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Comparative efficacy of selected insecticides against brown planthopper (*Nilaparvata lugens* Stål)

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Abstract
Brown planthopper (*Nilaparvata lugens* Stål) is one of the most detrimental insect pests of paddy, causing severe yield losses by sucking cell sap and transmission of viral diseases. The present study was carried out during the kharif 2024 season at two locations of Punjab: Faridkot and Moga; to evaluate the field efficacy of selected insecticides against brown planthopper in rice. The experiment was laid out in a Randomized Complete Block Design (RCBD) with four replications using rice variety PR 126. Four treatments comprising Viola 10 SC (Flupyrimin) @ 750 mL ha^{-1}, Chess 50 WG (Pymetrozine) @ 300 g ha^{-1}, Imagine 10 SC (Flupyrimin) @ 750 mL ha^{-1} and an untreated control were evaluated. Brown planthopper populations were recorded before spraying and at 3, 7 and 10 days after spray (DAS) and grain yield was recorded at harvest. The brown planthopper population before spray was statistically similar among treatments. All insecticidal treatments significantly reduced brown planthopper populations compared to the untreated control throughout observation period. The maximum suppression was observed at 7 DAS when sprayed with Viola 10 SC and Imagine 10 SC recording the lowest populations of 1.02 and 1.06 brown planthoppers hill^{-1}, respectively. Percent reduction over the control exceeded 75 per cent in pooled analysis at 7 DAS, with Imagine 10 SC (78.1%) and Viola 10 SC (76.5%) performing best. Although a slight resurgence of brown planthopper was observed at 10 DAS, all insecticidal treatments maintained populations below the economic threshold level (ETL). A significantly higher gain yield was observed in chemical treatments at both locations with an increase up to 9.45 per cent as compared to the untreated control.

Keywords: *Nilaparvata lugens*, Paddy, Chemical control, Insecticide efficacy, Grain yield

Introduction

Paddy is one of the most important cereal crops cultivated in Punjab and makes a significant contribution to India's food grain reserves. Despite accounting for only a small share of the country's geographical area, Punjab contributes nearly 28% of the rice procured for the central pool (Majumder and Dhaliwal, 2024) [10]. The crop is highly responsive to climatic conditions and being a short-day species, performs best under hot temperature, high atmospheric humidity, ample sunshine and rainfall (Dhaliwal *et al* 2024) [5]. In 2024-25, rice occupied 32.43 lakh hectares in Punjab with a total production of 144.19 lakh tonnes, recording an average productivity of 66.70 q ha^{-1} (Anonymous, 2026) [3].

The rice crop is attacked by more than 100 species of insects and out of these 20 can cause economic damage. Brown planthopper (*Nilparvata lugens* Stal) is one of the most important insect pests of rice crop (Anand *et al* 2023) [2]. Both nymphs and adults of this insect inflict damage by extracting sap from the xylem and phloem tissues of rice plants. Continuous feeding disrupts normal plant physiology, resulting in leaf yellowing, wilting, desiccation and in severe infestations eventual plant death. Heavy infestations produce characteristic circular patches of dried plants referred to as hopper burn. In addition to direct feeding injury, the pest acts as a vector of rice grassy stunt virus and adversely affects leaf quality by reducing its protein content (Matharu and Tanwar, 2020b) [11]. It causes considerable losses around the world, especially in the Asia-Pacific region (Lamba and Dono, 2021).

Chemical control remains the primary strategy for managing this pest across many rice-growing regions of the world (Alam, 2013; Hasan *et al* 2015) [1, 6]. However, prolonged and indiscriminate application of conventional insecticides has resulted in several adverse consequences like development of insecticide resistance, pest resurgence, reduction of natural enemy populations and environmental pollution (Matsumura and Morimura, 2010) [12]. Incidences of brown planthopper resurgence following insecticide application have been well documented in several rice-producing countries, including Bangladesh (Alam, 2013) [1], India (Lakshmi *et al* 2010) [9], Indonesia (Oka, 1991) [13] and the Philippines (Heong and Hardy, 2009) [7]. Hence, evaluation of newer molecules for effective management of brown planthopper in paddy remains research priority. Therefore, the present study was conducted to evaluate the efficacy of newer molecules against brown planthopper in paddy.

