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## Research Article

# Comparative Efficacy of Dinotefuran, Imidacloprid and Pymetrozine against Rose Aphid (*Macrosiphum rosae*) under Controlled and Field Conditions

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## ABSTRACT

*Macrosiphum rosae* is the major pest of rose plants and crops. There is limited research on using reduced-risk insecticides for rose aphid control, highlighting the need for more insights into their effectiveness and sustainable application. The study evaluated aphidicidal impact of novel chemistry insecticides i.e. Dinotefuran, Imidacloprid and Pymetrozine against rose aphids under laboratory and field conditions. Efficiency of Dinotefuran (T1), Imidacloprid (T2), and Pymetrozine (T3) against rose aphids were evaluated over 24, 48, and 72 hours in a laboratory by using leaf dip method. Imidacloprid (T2) showed the highest mortality, increasing from 15.5%-85.4% at 24 hours to 28.3%-96.6% at 72 hours. Dinotefuran (T1) followed closely, with mortality rising from 13.3%-80.9% to 22.6%-94.3% over the same period. Pymetrozine (T3) was slightly less effective, with mortality ranging from 20.2%-85.7% at 24 hours to 34.5%-92.9% at 72 hours. Field results also confirmed Imidacloprid long-term effectiveness, increasing to 31.7% by Day 5, with Dinotefuran and Pymetrozine slightly behind. Overall, Imidacloprid proved to be the most effective treatment, with Dinotefuran close behind and Pymetrozine slightly less successful.

**Keywords:** *Macrosiphum rosae*, New Chemistry Insecticides, Dinotefuran, Imidacloprid, Pymetrozine, Leaf Dip Method.



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## INTRODUCTION

Globally, around 18,000 varieties of roses are cultivated. This extensive cultivation is largely due to its renowned status as the "king of flowers" and the substantial profits earned by its growers (Quratulain et al., 2015; Stef et al., 2019). The rose, a thorny ornamental shrub belongs to the Rosaceae family. Roses play a vital role in agriculture, the floral industry, medicine, and landscape. Rose hips, known for one of the richest natural sources of Vitamin C, are particularly valued for their use in rose hip syrup, which is considered highly effective for curing scurvy (Yousuf and Buhroo, 2020). Roses are cultivated worldwide due to the vast variety of species, decorative thorns and fruits, and the seasonal variation in their leaves, which adds to their ornamental appeal (Golizadeh et al., 2017; Jaskiewicz, 2006; Jaśkiewicz, 2000).

Aphids are major agricultural pests commonly called as Plant lice belong to order Hemiptera and family *Aphididae*. They have worldwide distribution, but mostly found in temperate regions. Worldwide, there are estimated to be 5000 different species of aphids, also referred to as plant lice (Blackman and Eastop, 2018; Favret, 2017). They affect plant yield at different stages and can reduce crop yield up to 90% (Maryam et al., 2019; Rana, 2005).

The major pest of roses, *M. rosae* is an aphid species with a global distribution. Rose aphid causes harm to the blossoming particularly at budding. The rose aphid directly damages the young leaves and by sucking the sap to developing buds, which results in gall formation, stunted growth, and leaf discoloration. Honeydew production on flowers and on the leaves surface which causes indirect loss, on which molds grow which reduces photosynthesis and ultimately the yield (Jalalizand et al., 2012). All of these elements seriously harm plants of rose by lowering their aesthetic appeal and the market value of flower cutting. They can also spread the viruses like cauliflower mosaic, cabbage black ring spot and pea mosaic (Yousuf and Buhroo, 2020).

In both developing and underdeveloped nations, the use of pesticides is a widely used method for controlling insect pests (Saleem et al., 2018). This method lowered the number of the targeted pests, but the public has also been very concerned about the harmful effects of pesticides because they not only harm people and animals, but they also destroy the ecosystem (Alavanja et al., 2004). The widespread and extensive use of pesticides may lead to pest resistance and the demise of natural enemies of insects (Gogi et al., 2006). Insecticides can affect physical and biochemical processes affecting the natural enemies survival rate, reproduction rate, orientation, and behavioral aspects (De Castro et al., 2013; Desneux et al., 2005). They can also modify the behavior of these beneficial creatures even at a level that is not deadly (Atta et al., 2021; Mengoni Goñalons and Farina, 2015; Saran et al., 2014; Sohn et al., 2018).

Today several control methods have been used for reducing aphid infestation. Insecticides are important tools for pest management throughout the world, but they also have some useful and harmful effects (Dewar and Denholm, 2017). Chemical pesticides are the primary line of defense against this expanding aphid annoyance (Yousuf and Buhroo, 2020). The detrimental effects of these insecticides on humanity and the environment have led to the development of resistance in this pest insect (Denholm et al., 1999; Georghiou and Mellon, 1983).

Neonicotinoid pesticides, such as imidacloprid and dinotefuran, work well against pests but harm beneficial predators over an extended period of time (Kim et al., 2018). Dinotefuran, a third-generation neonicotinoid introduced in 1998, is widely used to control sucking pests. It is well renowned for working well as an insecticide in agricultural environments (Wakita et al., 2003). It is a low-toxicity contact toxin that harms mammals, but it damages insects irreversibly by acting systemically on their stomachs (Chen et al., 2020). Pymetrozine is a pyridine azomethine insecticide used to control sap-feeding pests in field, fruit, and ornamental crops. It functions by preventing the penetration of stylets which immediately stops aphids from feeding making it highly effective in preventing pest damage to plants (Raj Boina et al., 2011). Imidacloprid is a neonicotinoid, affects the nervous systems of insects by blocking nicotinic acetylcholine receptors. It provides effective long-term control of homopterous pests with a low risk to non-target species (Atta et al., 2021).

