

COMBATING SUNFLOWER NECROSIS DISEASE: INSECTICIDAL STRATEGIES FOR DISEASE SUPPRESSION AND YIELD ENHANCEMENT

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ABSTRACT

Sunflower necrosis disease (SND), caused by *Tobacco streak virus* (TSV), is a major constraint to sunflower production, with thrips facilitating disease transmission through virus-contaminated pollen. A field experiment was conducted at the Zonal Agricultural Research Station, GKVK, Bengaluru, during 2023 and 2024 to evaluate the efficacy of selected insecticidal treatments in managing SND and improving seed yield. Seven treatments were evaluated in a Randomized Complete Block Design (RCBD) with three replications using the susceptible sunflower hybrid KBSH-44. The treatments comprised seed treatment with Imidacloprid 600 FS @ 5 ml kg⁻¹ seed followed by foliar applications of different insecticides at 30, 45 and 60 days after sowing, along with an untreated control. Among the treatments, Imidacloprid seed treatment followed by foliar sprays of Diafenthiuron 50 WP @ 1 g l⁻¹ was found most effective, recording the lowest disease incidence of 9.25 and 5.34 per cent during 2023 and 2024, respectively, with a pooled mean of 7.29 per cent. This treatment achieved the highest disease reduction (66.89%) over the untreated control and recorded the maximum pooled seed yield (2258.50 kg ha⁻¹), representing a 27.24 per cent yield increase. The next effective treatment was Imidacloprid seed treatment followed by foliar sprays of Imidacloprid 17.8 SL @ 0.5 ml l⁻¹, which recorded 8.66 per cent pooled disease incidence and 2216.50 kg ha⁻¹ seed yield. The untreated control recorded the highest pooled disease incidence (22.02%) and lowest seed yield (1775.00 kg ha⁻¹). The findings demonstrated that Imidacloprid seed treatment combined with Diafenthiuron foliar applications was an effective insecticidal strategy for reducing sunflower necrosis incidence and enhancing seed yield under field conditions.

KEYWORDS: *Sunflower, Tobacco streak virus, sunflower necrosis disease, Imidacloprid, Diafenthiuron, disease management.*

1. INTRODUCTION

Sunflower (*Helianthus annuus* L.) is an important edible oilseed crop cultivated in India for its high-quality oil and adaptability to diverse agroclimatic conditions. However, its productivity is constrained by several biotic stresses, among which sunflower necrosis disease (SND), caused by Tobacco streak virus (TSV) belonging to the genus *Ilarvirus*, has emerged as a serious threat. The disease is characterized by chlorotic and necrotic lesions, leaf distortion, systemic necrosis, stunting and, in severe cases, premature plant death, resulting in substantial yield losses. The widespread occurrence and economic importance of SND in sunflower-growing regions have been highlighted by Chaitra *et al.* (2025) and Chethana *et al.* (2026).

The epidemiology of SND is closely associated with thrips-assisted transmission of TSV through virus-contaminated pollen. Thrips facilitate the transfer of infected pollen onto susceptible plant tissues, thereby contributing to disease spread under field conditions. The presence of alternative weed hosts, favourable environmental conditions and seasonal fluctuations in thrips populations further influence disease development. Rajadurai *et al.* (2025) emphasized the importance of vector ecology, host resistance and integrated management practices in minimizing TSV infection in sunflower. Precision and smart farming approaches can support improved crop monitoring, resource management, and timely agricultural decision-making (Geetanjali & Singh, 2025). Machine-learning approaches also offer potential applications in agricultural data analysis, including pest and disease detection, which may complement conventional field surveillance (Taqvi, 2025).

Management of SND remains challenging because of the limited availability of stable resistant cultivars and the influence of environmental conditions on disease incidence. Consequently, suppression of thrips populations through suitable insecticidal interventions constitutes an important component of disease management. Hurakadli and Rangaswamy (2017) demonstrated that seed treatment with imidacloprid, combined with foliar application of fipronil and integrated management practices, effectively reduced thrips populations and sunflower necrosis incidence. Similarly, Poornima *et al.* (2024) reported the effectiveness of Imidacloprid seed treatment followed by foliar applications of insecticides, including Diafenthiuron and flonicamid, in reducing sunflower necrosis incidence and improving seed yield. Sangeetha *et al.* (2024) also demonstrated the potential of integrated disease management strategies in reducing sunflower necrosis incidence and enhancing productivity.