Materials and Methods

Experimental site and treatments

Field experiments were conducted during the *kharif* 2024 season at two locations: Faridkot and Moga, Punjab using the rice variety PR 126 to evaluate the efficacy of selected insecticides against the brown planthopper (*Nilaparvata lugens*). The experiment was laid out in a Randomized Complete Block Design (RCBD) with four replications. The study comprised four chemical treatments: Viola 10 SC (Flupyrimin), Chess 50 WG (Pymetrozine), Imagine 10 SC (Flupyrimin) and an untreated control. Insecticidal treatments were applied as foliar sprays when the brown planthopper population reached the economic threshold level (ETL). The insecticides were applied at their recommended doses using a knapsack sprayer, ensuring uniform coverage of the crop canopy.

Data collection

The brown planthopper population were recorded from 25 randomly selected rice plants in each experimental plot one day before insecticide application and at 3, 7, and 10 days after spraying (DAS) of insecticide. The number of adult brown planthoppers present on each selected hill was counted and the mean population per hill was calculated under each treatment for statistical analysis. Grain yield was recorded at crop maturity from each experimental plot and expressed on a hectare basis after appropriate conversion.

Statistical analysis

The data on brown planthopper population and grain yield were subjected to analysis of variance (ANOVA) using the Randomized Complete Block Design. Prior to analysis, insect count data were transformed to satisfy the assumptions of ANOVA (Table 1). Treatment means were separated using the Least Significant Difference (LSD) test at the 5% probability level ($P \leq 0.05$) to determine significant differences among treatments.

Results and Discussion

Brown planthopper population under different treatments

The overall mean brown planthopper population did not differ significantly among treatments before insecticide application, indicating a uniform initial pest infestation across all experimental plots (Figure 1). Following insecticide application, all treated plots exhibited a marked decline in brown planthopper population compared to the untreated control. At 3 days after spray (DAS), the lowest population was recorded in Viola 10 SC @ 750 mL ha^{-1} (1.94 brown planthoppers hill^{-1}), followed by Chess 50 WG @ 300 g ha^{-1} (2.09 brown planthoppers hill^{-1}) and Imagine 10 SC @ 750 mL ha^{-1} (2.22 brown planthoppers hill^{-1}), whereas the untreated control maintained a high population of 7.18 brown planthoppers hill^{-1}. The present findings are in agreement with those of Singh and Bal (2025) [16], who reported that flupyrimin 10 SC effectively suppressed brown planthopper and white-backed planthopper populations under field conditions. Application at 750 ml ha^{-1} resulted in more than 90% suppression of brown planthopper, produced higher grain yield than the untreated control and was comparable to pymetrozine. Similar results have been reported by Dhaka *et al* (2020) [4], who observed that Pymetrozine 50 WG (300 g ha^{-1}) also provided excellent control of BPH and was among the best-performing insecticides. Rudrappa *et al* 2016 also reported that Pymetrozine at 350 g a.i. ha^{-1} significantly reduced BPH populations. The maximum suppression of brown planthopper was observed at 7 DAS, where Viola 10 SC and Imagine 10 SC recorded the lowest populations of 1.02 and 1.06 brown planthoppers hill^{-1}, respectively, followed closely by Chess 50 WG (1.14 brown planthoppers hill^{-1}), while the untreated control recorded 7.10 brown planthoppers hill^{-1}. A slight increase in brown planthopper population was observed at 10 DAS, indicating the onset of pest resurgence; however, all insecticidal treatments continued to maintain significantly lower brown planthopper populations than the untreated control. At this stage, Viola 10 SC (1.74 brown planthoppers hill^{-1}) remained the most effective treatment, followed by Chess 50 WG (1.86 brown planthoppers hill^{-1}) and Imagine 10 SC (1.89 brown planthoppers hill^{-1}), whereas the untreated control registered the highest population (7.90 brown planthoppers hill^{-1}). Overall, Viola 10 SC @ 750 mL ha^{-1} consistently provided the greatest suppression of brown planthopper throughout the observation period.

