

Evaluation of the Effectiveness of Olive Leaf Extract as a Natural Insecticide for the Control of Olive Psyllid (*Euphyllura olivina*)

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تقييم فعالية مستخلص أوراق الزيتون كمبيد حشري طبيعي لمكافحة آفة بسلا الزيتون

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Received: April 11, 2026

Accepted: June 20, 2026

Published: June 28, 2026

Abstract

This study aimed to evaluate the insecticidal effectiveness of olive leaf extracts (local Enduri cultivar) against the olive psyllid (*Euphyllura olivina*) in Libya. The research investigated two extraction methods: Aqueous Infusion and Organic Solvent (Methanolic) Extract. Experiments were conducted under laboratory and field conditions using three concentrations (15%, 20%, and 25%), compared with a conventional chemical insecticide and a control group. The results demonstrated the superiority of the Methanolic Extract, achieving the highest mortality rate of 87% at the 25% concentration, followed by the Aqueous Extract at 80% after 72 hours of treatment. Field trials further confirmed the extracts' efficiency in significantly reducing pest population density. The study concludes that olive leaf extracts, particularly the methanolic one, serve as a safe and effective bio-alternative to synthetic pesticides, supporting Integrated Pest Management (IPM) strategies and sustainable agriculture.

Keywords: Olive psyllid, Olive leaf extract, Aqueous extract, Methanolic extract, Enduri cultivar, Biopesticides.

الملخص:

هدفت هذه الدراسة إلى تقييم الفعالية الإبادية لمستخلصات أوراق الزيتون (صنف اندوري محلي) ضد آفة بسلا الزيتون (*Euphyllura olivina*) في ليبيا، مع مقارنة تأثير نوعين من المذيبات: المستخلص المائي والمذيب العضوي (الميثانول). أجريت التجارب تحت الظروف المعملية والحقلية باستخدام ثلاثة تراكيز (15%، 20%، 25%)، وتمت مقارنتها بمبيد كيميائي تقليدي ومجموعة تحكم. أظهرت النتائج تفوق المستخلص الميثانولي في تحقيق أعلى معدلات نفوق، حيث وصلت نسبة الإبادة عند تركيز 25% إلى 87%، يليه المستخلص المائي بنسبة 80% بعد 72 ساعة من المعاملة. كما أثبتت التجارب الحقلية كفاءة المستخلصات في خفض الكثافة العددية للآفة بشكل ملحوظ. تخلص الدراسة إلى أن مستخلص أوراق الزيتون، وخاصة المستخلص الميثانولي، يمثل بديلاً حيوياً آمناً وفعالاً للمبيدات الكيميائية، مما يساهم في تعزيز استراتيجيات الإدارة المتكاملة للآفات (IPM) والزراعة المستدامة.

الكلمات المفتاحية: بسلا الزيتون، مستخلص أوراق الزيتون، المستخلص المائي، المستخلص الميثانولي، صنف اندوري، المبيدات الحيوية.

1. Introduction:

The olive tree (*Olea europaea* L.) is a cornerstone strategic crop in Libya and the Mediterranean basin, holding immense economic, social, and cultural significance. However, this crop faces numerous environmental challenges and pests that reduce production quality and quantity. Among the most damaging pests is the olive psyllid (*Euphyllura olivina*), which causes direct damage by sucking plant sap and indirect damage through the secretion of honeydew and "cottony" wax, which encourages sooty mold growth and hinders photosynthesis. In alignment with the global shift toward sustainable agriculture, there is an urgent need for safe natural alternatives to synthetic pesticides. Olive leaf extracts are particularly promising due to their high content of active phenolic compounds, such as Oleuropein, which possess potent insecticidal and repellent properties.

2. Literature Review:

Numerous studies have highlighted the efficacy of plant extracts in olive pest control. Research by [6] demonstrated that aqueous extracts of wild olive leaves exhibit toxic effects on Psylla larvae. Furthermore, phenolic compounds have been shown to act as antifeedants and neurotoxins in insects. While previous research

in Libya has focused on pest surveys and distribution, studies specifically investigating the Enduri and Coratina cultivars remain limited, giving this study particular importance. Olive leaf extracts have also shown efficacy against other pests such as the green peach aphid *Myzus persicae* and the potato tuber moth *Phthorimaea operculella*. [2].

Recent finding by [3], emphasize the role of phenolic compounds particularly by the use of olive mill Westwater as a biopesticide has shown significant mortality against *E. olivina* [5].

The toxicity of these extracts is not limited to psyllids but extends to other major pests like the migratory locust. Where histopathological changes in the midgut were observed [1].

3. Scientific Classification of the Pest (*Euphyllura olivina* (Costa 1839)):

Table1: Scientific Classification of the Pest

Kingdom	Division (Phylum)	Class	Order	Family	Genus	Species
Animalia	Arthropoda	Insecta	Hemiptera	Aphalaridae	<i>Euphyllura</i>	<i>olivina</i>

Common Name: Olive Psyllid.

