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Efficacy of different treatment schedules against thrips in pomegranate ecosystem

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Abstract
The field experiment was conducted during the Kharif season of 2024-25 at village Dhopteshwar tq Badnapur and Dist Jalna. The experimental site is geographically situated at 19°1' and 21°3' North Latitudes and 75°4' and 76°4' East Longitudes. The minimum and maximum temperature is during the last five year were 15.25 °C and 43.85 °C and the mean relative humidity range from 30-91%. The field experiment was conducted at Dhopateshwar, Badnapur, during the Mrig Bahar season using a Randomized Block Design (RBD) with seven treatments replicated thrice. The pooled mean thrips population revealed that, significant differences observed among treatments over the cropping period. The sequence of NSKE followed by imidacloprid and lambda-cyhalothrin (T_3) achieved the lowest infestation and averaged 10.22 thrips per 15 cm twig. The integrated program of azadirachtin, thiamethoxam and spinosad (T_2) ranked second (11.71 thrips per 15 cm twig). Chlorpyrifos drenching (T_6) and the acetamiprid-emamectin-bagging schedule (T_4) recorded 12.28 and 13.27 thrips per 15 cm twig, respectively, indicated strong but slightly lower efficacy. The strategy combined sticky traps with chemical sprays (T_1) resulted in 16.08 thrips per 15 cm twig, while the exclusively biological intervention (T_5) averaged 18.10 thrips per 15 cm twig, suggesteed that biocontrol agents may require longer establishment and supplementary applications for optimum performance. The untreated control (T_7) noted the highest population, with 30.38 thrips per 15 cm twig, underscoring the effectiveness of integrated chemical and botanical interventions in managing thrips on pomegranate ecosystem.

Keywords: Pomegranate, thrips, imidacloprid, acetamiprid

Introduction
Pomegranate (*Punica granatum* L.) is a prominent fruit crop grown mainly in arid and semi-arid regions, particularly in Mediterranean countries such as Spain and Afghanistan, and widely in India. It is valued for its rich nutritional and antioxidant content, appealing taste, therapeutic value, and strong export potential. In India, major cultivation occurs in Maharashtra, Karnataka, Gujarat, Andhra Pradesh, and Rajasthan, covering about 285.6 thousand hectares with a production of 3.3 million metric tons and an average productivity of 11.5 MT/ha (Annual Report 2023).
Pomegranate in India is attacked by 91 insect species, 6 mite species, and 1 snail species, with the pomegranate butterfly (*Deudorix isocrates*) causing over 50% fruit loss; overuse of insecticides has promoted secondary sap-feeding pests—mealybugs, thrips, mites, aphids, and whiteflies—that weaken plants during flowering and fruiting and produce honeydew, fostering disease.
The thrips *Scirtothrips dorsalis* is major sucking pest of pomegranate, feeding on foliage and tender shoots. This pest causes considerable damage to flowers, fruits, twigs and leaves through scrapping and sucking sap, resulting in deteriorated poor fruit quality and reduced yields. Several species of thrips attack pomegranates, including *Scirtothrips dorsalis*, *Scirtothrips oligochaetus, Rhipiphorothrips cruentatus*, *Frankliniella schultzei*, *Frankliniella occidentalis* and *Thrips florum*. The high intensity of *S. dorsalis* infestations which increased the dependency on systemic insecticides, raising concerns about the sustainability of producing high-quality and export-grade pomegranates.
Although sucking pests were traditionally regarded as minor threats in pomegranate cultivation but now a days emerged with major pest status in recent years (Balikai *et al.*, 2009) [2]. Researchers like Zirpe (1966) [13] and Mote *et al.* (1992) [6] have highlighted strategies for protecting orchards and maximizing yields.

One key approach is a well-planned spray schedule, involving the timed application of pesticides and fungicides against pests such as aphids, thrips, whiteflies, and mites, and diseases like powdery mildew, Alternaria fruit rot, and bacterial blight.

