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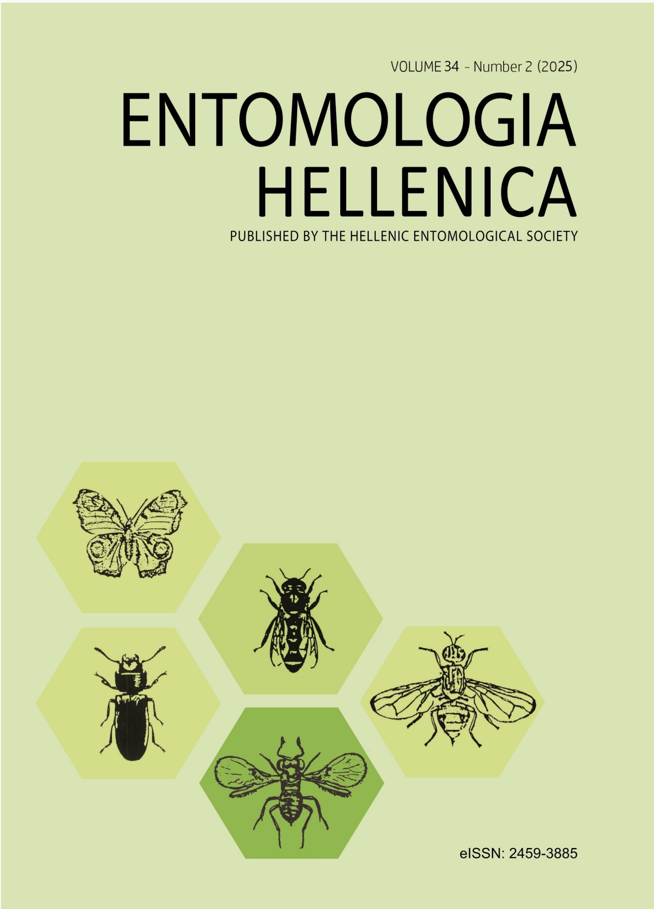

Infestation of Olive Groves by the Olive Whitefly, Aleurolobus olivinus (Silvestri, 1911) (Hemiptera: Aleyrodidae) in Bouira, Algeria

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Infestation of Olive Groves by the Olive Whitefly, *Aleurolobus olivinus* (Silvestri, 1911) (Hemiptera: Aleyrodidae) in Bouira, Algeria

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ABSTRACT

The olive whitefly, *Aleurolobus olivinus* (Silvestri, 1911) (Hemiptera: Aleyrodidae), is considered a secondary pest of olive trees. As a phloem-sap-feeding insect, it adversely affects tree health and productivity by inducing premature leaf drop and facilitating the development of sooty mold through the secretion of honeydew, particularly under favorable environmental conditions. It is specific to the Oleaceae family, particularly *Olea europaea* L., yet remains relatively understudied. This three-year study was conducted in an olive orchard in Taghzout (Bouira: Algeria), focusing on the Chemlal olive variety to investigate the pest's population dynamics. Sampling was performed by manually collecting leaves and using yellow sticky traps. Factors favoring whitefly proliferation included the absence of insecticide treatments and proximity to vegetated areas. The nymphal stage is particularly harmful due to its continuous feeding and promotion of black sooty mold formation. Nevertheless, natural enemies may help keep populations below damaging thresholds. A strong positive correlation (Pearson's r = 0.899) was found between adult and nymphal counts, indicating closely linked population trends across life stages.

KEY WORDS: Damage, sooty mold, Oleaceae, olive tree pest, phytophagous insect, yellow sticky traps.