Although several management practices have been evaluated against SND, the relative effectiveness of insecticidal molecules may vary across seasons and under different levels of disease pressure. Therefore, evaluation of insecticides under field conditions is essential for identifying effective management options. In this context, the present investigation was undertaken during 2023 and 2024 to assess the reaction of sunflower genotypes to SND and to evaluate the efficacy of Imidacloprid seed treatment followed by foliar applications of selected insecticides at 30, 45 and 60 days after sowing in reducing disease incidence and improving seed yield.

2. MATERIALS AND METHOD

2.1 Management of sunflower necrosis disease under field condition.

Field experiment was conducted during *Kharif* 2023-24 and 2024-25 at ZARS, GKVK, Bengaluru, to evaluate the efficacy of different chemical insecticides and methods of application in managing sunflower necrosis disease through its thrips vector. The experiment comprised seven treatments (Table 1) arranged in a Randomized Complete Block Design (RCBD) with three replications. Each plot measured 3×3 M and was maintained at a spacing of 60×30 cm. The recommended package of practices was followed, for the cultivation of the sunflower crop using the national check KBSH-44, known to be susceptible to necrosis disease.

Table 1: Treatments imposed to evaluate the effect of chemical molecules (Insecticides) in the management of sunflower necrosis disease

Treatments	
T ₁	Seed treatment with <i>Imidacloprid</i> 600FS @5ml/kg seed and foliar spray with <i>Imidacloprid</i> 17.8SL @0.5ml/l at 30,45 and 60DAS
T ₂	Seed treatment with <i>Imidacloprid</i> 600FS @5ml/kg seed and foliar spray with Fipronil5SC(Regent) @1ml/l at 30,45 and 60DAS
T ₃	Seed treatment with <i>Imidacloprid</i> 600FS @5ml/kg seed and foliar spray with Triazophos 40EC @1ml/l at 30,45 and 60DAS
T ₄	Seed treatment with <i>Imidacloprid</i> 600FS @5ml/kg seed and foliar spray with Diafenthiuron 50WP @1g/l at 30,45 and 60DAS
T ₅	Seed treatment with <i>Imidacloprid</i> 600FS @5ml/kg seed and foliar spray with Flonicamide50WG @0.25g/l at 30,45 and 60DAS
T ₆	Seed treatment with <i>Imidacloprid</i> 600FS @5ml/kg seed and foliar spray with Spiromesifen 24SC (Oberon)@1ml/l at 30,45 and 60DAS
T ₇	Control

3. RESULTS AND DISCUSSION

Effective management of vector-borne viral diseases requires not only the deployment of resistant cultivars but also the suppression of vector-mediated transmission. Although field screening identified several sunflower genotypes with low SND incidence, their reactions varied with season and disease pressure, indicated that host resistance alone may not provide consistent protection. Therefore, as a management strategy, selected insecticidal molecules were also evaluated for their ability to suppress thrips populations, which facilitates the TSV transmission through virus-contaminated pollen, and thereby reduce SND incidence.

The insecticidal treatments were evaluated under field conditions during 2023 and 2024 for their efficacy against sunflower necrosis disease. The insecticidal treatments (T₁-T₇) consisted of seed treatment with Imidacloprid 600 FS @ 5 ml kg⁻¹ seed, followed by three foliar sprays of the respective insecticides at 30, 45 and 60 DAS. The data on disease incidence, reduction in disease over the untreated control, seed yield and increase in yield over the untreated control were all reviewed for the efficiency (Table 2, Fig 1 and Table 3, Fig 2).