This manuscript presents a study evaluating the comparative efficacy of three new chemistry insecticides Dinotefuran, Imidacloprid, and Pymetrozine against *M. rosae*. Various factors were examined, including insecticide concentration, application techniques, exposure duration, and aphid mortality rates over predetermined intervals. The assessment of insecticide efficacy was conducted in both field and laboratory settings using field spraying and the leaf dip method. The findings contribute to the growing body of knowledge on pest management strategies for rose aphids and offer valuable insights into the potential effectiveness of these insecticides.

## MATERIALS AND METHODS

The study was conducted between January and June 2023 at the Institute of Horticultural Sciences and Department of Entomology University of Agriculture Faisalabad rich in the diversity of rose blossoms. A random sample of 65 leaves, 65 stems, 65 flower buds, and 65 rose blossoms were taken from each affected plant. Counts were performed using a fine brush to determine the numbers of aphids on the under and upper sides of leaves, on newly emerging stems, on rose buds, and on rose blossoms. During this procedure, great care was used to prevent harming the aphids.

The aphids were transferred into a clean, ventilated container to ensure proper air exchange and prevent suffocation. Fresh rose leaves were placed inside the container to serve as food for the aphids. To avoid warming and causing stress to the aphids, the containers were thereafter put in a cool, shady area.

### Controlled Environment

The aphids were put in 90 mm sterile petri dishes with moistened filter paper at the bottom to maintain humidity. Fresh rose leaves were supplied as a constant food source. The petri dishes were then placed in a humidity-controlled chamber to prevent desiccation. Temperature maintained between 20-25°C and a 16:8-hour light cycle

was provided to maintain natural conditions. The health of the aphids was regularly observed and checked, with rose leaf discs being replaced as needed and proper humidity levels being maintained.

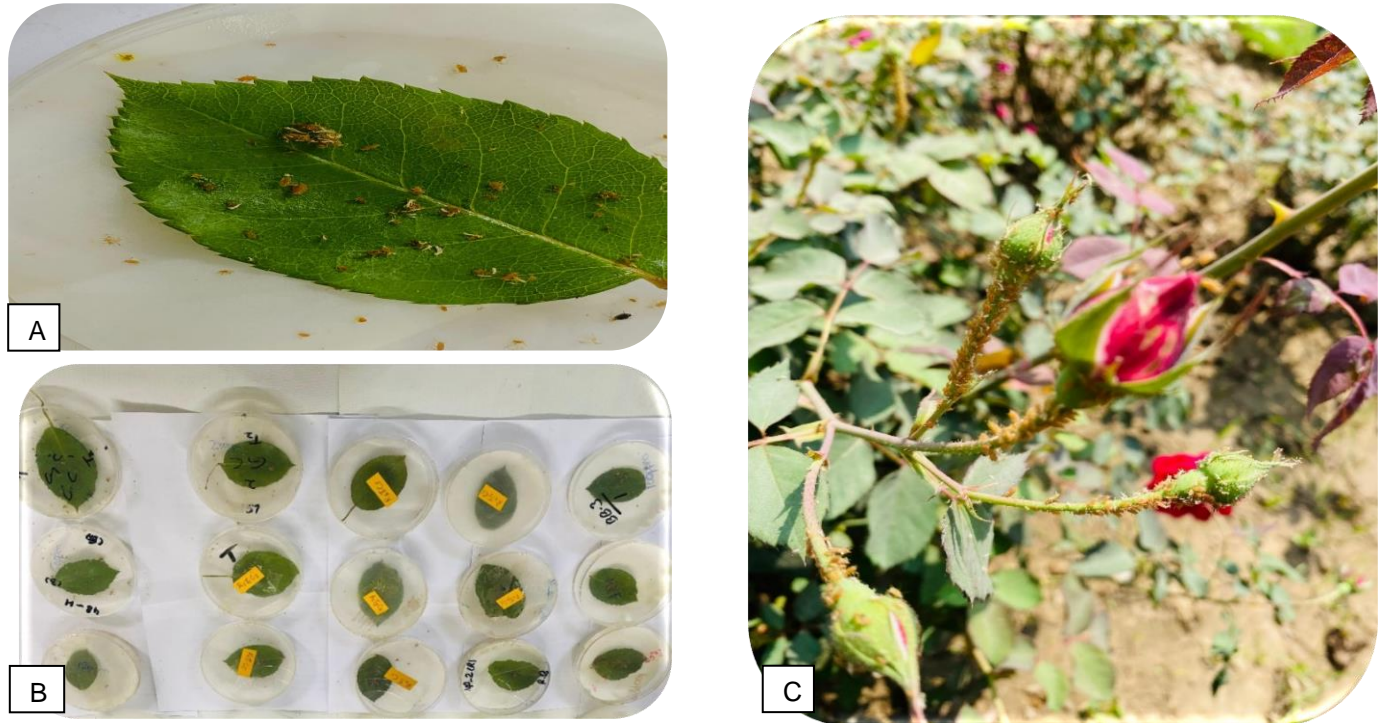


Figure 1. Leaf dip method (A and B), spraying rose plants in field (C)

### Insecticides

Three commercial insecticides dinotefuran, imidacloprid and pymetrozine were used in bioassays. Dinotefuran (Oshin 20SG) was provided by Arysta LifeScience. Imidacloprid (Confidor 20% SL) was provided by Plantcare. Pymetrozine (Suruga 50% WG) was provided by Eltra insecticide.

