.19	5.09 (13.04)^{a}	10.75 (19.14)^{a}
Spinosad 45 SC	0.25	10.56 (3.32)	5.56 (2.46)^{b}	3.56 (2.01)^{b}	3.44 (1.99)^{b}	3.11 (1.90)^{b}	1.78 (1.51)^{b}	0.67 (1.08)^{b}	94.31	7.90 (16.32)^{b}	12.27 (20.50)^{a}
Dimpropyridaz 120g/L SL	1.0	11.00 (3.39)	7.56 (2.84)^{c}	5.56 (2.46)^{c}	5.44 (2.44)^{c}	5.11 (2.37)^{c}	3.89 (2.09)^{c}	3.00 (1.87)^{c}	75.54	12.60 (20.79)^{c}	27.97 (31.93)^{c}
Broflanilide 30 SC	0.08	10.44 (3.31)	4.00 (2.12)^{a}	2.44 (1.72)^{a}	2.33 (1.68)^{a}	1.33 (1.35)^{a}	0.89 (1.17)^{a}	0.22 (0.84)^{a}	98.11	4.43 (12.15)^{a}	7.97 (16.40)^{a}
Lambda-cyhalothrin 4.9 CS	0.5	11.11 (3.41)	9.00 (3.08)^{d}	6.56 (2.66)^{d}	6.67 (2.68)^{d}	5.44 (2.44)^{d}	4.78 (2.30)^{d}	4.11 (2.15)^{e}	66.82	19.78 (26.41)^{d}	44.56 (41.88)^{d}
Untreated control	-	11.56 (3.47)	12.11 (3.55)^{e}	13.67 (3.76)^{e}	13.89 (3.79)^{e}	13.78 (3.78)^{e}	13.22 (3.70)^{e}	12.89 (3.66)^{f}	-	42.55 (40.72)^{f}	52.49 (46.43)^{e}
Sem	-	**0.07**	**0.04**	**0.03**	**0.03**	**0.04**	**0.06**	**0.04**	-	**0.49**	**1.91**
CD at 5%	-	**0.23**	**0.13**	**0.10**	**0.10**	**0.13**	**0.17**	**0.13**	-	**1.49**	**5.80**

*indicates significant; values in the parenthesis are as SQRT (√x +0.5) transformation values; DAP – days after pruning, ** Values arc sign transformation were the most effective treatments in suppressing thrips populations and minimizing per cent bunch and berry damage at Budigere. Fluxametamide 10 EC and dimpropyridaz 120 g/L SL were moderately effective, while cyantraniliprole 10.26 OD and lambda-cyhalothrin 4.9 CS were comparatively less effective. The untreated control recorded the highest thrips population and highest per cent bunch and berry damage during efficacy study period.

Konaghatta (Trial II)

The data on the efficacy of various insecticidal treatments against thrips on grape cv. Bangalore Blue at Konaghatta are presented in Table 2. The pre-treatment thrips population varied from 10.22 to 11.89 thrips per shoot, with no significant difference among treatments.

At three days post-treatment, all the treatments were found significantly superior over untreated control, but the lowest mean number of thrips population was observed in broflanilide 30 SC (T_6) with 4.33 thrips per shoot, which was statistically superior to all other treatments. This was followed by spinetoram 11.70 SC and spinosad 45 SC, recording 5.67 and 5.89 thrips per shoot, respectively and was statistically on par with each other. Moderate suppression of thrips population was noted in fluxametamide 10 EC (T_2) and dimpropyridaz 120 g/L SL with 7.22 and 7.67 thrips per shoot, whereas cyantraniliprole 10.26 OD and lambda-cyhalothrin 4.9 CS were found less effective with 8.78 and 9.33 thrips per shoot, respectively. The untreated control recorded the highest thrips population with 12.44 thrips per shoot.

The observations recorded at seven days after the first spray revealed that broflanilide 30 SC continued to show the highest efficacy against thrips with 2.78 thrips per shoot and significantly superior to all other treatments. It was followed by spinetoram 11.70 SC, spinosad 45 SC with 3.67 and 3.89 mean number of thrips per shoot, respectively. Moderate suppression was seen in fluxametamide 10 EC and dimpropyridaz 120 g/L SL with 5.78 and 5.89 thrips per shoot, respectively and were on par with each other. Cyantraniliprole 10.26 OD and lambda-cyhalothrin 4.9 CS were found relatively less effective in controlling thrips, while the untreated control remained with highest mean number of thrips (14.00 thrips per shoot).