Percent reduction over control (PROC)

The efficacy of the insecticidal treatments varied across observation periods and locations, but all treatments resulted in substantial reductions in brown planthopper population compared to the untreated control (Figure 2). At 3 days after spray (DAS), the highest reduction in brown planthopper population was recorded with Imagine 10 SC @ 750 mL ha^{-1} in Faridkot (78.9%) and in the overall analysis (70.8%), whereas Chess 50 WG @ 300 g ha^{-1} exhibited the highest reduction in Moga (67.1%). Singh *et al* (2025) [15] also concluded that Pymetrozine effectively controlled BPH. The percentage reduction increased further at 7 DAS, indicating the peak efficacy of all insecticides. In Faridkot, Imagine 10 SC @ 750 mL ha^{-1} recorded the maximum reduction (85.2%), followed by Viola 10 SC @ 750 mL ha^{-1} (83.2%) and Chess 50 WG @ 300 g ha^{-1} (82.6%). Similarly, in Moga, Viola 10 SC @ 750 mL ha^{-1} and Imagine 10 SC @ 750 mL ha^{-1} achieved the highest reduction (71.8% each), while in the pooled analysis, Imagine 10 SC @ 750 mL ha^{-1} exhibited the greatest reduction (78.1%), followed by Viola 10 SC @ 750 mL ha^{-1} (76.5%) and Chess 50 WG @ 300 g ha^{-1} (75.4%). At 10 DAS, a slight decline in percentage reduction was observed for all treatments, suggesting the beginning of a reduction in residual efficacy. Nevertheless, all insecticides continued to suppress brown planthopper populations effectively, with reductions exceeding 69% at both locations. In the overall analysis, Viola 10 SC @ 750 mL ha^{-1} maintained the highest reduction (76.2%), followed closely by Imagine 10 SC @ 750 mL ha^{-1} (75.9%) and Chess 50 WG @ 300 g ha^{-1} (75.1%). The results indicate that all three insecticides provided effective control of brown planthopper throughout the observation period, with maximum efficacy at 7 DAS and only a marginal decline by 10 DAS, thereby maintaining the pest population well below the economic threshold level. Roy *et al* 2025 concluded that most Indian BPH populations remained highly susceptible to flupyrimin. No cross-resistance was observed with pymetrozine, indicating that both insecticides can be useful in resistance-management programs.

Grain yield

The data revealed a significantly higher grain yield in all the pesticide treatments at both the locations as well as overall analysis. For example, in Faridkot district, foliar spray of Viola 10 SC @ 750 mL/ha and Imagine 10 SC @ 750 mL/ha registered 9.45 and 6.18 per cent higher grain yield of paddy as compared to untreated control (68.75 q/ha). The increase in grain yield due to foliar spray of insecticides can be attributed to efficient control of planthoppers while keeping the population level below economic threshold level (ETL). Singh *et al* 2025 also observed that Flupyrimin and Pymetrozine improved grain yield compared with untreated plots.

Table 1: Effect of foliar spray of different insecticides on planthopper population in rice crop at Faridkot and Moga

Location	Faridkot (Location 1)				Moga (Location 2)				Overall			
Treatment	**Before spray**	**3 DAS**	**7 DAS**	**10 DAS**	**Before spray**	**3 DAS**	**7 DAS**	**10 DAS**	**Before spray**	**3 DAS**	**7 DAS**	**10 DAS**
Viola 10 SC @ 750 mL/ha	5.80 ± 0.297 (13.92)	1.40 ± 0.227 (6.72)	1.02 ± 0.041 (5.78)	1.12 ± 0.07 (6.1)	7.12 ± 0.507 (15.45)	2.48 ± 0.315 (8.99)	2.32 ± 0.449 (8.62)	2.36 ± 0.03 (8.83)	6.46 ± 0.346 (14.71)	1.94 ± 0.266 (7.94)	1.67 ± 0.277 (7.33)	1.74 ± 0.097 (7.57)
Chess 50 WG @300 g/ha	6.26 ± 0.462 (14.46)	1.82 ± 0.112 (7.73)	1.14 ± 0.081 (6.11)	1.20 ± 0.079 (6.28)	6.94 ± 0.106 (15.26)	2.36 ± 0.212 (8.79)	2.44 ± 0.033 (8.98)	2.52 ± 0.448 (9.02)	6.60 ± 0.246 (14.87)	2.04 ± 0.105 (8.29)	1.79 ± 0.078 (7.68)	1.86 ± 0.287 (7.76)
Imagine 10 SC @ 750 mL/ha	6.84 ± 0.482 (15.13)	1.48 ± 0.089 (6.97)	1.06 ± 0.056 (5.90)	1.34 ± 0.074 (6.64)	6.99 ± 0.183 (15.32)	2.96 ± 0.066 (9.90)	2.28 ± 0.033 (8.67)	2.44 ± 0.062 (8.98)	6.92 ± 0.307 (15.23)	2.22 ± 0.078 (8.57)	1.67 ± 0.04 (7.42)	1.89 ± 0.118 (7.89)
Untreated control	6.80 ± 0.063 (15.11)	6.96 ± 0.109 (15.29)	7.10 ± 0.299 (15.44)	7.40 ± 0.323 (15.77)	7.16 ± 0.503 (15.48)	7.40 ± 0.09 (15.78)	8.28 ± 0.037 (16.72)	8.40 ± 0.024 (16.84)	6.98 ± 0.277 (15.31)	7.18 ± 0.071 (15.54)	7.69 ± 0.138 (16.10)	7.90 ± 0.245 (16.32)
LSD (p=0.05)	NS	0.51	0.49	0.51	NA	0.66	0.73	0.75	NS	0.51	0.56	0.56
CV	11.10	10.71	11.59	11.39	12.20	10.72	11.82	11.78	11.49	9.35	10.81	10.23