Table 1. Detailed information of insecticides to be used against rose aphid (*Macrosiphum rosae*).

Chemical Name	Trade Name	Type	Concentrations (ppm)	Company name
Imidacloprid	Confidor 20%SL	Neonicotinoids	50,100,150,200,250, 300	Plantcare
Pymetrozine	Suruga 50% WG	Neonicotinoids	50,100,150,200,250, 300	Eltra insecticide
Dinotefuran	Oshin 20SG	Neonicotinoids	50,100,150,200,250, 300	Arysta Life Science

### Preparation of Insecticides dilutions

Using the (Atta et al., 2015) methodology, five test dilutions of each pesticide (Table 1) were made from the corresponding stock solutions, which had the greatest concentration. Each pesticide's highest concentration stock solution (300 ppm) was made using Charles's equation ( $C_1V_1 = C_2V_2$ ), the subsequent serial dilution ( $C_2$ ) of each pesticide was prepared by taking half the volume of the stock solution and diluting it to its original proportion in a separate measuring cylinder using distilled water.

Using this technique, the subsequent dilutions were made up to five dilutions of each pesticide and a control treatment (Table 1). Shortly after preparation, the dilutions were applied to bioassay studies.

### Field Trails

The study was carried out in the University of Agriculture Faisalabad, Institute of Horticultural Sciences, which is situated in a region rich in a variety of rose blooms between 31.43°N latitude and 73.07°E longitude. Insecticide applications and observations were made between the beginning of February and the end of June. One of the institute's gardens, total 432 square meters, was chosen for the investigation. Three 148 square meter blocks, each having a completely randomized block design (CRBD), were used in the experimental setup.

Three 38 square meter treatment plots with a one-meter gap between each treatment were created from each block. The experiment covered 458 square meters in total. Marked rose bushes were used to collect baseline data on the aphid population before pesticides were applied. Each pesticide solution was then sprayed over the undersides of

leaves and the appropriate treatment plots using a spray bottle. Distilled water was sprinkled over the control plots. Aphid populations were observed and recorded at 1, 3, and 5 days after treatment, to note down the quantity of both live and dead aphids on each plot. This allowed for the evaluation of the efficacy of each treatment.

### Data Analysis

A Completely Randomized Design (CRD) was utilized to observe every treatment in the laboratory, whereas a Randomized Complete Block Design (RCBD) was employed in the field. Using Statistix 10 software, the mean values of treatments were compared at a 0.05 probability level using Tukey test.

For lab condition percentage mortality was derived by using Abbots Formula

$$\text{Mortality (\%)} = (\text{Mortality in Tr.} - \text{Av. In control}) / (100 - \text{Av. In control}) * 100$$

For Field Percentage mortality was derived by using Henderson- Tilton's Formula

$$\text{Mortality (\%)} = n \text{ in Co before treat} * n \text{ in T after treat} / n \text{ in control after treat} * n \text{ in T before treat}$$

## RESULTS

### Relative efficacy of dinotefuran on *M. rosae* after 1, 2 and 3 Days

Figure 2 shows the mortality percentage of *M. rosae* exposed to different concentrations of dinotefuran (50 ppm to 300 ppm) over three days. Mortality increases both with higher concentrations and with longer exposure times. Day 1: At lower concentrations (50–150 ppm), mortality is relatively low, ranging from around 10% at 50 ppm to approximately 50% at 150 ppm. The highest concentration (300 ppm) reaches about 70% mortality, indicating significant initial efficacy. Day 2: Mortality rises across all concentrations compared to Day 1. For instance, 100 ppm achieves over 50% mortality, whereas 300 ppm almost reaches 100%, showing that the dinotefuran becomes more effective with prolonged exposure. Day 3: Even the lowest concentration (50 ppm) causes around 40% mortality, while higher concentrations (250 and 300 ppm) approach or achieve 100% mortality. This suggests that by the third day, the insecticide reaches its peak effect, especially at higher doses. Overall, the graph indicates a clear dose-response effect, with both concentration and time enhancing aphid mortality.