At ten days after post-treatments, broflanilide 30 SC recorded the lowest mean population (1.89 thrips per shoot), followed by spinetoram 11.70 SC (3.56) and spinosad 45 SC (3.78). These treatments were statistically on par and significantly superior to the rest of the treatments. Fluxametamide 10 EC (5.22) and dimpropyridaz 120 g/L SL (5.89) were found moderately effective, whereas cyantraniliprole 10.26 OD (6.67) and lambda-cyhalothrin 4.9 CS (7.00) were found least effective among chemical treatments. The untreated control recorded the highest thrips population with14.22 per shoot.

A similar trend was also observed after the second spray. At three days after post-treatments, it was found that broflanilide 30 SC with 1.56 thrips per shoot showed highest efficacy against thrips and significantly superior over all other treatments. This was followed by spinetoram 11.70 SC (2.89) and spinosad 45 SC (3.00) and equally effective in reducing the thrips population. Fluxametamide 10 EC (4.78) and dimpropyridaz 120 g/L SL (4.89) were found moderately effective against thrips. Cyantraniliprole 10.26 OD (6.22) and lambda-cyhalothrin 4.9 CS (6.67) were found comparatively less effective. The untreated control recorded highest mean number of thrips with 14.11 per shoot.

At seven days after post treatments, broflanilide 30 SC found significantly superior to all other treatments with 1.11 thrips per shoot. It was followed by spinetoram (2.00) and spinosad (2.11) treatments which were found equally effective in reduction of mean number of thrips per shoot. Fluxametamide (3.33) and dimpropyridaz (4.22) were found moderately effective. These were followed by cyantraniliprole (4.56), and lambda-cyhalothrin (5.11) which were observed to be relatively less effective.

At the tenth day after the second spray, broflanilide 30 SC recorded the lowest mean number of thrips (0.33 thrips per shoot) and achieved the highest per cent reduction over control (97.25%). This was followed by spinetoram 11.70 SC and spinosad 45 SC with 0.78 and 0.89 thrips per shoot, achieved 93.49% and 92.65% reduction over untreated control, respectively and were on par with each other. Fluxametamide 10 EC (2.11 thrips/shoot) and dimpropyridaz 120 g/L SL (3.33 thrips/shoot) showed moderate efficacy with 83.09% and 73.57% reduction, respectively. Cyantraniliprole 10.26 OD (3.89 thrips/ shoot) and lambda-cyhalothrin 4.9 CS (4.44 thrips/ shoot) were not effective enough to be superior over the above treatments with 65-66% reduction over untreated control.

Table 2: Efficacy of insecticides against thrips on cv. Bangalore Blue grapes (Konaghatta)

Treatments	Dosage formulation ml/L	Pre-count	Mean number of thrips per shoot*						Reduction over control (%)	Bunch damage (%)**	Berry damage (%)**
			First spray			Second spray					
			3 DAS	7 DAS	10 DAS	3 DAS	7 DAS	10 DAS			
Cyantraniliprole 10.26 OD	1.4	10.22 (3.27)	8.78 (3.05)^{d}	6.78 (2.70)^{d}	6.67 (2.68)^{d}	6.22 (2.59)^{d}	4.56 (2.25)^{de}	3.89 (2.09)^{de}	65.77	27.07 (31.35)^{e}	43.89 (41.49)^{e}
Fluxametamide 10 w/w EC	0.8	11.22 (3.42)	7.22 (2.78)^{c}	5.78 (2.51)^{c}	5.22 (2.39)^{b}	4.78 (2.30)^{c}	3.33 (1.96)^{c}	2.11 (1.61)^{c}	83.09	13.05 (21.17)^{c}	17.42 (24.67)^{c}
Spinetoram 11.70 SC	0.6	10.78 (3.36)	5.67 (2.48)^{b}	3.67 (2.04)^{b}	3.56 (2.01)^{b}	2.89 (1.84)^{b}	2.00 (1.58)^{b}	0.78 (1.13)^{b}	93.49	7.06 (15.40)^{a}	9.92 (18.36)^{ab}
Spinosad 45 SC	0.25	10.89 (3.37)	5.89 (2.53)^{b}	3.89 (2.09)^{b}	3.78 (2.07)^{b}	3.00 (1.87)^{b}	2.11 (1.62)^{b}	0.89 (1.18)^{b}	92.65	10.11 (18.54)^{b}	12.38 (20.60)^{bc}
Dimpropyridaz 120g/L SL	1.0	11.33 (3.44)	7.67 (2.86)^{c}	5.89 (2.53)^{c}	5.78 (2.51)^{c}	4.89 (2.32)^{c}	4.22 (2.17)^{d}	3.33 (1.96)^{d}	73.57	14.59 (22.46)^{c}	27.57 (31.68)^{d}
Broflanilide 30 SC	0.08	10.78 (3.36)	4.33 (2.20)^{a}	2.78 (1.81)^{a}	1.89 (1.55)^{a}	1.56 (1.43)^{a}	1.11 (1.26)^{a}	0.33 (0.90)^{a}	97.25	6.19 (14.41)^{a}	5.95 (14.12)^{a}
Lambda-cyhalothrin 4.9 CS	0.5	11.44 (3.45)	9.33 (3.14)^{d}	6.89 (2.72)^{d}	7.00 (2.74)^{d}	6.67 (2.68)^{d}	5.11 (2.37)^{e}	4.44 (2.22)^{e}	65.09	21.29 (27.48)^{d}	46.00 (42.70)^{e}
Untreated control	-	11.89 (3.52)	12.44 (3.60)^{e}	14.00 (3.81)^{e}	14.22 (3.84)^{e}	14.11 (3.82)^{e}	13.56 (3.75)^{f}	13.22 (3.70)^{f}	-	44.51 (41.85)^{f}	52.62 (46.50)^{f}
Sem		**0.07**	**0.04**	**0.03**	**0.03**	**0.05**	**0.06**	**0.05**	-	**0.74**	**0.68**
CD at 5%		**0.22**	**0.13**	**0.10**	**0.08**	**0.15**	**0.18**	**0.15**	-	**2.24**	**2.12**