Introduction

The bioecology of *Aleurolobus olivinus* (Hemiptera: Aleyrodidae) remains little known in the world and completely unknown in Algeria. It is a polyphagous insect that exists on more than 600 different plant species (Bayhan et al., 2006; Stansly and Natwick, 2009). It is mainly associated with olive trees (*Olea europaea*) (Lamiales: Oleaceae), but has also been recorded from *Phillyrea angustifolia* and *Ph. latifolia* (Oleaceae), as well as from *Erica* (Ericales: Ericaceae) (Martin et al., 2000). It inflicts both direct and indirect damage on olive trees. Direct effects stem from phloem sap feeding, during which toxins are injected, disrupting nutrient transport and potentially transmitting plant viruses. Severe infestations can lead to chlorosis and premature leaf drop. Indirect damage results from honeydew excretion, which fosters the growth of black sooty mold (fumagine), thereby reducing photosynthetic efficiency and weakening leaf vitality (Li et al., 2021). *A. olivinus* is recognized by its black coloration and round shape, resembling black spots on the leaves (Martin et al., 2000; Wilson and Streito,

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2010). Although frequent and not directly harmful, the honeydew secreted serves as a substrate for the development of sooty mold fungi (fumagine) (Vieira et al., 2013; Chomnunti et al., 2014; Arnemann et al., 2019). *A. olivinus* is considered as a secondary pest of olive trees (Šimala et al., 2015). It has several natural enemies belonging mainly to two families; Scelionidae and Platygastridae (Hymenoptera) as well as spiders that parasitize or feed on a diverse range of insects (Austin et al., 2005). According to (Löhr et al., 2018) *Encarsia lutea* (Masi, 1909) (Hymenoptera: Aphelinidae) has been reported in Colombia as a parasitoid of whiteflies. According to (Polaszek, 1991) several species from the genera *Encarsia* (Hymenoptera: Aphelinidae) and *Amitus* (Hymenoptera: Platygastridae), including *E. arabica*, *E. elegans*, *E. olivina*, and *Amitus minervae*, are known parasitoids of the olive whitefly, *Aleurolobus olivinus* (Abd-Rabou and Ahmed, 2012).

The objective of the present study is to provide a comprehensive analysis of *A. olivinus* using a multidisciplinary approach that integrates morphological, biological, and ecological components. The research aims to describe the morphological features of the insect across its developmental stages, investigate aspects of its life cycle and generational turnover, and assess population dynamics based on monthly and seasonal fluctuations. The study also evaluates the extent of damage caused by this pest on the Chemlal olive variety, which is widely cultivated in the Taghzout region of northern Algeria. A key focus of this research is to determine the seasonal dynamics of *A. olivinus* by identifying peak periods of adult and nymphal abundance in olive orchards. In parallel, it investigates the relationships between pest population trends and major climatic variables, including temperature, rainfall, relative humidity, and wind speed. Data collected over three consecutive years enable the evaluation of how climatic conditions influence the development and abundance of the species. Ultimately, the findings aim to inform the optimal timing of control measures and support the development of locally adapted integrated pest management (IPM) strategies.

Materials and Methods

Study area: The study area is situated in the Ismlane region, within the commune of Taghzout, approximately 15 km east of Bouira Province in northern Algeria. Geographically, it lies at coordinates 36° 26'24.1"N and 3°56'52.7"E, at an altitude of 100 meters.

The area experiences a Mediterranean climate, characterized by hot, dry summers and mild, wet winters, which significantly influence local agriculture and natural vegetation. The semi-mountainous landscape features a mix of cultivated land and natural forest cover (Figure 1).

The orchard under study is located on a gently sloping terrain in the Taghzout region and covers an area of approximately 3 hectares. It consists of young olive trees of the Chemlal variety, around 15 years old, traditionally cultivated with a planting distance of 7 × 7 meters. The orchard is surrounded by other olive groves. Pruning is carried out during and after the olive harvest, and no phytosanitary treatments are applied.

Sampling Methods

Field trips were conducted regularly throughout the study period, from January 2022 to February 2025, in the experimental olive grove of Taghzout.

Leaf sampling (nymphal stage): During each sampling trip, four olive trees were randomly selected. From each tree, 20 leaves were collected, five leaves from each of the four cardinal directions, at a height between 1.70 and 1.80 meters (Gacem et al., 2024). The sampled leaves were individually placed in labeled bags indicating the date, location, tree number, and sampling direction, and then transported to the laboratory for further examination (Mezerdi and Gacem, 2025).

