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Assessment of Aphid (Hemiptera: Aphididae) Biodiversity and Abundance of Arboriculture in a North-Eastern part of Algeria

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Abstract
Aphids form large group of insects, belonging to the Aphididae family. They are carecterized by a small, soft-bodied insects that belong to the superfamily Aphidoidea. Aphids are containing many species that cause damage in cultivated crops. There are over 4.000 species of aphids that have been described and they can be found in a variety of habitats throughout the world. Aphids are sap-sucking insects that cause yellowing, curling leaves, stunted growth and sticky "honeydew" residue; often resulting in black sooty mold. Common on vegetables, roses and shrubs, they multiply rapidly in spring. Aphids, through their feeding and virus transmission, represent a significant phytosanitary constraint, since they are defined as a major pest of agriculture. Arboriculture is a key component of sustainable agriculture, integrating ecological and socio - economic functions. This study assessed aphid diversity in apricot and plum (Prunus) orchards in the Tizi-Ouzou region, Algeria. The sampling was conducted in Oued-Aissi from February to July 2023 period. In apricot orchards, 20 aphid species were recorded, dominated by Hyalopterus pruni (73.41%) with a peak in diversity in March. In plum orchards, 25 species were identified, with Saltusaphis scirpus being the most abundant (23.19%) and showing the highest diversity in May. H. pruni persisted throughout the entire sampling period in both hosts. The abundance of winged aphids followed the phenology of the hosts, peaking during the flowering of apricots and plums and remaining low at other times. The positive interactions between species suggest a stable balance in untreated Prunus orchards. These results provide information for better phytosanitary guidance and sustainable management strategies.
***Keywords**: Aphid, diversity, Prunus orchards, host plant phenology, integrated pest management.*

INTRODUCTION

The Aphididae represents a large insect family in the aphid superfamily (Aphidoidea) of the order Hemiptera. Several species from this family, are considered plant/crop pests and some are plant virus vectors, mainly the green peach aphid (Myzus persicae) being one of the most prevalent and indiscriminate carriers. These aphid species are so small, that winds can transport them for fairly long distances. They move quite slowly and cannot jump. These insects are fed by sucking the sap from plant leaves and excrete a sugary liquid called honeydew, because the plant sap contains excess carbohydrates relative to its low protein content. In order to satisfy their protein needs, they absorb large amounts of sap and excrete the excess carbohydrates. This honeydew is used as food by ants, honeybees, and many other insects (Dixon, 1977) .