*indicates significant; values in the parenthesis are as SQRT ($\sqrt{x}$ +0.5) transformation values; DAP – days after pruning, **Values arc sign transformation

At the harvest, broflanilide 30 SC (6.19%) and spinetoram 11.70 SC (7.06%) found significantly superior over all other treatments with respect to per cent bunch damage. These were followed by spinosad 45 SC (10.11%) which performed significantly better than the rest of the treatments. Moderate protection to grape bunches was noted in fluxametamide 10 EC (13.05%) and dimpropyridaz 120 g/L SL (14.59%), while lambda-cyhalothrin 4.9 CS (21.29%) and cyantraniliprole 10.26 OD (27.07%) were found least effective. The untreated control recorded the highest per cent bunch damage (44.51%).

A similar pattern was also evident for per cent berry damage. The lowest per cent berry damage was observed in broflanilide 30 SC (5.95%), which was statistically on par with spinetoram 11.70 SC (9.92%). This was followed by spinosad 45 SC (12.38%). Moderate reduction with per cent berry damage was achieved with fluxametamide 10 EC (17.42%) and dimpropyridaz 120 g/L SL (27.57%), whereas cyantraniliprole 10.26 OD (43.89%) and lambda-cyhalothrin 4.9 CS (46.00%) were found least effective in reducing per cent berry damage. The highest per cent berry damage was observed in the untreated control (52.62%).

Overall, at Konaghatta, the efficacy results clearly revealed that broflanilide 30 SC, spinetoram 11.70 SC, and spinosad 45 SC were found the most effective treatments, consistently reducing thrips incidence and fruit damage after two sprays at 10 days interval. Fluxametamide 10 EC and dimpropyridaz 120 g/L SL provided moderate protection against thrips. Whereas cyantraniliprole 10.26 OD and lambda-cyhalothrin 4.9 CS was found comparatively less effective.

Pooled data

The pooled data on the efficacy of different insecticidal treatments against thrips on grape cv. Bangalore Blue is given in Table 3. The pre-treatment population ranged from 10.06 to 11.72 thrips per shoot.

Three days post treatments, all the treatments were significantly superior over control, but the lowest mean number of thrips (4.17 thrips per shoot) was observed in broflanilide 30 SC after first spray. This was followed by spinetoram 11.70 SC (5.50 thrips/shoot) and spinosad 45 SC (5.72 thrips/shoot), which were found statistically at par with each other. Further, these were also found significantly superior over fluxametamide 10 EC (7.06 thrips/shoot) and dimpropyridaz 120 g/L SL (7.61 thrips/shoot). Relatively the highest thrips population was observed in lambda-cyhalothrin 4.9 CS and cyantraniliprole 10.26 OD with 9.17 and 8.61 thrips/shoot, respectively, which were least effective but still significantly superior to the untreated control (12.28 thrips/shoot).