Yellow Sticky Traps (adult sampling): To monitor adult populations, yellow sticky traps (Biotop, 25 × 10 cm) were installed on four randomly selected trees located in the southeast area of the grove. One trap was placed on each tree at a height ranging from 1.50 to 1.70 meters (Mezerdi and Gacem, 2022).

The traps were collected and replaced weekly. Each trap was labeled with the date, location, and corresponding tree number before being transferred to the laboratory for analysis under a binocular loupe and digital microscope (Gacem and Mezerdi, 2022).

Laboratory Observation: In the laboratory, both nymphal and adult stages of the olive whitefly, *A. olivinus* were observed and counted using a digital microscope and a binocular magnifying glass (Gacem et al., 2022).

ANOVA Analysis: The collected data were analysed comparatively to assess the outlined aspects. To investigate potential differences in population densities between the adult and nymphal stages of *A. olivinus*, a one-way analysis of variance (ANOVA) was applied. The analysis was carried out using Microsoft Excel, with the significance level set at 5% ($P < 0.05$). This statistical approach facilitated the detection of notable variations in population structure between developmental stages, enhancing our understanding of the species' ecological patterns and supporting the development of more effective management strategies.

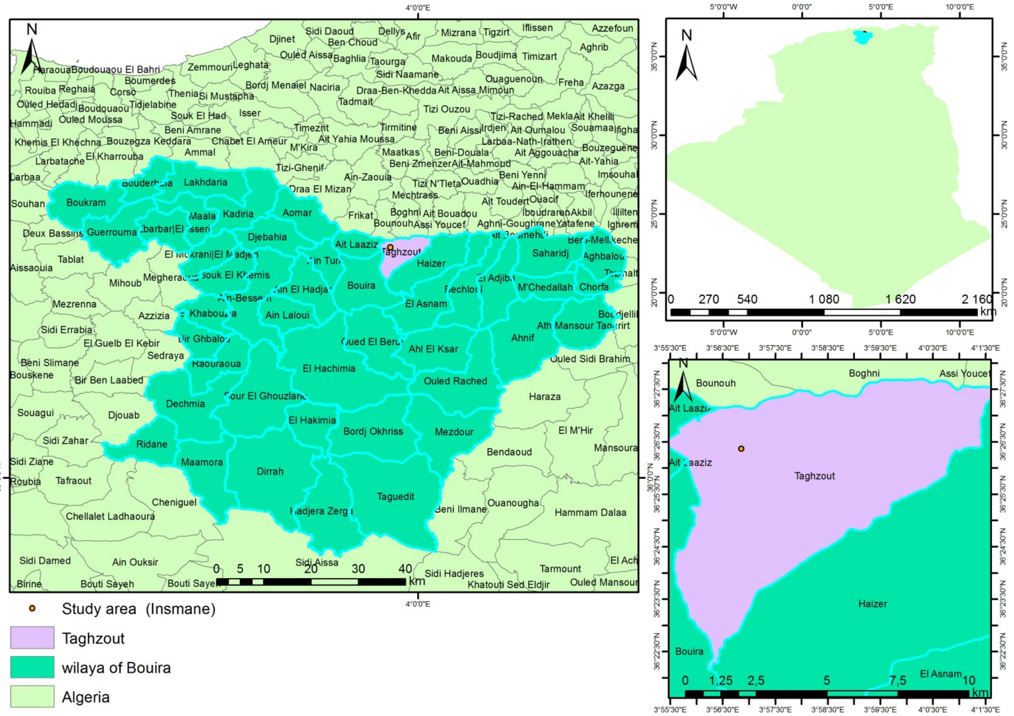

FIG. 1: Location of the olive grove in the study area of Taghazout.

Results

Description of the egg, nymphal, and adult stages of *Aleurolobus olivinus*: The description of the developmental stages of *A. olivinus* was essential to improve the understanding of its life cycle, facilitate accurate identification, and support effective monitoring and control measures. The egg of *A. olivinus* is sub-elliptical, with a slightly tapered apex and a straw-yellow colour that darkens to brown toward the end of embryonic development. It is attached to the leaf surface by a short pedicel, with dimensions ranging from 0.24 to 0.25 mm in length and from 0.11 to 0.12 mm in width.