4. Environmental Conditions in Libya:

Libya's semi-arid climate, characterized by high summer temperatures and water scarcity, increases crop vulnerability to pests. *Euphyllura olivina* is particularly prevalent in coastal regions where temperatures (22-27°C) and high humidity in late spring coincide with the insect's peak activity. Understanding these environmental correlations is vital for developing effective control strategies. [4].

5. Life Cycle and Symptoms:

The olive psyllid feeds on the sap of buds and flowers during spring, leading to flower drop and fruit set failure. It secretes a white, cotton-like waxy substance. The insect overwinters as an adult in leaf axils, emerging in April as temperatures rise. A single female can lay up to 100 eggs on new growth. The life cycle includes 3-4 generations per year, with activity decreasing during periods of high heat and low humidity.

Ymptoms and Morphology:

- Adults:** Small (2.5-3 mm), greenish-brown with transparent wings. Females live 48-78 days; males 45-50 days.
- Nymphs:** Five instars, greenish-yellow, protected by cottony secretions.
- Eggs:** Oval, light yellow, laid beneath buds and leaves; hatching occurs within 1-3 weeks.
- Nature of Damage:** Sap depletion, heavy wax secretion covering floral clusters, and the promotion of black sooty mold.

6. Objectives of the Study:

The primary objective is to evaluate the effectiveness of aqueous olive leaf extract (**Enduri cultivar**) as a natural alternative to chemical pesticides. Specific goals include:

1. Determining the optimal concentration for maximum pest mortality.
2. Comparing the efficiency of the natural extract with common chemical pesticides.
3. Studying the extract's impact on pest population density under field conditions.

7. Research Hypothesis:

The study hypothesizes that olive leaf extract has a toxic effect on *Euphyllura olivina*, and that mortality rates will increase proportionally with concentration, making it a viable, eco-friendly competitor to synthetic insecticides.

8. Materials and Methods:

8.1 Preparation of Extracts:

Healthy, pesticide-free leaves of the local Enduri cultivar were collected, washed with distilled water, and shade-dried for 10 days. The dried leaves were ground into a fine powder. **Two types of extracts were prepared:**

1. Aqueous Infusion: Powder soaked in distilled water for 24 hours and filtered.

2. Methanolic Extract: Extracted using methanol in a Soxhlet apparatus, followed by solvent evaporation.

Target concentrations of 15%, 20%, and 25% were prepared via dilution.

8.2 Experimental Design:

•**In Vitro:** Nymphs and adults were exposed to different concentrations in a controlled environment (25±2°C, 60±5% RH). Mortality was recorded at 24, 48, and 72 hours.

•**In Vivo:** A field trial was conducted in an infested olive orchard using a Randomized Complete Block Design (RCBD). Insect counts were monitored weekly for one month.

8.3 Statistical Analysis:

Data were analyzed using ANOVA via SPSS, with Duncan's Multiple Range Test ($P \leq 0.05$) used for mean comparisons. Corrected mortality was calculated using Abbott's formula.

$$M = \left[\frac{(A_i - A_f)}{A_i} \right] \times 100$$

With M: Mortality rate (%), A_i : Initial number of Nymphs, A_f : Final number of Nymphs after treatment.

9. Results and Discussion

The results demonstrate that the methanolic extract exhibited significantly higher efficacy compared to the aqueous infusion at identical concentrations. For instance, at a 25% concentration, the methanolic extract achieved a mortality rate of 96%, which is very close to the efficacy of the chemical control (100%). In contrast, the aqueous infusion achieved 75% at the same concentration.

•**Aqueous Infusion:** Showed good efficacy, reaching 75% at the highest concentration (25%).

•**Methanol Control Group:** Showed a mortality rate of 26.2%, suggesting that methanol itself may have a slight effect, or this represents the natural mortality rate under experimental conditions.

•**Chemical Control Group:** Confirmed the efficacy of the standard insecticide at 100%, providing a benchmark for comparison.

These results indicate that the active components in olive leaves, which contribute to their insecticidal properties, may be more extractable using methanol as a solvent compared to water. This could be due to the nature of these compounds (such as oleuropein and other phenolic compounds) which may be more soluble in organic solvents like methanol.