Among the seven treatments evaluated, T₄ comprising seed treatment with Imidacloprid 600 FS @ 5 ml kg⁻¹ seed followed by foliar sprays of Diafenthiuron 50 WP @ 1 g l⁻¹ at 30, 45 and 60 DAS, was consistently the most effective during 2023 and 2024 (Table 4 and Fig 3). It recorded the lowest disease incidence of 9.25 and 5.34 per cent during 2023 and 2024, respectively, with a pooled mean of 7.29 per cent. The treatment achieved the maximum disease reduction over the untreated control (66.89%) and produced the maximum pooled seed yield (2258.50 kg ha⁻¹), representing a 27.24 per cent increase over the control. These results indicate that Imidacloprid seed treatment combined with Diafenthiuron sprays effectively reduced disease incidence and improved seed yield.

The next best treatment was T₁ - seed treatment with Imidacloprid 600FS followed by foliar spray of Imidacloprid 17.8SL @ 0.5 ml l⁻¹, which recorded disease incidences of 10.83 and 6.49 per cent during 2023 and 2024, respectively, with a pooled mean of 8.66 per cent. The treatment reduced disease incidence by 60.67 per cent over control and recorded a yield of 2216.50 kg ha⁻¹, with 24.87 per cent increase in yield over control. This was followed by T₂ - foliar spray of Fipronil 5SC @ 1 ml l⁻¹, which recorded 12.08 and 9.60 per cent disease incidence during 2023 and 2024, respectively, with a pooled incidence of 10.84 per cent, resulting in 50.77 per cent reduction of disease over control and a yield of 2170.00 kg ha⁻¹ with 22.25 per cent increase in yield over control.

Among the insecticidal treatments, T₆ comprising seed treatment with Imidacloprid 600 FS followed by foliar applications of Spiromesifen 24 SC @ 1 ml l⁻¹, showed the lowest efficacy. It recorded disease incidences of 13.33

and 18.01 per cent during 2023 and 2024, respectively, with a pooled incidence of 15.67 per cent. The treatment reduced disease incidence by 28.84 per cent and produced a pooled seed yield of 2037.00 kg ha⁻¹, representing a 14.76 per cent increase over the untreated control. The relatively higher disease incidence and lower yield advantage suggest that T₆ provided comparatively limited suppression of thrips-mediated virus transmission under field conditions.

The untreated control (T₇) recorded the maximum disease incidence of 21.66 and 22.39 per cent during 2023 and 2024, respectively, with a pooled mean incidence of 22.02 per cent, and produced the lowest seed yield of 1775.00 kg ha⁻¹. The statistical analysis revealed significant differences among treatments, with a CD value of 3.09 at 5 per cent level of significance, indicating that the evaluated insecticides effectively reduced disease incidence and improved crop productivity.

The superior efficacy of T₄ comprising seed treatment with Imidacloprid 600 FS @ 5 ml kg⁻¹ seed followed by foliar sprays of Diafenthiuron 50 WP @ 1 g l⁻¹ at 30, 45 and 60 DAS may be attributed to the complementary modes of action of Imidacloprid and Diafenthiuron. Imidacloprid is a systemic neonicotinoid (IRAC Group 4A) that binds to insect nicotinic acetylcholine receptors, causing hyperexcitation, paralysis and mortality. Diafenthiuron is a thiourea insecticide (IRAC Group 12A) that is converted into an active carbodiimide metabolite, which inhibits mitochondrial ATP synthase and disrupts cellular energy production (Ruder and Kayser, 1992; IRAC, 2026). Thus, Imidacloprid seed treatment provided early systemic protection, while Diafenthiuron sprays suppressed thrips during later crop stages, thereby reducing thrips-mediated TSV transmission and improving seed yield. Similar effectiveness of Diafenthiuron against sunflower necrosis was reported by Poornima *et al.* (2024). Similar findings were reported by Bhat *et al.* (2012), who observed that seed treatment with Imidacloprid followed by three foliar sprays of Imidacloprid at 15, 30 and 45 days after sowing, together with three rows of sorghum as a border crop, reduced the thrips population to 0.70 thrips plant⁻¹ and disease incidence to 4.65 per cent, compared with 4.06 thrips plant⁻¹ and 21.16 per cent disease incidence in the untreated control.