At seven days post treatments of the first spray, broflanilide 30 SC recorded the minimum thrips population of 2.61 thrips per shoot, which was significantly superior over all other treatments. Spinetoram 11.70 SC (3.50 thrips/shoot) and spinosad 45 SC (3.72 thrips/shoot) were found equally effective in reducing thrips population and these were significantly superior to fluxametamide 10 EC (5.61 thrips/shoot), dimpropyridaz 120 g/L SL (5.72 thrips/shoot), cyantraniliprole 10.26 OD (6.61 thrips/shoot) and lambda-cyhalothrin 4.9 CS (6.72 thrips/shoot). Similar trend was also observed at ten days post treatments after first spray, where broflanilide 30 SC continued to register the least thrips population (2.11 thrips/shoot) and this was followed by spinetoram 11.70 SC (3.39 thrips/shoot) and spinosad 45 SC (3.61 thrips/shoot), all of which were significantly superior to the rest of the treatments.

Similar trend was also observed at three days post treatments after second spray. Broflanilide 30 SC (1.44 thrips/shoot) recorded the lowest thrips population and found significantly superior over all other treatments. Spinetoram 11.70 SC (2.89 thrips/shoot) and spinosad 45 SC (3.06 thrips/shoot) were found equally effective in reduction of thrips populations, followed by fluxametamide 10 EC (4.89 thrips/shoot) and dimpropyridaz 120 g/L SL (5.00 thrips/shoot). Cyantraniliprole 10.26 OD (6.06 thrips/shoot) and Lambda-cyhalothrin 4.9 CS (6.05 thrips/shoot) were least effective but significantly superior over the untreated control (13.94 thrips/shoot). Similar trends were also noticed at seven days and ten days post treatments, where broflanilide 30 SC with 1.00 and 0.28 thrips/shoot, respectively was found significantly superior to all other treatments, followed by spinetoram 11.70 % SC (1.83 and 0.67 thrips/shoot) and spinosad 45 SC (1.94 and 0.78 thrips/shoot). Fluxametamide 10 EC (3.39 and 2.33 thrips/shoot) and dimpropyridaz 120 g/L SL (4.06 and 3.17 thrips/shoot) were found moderately effective against thrips. Cyantraniliprole 10.26 OD (4.39 and 3.72 thrips/shoot) and lambda-cyhalothrin 4.9 CS (4.94 and 4.28 thrips/shoot) were not effective enough to be superior over the above treatments.

Table 3: Efficacy of insecticides against thrips on cv. Bangalore Blue grapes (pooled)