LSD means Least significant difference at the 5% probability level (P ≤ 0.05); CV means coefficient of variation (%); N.S. means non-significant; DAS means Days after sowing; Values in parentheses are angular root transformed values.

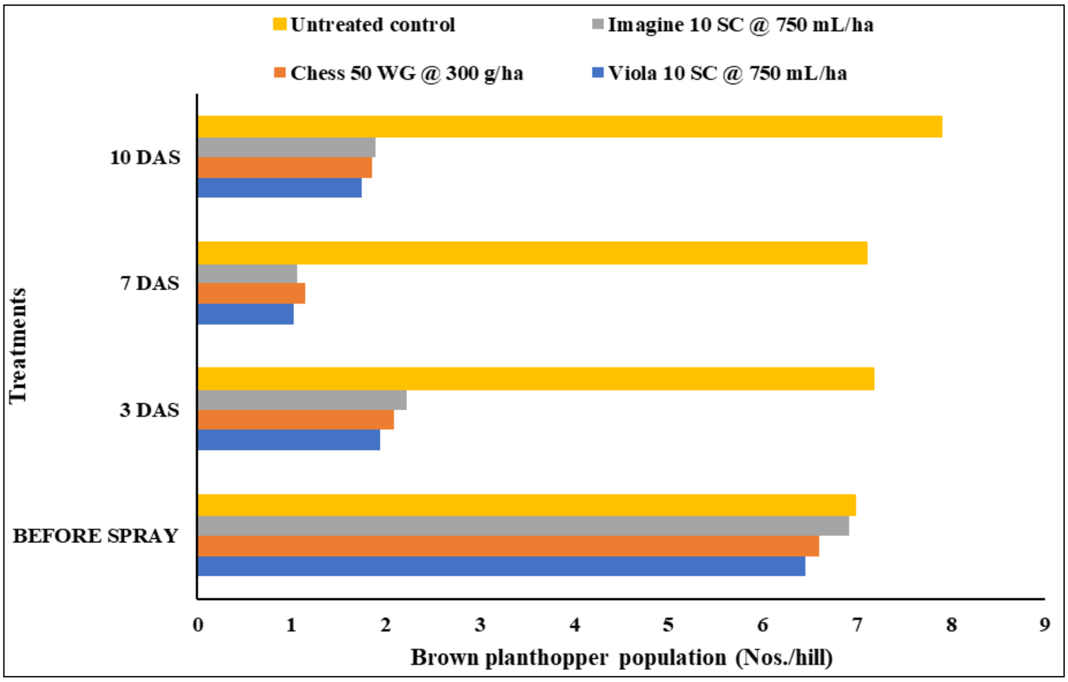

Fig 1: Trends of variation in population of planthoppers in rice crop as affected by foliar spray of different insecticides