Materials and Methods

The field experiment was conducted during the *Kharif* season of 2024-25 at village Dhopteshwar tq Badnapur and dist Jalna. The experimental site is geographically situated at 19°1' and 21°3' North Latitudes and 75°4' and 76°4' East Longitudes, with an elevation of approximately 414 meters above mean sea level. The average rainfall of station is about 650 mm received mostly during June to September. The minimum and maximum temperature is during the last five year were 15.25 °C and 43.85 °C and the mean relative humidity range from 30-91%. The field experiment was conducted at Dhopateshwar, Badnapur, during the *Mrig* Bahar season using a Randomized Block Design (RBD) with seven treatments replicated thrice. The orchard consisted of 3-year-old pomegranate plants of the variety Solapur Lal, planted at a spacing of 4 × 3 m with a plot size of 144 m². The date of planting was 03/03/2021 and the experimental layout ensured proper treatment distribution for reliable evaluation of results.

The population of thrips was recorded by gently tapping 15 cm long tender twigs of pomegranate on a white paper sheet. The dislodged insects were counted directly from the sheet, and the average number per twig was calculated. The population of whiteflies was recorded by direct counting of adults present on 15 cm tender twigs. The numbers were noted visually and expressed as the average population per twig (Gaikwad *et al.*, 2023) [4]. Treatment details give as follow:

Table 1: Treatment details:

Tr. No	Spray 1	Dose per L	Spray 2	Dose per L	Spray 3	Dose per L
T_1	Sticky traps (yellow & blue 4+2/plant)		Azadirachtin 10000 ppm	2ml	Chlorantraniliprole18.5%SC	0.4 ml
T_2	Azadirachtin 10000 ppm	2 ml	Thiamethoxam 25%WG	0.25g	Spinosad 45%SC	0.3 ml
T_3	NSKE	5%	Imidacloprid 17.8%SC	0.25ml	Lambda cyhalothrin 5%EC	0.5 ml
T_4	Acetamiprid 20%SP	0.25ml	Emamectin benzoate 5% SG	4 gm	Bagging of fruits	
T_5	*Lecanicillium lecanii*	4 gm	*Metarhizium anisoplie*	4 gm	*Beauveria bassiana*	4 gm
T_6	Drenching of chloropyriphos 50%EC	2.5 ml	Thiamethoxam 25% WG	0.25g	Cyantraniliprole 10.26%	0.75 ml
T_7	Untreated control		Untreated control		Untreated control	

Table 2: Efficacy of different treatment schedules against thrips in pomegranate ecosystem.