Most aphid species can reproduce both asexually and sexually, with several parthenogenetic generations between each period of sexual reproduction. This is known as cyclical parthenogenesis and, in temperate regions, sexual reproduction occurs in autumn and results in the production of overwintering eggs, which hatch the following spring and initiate another cycle. Many pest aphids, however, do not overwinter as an egg but as nymphs or adults and others as both eggs and active stages (Dixon, 1977; Williams and Dixon, 2007). For their size, the parthenogenetic individuals have very short developmental times and potentially prodigious rates of increase (Dixon, 1977). Thus, aphids show very complex and rapidly changing within-year dynamics, with each clone going through several generations during the vegetative season and being made up of many individuals, which can be widely scattered in space. The survival of the eggs and/or overwintering aphids determines the numbers of aphids present the following spring. (Kindelmann et al., 2010). The production of winged morphs in aphids is modulated by the phenology and quality of the host, as well as by colony density and environmental signals (Wang et al., 2024; Engel et al., 2025). It was demonstrated that, in stone fruit trees, that phenological transitions, such as budburst or flowering, promote the production of parthenogenetic alates and provide optimal conditions for the colonization of new tissues or trees (Dedryver et al., 2010). In northern Algeria, the peak of winged individuals observed in March on apricot, coinciding with its early flowering, corresponds to early parthenogenetic winged females (precocious Alatae virginoparae) produced by the first spring generations of fundatrices. The peak recorded in May on plum, which flowers later, reflects the production of winged parthenogenetic females of later generations (late Alatae virginoparae), synchronized with the availability of nutritional resources and colony density. The within-year dynamics of aphids are largely determined by seasonal changes in host quality. Aphids do best when amino acids are actively translocated in the phloem (Dedryver et al., 2010). Some Aphid species are among the most harmful pests in greenhouse and field crops, causing plant stress, virus transmission and yield loss. Arboriculture is among the main support of aphid biodiversity and also is the resilience of agroecosystems. Algeria ranks the fourth worldwide in apricot production and the first in Africa, with 300.000 tons in 2024 (Algeria Invest, 2024) and twentieth for fresh plum production, with 99.050 tons (Tridge, 2024). However, apricot and plum trees are frequently affected by aphids, which weaken the trees by sucking their sap, reduce the growth, cause the flower abortion and transmit pathogenic viruses (Nsibi, 2021; Turpeau et al., 2024). Monitoring these pests is crucial to maintaining yields and controlling aphid-transmitted diseases (Arnal et al., 2019). Several aphid species were previously reported in Algeria also recorded during our sampling. Acyrthosiphon pisum is known to infest pea (Pisum sativum) and faba bean (Vicia faba) and Carthamus lanatus and artichoke (Cynara scolymus) were reported in Batna and the Ziban region (Biskra); (Laamari and Coeur D'acier, 2013; Hemidi and Laamari., 2020) and also reported in Naciria (Boumerdes) (Bouabida and Benoufella-Kitous, 2021). Aulacorthum solani and Macrosiphum euphorbiae have been recorded on potato (Solanum tuberosum), while Myzus persicae is frequently associated with potato and vegetable crops in Tizi-Ouzou (Ait Amar & Benoufella-Kitous, 2021) and Batna regions (Slimani & Fekkoun, 2021; Hemidi and Laamari, 2020). In addition, Sitobion fragariae has been reported on barley (Hordeum vulgare) and durum wheat (Triticum durum) in Ain Kercha, Oum El Bouaghi and Guelma, while Brevicoryne brassicae is associated with Brassicaceae crops in northeastern Algeria (Ghazali et al., 2015). The existing data on aphids in Algeria is limited and outdated. Previously, in algeria, aphid insects were studied in crops (Laamari et al., 2009) and their parasitoids of the recorded species achieved (Sadat et al. 2019). Notable studies include were carried out on arthropods of apricot trees in Biskra (Achoura & Belhamra, 2010), with the record of different aphid species and it was reported that H. pruni was a dominant pest of stone fruit trees. To our knowledge, no comparative study has examined aphid diversity across Prunus species in this region. This study aims to assess aphid communities on apricot and plum in order to understand host-insect interactions in order to develop a suitable program control for these pests.

MATERIALS AND METHODS

-Study area presentation

This study was carried out in apricot Prunus armeniaca and plum Prunus domestica orchards with 180 of 21-year-old trees. The study area is situated at an altitude of 128 m above the sea level, at district of Oued Aissi on the western side of the Tizi-Ouzou town (36º 42' 13"N, 4º 06' 19" E), about 110 km East of Algiers, the capital of algeria (Figure 1). The climate is sub-humid Mediterranean, with mild, rainy winters and hot, dry summers. The orchards are located 1.5 km as the crow flies from the Taksabt dam (Algeria's second-largest dam) and did not undergo any phytosanitary treatment during the sampling period.

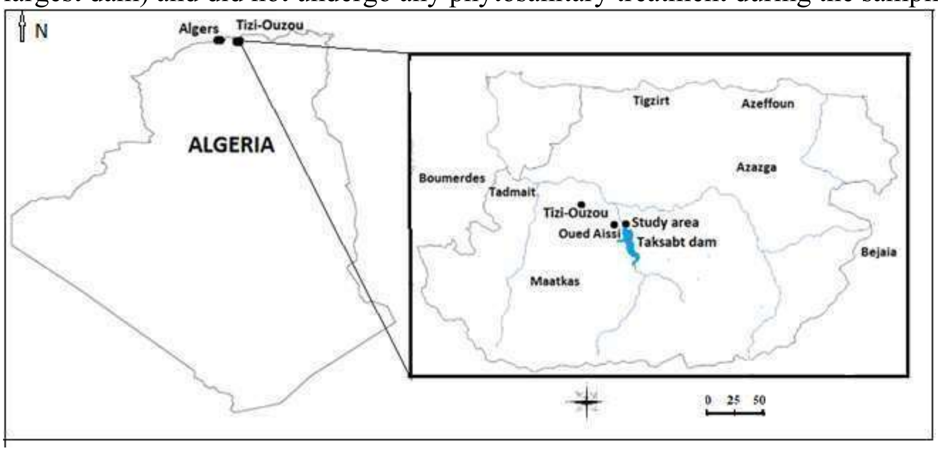

Fig. 1. Geographical situation of the study area. Source: authors, 2025.