Treatments	Dosage formulation ml/L	Pre-count	Mean number of thrips per shoot						Reduction over control (%)	Bunch damage (%)**	Berry damage (%)**
			First spray			Second spray					
			3 DAS	7 DAS	10 DAS	3 DAS	7 DAS	10 DAS			
Cyantraniliprole 10.26 OD	1.4	10.06 (3.25)	8.61 $(3.02)^{d}$	6.61 $(2.67)^{d}$	6.50 $(2.65)^{e}$	6.06 $(2.56)^{d}$	4.39 $(2.21)^{de}$	3.72 $(2.05)^{e}$	66.82	26.22 $(30.80)^{e}$	45.44 $(42.38)^{e}$
Fluxametamide 10 w/w EC	0.8	11.06 (3.40)	7.06 $(2.75)^{c}$	5.61 $(2.47)^{c}$	5.28 $(2.40)^{c}$	4.89 $(2.32)^{c}$	3.39 $(1.97)^{c}$	2.33 $(1.68)^{c}$	81.09	12.89 $(21.04)^{c}$	18.34 $(25.76)^{c}$
Spinetoram 11.70 SC	0.6	10.61 (3.33)	5.50 $(2.45)^{b}$	3.50 $(2.00)^{b}$	3.39 $(1.97)^{b}$	2.89 $(1.84)^{b}$	1.83 $(1.53)^{b}$	0.67 $(1.08)^{b}$	94.33	6.07 $(14.26)^{a}$	10.33 $(18.75)^{ab}$
Spinosad 45 SC	0.25	10.72 (3.35)	5.72 $(2.49)^{b}$	3.72 $(2.05)^{b}$	3.61 $(2.03)^{b}$	3.06 $(1.89)^{b}$	1.94 $(1.56)^{b}$	0.78 $(1.13)^{b}$	93.47	8.99 $(17.45)^{b}$	12.79 $(20.55)^{b}$
Dimpropyridaz 120g/L SL	1.0	11.17 (3.41)	7.61 $(2.85)^{c}$	5.72 $(2.49)^{c}$	5.67 $(2.48)^{d}$	5.00 $(2.35)^{c}$	4.06 $(2.13)^{d}$	3.17 $(1.91)^{d}$	74.53	13.59 $(21.63)^{c}$	27.77 $(31.80)^{d}$
Broflanilide 30 SC	0.08	10.61 (3.33)	4.17 $(2.16)^{a}$	2.61 $(1.76)^{a}$	2.11 $(1.62)^{a}$	1.44 $(1.39)^{a}$	1.00 $(1.22)^{a}$	0.28 $(0.88)^{a}$	97.63	5.31 $(13.32)^{a}$	6.96 $(15.30)^{a}$
Lambda-cyhalothrin 4.9 CS	0.5	11.28 (3.43)	9.17 $(3.11)^{d}$	6.72 $(2.69)^{d}$	6.83 $(2.71)^{e}$	6.05 $(2.54)^{d}$	4.94 $(2.33)^{e}$	4.28 $(2.19)^{f}$	65.95	20.53 $(26.94)^{d}$	45.28 $(42.29)^{e}$
Untreated control	-	11.72 (3.50)	12.28 $(3.57)^{e}$	13.83 $(3.79)^{e}$	14.06 $(3.82)^{f}$	13.94 $(2.80)^{e}$	13.39 $(3.73)^{f}$	13.06 $(3.68)^{g}$	-	43.52 $(41.28)^{f}$	52.55 $(46.46)^{f}$
F-test		**NS**	*	*	*	*	*	*	-	*	*
Sem		**0.07**	**0.04**	**0.03**	**0.03**	**0.04**	**0.05**	**0.03**	-	**0.71**	**0.89**
CD at 5%		**0.22**	**0.13**	**0.10**	**0.09**	**0.12**	**0.16**	**0.09**	-	**2.16**	**2.56**

*indicates significant; values in the parenthesis are as SQRT ($\sqrt{x}$ +0.5) transformation values; DAP – days after pruning, **Values arc sign transformation

Among all the treatments, broflanilide 30 SC recorded the lowest per cent bunch damage (5.31 %) and berry damage (6.96 %) (Table 3), which was on par with spinetoram 11.70 SC (10.33 % and 6.07 %). These were followed by spinosad 45 SC (8.99% bunch and 12.79 % berry damage, respectively) significantly superior to fluxametamide 10 EC (12.89% bunch and 18.34 % berry damage, respectively), and dimpropyridaz 120 g/L SL (13.59% bunch and 27.77 % berry damage, respectively), whereas the highest per cent bunch (43.52 %) and berry (52.55 %) damage was observed in the untreated control.

The per cent reduction of thrips population over control was highest in Broflanilide 30 SC (97.63 %) followed by spinetoram 11.70 SC (94.33 %) and spinosad 45 SC (93.47 %). Moderate efficacy was observed with fluxametamide 10 EC (81.09 %) and dimpropyridaz 120 g/L SL (74.53 %), whereas cyantraniliprole 10.26 OD and lambda-cyhalothrin 4.9 CS with 66.82 % and 65.95 % reduction respectively were found relatively less effective.

Overall, pooled results across both locations revealed that broflanilide 30 SC, spinetoram 11.70 SC, and spinosad 45 SC were the most effective insecticidal treatments in suppressing thrips population and minimizing berry and bunch damage, followed by fluxametamide 10 EC and dimpropyridaz 120 g/L SL. The least effective treatments were cyantraniliprole 10.26 OD and lambda-cyhalothrin 4.9 CS, although they performed significantly better than the untreated control.

As thrips is one of the major sucking pests on Bangalore Blue causing huge economic loss to farmers by damaging inflorescence and berries, it is very essential to take up the management practices to control the pest. In the present study among the seven tested chemicals, broflanilide 30 SC @ 0.08 ml/L was found to be most effective and superior over all other treatments. This agrees with the observations of Samreen and Pavana. (2025) who demonstrated that broflanilide 30 SC provided consistently high levels of control (93.61% efficacy) in the field against the invasive thrips species, *T. parvispinus*, on chilli followed by fluxametamide 10 EC with a 90.72% reduction and cyantraniliprole 10.26 OD (60.54%). The present findings are also in line with the observations of Chen *et al.* (2022), who demonstrated that broflanilide provided consistently high levels of control (90-93 per cent efficacy) against *Thrips palmi* up to 14 days and >90 per cent egg mortality.