Tr. No	No. of thrips per 15 cm twig													
	1st spray					2nd spray				3rd spray				Pooled mean
	1 DBS	3 DAT	7 DAT	14 DAT	Mean	3 DAT	7 DAT	14 DAT	Mean	3 DAT	7 DAT	14 DAT	Mean	
T_1	22.2 (4.68)*	15.5 (3.91)	15.4 (3.89)	15.3 (3.88)	15.40 (3.89)	18.4 (4.28)	13.4 (3.65)	8.8 (2.98)	13.53 (3.64)	22.5 (4.71)	9.5 (3.07)	25.9 (5.09)	19.30 (4.29)	16.08 (3.94)
T_2	20.4 (4.50)	14.4 (3.79)	12.6 (3.55)	12.9 (3.60)	13.30 (3.65)	15.8 (3.98)	7.5 (2.74)	28.8 (5.35)	17.37 (4.02)	5.0 (2.25)	3.8 (1.96)	4.6 (2.14)	4.47 (2.12)	11.71 (3.26)
T_3	16.8 (4.10)	16.7 (4.08)	11.9 (3.45)	3.5 (1.88)	10.70 (3.14)	4.9 (2.22)	3.4 (1.84)	3.0 (1.75)	3.77 (1.94)	27.4 (5.23)	15.8 (3.97)	5.4 (2.32)	16.20 (3.84)	10.22 (2.97)
T_4	17.7 (4.21)	6.0 (2.46)	5.8 (2.40)	12.9 (3.60)	8.23 (2.82)	7.6 (2.75)	6.8 (2.59)	5.6 (2.38)	6.67 (2.57)	30.2 (5.47)	21.8 (4.67)	23.6 (4.85)	20.25 (5.00)	13.27 (3.46)
T_5	17.3 (4.16)	16 (4.00)	11.6 (3.41)	5.8 (2.42)	11.13 (3.28)	15.8 (3.97)	18.1 (4.22)	23.6 (4.86)	19.17 (4.35)	25.2 (5.02)	23.0 (4.80)	23.8 (4.88)	24.00 (4.90)	18.10 (4.18)
T_6	16.1 (4.01)	9.5 (3.06)	10.1 (3.17)	4.3 (2.08)	7.97 (2.77)	7.4 (2.71)	4.9 (2.21)	5.6 (2.37)	5.97 (2.43)	15.8 (3.98)	21.9 (4.67)	31 (5.56)	22.90 (4.74)	12.28 (3.31)
T_7	15.2 (3.90)	28.0 (5.29)	26.9 (5.18)	29 (5.36)	27.97 (5.28)	26 (5.04)	28.6 (5.34)	32.2 (5.66)	28.93 (5.35)	33.6 (5.78)	32.4 (5.66)	36.7 (6.02)	34.23 (5.82)	30.38 (5.48)
SE(m) ±	0.21	0.19	0.19	0.17	0.19	0.22	0.18	0.18	0.20	0.22	0.19	0.20	0.21	0.20
CD at (5%)	NS	0.58	0.59	0.55	0.57	0.69	0.56	0.56	0.61	0.69	0.59	0.62	0.64	0.61
CV (%)	8.57	8.58	9.27	10.29	9.38	10.89	9.81	8.81	9.84	8.46	8.11	8.00	8.19	9.14

DAT-Days after treatment
* Data presented in parentheses indicate $\sqrt{(x+0.5)}$ transformed value

This trial was conducted to evaluate the efficacy of seven treatments (T_1-T_7) against thrips in pomegranate fruit crop. Each treatment involved three sequential sprays and observation on thrips populations were recorded at 3, 7 and 14 days after each spray. Below are the mean thrips counts for each spray and the overall pooled mean efficacy.

First Spray Application

The data tabulated in table 2 revealed different levels of effectiveness of various treatments against thrips populations at 3, 7, and 14 days after treatment (DAT). T_4 (Acetamiprid 20% SP at 0.25 ml/L) exhibited the lowest mean thrips population of 8.23 per 15 cm twig across the three observation periods and which indicated superior efficacy and was closely followed by T_6 (soil drenching with Chlorpyriphos 50% EC at 2.5 ml/L) (7.97 thrips per 15 cm twig) and T_3 (NSKE 5%) (10.70 thrips per 15 cm twig). T_2 (Azadirachtin 10000 ppm at 2 ml/L) showed moderate efficacy with 13.30 thrips, while T_1 (sticky traps combined with Azadirachtin) noted 15.40 thrips per 15 cm twig. The biological control treatment T_5 (*Lecanicillium lecanii* at 4 gm/L) observed with lower efficacy with 11.13 thrips per 15 cm twig. The untreated control (T_7) recorded the highest population of 27.97 thrips per 15 cm twig. T_2 found as superior treatment followed by T_4, T_3 and T_5 and stood at par with T_2. These results corroborate Bazla *et al.* (2023) [3], who reported acetamiprid 20% SP as the most effective treatment, and Sathyan *et al.* (2017) [9], who also found acetamiprid highly effective in reducing thrips under field conditions.