The first instar nymph is ovoid and dark ashy-black, surrounded by fine, conspicuous setae. It lacks wax secretion and exhibits indistinct dorsal segmentation. Its size ranges from 0.30 to 0.61 mm in length and from 0.20 to 0.53 mm in width. The second instar nymph, similar in appearance but slightly larger, is elliptical and black, with reduced visibility of the setae and segmental divisions faintly visible laterally. It measures between 0.61 to 1.10 mm in length and 0.53 to 0.96 mm in width.

The third instar nymph becomes more flattened and nearly circular, bordered by a fringe of white wax, with a finely crenulated margin and clearly visible thoracic and abdominal sutures. The submarginal area and central disc are well defined, though the vasiform orifice remains indistinct. Its dimensions range from 1.10 to 1.54 mm in length and 0.96 to 1.38 mm in width. The fourth instar is circular and markedly flattened, with a broader posterior region, a delicately denticulate margin, and clearly defined intersegmental sutures. The dorsal disc is bordered by a submarginal suture, and the vasiform orifice becomes clearly visible. Nymphal size ranges from 1.50 to 1.90 mm in length and from 1.38 to 1.50 mm in width (Figures 2, 3, and 4). Nymphs are restricted to the upper surfaces of olive leaves, where they feed on phloem sap and excrete honeydew through the vasiform orifice.

The adult is a small fly (~1.7 mm) with transparent wings bearing distinct purple spots. Its yellowish body is dusted with wax, and the abdomen is globular and posteriorly tapered, with well-developed genital structures (Figure 6). Adults emerge from the nymphal case via a characteristic T-shaped incision. The complete life cycle from the first instar to adult emergence spans approximately 79 to 98 days. Morphometric monitoring revealed a strong positive correlation between nymph length and width (Figure 5).

This detailed characterisation was necessary due to the limited literature available on *A. olivinus*, particularly within the Mediterranean region. It provides essential diagnostic criteria for distinguishing this species from closely related taxa such as *Aleurothrixus floccosus* (Maskell, 1896) and *Bemisia tabaci* (Gennadius, 1889), which frequently co-occur in olive orchards. The

FIG. 2: Upper side of different stages of *Aleurolobus olivinus*.

FIG. 3: Underside of different stages of *Aleurolobus olivinus*.

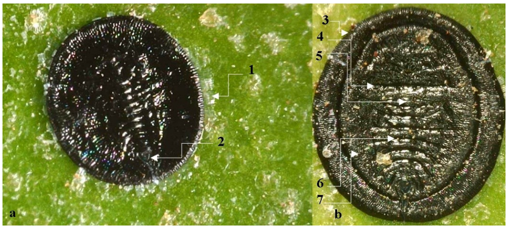

FIG. 4: Morphology of *Aleurolobus olivinus*. a. L2 stage, b. L4 or nymph, 1. Little visible bristles, 2. Vasiform orifice, 3. Margin, 4. Inter-segmental suture, 5. Suture, 6. Segments, 7. Sub-marginal area.

FIG. 5: *Aleurolobus olivinus* nymphs during honeydew secretion.

presence of a T-shaped emergence slit and the progressive visibility of the vasiform orifice in later instars are consistent with the descriptions provided by Bink-Moenen (1983) and Martin and Mound (2007), serving as key morphological markers.

FIG. 6: Adult olive whitefly *Aleurolobus olivinus*.

The exclusive development of nymphs on the upper surface of olive leaves represents a novel behavioural trait that has not been widely documented in previous studies. This observation has practical implications for both pest detection and the application of targeted treatment strategies. Similarly, Fraval (2009) confirmed the morphology of the adult stage, highlighting the pale yellow body covered in white wax and the presence of purple markings on the wings.