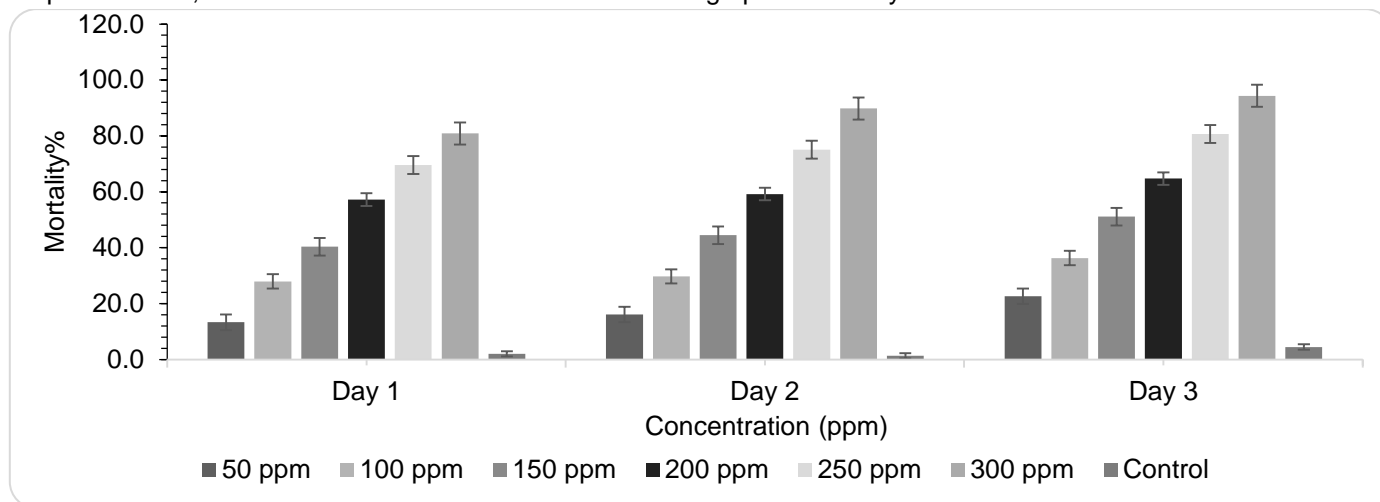


Figure 2. Comparative efficacy of different concentrations of dinotefuran (Means  $\pm$  SE;  $n = 5$ ) at Day 1, 2 and 3 on *M. rosae*.

### Relative efficacy of Pymetrozine on *M. rosae* after 1, 2 and 3 Days

Figure 3 displays the mortality rate of *M. rosae* over three days following exposure to different concentrations of pymetrozine (50 ppm, 100 ppm, 150 ppm, 200 ppm, 250 ppm, 300 ppm). On Day 1, aphid mortality due to Pymetrozine treatment increased with concentration, reaching around 80% at the highest concentration of 300 ppm, while the lowest concentration (50 ppm) showed approximately 10% mortality. On Day 2, all concentrations showed increased mortality rates, with 300 ppm reaching over 85% mortality, while mid-range concentrations (100–200 ppm) achieved between 30–70% mortality. By Day 3, the 300 ppm treatment attained close to 90% mortality, while other concentrations also showed incremental increases in mortality.

### Relative efficacy of Imidacloprid on *M. rosae* after 1, 2 and 3 Days

Figure 4 assessed the efficacy of imidacloprid on *M. rosae* using concentrations of 50, 100, 150, 200, and 300 ppm, with mortality rates measured at 1, 2 and 3 days intervals. The results showed a clear dose- and time-dependent

increase in aphid mortality, with the highest efficacy observed at 300 ppm, achieving 97% mortality by 3 days, followed by 250 ppm at 85.3%, and 200 ppm at 68.4%. These findings suggest that imidacloprid, particularly at higher concentrations, is highly effective in controlling *M. rosae*, making it a viable option for managing rose aphid populations.

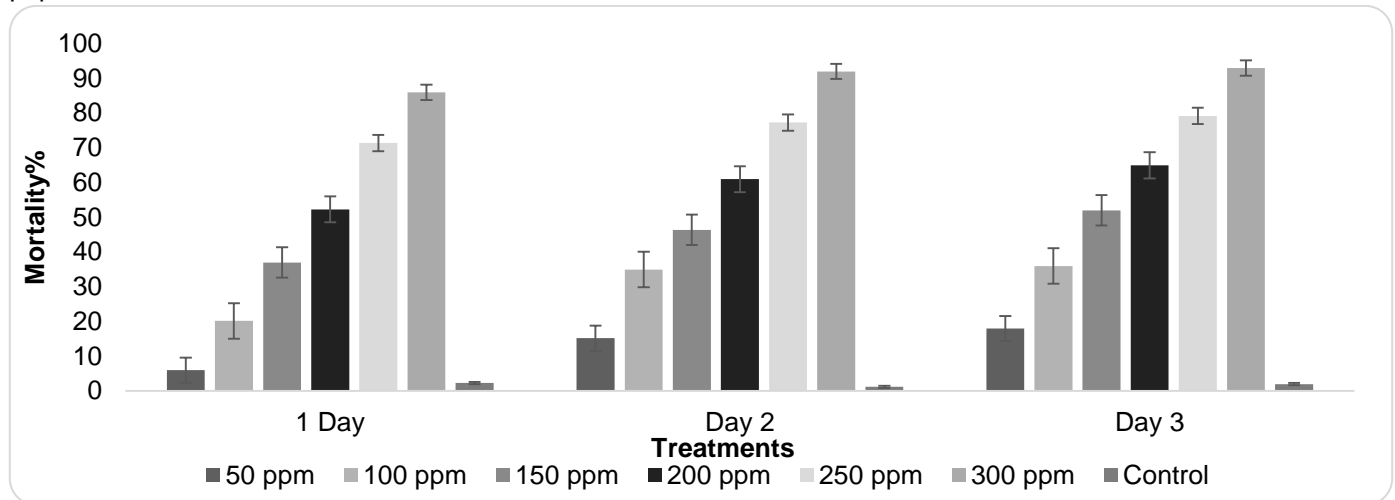


Figure 3. Comparative efficacy of different concentrations of pymetrozine (Means  $\pm$  SE; n = 5) at Day 1, 2 and 3 on *M. rosae*.