Second Spray Application

The data presented in table 2 on second spray revealed that, T_3 (Imidacloprid 17.8% SC at 0.25 ml/L) recorded lowest thrips population (3.77 thrips per 15 cm twig) followed by T_6 (Chlorpyriphos drenching followed by Thiamethoxam 25% WG at 0.25 g/L) maintained consistent efficacy with 5.97 thrips per 15 cm twig and at par to T_3, while T_4 (Emamectin benzoate 5% SG at 4 gm/L) recorded 6.67 thrips per 15 cm twig. T_1 (Azadirachtin followed by Chlorantraniliprole at 0.4 ml/L) showed 13.53 thrips per 15 cm twig and T_2 (Azadirachtin followed by Thiamethoxam) recorded 17.37 thrips per 15 cm twig. T_5 (Metarhizium anisopliae at 4 gm/L) noted highest thrips count (19.17 thrips per 15 cm twig) except the untreated control T_7 (28.93 thrips per 15 cm twig). These results are supported by Thuppukonda and Kumar (2022) [11], who reported imidacloprid as highly effective with 94.52% reduction, and by Raut and Kumar (2024) [7, 8], who found that imidacloprid 17.8% SL reduced chilli thrips by 53.5% over untreated control.

Third Spray Application

During the third spray evaluation, T_2 (Spinosad 45% SC @ 0.3 ml/L) observed with the significant reduction in thrips count with a mean of 4.47 thrips per 15 cm twig and proved highly effective. T_3 (Lambda cyhalothrin 5% EC at 0.5 ml/L) recorded 16.20 thrips per 15 cm twig, while T_1 (with fruit bagging) showed thrips per 15 cm twig. T_4 (with fruit bagging alone) resulted in 20.25 thrips per 15 cm twig and T6 (Cyantraniliprole 10.26% at 0.75 ml/L) recorded 22.90 thrips per 15 cm twig. The biological treatment T_5 (*Beauveria bassiana* at 4 gm/L) showed the poor efficacy among treatments with 24.00 thrips per 15 cm twig, though still significantly better than the untreated control T_7, which peaked at thrips per 15 cm twig. These results are supported by Shinde *et al.* (2018) [10], who reported spinosad 45% SC as the most effective treatment with the lowest thrips population, and Tirkey and Kumar (2017) [12], who also confirmed its field efficacy. The findings further align with Raut and Kumar (2024) [7, 8], who demonstrated that spinosad reduced chilli thrips by 76.59% over control.

Pooled Mean Analysis:

Based on data pooled mean showed in table 2, represented the overall efficacy across all three spray applications, which give the comprehensive assessment of treatment throughout the cropping period. Treatment T_3 (NSKE followed by Imidacloprid and Lambda cyhalothrin sequence) noted lowest thrips count among all treatments and which recorded 10.22 thrips per 15 cm twig, indicated consistent pest suppression across the growing season followed by T_2 (Azadirachtin-Thiamethoxam-Spinosad sequence) recorded 11.71 thrips per 15 cm twig and T_6 (Chlorpyriphos drenching sequence) recorded 12.28 thrips per 15 cm twig and T_4 (Acetamiprid-Emamectin-bagging schedule) showed 13.27 thrips per 15 cm twig and which were stood at par with T_3. T_1 (sticky traps with chemical sprays) resulted in 16.08 thrips per 15 cm twig and the entirely biological approach T_5 recorded 18.10 thrips per 15 cm twig and which indicated that biological agents alone may require longer establishment periods or additional applications for comparable efficacy. The untreated control T_7 maintained the highest thrips count and recorded pooled mean of 30.38 thrips per 15 cm twig.

Conclusion

The sequential spray trials demonstrated that integrated treatments combined with various botanical, systemic insecticides and contact insecticides exhibit the most consistent and sustained reduction of thrips infestation in pomegranate crop. Treatment T_3 (NSKE followed by Imidacloprid and Lambda-cyhalothrin) delivered the lowest pooled mean thrips count (10.22 per 15 cm twig), indicated superior overall efficacy. Chemical-biological sequences such as T_2 and T_6 showed good performance while biological intervention (T_5) or trap-based (T_1) approach management were proved less effective. These findings underscore the importance of rotating modes of action and integrating multiple control tactics to manage thrips populations efficiently and minimize dependency on any single insecticide class.

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