In addition, the observed size variation among instars, the correlation between developmental parameters, and the influence of climatic conditions on developmental rates contribute valuable new insights into the biology of *A. olivinus*. While the total duration of development is broadly comparable to that of other whitefly species, the specific timings and measurements reported here are more reflective of the agroecological conditions prevalent in northern Algeria. Consequently, this work not only fills a critical gap in the entomological literature but also establishes a foundation for the development of more precise and locally adapted integrated pest management strategies.rable to that of other whitefly species, the specific timings and measurements reported here are more reflective of the agroecological conditions prevalent in northern Algeria. Consequently, this work not only fills a critical gap in the entomological literature but also establishes a foundation for the development of more precise and locally adapted integrated pest management strategies.

Seasonal Fluctuation and Abundance Patterns of *Aleurolobus olivinus*: A comprehensive statistical analysis of monthly population data revealed high variability in both adult and nymphal stages, with mean values of 27.11 and 24.45 individuals per sample, and standard deviations of 23.18 and 23.61, respectively (Table 1).

Table 1. Descriptive statistics of *Aleurolobus olivinus* population dynamics.

Metric	**Adults**	**Nymph**
Count	38	38
Mean	27.11	24.45
Standard Deviation	23.18	23.61
Minimum	0.00	0.00
25th Percentile	6.50	5.50
Median (50th)	23.00	18.00
75th Percentile	42.75	38.50
Maximum	98.00	81.00

Population counts ranged from zero to peaks of 98 adults and 81 nymph. Percentile analysis provided further insight: in 25% of the months, adult counts were 6.5 or fewer and nymph 5.5 or fewer, while median values (23 adults, 18 nymph) were slightly lower than the means, indicating a skewed distribution influenced by occasional outbreaks. In 75% of the months, adult counts did not exceed 42.75, and nymph counts stayed at or below 38.50, underscoring the wide range of densities observed.

Correlation Between Developmental Stages: The Pearson correlation coefficient between nymphal and adult populations was 0.899, indicating a strong positive relationship between the number of adult whiteflies and nymphs. This high correlation supports the reliability of using nymphal counts as predictive indicators for subsequent adult infestations (Table 2).

Comparative Analysis of Developmental Stage Abundance (ANOVA): A one-way analysis of variance (ANOVA) was conducted to determine whether there was a statistically significant difference in the mean population numbers between the adult and nymphal stages of the olive whitefly, *A. olivinus*, during the study period. The average number of adults was 27.11, while the average number of nymph was 24.45. Despite this slight difference in means, the ANOVA results showed that the variation was not statistically significant. The calculated F-value was 0.245, which is well below the critical F-value of 3.97 at a 0.05 significance level. Furthermore, the P-value was 0.622, which is greater than 0.05, confirming that the difference in means between the two stages is not statistically significant (Table 3).

The null hypothesis is retained, indicating that there is no significant difference in the population dynamics of adult and nymphal stages of *A. olivinus* during the sampling period were statistically comparable, suggesting a similar trend in their abundance over time without a clear dominance of one stage over the other.

Table 2. Pearson Correlation Coefficient (Adults and nymph).

	Adult	**Nymph**
Adult	1	
Nymph	0,899474	1

Table 3. ANOVA: Comparison of Adult and nymphal Populations of the Olive Whitefly.

SUMMARY						
Groups	***Count***	***Sum***	***Average***	***Variance***		
Adult	38	1030	27,10526	537,394		
Nymph	38	929	24,44737	557,4972		
ANOVA: Single-Factor						
Source of Variation	***SS***	***df***	***MS***	***F***	***P-value***	***F crit***
Between Groups	134,2237	1	134,2237	0,245182	0,621955	3,97023
Within Groups	40510,97	74	547,4456			
Total	40645,2	75				

Population Dynamics and Climatic Correlations: The population of *A. olivinus* exhibited a distinct seasonal pattern during the study period, closely associated with climatic variables.

A clear seasonal trend was observed, strongly influenced by temperature variation. Over the three-year period, both adult and nymphal stages were absent or present at very low levels during the cold months (January to March), when average temperatures ranged between 11°C and 14°C. A noticeable population increase began as temperatures exceeded 15°C, with a significant surge observed from May onwards. Peak densities occurred during the summer (July to September), coinciding with average temperatures of 25–33°C, maximums exceeding 40°C, and minimums consistently above 20°C. These conditions appear optimal for development, reproduction, and survival. Populations declined during autumn and early winter, as temperatures fell below thresholds necessary for active growth. Nymphal peaks typically followed adult peaks, reflecting developmental progression (Figure 7).