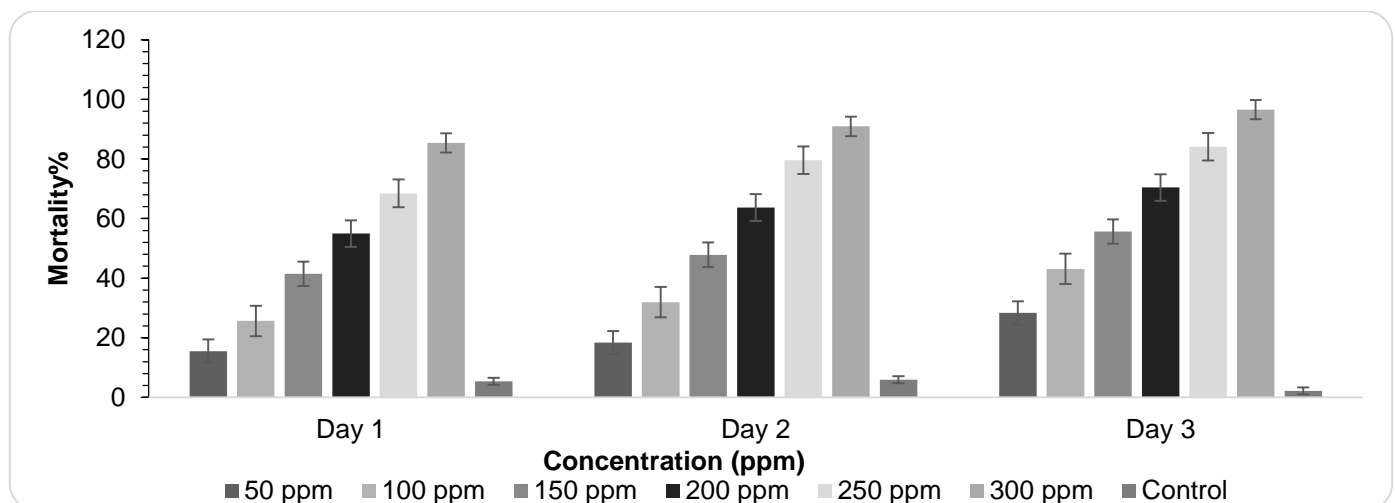


Figure 4. Comparative efficacy of different concentrations of imidacloprid (Means  $\pm$  SE; n = 5) at Day 1, 2 and 3 on *M. rosae*.

## Field Trials

### Relative efficacy of different concentrations of Dinotefuran against *M. rosae* after 1, 3 and 5 Days

Figure 5 assessed mortality of *M. rosae* at concentrations of 50, 100, 150, 200, 250, and 300 ppm of dinotefuran over Days 1, 3, and 5, along with a control group. On Day 1, mortality was low across all concentrations, with around 10% mortality at 50 ppm, increasing to approximately 15-20% at higher concentrations. By Day 3, mortality showed a slight increase, reaching about 15% at 50 ppm and around 18-20% for concentrations of 100 ppm and above, indicating an accumulative effect. On Day 5, mortality continued to rise modestly, with 50 ppm reaching 15-20% and higher concentrations (150–300 ppm) stabilizing around 20-30%. These results suggest Dinotefuran has a gradual, cumulative impact, with higher concentrations showing slightly increased mortality. These findings imply that dinotefuran is an effective means of managing *M. rosae* populations, and its increasing efficacy with higher concentrations suggests that optimizing application rates could enhance pest control strategies.

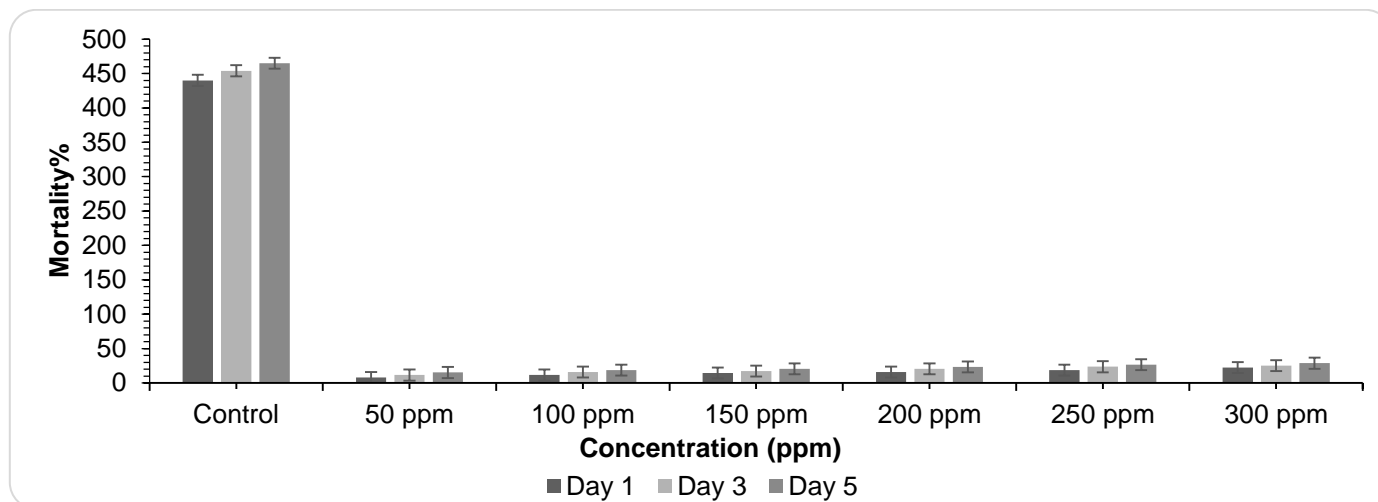


Figure 5. Effect of different concentrations of Dinotefuran (Mean $\pm$  S.E) on *M. rosae* mortality after 1, 3 and 5 Days.

