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Field evaluation of novel insecticides against olive psyllid, *Euphyllura straminea* Loginova, in northern Iran

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Abstract

The olive psyllid, *Euphyllura straminea* Loginova (Hemiptera: Aphalaridae), is one of the most destructive pests of olive orchards in Iran, causing substantial economic losses through nymphal feeding on plant sap, flower buds, and young shoots. Severe infestations can reduce tree vigor, induce flower bud abscission, impair flowering, and ultimately decrease fruit set and yield. The present study was conducted to evaluate the field efficacy of selected insecticides as potential alternatives to obsolete compounds for the management of olive psyllid nymphs in an olive orchard located in Azadshahr County, Golestan Province, northern Iran. Five insecticides, including Asphit, spirotetramat, abamectin, matrine, and spinosad, were applied at the recommended field rates in a randomized field experiment with three replicates. Nymphal populations were assessed one day before treatment and at 3, 7, and 14 days after application. Insecticidal efficacy was calculated using the Henderson–Tilton formula, and treatment effects were compared statistically. Significant differences were detected among the evaluated insecticides throughout the assessment period. Fourteen days after application, Asphit provided the highest level of control, achieving 92.36 ± 4.56% efficacy against olive psyllid nymphs, whereas abamectin exhibited the lowest efficacy, resulting in only 10.52 ± 3.77% control. Matrine also demonstrated substantial and persistent activity, reaching 83.10 ± 3.02% efficacy at the final evaluation. The superior and sustained performance of Asphit indicates its potential as an effective component of olive psyllid management programs targeting the nymphal stage. These findings provide valuable information for optimizing integrated pest management strategies in olive orchards and support the adoption of more sustainable pest-control practices while reducing reliance on high-risk insecticides and preserving agroecosystem stability.

Keywords: *Euphyllura straminea*, olive psyllid, insecticide efficacy, Asphit, matrine, integrated pest management

Introduction

The olive tree, *Olea europaea* L. (Oleaceae), is one of the most economically and ecologically important perennial crops in Mediterranean regions and plays a pivotal role in the agricultural economies of many countries. In Iran, olive cultivation has expanded substantially over recent decades, particularly in the provinces of Golestan, Gilan, Zanjan, Qazvin, and Fars, which represent the principal olive-producing areas. Despite this expansion, olive production is increasingly constrained by a range of arthropod pests, among which the olive psyllid, *Euphyllura straminea* Loginova (Hemiptera: Aphalaridae), is regarded as one of the most economically important species. Both nymphs and adults damage olive trees through sap-feeding on young shoots, leaves, flower buds, and developing fruits. Severe infestations may reduce tree vigor, impair flowering, decrease fruit set, and ultimately result in substantial yield losses. Furthermore, nymphs produce abundant honeydew and waxy secretions that promote secondary contamination and negatively affect plant growth and productivity. The pest is widely distributed throughout the major olive-growing regions of Iran and has also been reported as an economically important pest in several Mediterranean and Middle Eastern countries, including Iraq, Jordan, Tunisia, Greece, and Turkey (Marouf *et al*., 2020) [2]. Management of olive psyllid has traditionally relied on chemical control. However, growing concerns regarding environmental contamination, negative impacts on beneficial arthropods, increasing regulatory restrictions on conventional insecticides, and the potential development of insecticide resistance have highlighted the need for more sustainable and effective control strategies. Consequently, the identification of effective insecticides compatible with integrated pest management (IPM) programs has become an important research priority. Recent investigations have emphasized the continued economic importance of *E. straminea* in olive-growing regions and the need for improved management strategies. Studies conducted in Iran have reported substantial yield reductions associated with severe infestations of olive psyllid, highlighting the necessity of effective control measures (Marouf *et al*., 2020) [2]. In addition, host plant characteristics and phenolic compounds have been shown to influence psyllid abundance among olive cultivars, suggesting that pest management should integrate both chemical and non-chemical approaches (Azimi *et al*., 2025) [5]. Recent field evaluations have further demonstrated that insecticides with novel modes of action, including spirotetramat and sulfoxaflor, can provide high levels of suppression against olive psyllid populations and may contribute to resistance management programs (Hamzah *et al*, 2025) [8]. Nevertheless, information regarding the efficacy of newly available

insecticides under the environmental conditions of northern Iran remains limited, particularly for compounds that are increasingly incorporated into integrated pest management programs (Abbasi Mojdehi *et al*, 2025) [1].