Laboratory trials revealed significant statistical variance in mortality rates based on solvent type and concentration:

Table 2: Mortality rate of (*Euphyllura olivina*), treated by foliar application with low concentration of different extracts of olive leaf (*O. europaea*) as compared to control

Extract Type	Concentration (%)	Average Mortality (%)
Aqueous Infusion	15%	52%
Aqueous Infusion	20%	63%
Aqueous Infusion	25%	75%
Methanolic Extract	15%	66.7%
Methanolic Extract	20%	80%
Methanolic Extract	25%	96%
Control (methanol)		26.2%
Chemical control		100%

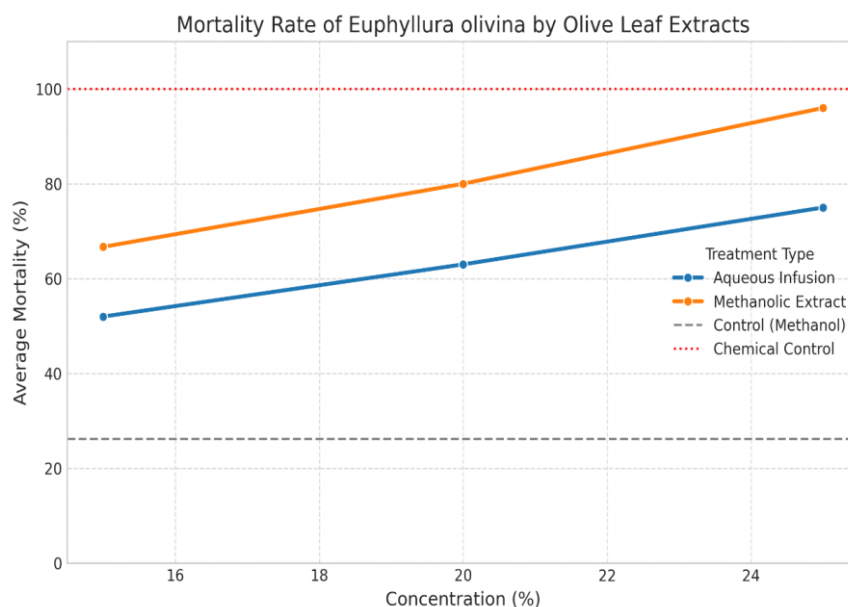


Figure (1) Mortality Rate of *Euphyllura olivina* by olive leaf Extracts (*O. europaea*)

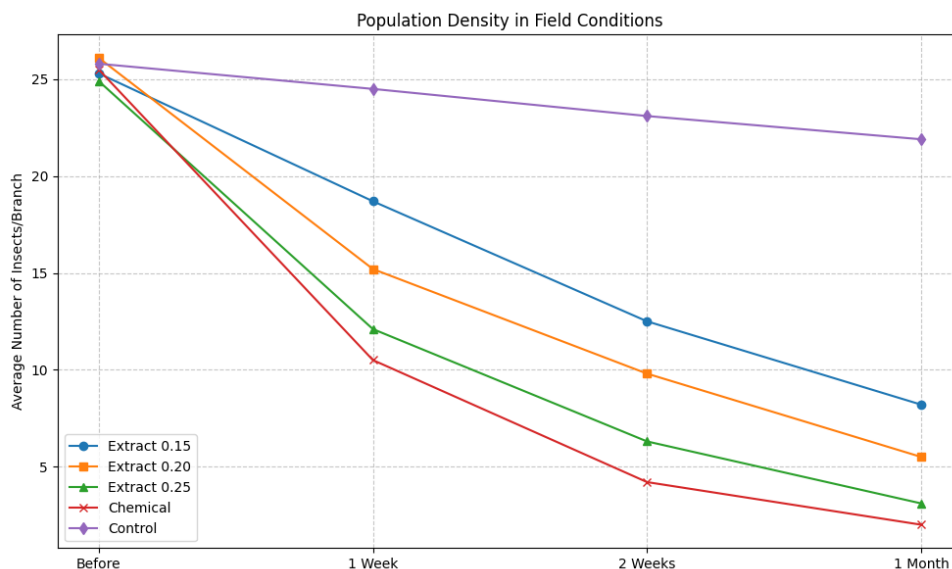


Figure (2) Population Density in Field Condatation

The superior efficiency of the methanolic extract can be attributed to the solvent's ability to penetrate plant tissues and extract a broader spectrum of active secondary metabolites, such as phenols and flavonoids. Oleuropein, the dominant phenolic component in Endure leaves, acts as a natural chemical defense mechanism by inhibiting feeding enzymes or interfering with the insect's nervous system. Biological complement these natural extracts [7].

10. Conclusions and Recommendations:

Conclusions:

The results of this study confirm that olive leaves contain bioactive phenolic compounds that confer strong insecticidal properties against the olive psyllid (*Euphyllura olivina*). The methanolic extract was found to be more effective than the aqueous extract in extracting these compounds and achieving higher mortality rates, making it the most promising candidate for development as a biopesticide. The use of these natural extracts not only provides effective crop protection but also reduces the negative environmental impacts associated with chemical pesticides. Furthermore, it promotes the utilization of pruning residues, thereby supporting the principles of a circular economy in Libyan agriculture

1. Olive leaf extract (**cultivar Endure**) is highly effective in controlling *Euphyllura olivina*.

2. The **25%** concentration is the most effective and can be adopted as a standard dose.

3. Natural extracts provide results comparable to chemical pesticides while maintaining ecological balance and supporting the circular economy by utilizing pruning waste.