#### Relative efficacy of different concentrations of Pymetrozine against *M. rosae* after 1, 3 and 5 days

Figure 6 shows the efficacy of Pymetrozine against *M. rosae* was assessed over three days using selected concentrations of 100 ppm, 200 ppm, and 300 ppm of Pymetrozine. On Day 1, the mortality rates demonstrated a positive correlation with concentration: 6.8% at 100 ppm, 11.3% at 200 ppm, and 16.7% at 300 ppm. By Day 3, the mortality rates showed further increases, with 13.3% at 100 ppm, 17.0% at 200 ppm, and 23.0% at 300 ppm. On Day 5, the mortality rates reached 16.0% at 100 ppm, 19.1% at 200 ppm, and 25.2% at 300 ppm. The continuous rise in mortality rates across all concentrations highlights potential of Pymetrozine for effective long-term control of rose aphid populations. The implications of these results underscore the potential for Pymetrozine to be utilized as a key element in integrated pest management strategies for rose cultivation.

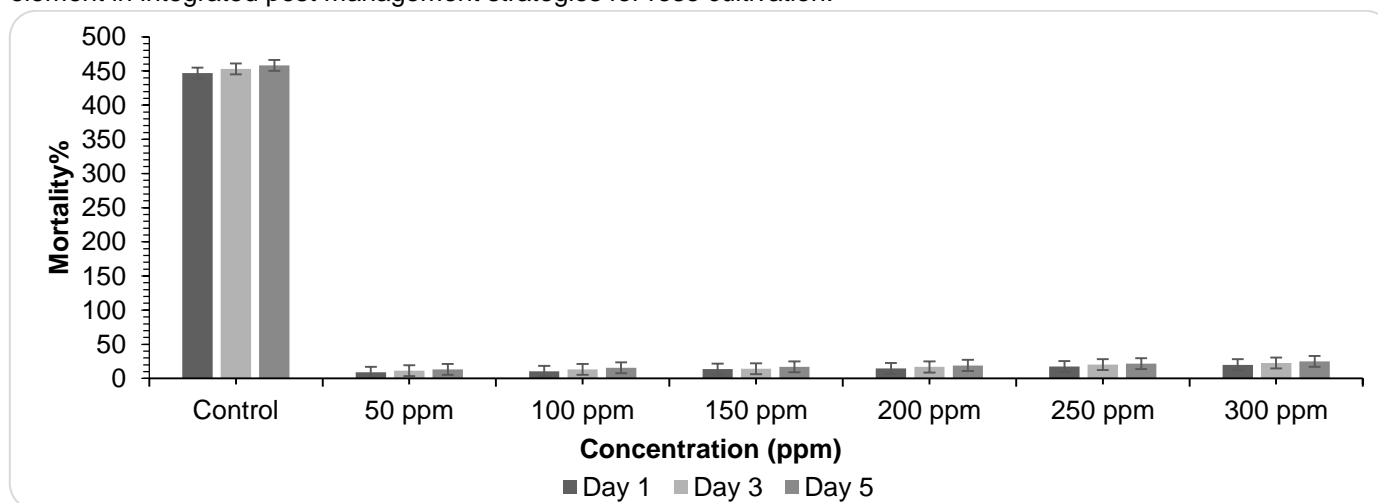


Figure 6. Effect of different concentrations of Pymetrozine (Mean $\pm$  S.E) on *M. rosae* mortality at Day 1, 3 and 5

#### Relative efficacy of different concentrations of Imidacloprid against *M. rosae* after 1, 3 and 5 days

Figure 7 shows the efficacy of Imidacloprid using selected concentrations of 100 ppm, 200 ppm, and 300 ppm against *M. rosae* demonstrated a clear dose-dependent relationship in mortality rates over a five-day period. On Day 1, a significant increase in aphid mortality was observed with higher concentrations, with 12.2% mortality at 50 ppm, rising to 24% at 300 ppm. By Day 3, mortality rates further escalated, reaching 28.2% at 300 ppm, highlighting imidacloprid effectiveness as a pest management tool, especially at higher concentrations. On Day 5, the mortality rate peaked at 32% for the highest concentration. Notably, the data suggested that mortality rates consistently increased with concentration, indicating a potential optimal concentration range for effective aphid management. Overall, these findings underscore Imidacloprid as a valuable component in integrated pest management strategies for rose cultivation, emphasizing its capacity to significantly reduce aphid populations.