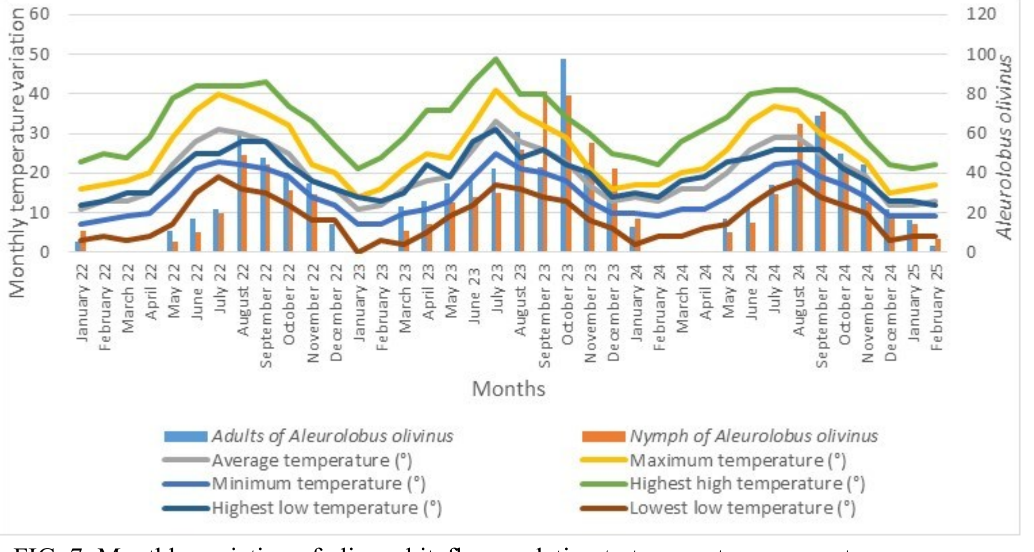

FIG. 7: Monthly variation of olive whitefly population to temperature parameters.

Rainfall also showed a potential influence on population levels. During wetter months (e.g. March and April 2022, February and November 2024), both adult and nymphal densities were low or absent. This suggests that high or frequent rainfall may negatively impact survival or development, possibly through mechanical disturbance or disruption of oviposition. Conversely, population peaks were recorded during the driest months (July to October), with total rainfall ranging between 1 and 9 mm and minimal daily precipitation. These dry conditions likely favoured survival, particularly of nymphs. However, rainfall alone did not always suppress populations; for instance, high numbers persisted in May and June 2023 despite moderate rainfall (15–36 mm monthly). This indicates that rainfall timing and intensity, rather than total volume, may be more critical (Figure 8).

Wind appeared to play a modulatory role depending on temperature. Warm, moderate winds (14–17 km/h with temperatures above 18°C), particularly between July and October, were associated with increased activity and proliferation. These conditions may enhance dispersal and physiological activity. However, similar wind speeds during colder months coincided with low or absent populations, indicating that cold winds may impose mechanical stress and suppress development. Therefore, the impact of wind is largely dependent on accompanying thermal conditions (Figure 9).