Although several studies have investigated the management of olive psyllid, comparative information on the field performance and residual efficacy of recently introduced insecticides against nymphal populations of *E. straminea* under the environmental conditions of northern Iran remains limited. Addressing this knowledge gap is essential for developing region-specific recommendations and improving pest management programs in commercial olive orchards.

Therefore, the present study was conducted to evaluate the field efficacy of selected insecticides, including Asphit, spirotetramat, abamectin, matrine, and spinosad, against nymphal populations of *E. straminea* in olive orchards of Golestan Province, Iran. We hypothesized that these insecticides would differ significantly in their efficacy and persistence under field conditions. The findings of this study provide practical information for optimizing IPM programs and supporting the development of sustainable management strategies for olive psyllid in commercial olive production systems.

Materials and Methods

The field experiment was conducted in a commercial olive orchard located in the Agh Emam region, Azadshahr County, Golestan Province, northern Iran (37.113489°N, 55.214990°E). The study site was selected due to its history of severe infestations and recurrent outbreaks of the olive psyllid, *Euphyllura straminea* Loginova. The orchard consisted of 5–7-year-old olive trees naturally infested with olive psyllid populations. Insecticide applications were performed on 12 June 2025 under field conditions. Five insecticides were evaluated, including two bioinsecticides (matrine and spinosad) and three synthetic insecticides (Asphit, spirotetramat, and abamectin), applied at the manufacturers' recommended field rates. The experiment was designed to compare the efficacy of these insecticides against nymphal populations of *E. straminea* under natural infestation conditions and to identify effective alternatives for incorporation into integrated pest management (IPM) programs in olive orchards of northern Iran.



Fig 1: Olive trees with natural infestation.

Table 1: Insecticides used in the study and their application rates

No.	Common name (active ingredient)	Commercial name	Manufacturer	Recommended concentration
1	Asphit 90% SG	Tidefit	Giah Parnian Atlas	0.5 ‰ (0.5 per thousand)
2	Spinosad 5% SC	Pirouzan	Giah Parnian Atlas	0.5 ‰
3	Spirotetramat 10% SC	Movento	Kavosh Kimia	0.75 ‰
4	Matrine 0.6% SL	Ruy Agro	Giah Parnian Atlas	2 ‰
5	Abamectin 10% SC	Verlack	Giah Parnian Atlas	1 ‰



Fig 2: Insecticides evaluated in the study.

Insecticide mode of action

Asphit (organophosphate) acts as an acetylcholinesterase inhibitor, disrupting synaptic transmission in the insect nervous system and causing mortality. Spinosad (spinosyn group) targets nicotinic acetylcholine receptors, inducing continuous neural excitation, paralysis, and death. Spirotetramat (tetramic acid derivative) inhibits lipid biosynthesis, affecting fatty acid and triglyceride formation and disrupting growth and development. Matrine, a plant-derived alkaloid from *Sophora* spp., affects insect nervous system function, resulting in paralysis and mortality. Abamectin (avermectin group) acts via ingestion by activating glutamate-gated chloride channels, leading to neuromuscular paralysis and death.

Experimental design and sampling procedure

Each experimental unit consisted of two 5–7-year-old olive trees, with buffer trees established between treatments to minimize spray drift. A randomized complete block design (RCBD) was used for treatment allocation. Trees were sprayed with approximately 10 L of insecticide solution using a 20-L knapsack sprayer equipped with a pistol-type nozzle, ensuring complete canopy coverage. Sampling was conducted one day before treatment and at 3, 7, and 14 days after application. At each sampling date, five 20-cm shoots were randomly collected from different parts of each tree. Nymphal stages of the olive psyllid were examined under a stereomicroscope in the Plant Protection Research Laboratory. Mortality was assessed based on immobility and color change in nymphs.



Fig 3: Field spray application of insecticides.

Statistical analysis

Insecticidal efficacy was calculated using the Henderson–Tilton formula (Henderson and Tilton, 1955), which corrects for population changes in both treated and control plots:

$$\text{Efficacy (\%)} = 100 \times [1 - (Ta \times Cb) / (Tb \times Ca)]$$

where:

Ta = mean pest population in treated plots after application
Tb = mean pest population in treated plots before application
Ca = mean pest population in control plots after application
Cb = mean pest population in control plots before application

Data were subjected to analysis of variance (ANOVA) to determine significant differences among treatments. When significant effects were detected, means were separated using Tukey's honestly significant difference (HSD) test at $P \leq 0.05$. All analyses were performed using SAS software (version 9.4; SAS Institute Inc., Cary, NC, USA).