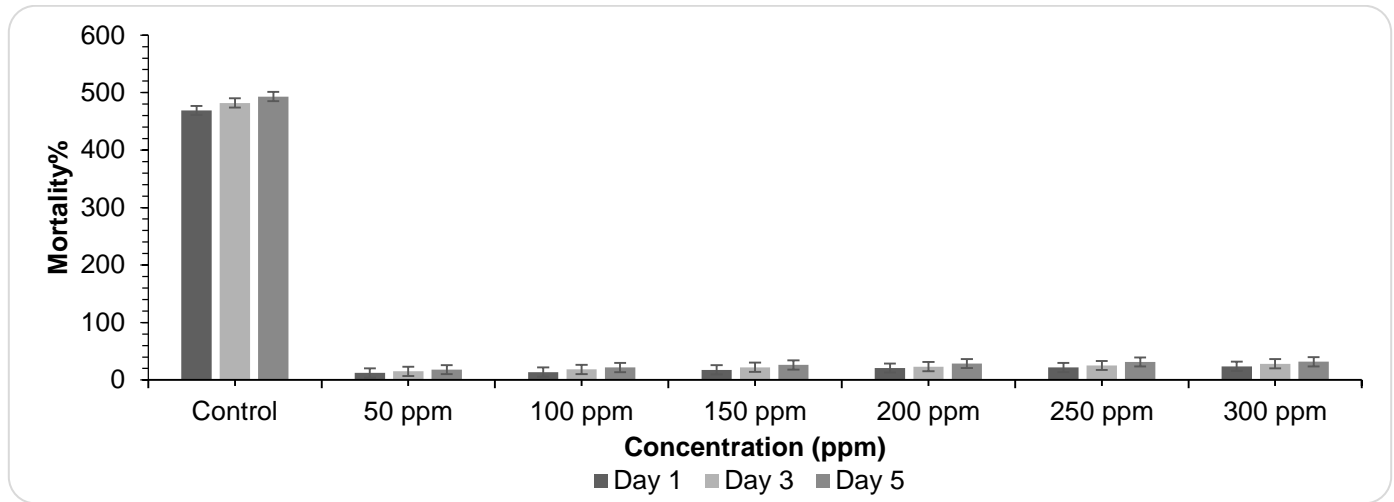


Figure 7. Effect of different concentrations of imidacloprid (Mean± S.E) on *M. rosae* mortality at 1, 3 and 5 Days.

Table 2. Comparison of insecticides with respect to relative efficacy of *M. rosae* in field.

Insecticides	Mortality%					
	Day 1	S.E	Day 3	S.E	Day 5	S.E
Dinotefuran (T1)	8.0 E	±0.1	11.5 F	±0.1	15.2 A	±0.02
	11.5 DE	±0.1	15.8 E	±0.1	18.7 B	±0.28
	14.4 CD	±0.7	17.2 D	±0.4	20.4 E	±0.3
	15.8 BC	±0.4	20.4 C	±0.1	23.2 D	±0.2
	18.5 B	±0.3	23.6 B	±2.8	26.4 C	±0.08
	22.4 A	±2.6	25.2 A	±0.2	28.7 B	±0.4
	Control	0.02	Control	±0.4	Control	±0.04
Imidacloprid (T2)	12.2 C	±0.6	15.0 A	±0.27	18.0 E	±0.13
	13.8 BC	±0.2	18.3 E	±0.28	21.7 D	±0.08
	17.7 ABC	±2	22.0 D	±0.21	26.2 C	±0.40
	20.8 AB	±2	23.2 C	±0.2	28.5 C	±0.4
	21.8 A	±2.6	25.3 B	±0.1	31.4 B	±0.2
	23.7 A	±4	28.2 A	±0.27	31.7 B	±0.11
	Control	±1.6	Control	±0.5	Control	±0.8
Pymetrozine (T3)	9.2 D	±0.56	11.4 E	±0.41	13.3 G	±0.33
	10.4 D	±0.17	13.3 D	±0.16	15.7 F	±0.28
	13.6 C	±0.88	14.2 D	±0.19	17.2 E	±0.09
	14.8 C	±0.17	16.8 C	±0.22	19.1 D	±0.34
	17.6 B	±0.27	20.1 B	±0.32	21.8 C	±0.17
	20.1 A	±0.26	22.6 A	±0.12	25.2 B	±0.14
	Control	±0.32	Control	±0.33	Control	±0.59

Comparison of insecticides show the percentages of rose aphids that died after 1, 3, and 5 days of treatment with Dinotefuran (T1), imidacloprid (T2), and Pymetrozine (T3). With death rates increasing from 9.2% to 23.7% on Day 1 to 31.7% by Day 5, imidacloprid (T2) shows the best overall efficacy, demonstrating its better long-term effectiveness. Significant increases in mortality are observed with dinotefuran (T1), from 8.0% to 22.4% on Day 1 to 28.7% on Day 5. With mortality rates ranging from 10.4% to 20.1% on Day 1 to 25.2% by Day 5, Pymetrozine (T3) exhibits consistent, moderate effectiveness. Imidacloprid (T2), Dinotefuran (T1), and Pymetrozine (T3) are the most effective insecticides against rose aphids overall. But the highest mortality was observed with respect to Imidacloprid. Over the course of the 1, 3, and 5-day observation periods, no aphid mortality was noted in the control group, which received simply distilled water applied to the rose plants. On the contrary, rose aphid populations were on the rise. This finding highlights the need for employing appropriate insecticides in conjunction with distilled water to effectively control rose aphid populations.

Table 3. Comparison of insecticides with respect to relative efficacy of *M. rosae* in Laboratory.