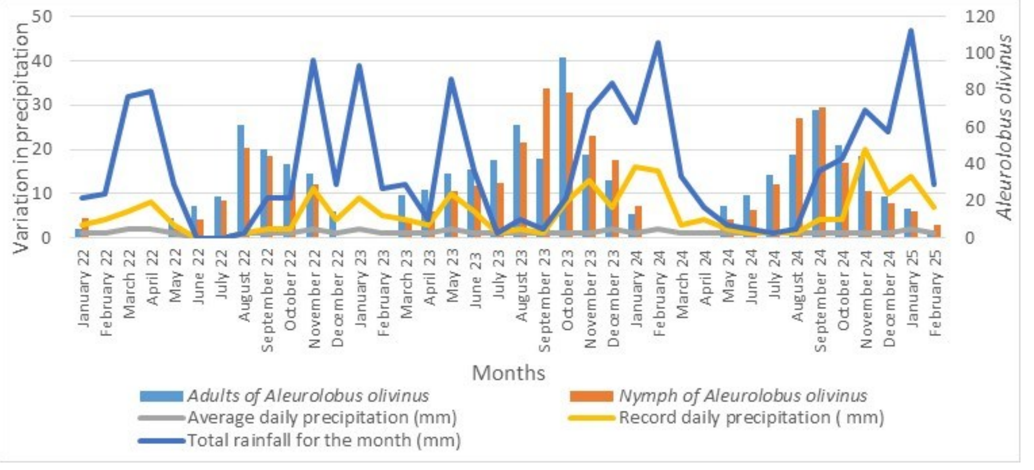

FIG. 8: Monthly variation of olive whitefly population to precipitation parameters.

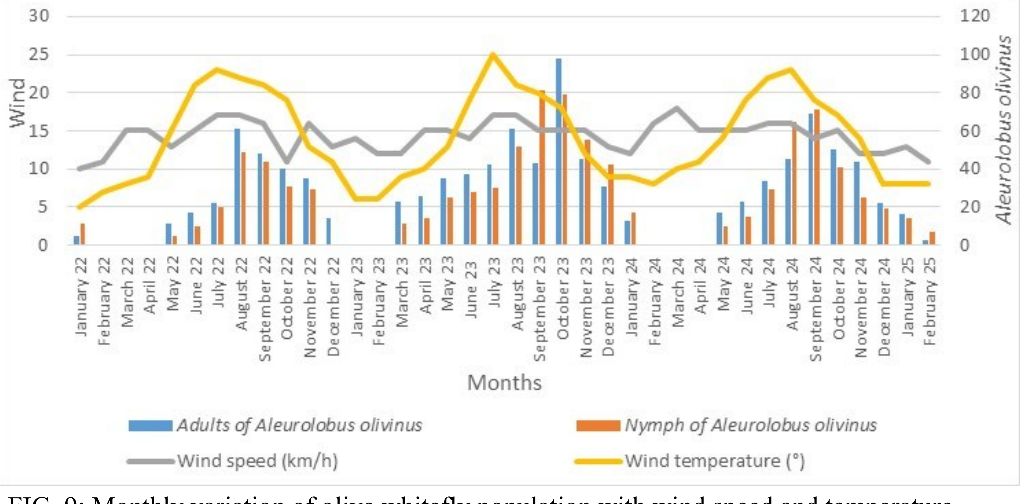

FIG. 9: Monthly variation of olive whitefly population with wind speed and temperature.

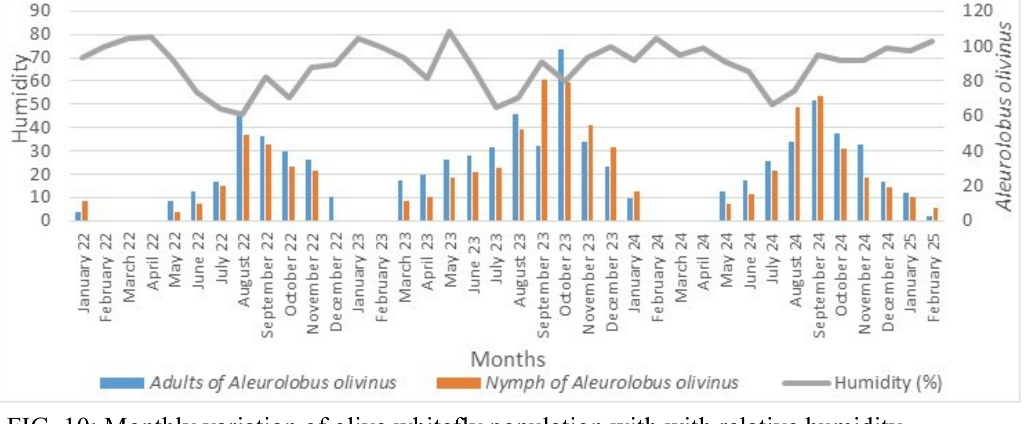

FIG. 10: Monthly variation of olive whitefly population with with relative humidity.