-Sampling method

The aphid adults samling was carried out through the period, from February to July 2023 in stone fruit orchards of plum (Prunus domestica L.) and apricot (Prunus armeniaca L.). Fifteen yellow water traps were installed at the orchard center of 3 × 3 tree plots, at a height of 1.6 m. The traps were placed close to shoots and buds infected by aphids, while the orchard edge effects were avoided the exposure to wind and to minimize mainly the influence of surrounding habitats on captures (Tscharntke et al., 2021; Mahas et al., 2024; Gao et al., 2024; Abbas et al., 2025). The yellow color of traps is attractive to phytophagous insects, enhances aphid attraction and capture (Mahas et al., 2024). The traps contained water with a few drops of detergent to reduce surface tension and rapidly drown the captured insects (Schellhorn et al., 2020). Surveys were conducted Weekly, when the traped insects were taken softly and placed in a bottle containing 70% ethanol, in order to preserve the morphological structure for identification (Martoni et al., 2021). In the laboratory, the aphid species identification was performed according to the taxonomic keys previously reported and adapted (Jacky and Bouchery,1982; Remaudière et al., 1985; Autrique and Ntahimpira, 1994; Remaudière and Remaudière, 1997; Blackman and Eastop, 2000; Favret, 2022). Blackman & Eastop, 2000). These keys are based on the morphology of siphunculi, the shape of the cauda, the structure of the last antennal segment, wing venation, and abdominal pigmentation of the adult aphid.

-Statistical analyzes

Statistical analyses were performed for comparing the aphid abundance, between the sites; apricot and plum orchards and to evaluate the significant differences. A multifactorial principal component analysis (PCA) was conducted on the species abundance matrix, with data centered and scaled prior to analysis. The PCA summarized variability, explor relationships between species and environmental variables and highlighted peak abundances in each orchard, thereby linking temporal fluctuations to key ecological drivers.

Species frequency of occurrence is commonly used to describe the distribution of species within sampled areas. It represents the proportion of sampling units (such as quadrats) in which a particular species occurs relative to the total number of sampling units studied. Species frequency is usually expressed as a percentage and is calculated using the formula: $\mathrm{Fi} = \frac{\mathrm{ni}}{\mathrm{N}} \times 100$, where Fi is the frequency of species i, ni is the number of quadrats in which the species occurs and N is the total number of quadrats sampled. Based on the obtained values, the species can be classified into frequency classes to describe their occurrence in the community: 0–20% (accidentel), 21–40% (accessory), 41–60% (frequent), 61–80% (very frequent), and 81–100% (constant species). This classification helps to describe species distribution patterns and community structure in ecological studies (Tesfaye et al., 2024).

RESULTS

During the survey 252 aphid adultes were captured in apricot orchards, from where 20 species of aphids were identified. These were distributed across 12 genera, belonging to 4 tribes and 3 subfamilies (Table 1). Hyalopterus pruni was the predominant species (73.41%), followed by Pemphigus sp. (5.56%), which are representing 94.04% from the Aphidinae Subfamilie, of the collected individuals. Among this, the tribe Aphidini was predominant with 89.67%, including the genera of Hyalopterus (H. pruni, 73.41%), Aphis (8.73%, 5 species) and Rhopalosiphum (6.74%, 3 species), followed by Pemphigini (5.56%), Macrosiphini (4.37%), and Saltusaphidini (0.4%) (Table 1).

Table 1: Aphid abundance on plum and apricot orchards in the Oued-Aissi region, Tizi-Ouzou distrct, Algeria).

Subfamilies	Tribes	Genera	Aphid species	Plum's aphid (%)	Apricot's aphid (%)
Aphidinae	Aphidini	Aphis	A. craccivora Koch, 1854	4. 35	0.79
			A. fabae Scopoli, 1763	1.45	3.17
			A. gossypii Glover, 1877	4.35	3.97
			A. nerii Boyer de Fonscolombe, 1841	4.35	0.40
			Aphis sp.	2.90	-
			A. pomi De Geer, 1773	1.45	-