Insecticides	Mortality%					
	Day 1	S.E	Day 2	S.E	Day 3	S.E
Dinotefuran (T1)	13.3 D	±2.96	16.1 F	±3.02	22.6 C	±3.01
	27.9 C	±3	29.7 E	±2.99	36.3 C	±3
	40.3 C	±2.98	44.5 D	±3	51.1 B	±2.8
	57.2 B	±2.95	59.2 C	±1.96	64.7 B	±2.99
	69.6 AB	±1.95	75.1 B	±3	80.7 A	±3.01
	80.9 A	±3	89.8 A	±2	94.3 A	±3
	Control	±1.15	Control	±0	Control	±1.13
Imidacloprid (T2)	15.5 E	±1.95	18.4 D	±1.96	28.3 D	±3.95
	25.7 E	±2	32 D	±3.9	43.1 C	±3.01
	41.5 D	±2.98	47.9 C	±3	55.6 C	±1.97
	55.0 C	±3	63.7 B	±3	70.4 B	±3
	68.5 B	±2.98	79.6 A	±2	84.1 AB	±3.01
	85.4 A	±3	90.9 A	±2.9	96.6 A	±1.97
	Control	±2	Control	±1.33	Control	±1.14
Pymetrozine (T3)	6.0 F	±2.4	15.3 E	±4.08	17.9 E	±4.12
	20.2 E	±3.2	35.3 D	±3.11	34.5 D	±3.15
	37 D	±3.15	51.8 C	±3.1	46.4 CD	±2.06
	52.4 C	±3.2	64.7 C	±2	60.7 C	±2.1
	71.4 B	±2.06	78.8 B	±2.04	77.4 B	±3.2
	85.7 A	±2.1	92.9 A	±2	92.9 A	±4.1
	Control	±2.1	Control	±2	Control	±1.2

The data displays the mortality percentages of rose aphids treated for 1, 2 and 3 days with three different insecticides: Dinotefuran (T1), imidacloprid (T2), and Pymetrozine (T3). Dinotefuran (T1) has a considerable effect over time, as seen by the increase in mortality from 13.3% to 80.9% at 24 hours to 22.6% to 94.3% at 72 hours. As the most effective insecticide overall, imidacloprid (T2) consistently exhibits great efficacy, with mortality rates increasing from 15.5% to 85.4% at 24 hours to 28.3% to 96.6% at 72 hours. With death rates rising from 20.2% to 85.7% at 24 hours to 34.5% to 92.9% at 72 hours, Pymetrozine (T3) demonstrates a moderate initial mortality that slowly improves over time. Overall, it appears that imidacloprid (T2) works best against rose aphids, with Dinotefuran (T1) coming in second. Pymetrozine (T3) is also effective, however less potent.

## DISCUSSION

*M. rosae* have become a significant pest for rose plants globally, inflicting damage by feeding on sap, leading to stunted growth, reduced vigor, and the potential spread of plant viruses. Severe infestations can drastically diminish both the aesthetic appeal and commercial value of roses. Traditional control methods, including neem extracts and detergent sprays, are commonly employed by growers, but these approaches can adversely affect the health of the rose plants themselves. In contrast, our study tested the new chemistry insecticides dinotefuran, imidacloprid, and Pymetrozine, revealing that both dinotefuran and imidacloprid exhibited significantly greater efficacy against rose aphids over time, while Pymetrozine proved less effective.

The findings align with previous research, (Zhang et al., 2023), which demonstrated that imidacloprid treatments substantially decreased the survival rates of several aphid species, including *S. avenae* and *R. padi*, in both laboratory and field conditions. This consistency reinforces the reliability of imidacloprid as a robust solution for aphid management. Our observations of imidacloprid efficacy—showing mortality rates increasing over 72 hours—echo the findings of Amini Jam et al. (2014), who reported comparable toxicities in laboratory settings for *Aphis gossypii*, highlighting the compound's effectiveness across different aphid species.

While our study supports the conclusion that imidacloprid and dinotefuran can significantly manage aphid infestations, it is crucial to follow application guidelines meticulously to minimize the risk of developing insecticide resistance. Rotating these insecticides according to manufacturer recommendations and reapplying them every 7 to 14 days, depending on infestation severity, is essential for sustainable management practices.

In comparison, (Cheng et al., 2021) noted that while dinotefuran was effective in reducing parasitism rates of

beneficial insects, our research showed that its use led to a marked decline in the rose aphid population within a day. This suggests that while dinotefuran may have some non-target effects, its efficacy against rose aphids can provide an effective control measure when used judiciously.

Our findings also resonate with (Sreedhar, 2020), who identified alternative molecules to neonicotinoids for aphid control. Pymetrozine was evaluated alongside other pesticides, revealing it as relatively less toxic to aphid predators. Although Pymetrozine did show some effectiveness in our study, it was not as potent as imidacloprid or dinotefuran, which aligns with the observations of (Li et al., 2018) that highlighted imidacloprid potential to control various growth and developmental stages of sap-sucking aphids.

In summary, this study underscores the effectiveness of imidacloprid and dinotefuran in managing rose aphids while emphasizing the importance of careful application to mitigate any negative impacts on beneficial organisms. Continued research into the long-term effects and resistance management strategies will be vital for maintaining effective integrated pest management practices.

## CONCLUSION

The results indicated that imidacloprid was the most effective insecticide, demonstrating superior efficacy due to its unique chemical properties. While Pymetrozine was less effective than imidacloprid and dinotefuran, it remains a viable option, particularly in integrated pest management strategies that aim to minimize impacts on non-target organisms. The study highlights the need to select insecticides based on environmental conditions and management goals. A balanced approach incorporating all three insecticides may enhance pest management strategies. Future research should focus on optimizing application methods and monitoring for potential resistance development to ensure sustainable control of aphids.

## AUTHOR CONTRIBUTIONS

All authors contributed equally to this research.

## COMPETING OF INTEREST

The authors declare no competing interests.

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