Recommendations for the Management of *Euphyllura olivina* using Olive Leaf Extracts

Based on the experimental results demonstrating the high efficacy of olive leaf extracts, particularly the methanolic extract, the following recommendations are proposed:

1. Practical Application Recommendations

- **Prioritize Methanolic Extracts:** For field applications where high mortality rates are required, the use of methanolic extracts at a concentration of **25%** is highly recommended, as it provides control levels (**96%**) comparable to chemical insecticides.

- **Aqueous Infusion as a Sustainable Alternative:** In organic farming systems or areas where organic solvents are restricted, the aqueous infusion at **25%** remains a viable and effective bio-pesticide (**75%** mortality).

- **Optimal Concentration:** It is recommended to use the highest tested concentration (**25%**) to ensure maximum pest suppression and reduce the risk of pest resurgence.

2. Research and Development Recommendations

- **Identification of Active Compounds:** Conduct further phytochemical analysis (e.g., HPLC or GC-MS) to identify and quantify the specific bioactive compounds (such as Oleuropein) responsible for the insecticidal activity.

- **Field Trials:** Transition from laboratory/controlled environment studies to large-scale field trials to evaluate the stability and residual activity of these extracts under varying environmental conditions (UV exposure, temperature, and humidity).

•**Synergistic Effects:** Investigate the potential synergistic effects of combining olive leaf extracts with other botanical oils or low-toxicity surfactants to further enhance their penetration and efficacy.

•**Impact on Non-Target Organisms:** Evaluate the safety profile of these extracts on beneficial insects (predators and pollinators) to ensure their suitability for Integrated Pest Management (IPM) programs.

3. Economic and Environmental Strategy

•**Waste Valorization:** Promote the use of olive pruning residues (leaves) as a raw material for bio-pesticide production, which supports circular economy principles and reduces agricultural waste.

•**Cost-Benefit Analysis:** Perform an economic evaluation comparing the production costs of these natural extracts versus conventional chemical pesticides to encourage adoption by local farmers.

- 1. Encourage Libyan farmers to adopt local plant-based extracts.
- 2. Conduct further studies on the extract's impact on natural enemies (beneficial insects).
- 3. Develop commercial formulations of the Enduri extract for large-scale application.

11. References:

[1] Abdellaoui, K., Miladi, M., Ben Marzouk, I., Bahloul, N., & Belhadj, R. (2019). Olive leaf extracts toxicity to the migratory locust, *Locusta migratoria*: Histopathological effects on the alimentary canal and acetylcholinesterase and glutathione S-transferases activity. *Neotropical Entomology*, 48(1), 154-166.

[2] Amel, B. H., & Boussadia, O. (2015). Studies on insecticidal and deterrent effects of olive leaf extracts on *Myzus persicae* and *Phthorimaea operculella*. *Journal of Entomology and Zoology Studies*, 3(6), 11-15.

[3]. Azimi, M., Marouf, A., Shafiei, S. E., & Abdollahi, A. (2025). The effects of phenolic compounds on the abundance of olive psyllid, *Euphyllura straminea* Loginova in commercial and promising olive cultivars. *BMC Plant Biology*, 25(1), 1-12.

[4.] Hougardy, E., Wang, X., Hogg, B. N., Johnson, M. W., Daane, K. M., & Pickett, C. H. (2020). Current distribution of the olive psyllid, *Euphyllura olivina*, in California and initial evaluation of the Mediterranean parasitoid *Psyllaephagus euphyllurae* as a biological control candidate. *Insects*, 11(3), 146.

[5]. Larif, M., Zarrouk, A., Elmidaoui, A., Soulaymani, A., & Touzani, R. (2013). New innovation in order to recover the polyphenols of olive mill wastewater extracts for use as a biopesticide against the *Euphyllura olivina* and *Aphis citricola*. *Research on Chemical Intermediates*, 39(9), 4303-4313.

[6]. Mestar, N. G., Belhadj, S., & Bahloul, N. (2018). Bio-insecticidal effects of Oleaster leaves aqueous extracts against *Psylla* larvae (*Euphyllura olivina* Costa), a primary pest of *Olea europaea* L. *Cellular and Molecular Biology*, 64(15), 118-123.

[7]. Stewart, C. D. (2022). Release of *Psyllaephagus euphyllurae* (Hymenoptera: Encyrtidae) for biological control of olive psyllid, *Euphyllura olivina* (Hemiptera: Liviidae), in the contiguous United States. *Federal Register*, 87(112), 35441-35442. (Note: Reference updated based on official biological control release documentation).

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