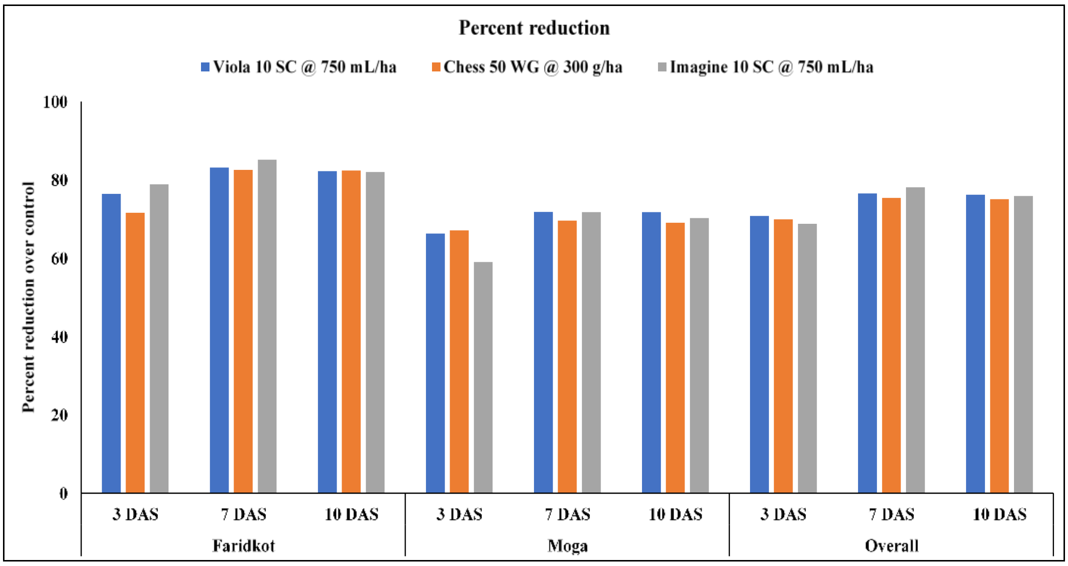

Fig 2: Percent reduction over control under different treatments

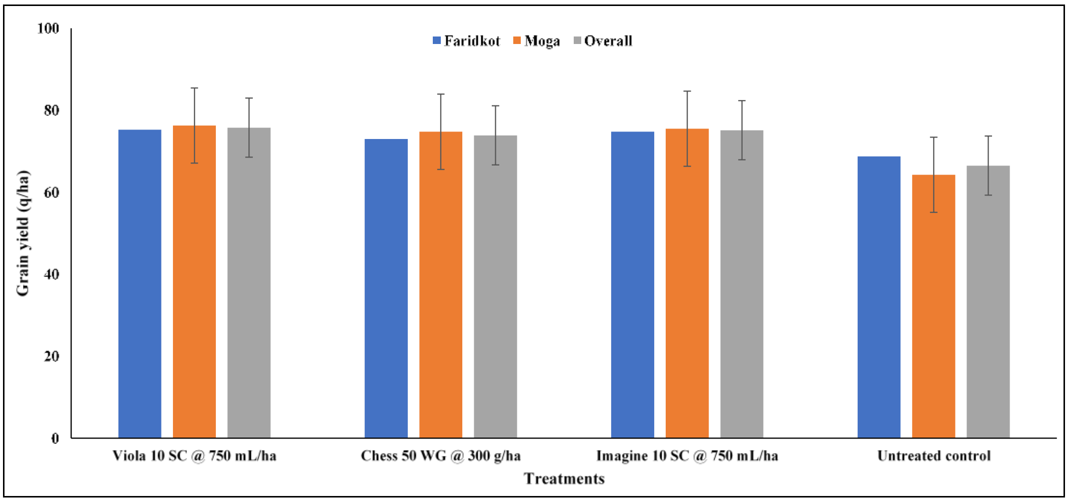

Fig 3: Grain yield of rice crop under different treatments

Conclusion

The present study demonstrated that all the evaluated insecticides effectively reduced brown planthopper populations and significantly increased rice grain yield compared with the untreated control. Maximum suppression was observed at 7 days after spray and effective control was maintained up to 10 days after spray. Overall, the findings suggest that these insecticides are effective options for brown planthopper management and can be integrated into rice pest management programmes. Their judicious use in rotation with insecticides having different modes of action is recommended to delay resistance development and ensure sustainable pest management.

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