Results

At 3 days after application, significant differences in efficacy among treatments were observed. Asphit showed the highest control of olive psyllid nymphs, with a mean efficacy of 81.88 ± 3.66%, while abamectin exhibited the lowest performance (49.76 ± 9.61%). Spinosad, spirotetramat, and matrine showed intermediate and statistically comparable efficacy levels, each providing approximately 60% control of the pest population (Figure 4).

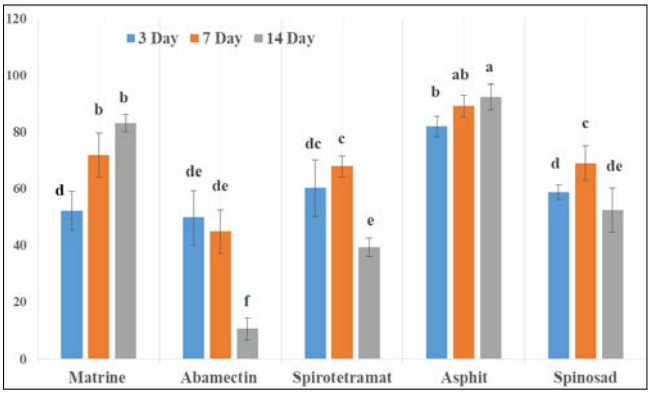


Fig 4: Mean efficacy (%) of insecticides over time.

At 7 days after application, the efficacy of several treatments increased relative to the initial assessment. Matrine and spinosad each achieved more than 70% control of olive psyllid nymphs. Nevertheless, Asphit remained the most effective treatment, with an efficacy of 89.17 ± 3.82%, whereas abamectin showed the lowest efficacy (44.91 ± 7.73%). The remaining treatments provided intermediate levels of control (Figure 4).

Fourteen days after application, Asphit continued to exhibit the highest efficacy, achieving 92.36 ± 4.56% control of olive psyllid nymphs. In contrast, abamectin remained the least effective treatment, with efficacy declining to approximately 10%. Matrine showed a progressive increase in efficacy over time, reaching 83.10 ± 3.02% at 14 DAT. The efficacy of spinosad and spirotetramat decreased relative to the 7-day assessment (Figure 4).

Discussion

The present study demonstrated significant differences in efficacy among the evaluated insecticides against nymphal populations of *Euphyllura straminea*. Asphit consistently provided the highest level of control throughout the evaluation period, achieving more than 92% efficacy at 14 days after application. The superior performance of Asphit may be attributed to its organophosphate mode of action, which rapidly disrupts acetylcholinesterase activity and causes high mortality in susceptible insect stages.

Matrine also exhibited substantial efficacy, with control levels increasing over time and reaching more than 83% at 14 days after application. This result suggests that matrine may represent a promising alternative within integrated pest management (IPM) programs, particularly where reduced reliance on conventional insecticides is desired. In contrast, abamectin showed limited and declining efficacy during the study period, indicating that it may not provide satisfactory control of olive psyllid nymphs under field conditions in the study area.

Previous studies in Iran have shown that winter oil applications can significantly reduce olive psyllid populations; however, additional interventions are often required when pest populations exceed economic thresholds during the growing season (Maroufi *et al*., 2019) [9]. The results of the present study indicate that timely application of Asphit during the nymphal stage can provide effective suppression of olive psyllid populations and may serve as a valuable component of IPM programs in olive orchards.

Conclusion

The present study demonstrated significant differences in the efficacy of the evaluated insecticides against nymphal populations of Euphyllura straminea. Among the tested compounds, Asphit provided the highest and most persistent level of control, achieving 92.36 ± 4.56% efficacy 14 days after application. Matrine also showed promising activity, whereas abamectin exhibited limited effectiveness under field conditions. These findings suggest that Asphit may serve as an effective component of integrated pest management programs for olive psyllid in olive orchards of northern Iran. Further studies are recommended to evaluate its long-term performance, compatibility with biological control agents, and potential role in resistance management strategies.

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