			A. verbasci Schrank, 1801	4.35	0.40
		Hyalopterus	H. pruni Geoffroy, 1762	2.90	73.41
		Protaphis	P. pseudocardui Theobald, 1915	-	0.79
		Rhopalosiphum	Rho. padi Linné, 1758	2.90	3.57
			R. rufiabdominalis Sasaki, 1899	-	1.98
			Rho. maidis Fitch, 1856	1.45	1.19
	Macrosiphini	Acyrthosiphom	Acy. pisum Harris, 1776	1.45	-
		Aulacorthum	Aul. solani Kaltenbach, 1843	-	0.40
		Brachycaudus	B. helichrysi Kaltenbach, 1843	1.45	0.79
		Brericoryne	Bre. brassicae Linnaeus, 1758	1.45	-
		Capitophorus	C. hippohaes Walker, 1852	1.45	-
		Hyadaphis	Hya. coriandri Das, 1918	1.45	-
		Dysaphis	D. apiifolia Theobald, 1923	-	0.79
		Sitobion	S. fragariae Marcheur, 1848	1.45	-
		Macrosiphum	M. euphorbiae Kirby, 1892	-	0.79
			M. rosae Linnaeus, 1758	1.45	0.40
		Myzus	Myz. persicae Sulzer, 1776	4.35	-
		Nasonovia	N. ribisnigri Mosley, 1841	-	0.40
		Thelaxes	T. dryophila Schrank, 1801	-	0.40
			T. laxes sp. Westwood, 1840	1.45	0.40
		Wahlgreniella	W. nervata Gillette, 1908	15.94	-
Calaphidinae	Panaphidini	Monelliopsis	Mon. pecanis, Bissell 1983	1.45	-
Chaitophorinae	Chaitophorini	Chaitophorus	Chai. tophorus sp. Koch, 1854	2.90	-
Eriosomatinae	Pemphigini	Pemphigus	Pemphigus sp.	7.25	5.56
Saltusaphidinae	Saltusaphidini	Saltusaphis	Sal. scirpus Theobald, 1915	23.19	0.40
Myzocallidinae	Myzocallidini	Myzocallis	Myz. castanicola Baker 1917	2.90	-
Plum: 5	**Plum: 7**	**Plum: 18**	**Plum: 25 sp.**	**69 individuals**	**252 individuals**
Apricot: 3	**Apricot: 4**	**Apricot:12**	**Apricot: 20 sp.**		

In the plum orchard 69 individuals of aphid adultes were trapted. From the systematic study 25 species were recorded across 18 genera, belonging to 7 tribes, and 5 subfamilies (table1). Saltusaphis scirpus was the most abundant species with 23.19%, followed by Wahlgreniella nervata with 15.94%. The tribe Aphidini represented by 30.45% of the individuals (H. pruni, Aphis, Rhopalosiphum), followed by Macrosiphini tribe with 30.44% (mainly W. nervata sp), Saltusaphidini with 23.19% (S. scirpus), Pemphigini with 7.25% (Pemphigus sp.) and Chaitophorini, Myzocallidini and Panaphidini are mower represented, each with 2.9% (Table 1). The present study revealed an early establishment of aphids in apricot orchards at the end of winter, likely followed by a migration to plum orchards in mid-spring. The early availability of nutrients in March promoted rapid aphid growth and a greater number of winged individuals. The similarity of the aphid community between apricots and plums was moderate (Jaccard index 37.5%). On apricots, March showed the greatest aphid diversity (Figure 2), with only H. pruni that are persisting throughout the spring season and dominate both in abundance and duration. On plums, aphid diversity was in its maximum during April (Figure 3), while no aphids were recorded in February and July.