The next best chemicals were spinetoram 11.7 SC @ 0.6 ml/L and spinosad 45 SC @ 0.25 ml/L. The present findings further align with findings of Guruprasad *et al*. (2019), who reported that spinetoram 11.7 SC significantly suppressed thrips incidence in grapes and the field evaluations highlighting the strong efficacy and selectivity of spinosyn compounds. Ghosh and Karmakar (2021) also reported that spinetoram + sulfoxaflor recorded the lowest thrips population (2.37 thrips/shoot) and highest per cenet reduction (84.55%) over the untreated control from the bio-efficacy insecticides trials against *T. palmi* on grapes. Current findings were also corroborated by National Research Centre for Grapes (ICAR-NRCG) field trials, which demonstrated that spinosad 45 SC achieved remarkable control of vineyard thrips (*S. dorsalis*), recording 65-92 per cent reduction in field populations and 85-98 per cent mortality in laboratory tests, clearly underscoring its strong performance in managing grape thrips (Yadav *et al.,* 2016). This also aligns with Kulkarni (2012), who reported that spinosad 45 SC (0.25 ml/l) significantly reduced thrips population in grapes was the highest among treatments.

In the present study, it was found that fluxametamide 10 EC consistently reduced thrips incidence to moderate levels, though its efficacy was slightly inferior to broflanilide and spinetoram, which showed near-complete suppression. However, laboratory bioassay studies by Kamakshi *et al.* (2024) demonstrated that fluxametamide 10 EC @ 400 ml/ha caused very high mortality of *T. parvispinus*, with efficacy statistically on par with broflanilide and superior to spinetoram and spinosad. These results are slightly in contradictory to current findings.

On the other hand, cyantraniliprole 10.26 OD and lambda-cyhalothrin 4.9 CS were the found least effective among chemical treatments, recording higher thrips counts throughout the trial. This sub optimal performance of lambda-cyhalothrin is consistent with the findings of Sun *et al.* (2024) who reported a LC_{50} value of 130.44 mg/L indicating a relatively low toxicity in practical applications. This aligns with findings from recent studies on chilli thrips (*S. dorsalis*), where spinetoram (11.7 SC at 60 g a.i./ha) achieved the highest mean reduction (93.35 per cent), while cyantraniliprole 10.26 OD at 60 g a.i./ha exhibited comparatively lower efficacy of 90.78 per cent from that of spinetoram (Poornima *et al*., 2024). Further, Mavridis *et al.* (2023) also reported high LC_{50} values and significantly lower field efficacy for cyantraniliprole against *Frankliniella occidentalis* compared to spinosyns. This is likely due to the systemic but slow action of diamide insecticides, which may not adequately control highly mobile and rapidly reproducing pests like thrips, combined with potential cross-resistance issues. However, these findings were slight contradictory to Priyanka *et al.* (2023) who reported that cyantraniliprole 300 g/L (90 g a.i./ha) provided highly effective in managing thrips population in grapes with higher yields and no phytotoxicity, it may be due to differences in local thrips susceptibility, environmental conditions, and application practices, which strongly influence cyantraniliprole performance. The untreated control naturally harboured the highest infestations at all intervals, confirming the effectiveness of applied insecticidal treatments in suppressing the thrips complex on grapes.

CONCLUSION

Based on the findings of the present study, broflanilide 30 SC @ 0.08 ml/ L, spinetoram 11.70 SC @ 0.6 ml/L, and spinosad 45 SC @ 0.25 ml/L were identified as the most effective insecticides for the management of grape thrips. Among these, broflanilide 30 SC not only provided superior suppression of thrips infestation and berry damage but also recorded the highest incremental cost–benefit ratio, making it the most economically viable option for grape growers. Fluxametamide 10 EC and dimpropyridaz 120 g/L SL exhibited moderate efficacy and may be incorporated into insecticide rotation programmes to diversify modes of action and delay the development of resistance in thrips populations.

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AUTHOR CONTRIBUTION

AAN- Investigation, data analysis and Manuscript writing; GK-Conceptualization, framing research, Supervision and Manuscript editing. AM and BM-Manuscript correction, feed back and members of advisory committee.

CONFLICT OF INTEREST

Authors don't have conflict of interest to express

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