4. CONCLUSION

The present investigation demonstrated that insecticidal interventions significantly reduced sunflower necrosis disease (SND) incidence and improved seed yield under field conditions during 2023 and 2024. Among the seven treatments evaluated, seed treatment with Imidacloprid 600 FS @ 5 ml kg⁻¹ seed followed by three foliar sprays of Diafenthiuron 50 WP @ 1 g l⁻¹ at 30, 45 and 60 days after sowing was the most effective, recording the lowest pooled disease incidence (7.29%), maximum disease reduction (66.89%) and highest seed yield (2258.50 kg ha⁻¹), with a 27.24 per cent yield advantage over the untreated control. This was followed by Imidacloprid seed treatment combined with foliar sprays of Imidacloprid 17.8 SL, which recorded 8.66 per cent disease incidence and 2216.50 kg ha⁻¹ seed yield. The findings suggest that Imidacloprid seed treatment followed by Diafenthiuron foliar applications is a promising strategy for managing sunflower necrosis disease and enhancing crop productivity. However, its suitability for wider adoption should be assessed in accordance with registered insecticide uses and through further multilocation validation.

5. ACKNOWLEDGMENT

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Table 2: Field evaluation of insecticidal treatments against sunflower necrosis disease (Late Kharif 2023)

Treatments	Disease incidence (%) 2023	Reduction of disease over control (%)	Yield (kg ha ⁻¹) 2023	Increase in yield over control (%)
T ₁ - Seed treatment with Imidacloprid 600FS @ 5 ml kg ⁻¹ seed + foliar spray with Imidacloprid 17.8SL @ 0.5 ml l ⁻¹ at 30, 45 and 60 DAS	10.83 (19.21)	50.00	2166.50	22.06
T ₂ - Seed treatment with Imidacloprid 600FS @ 5 ml kg ⁻¹ seed + foliar spray with Fipronil 5SC @ 1 ml l ⁻¹ at 30, 45 and 60 DAS	12.08 (20.34)	44.23	2120.00	19.44
T ₃ - Seed treatment with Imidacloprid 600FS @ 5	12.91 (21.06)	40.40	2183.50	23.01

ml kg ⁻¹ seed + foliar spray with Triazophos 40EC @ 1 ml l ⁻¹ at 30, 45 and 60 DAS				
T ₄ - Seed treatment with Imidacloprid 600FS @ 5 ml kg ⁻¹ seed + foliar spray with Diafenthiuron 50WP @ 1 g l ⁻¹ at 30, 45 and 60 DAS	9.25 (17.71)	57.29	2208.50	24.42
T ₅ - Seed treatment with Imidacloprid 600FS @ 5 ml kg ⁻¹ seed + foliar spray with Flonicamide 50WG @ 0.25 g l ⁻¹ at 30, 45 and 60 DAS	11.25 (19.60)	48.06	2180.50	22.85
T ₆ - Seed treatment with Imidacloprid 600FS @ 5 ml kg ⁻¹ seed + foliar spray with Spiromesifen 24SC @ 1 ml l ⁻¹ at 30, 45 and 60 DAS	13.33 (21.41)	38.46	2087.00	17.58
T ₇ - Untreated control	21.66 (27.74)	-	1775.00	-
S.Em ±	1.20	-	49.80	-
C.D. (P = 0.05)	2.34	-	96.90	-
C.V. (%)	9.90	-	4.10	-

Field evaluation of insecticidal treatments against sunflower necrosis disease (Late Kharif 2023)