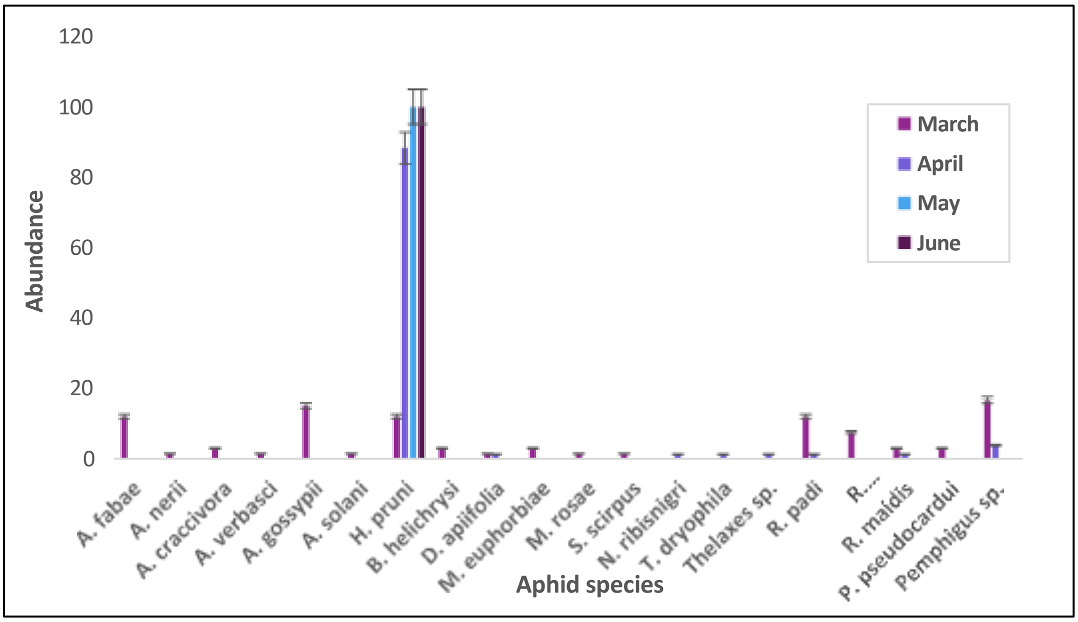

Fig. 2: The aphid species distributuion during the spring period, in apricot orchard of the stidied area.

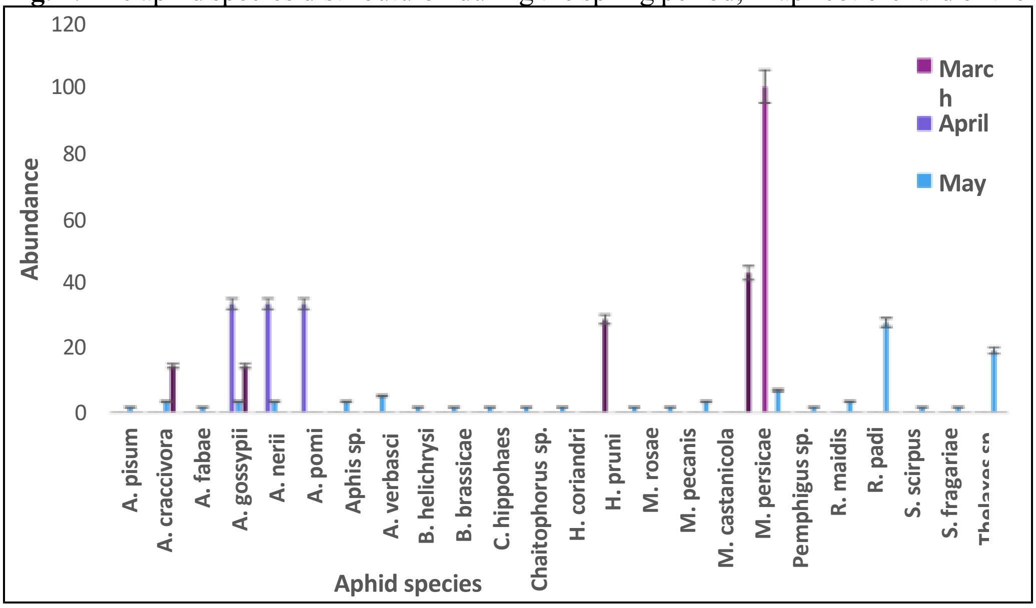

Fig. 3: The aphid species distributuion during the spring period, in plum orchard of the stidied area.
Significant differences in these orchards were observed for Brachycaudus helichrysi (p = 0.03) and Rhopalosiphum padi (p = 0.00), and very significant differences for Aphis fabae, Aphis gossypii and H. pruni (p = 0.00) (Figure 4). H. pruni reached the presence of 72.7% in April, 100% in May and 80% in June, with considerable higher proportions on apricot compared to plum.