Relative humidity showed a negative correlation with population levels. High humidity values (>70%), typical in winter and early spring (January to April), coincided with reduced or absent populations. In contrast, moderate humidity (50–68%) during summer and early autumn corresponded with peak densities, suggesting more favourable conditions for development and reproduction. Extremely low humidity (<50%) did not appear to significantly reduce populations, but persistently high humidity likely limited development, potentially due to an increased risk of fungal infections or unfavourable microclimates (Figure 10).

Although these climatic parameters are not tested under controlled experimental conditions in this study, the correlations observed provide valuable indications of their potential role in regulating *A. olivinus* populations. These relationships can serve as a foundation for future research and the development of predictive models for integrated pest management.

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Discussion

The present study provides valuable insights into the biology and ecology of *A. olivinus*, with particular emphasis on its phenology, spatial distribution, and responses to climatic variables. The continuous presence of nymphs and adults throughout the year, without a distinct overwintering phase, suggests that *A. olivinus* has multiple overlapping generations. This finding contrasts with other whitefly species where distinct seasonal peaks mark the generation turnover (Morsi et al., 2010). The lack of synchrony between nymph and adult peaks may indicate a flexible life cycle adapted to variable Mediterranean climatic conditions.

One of the key findings of this study is the exclusive development of nymphs on the upper surface of olive leaves, a behavioural trait that is rarely reported in whitefly species, which typically favour the abaxial (lower) surface (Shivalingaswamy & Satpathy, 2007).

The strong preference of *A. olivinus* for the upper leaf surface may be influenced by microclimatic advantages such as sunlight exposure and reduced humidity, which may promote development and survival. Similar behaviour has been reported by Kherroubi (2016) in the Tizi Ouzou region and by Haddag (2020), who observed the same photophilic tendencies in various olive-growing regions of Algeria. Moreover, this behaviour is ecologically significant since it facilitates easier visual detection during field scouting and may guide the application of targeted treatments.

The study also demonstrated a clear spatial preference for southern and eastern orientations of the olive canopy. These microhabitats provide higher light intensity and warmth, which are conducive to whitefly activity and oviposition (Houacine et al., 2022). The South-facing branches, in particular, harboured the highest infestation levels, a pattern also confirmed by Fraval (2009) and Boulahia-Kheder (2021). In contrast, the northern and western orientations were consistently less colonised. Such orientation-dependent distribution can be directly attributed to thermal and light gradients, which significantly influence insect movement and development.

Climatic factors played a decisive role in shaping the seasonal dynamics of *A. olivinus*. High summer temperatures were associated with accelerated development and increased reproduction, contributing to population surges. Conversely, extended rainfall and high humidity in winter and spring correlated with decreased activity and prolonged developmental periods, suggesting the pest's sensitivity to environmental stressors. These observations align with earlier research on whitefly responses to abiotic factors (Morsi et al., 2010; Dengel, 1981).

Furthermore, our findings revealed that the pest preferentially infests young, actively growing shoots, likely due to their higher nutrient content and more accessible phloem sap, making them ideal oviposition and feeding sites. This behaviour should be considered in monitoring strategies, with emphasis on inspecting new growth (Mezerdi et al., 2025).

In addition to the pest's biology, natural enemies were observed as a significant regulating factor. Various parasitoid species, particularly *Encarsia elegans*, *E. olivina*, *Eretmocerus* spp., and *Amitus minervae*, were previously identified as potential biological control agents (Abd-Rabou, 1997; Abbassi et al., 2019). While most whitefly species deposit eggs on the abaxial surface of leaves, the behaviour of *A. olivinus* stands out due to its egg-laying on the upper surface, a characteristic also noted for some species within the Alurodicinae subfamily (Gill, 1990). This unusual trait, combined with continuous activity throughout the year, highlights the need for refined IPM strategies that address both biological and environmental determinants of infestation.

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