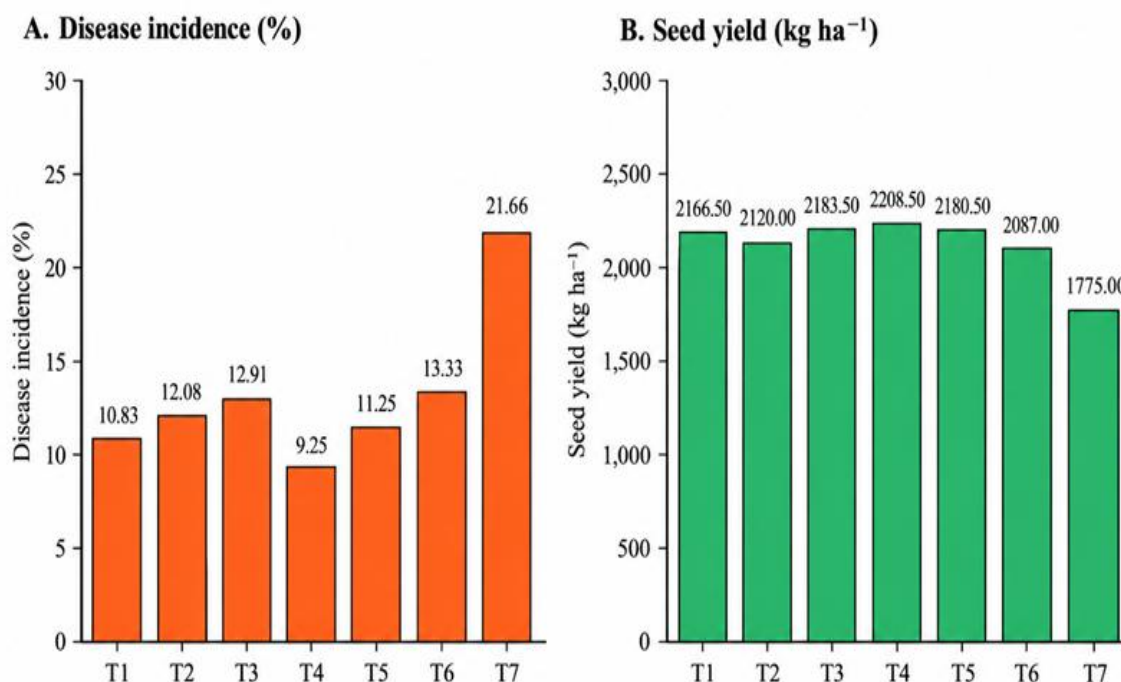


Fig. 1. Effect of insecticidal treatments on sunflower necrosis disease incidence (%) and seed yield (kg ha⁻¹) during late Kharif 2023.

Table 3: Field evaluation of insecticidal treatments against sunflower necrosis disease (Late Kharif 2024)

Treatments	Disease incidence (%) 2024	Reduction of disease over control (%)	Yield (kg ha-1) 2024	Increase in yield over control (%)
T ₁ - Seed treatment with Imidacloprid 600FS @ 5 ml kg-1 seed + foliar spray with Imidacloprid 17.8SL @ 0.5 ml l-1 at 30, 45 and 60 DAS	6.49 (14.76)	71.01	2266.50	27.69
T ₂ - Seed treatment with Imidacloprid 600FS @ 5 ml kg-1 seed + foliar spray with Fipronil 5SC @ 1 ml l-1 at 30, 45 and 60 DAS	9.60 (18.05)	57.12	2220.00	25.07
T ₃ - Seed treatment with Imidacloprid 600FS @ 5 ml kg-1 seed + foliar spray with Triazophos 40EC @ 1 ml l-1 at 30, 45 and 60 DAS	15.11 (22.87)	32.51	2083.50	17.38
T ₄ - Seed treatment with Imidacloprid 600FS @ 5 ml kg-1 seed + foliar spray with Diafenthiuron 50WP @ 1 g l-1 at 30, 45 and 60 DAS	5.34 (13.36)	76.15	2308.50	30.06
T ₅ - Seed treatment with Imidacloprid 600FS @ 5 ml kg-1 seed + foliar spray with Flonicamide 50WG @ 0.25 g l-1 at 30, 45 and 60 DAS	16.88 (24.26)	24.61	2080.50	17.21
T ₆ - Seed treatment with Imidacloprid 600FS @ 5 ml kg-1 seed + foliar spray with Spiromesifen 24SC @ 1 ml l-1 at 30, 45 and 60 DAS	18.01 (25.11)	19.56	1987.00	11.94
T ₇ - Untreated control	22.39 (28.24)	-	1775.00	-
S.Em ±	1.27	-	52.82	-
C.D. (P = 0.05)	3.91	-	94.50	-
C.V. (%)	10.50	-	4.35	-