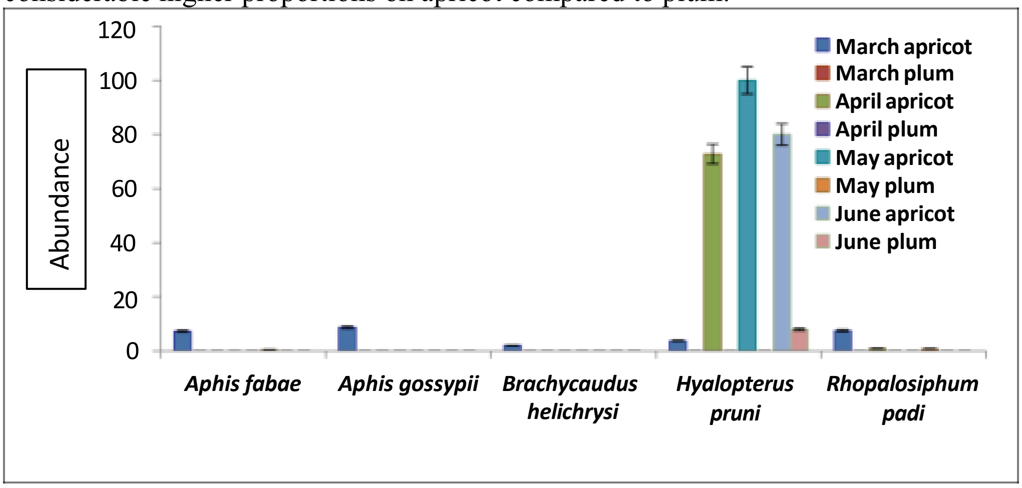

Fig. 4. Abundance of aphid species shows significant differences in apricot and plum orchards.

In the apricot orchard, Hya. pruni was identified as a very frequent species, with a frequency of 73.41%. In contrast, on the plum trees, Sal. scirpus was classified as an accessory species, showing a frequency of 23.19% (Table 2). The remaining species recorded in the study were categorized as accidental due to their low frequencies of occurrence.

Table 2: Aphid species recurence index.

Aphid species	Plum orchard (%)	Ecological class	Apricot orchard (%)	Ecological class
Hya. pruni	2.9	Accidentel	73.41	Very frequent
Pemphigus sp.	7.25	Accidental	5.56	Accidental
Aph. gossypii	4.35	Accidental	3.97	Accidental
Rho. padi	2.9	Accidental	3.57	Accidental
Aph. fabae	1.45	Accidental	3.17	Accidental
Rho. maidis	1.45	Accidental	1.19	Accidental
Aph. craccivora	4.35	Accidental	0.79	Accidental
Bra. helichrysi	1.45	Accidental	0.79	Accidental
Sal. scirpus	23.19	Accessory	0.4	Accidental
Mac. persicae	4.35	Accidental	0	Absent
Wah. nervata	15.94	Accidental	0	Absent

Positive interactions (significant values at threshold α=0,05) among aphid species suggest the maintenance of an ecological balance that could limit infestations. Variables and Individuals (axis F1 and F2: 79%). The principal component analysis highlights a temporal and host-related structuring of aphid assemblages (Figure 5), revealing a clear separation between apricot and plum orchards, as well as seasonal differentiation. These patterns may reflect host preferences and the specific dominance of certain species depending on the period. The consistently positive associations observed in untreated Prunus orchards support the hypothesis of a balanced community structure, providing a basis for refining targeted management strategies within an integrated pest management framework, should intervention be necessary.

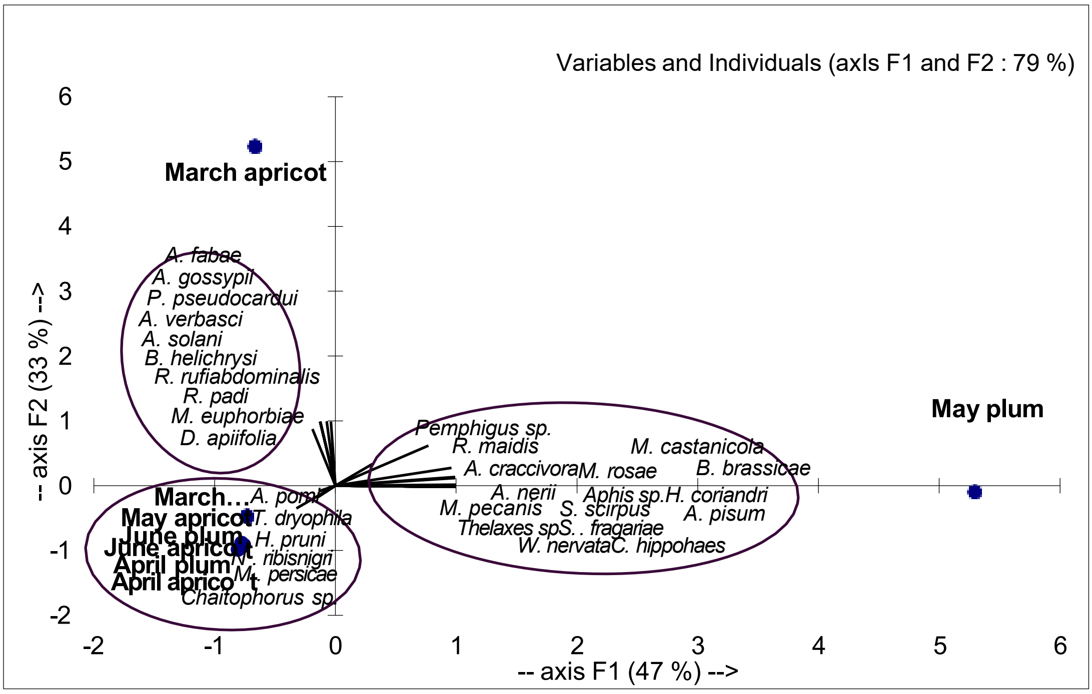

Fig. 5: Multifactor PCA analysis of aphid species distribution in apricot-plum orchards.

DISCUSSION

The within-year dynamics of aphids are largely determined by seasonal changes in host quality. Aphids do best when amino acids are actively translocated in the phloem. In spring, the leaves grow and import amino acids via the phloem; in summer leaves are mature and export mainly sugars. In autumn, the leaves senesce and export amino acids and other nutrients (Dedryver et al., 2010). Thus, on trees the leaves are most suitable for aphids in spring and autumn. The differences in within-year population dynamics of aphids are due to differences in the effect these seasonal fluctuations in host plant quality which have an increase and intraspecific competition in each species. This annual cycle; consisting of two short periods when the host plant is very favourable and a long intervening period when it is less favourable, is well documented for tree dwelling aphids. This has greatly facilitated the modelling of their population dynamics. In general, the aphid carrying capacity of annual crop plants tends to increase with the season until the plants mature after which it tends to decrease very rapidly. Thus, the aphids carrying capacity of trees tends to be high in spring and autumn and low in summer. Whereas that particularly of short-season annual crops tends to be low early in a year, peaking mid year and then declining (Kindelmann et al., 2010).

The present investigation indicates a delay in the establishment of aphids in plum orchard compared to apricot orchard, whose is flowering at the end of winter that promotes early colonization by the aphids. This dynamic could be explained by the flowering and bud break of plums followed by the production of new shoots, which may become more attractive to aphids. Depending on the phenology of this Prunus orchard, there is may be a dynamic migration of these insect pests from apricot to plum orchard, since the orchards are close to each other. This study revealed a succession of aphid colonization driven by phenology; apricot orchards were colonized first in March, with a peak in species diversity followed by the dominance of H. pruni, while plum orchards were colonized later, reaching maximum diversity in May. This temporal shift seems to be linked to the early availability of resources in apricot, exposure to late spring frosts and optimal conditions in plum orchards during full bloom. Phenological differences between apricot and plum trees, induced by rising temperatures at the end of winter, lead to earlier flowering in apricot trees (Nsibi et al., 2017). Apricot growth slowly from June, while plum growth rapidely from April to the end of May, making Prunus orchard sequentially available to pests (Rejeb et al., 2011; Nsibi et al., 2020; Groppi, 2021). The phenology of the apricot tree reflects local adaptation to climatic conditions. In March 2023, the average minimum and maximum temperatures in the studied region were 9.3°C and 21.4°C, respectively, representing a slight decrease in the minimum and an increase in the maximum compared to the previous year (ONMTO, 2024), which likely favored early bud break and accelerated vegetative growth (Nsibi, 2021). Reservoirs such as the Béni Haroun and Taksabt dams, in yhis region, contribute to the local regulation of temperature, further promoting early development of the apricot trees (Chebbah & Kabour, 2018; Gherraz & Alkama, 2020). Early-maturing Prunus is more vulnerable to pests, as young shoots and the intense sap flow provide accessible resources (Nsibi, 2021).