Effect of insecticidal treatments on sunflower necrosis disease incidence and seed yield
Late Kharif 2024

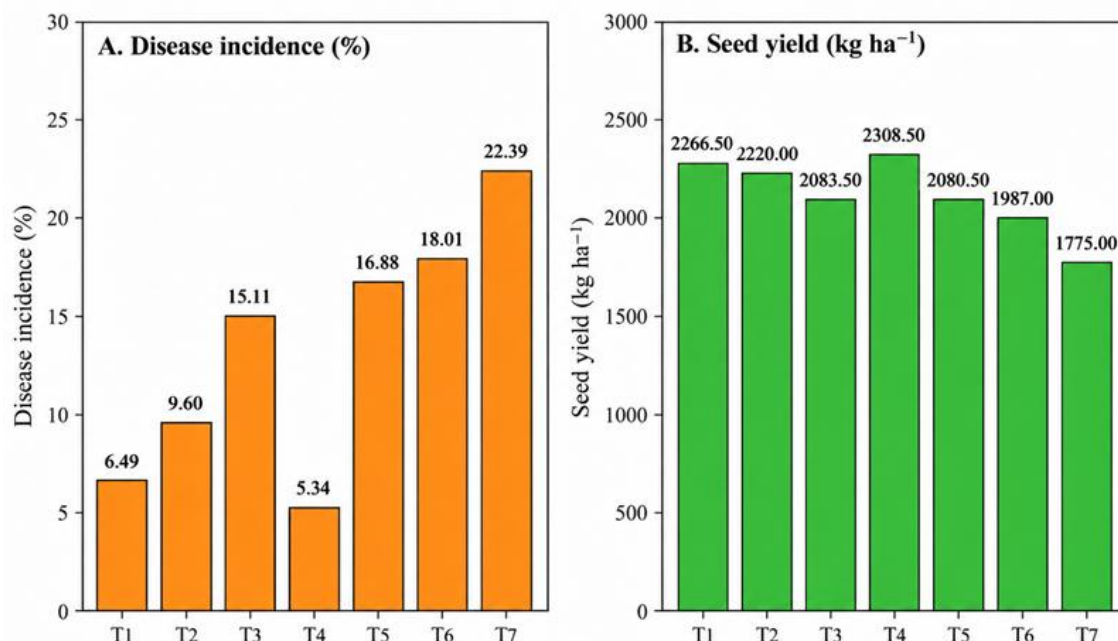


Fig. 2. Effect of insecticidal treatments on sunflower necrosis disease incidence (%) and seed yield (kg ha⁻¹) during late Kharif 2024.

Table 4: Field evaluation of insecticidal treatments against sunflower necrosis disease during 2023 and 2024 (Pooled data averages)

Treatments	Disease incidence (%) 2023	Disease incidence (%) 2024	Pooled mean (%)	Reduction of disease over control (%)	Yield (kg ha ⁻¹)	Increase in yield over control (%)
T ₁ - Seed treatment with Imidacloprid 600FS @ 5 ml kg ⁻¹ seed + foliar spray with Imidacloprid 17.8SL @ 0.5 ml l ⁻¹ at 30, 45 and 60 DAS	10.83 (19.21)	6.49 (14.76)	8.66 (16.98)	60.67	2216.5	24.87
T ₂ - Seed treatment with Imidacloprid 600FS @ 5 ml kg ⁻¹ seed + foliar spray with Fipronil 5SC @ 1 ml l ⁻¹ at 30, 45 and 60 DAS	12.08 (20.34)	9.60 (18.05)	10.84 (19.20)	50.77	2170	22.25
T ₃ - Seed treatment with Imidacloprid 600FS @ 5 ml kg ⁻¹ seed + foliar spray with Triazophos 40EC @ 1 ml l ⁻¹ at 30, 45 and 60 DAS	12.91 (21.06)	15.11 (22.87)	14.01 (21.96)	36.38	2133.5	20.2
T ₄ - Seed treatment with Imidacloprid 600FS @ 5 ml kg ⁻¹ seed + foliar spray with Diafenthiuron 50WP @ 1 g l ⁻¹ at 30, 45 and 60 DAS	9.25 (17.71)	5.34 (13.36)	7.29 (15.54)	66.89	2258.5	27.24