The presence of S. scirpus - noted but not reported in publications in Algeria - and of W. nervata, reported for the first time by Dahmani et al. (2022) in Staouali (northern Algeria), reflects their host plants, Cyperus rotundus and Rosa spp. (Hassan et al., 2024; EPPO, 2025), cultivated as ornamental plants at the psychiatric hospital beside. Similarly for Pemphigus sp., the third most abundant in plum orchards (7.25%) and the second in apricot orchards (5.56%), this aphid was the third most reported (7.14%) in Mostaganem (northern Algeria) by Akrich et al. (2025) on Populus alba - a species that dominates riparian forests along watercourses (Miletić et al., 2024) - reflecting its presence in the forest bordering the dam. This finding highlights the potential role of surrounding vegetation as a reservoir for aphid populations and suggest that landscape context should be taken considered in orchard pest control. The analysis highlights five species of aphids showing very significant differences between the apricot trees and the plum trees, emphasizing their importance as indicators of host-parasite relationships and ecosystem functioning.

Under a Mediterranean climate, the present results are consistent with those of Gacem and Mezerdi (2022) in Lakhdaria (Algeria), who report Hyalopterus pruni was the main pest of Prunus persica orchards (61.25%), as well as Sadat et al. (2019), in the Algiers region of Algeria, hae reported that the species reaches 65.5% (74.41% in Tizi-Ouzou) in apricot orchards and only 1.8% of aphid population in plum orchards. In northern Tunisia, H. pruni is as an important vector of Sharka (plum pox virus), has caused direct and indirect damage through honeydew production and virus transmission for plum orchads (Khaled-Gasmi et al., 2022; Saadi & Al-Hayali, 2024). Aphis fabae was moderately common, (Achoura & Belhamra, 2010; Khaled-Gasmi et al., 2022), while Aphis gossypii showed medium abundance, as reported by Ben Halima-Kamel (2012) and is recognized as a reference disease vector in Morocco (Sekkat et al., 2015) and in Tunisia

(Khaled-Gasmi et al., 2022). The weak presence of Brachycaudus helichrysi, in this study, confirms those of Gacem & Mezerdi (2022), who classifyed it as the third most harmful aphid with 4.85% in Prunus persica orchards in Lakhdaria (Kabylia, Algeria), with the second being Myzus persicae (26.46%), which ranks the fourth range in the plum orchards (4.35%). These data also agree with the observations made from northern Tunisia (Ben Halima-Kamel, 2012) and Morocco (Sekkat et al., 2015), in relation to Prunus and its reservoir Pittosporum tobira. Similarly, Rhopalosiphum padi predominated over R. maidis, confirmed a previous report (Laamari et al., 2009; Adss and Tabikha, 2021; Khaled-Gasmi et al., 2022).
The positive correlations between aphid species reveal a structured community, without competitive exclusion, suggesting an ecological balance possibly favored by plant defense mechanisms, particularly the production of secondary metabolites by endophytic fungi (Caicedo-López et al., 2021; Chacón et al., 2021). Nekrasov et al. (2022). Endophytic fungi species were identified in asymptomatic branches of Prunus mandshurica, dominated by Alternaria alternata, Cladosporium and Fusarium in the healthy of apricot trees. Misong et al. (2025) isolated endophytes from healthy shoots of Prunus yedoensis, mainly Fusarium acuminatum. The interactions between Prunus, U. dioica and their foliar endophytes could contribute to the regulation of aphids in the orchard and its maintenance in orchards could reflect ancestral knowledge guiding this practice that favors biological balance (Wulf et al., 2023). These results suggest that endophytic fungi of U. dioica could be involved in the regulation of aphids particularly H. pruni-and could help maintain a dynamic ecological balance in Prunus orchards, potentially limiting the development of resistances (Repajić et al., 2021; Yigit et al., 2021; Koczkodaj et al., 2023). Other factor, Nettle Urtica dioica is consciously conserved by farmers for its presumed role in controlling aphids, a practice that may be based on traditional empirical knowledge. The present results suggest a probable symbiosis between the abundant fungal endophytes of nettle and the Prunus host in the study area, leading to a natural regulation of aphid populations.

CONCLUSION

The aphid migration from apricot orchard to plum one appears to follow the phenology of the host, with Hyalopterus pruni dominating in apricot and a more diverse aphid community in plum. The synchronization of Prunus phenology could guide monitoring and support management strategies that minimize the use of chemical pesticides. The observed synchronization between the dynamics of winged aphids and tree development may promote natural regulation within the orchards. It could be suggested to preserve Urtica dioica in the orchards as a potential reservoir of endophytic fungal metabolites that could help regulate aphid populations. This study is particularly relevant to local pesticide-free agriculture, as it provides information to improve pest management while maintaining ecological balance. Thence, these results suggest that combining phenology-based monitoring with plant-microbe interactions could improve the sustainable management of aphids in Prunus orchards.
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