T ₅ - Seed treatment with Imidacloprid 600FS @ 5 ml kg ⁻¹ seed + foliar spray with Flonicamide 50WG @ 0.25 g l ⁻¹ at 30, 45 and 60 DAS	11.25 (19.60)	16.88 (24.26)	14.06 (21.93)	36.15	2130.5	20.03
T ₆ - Seed treatment with Imidacloprid 600FS @ 5 ml kg ⁻¹ seed + foliar spray with Spiromesifen 24SC @ 1 ml l ⁻¹ at 30, 45 and 60 DAS	13.33 (21.41)	18.01 (25.11)	15.67 (23.26)	28.84	2037	14.76
T ₇ - Untreated control	21.66 (27.74)	22.39 (28.24)	22.02 (27.99)	-	1775	-
S.Em ±	-	-	1.6	-	42.50	-
C.D. (P = 0.05)	-	-	3.09	-	82.75	-
C.V. (%)	-	-	20.69	-	4.95	-

Effect of insecticidal treatments on pooled sunflower necrosis disease incidence and seed yield
Pooled data (2023 and 2024)

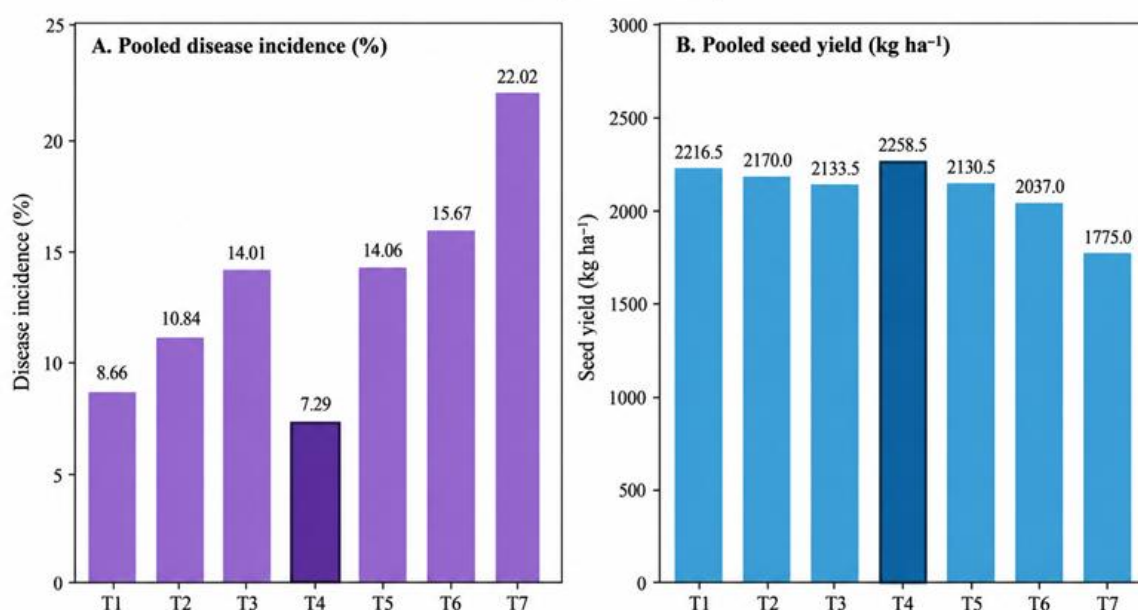


Fig. 3. Effect of insecticidal treatments on pooled sunflower necrosis disease incidence (%) and seed yield (kg ha⁻¹) during 2023 and 2024.

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