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ECOLOGICAL CHARACTERIZATION OF ARTHROPOD FAUNA AND PEST PRESSURE IN A HAZELNUT AGROECOSYSTEM

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Abstract. *The study aimed to characterize the arthropod fauna associated with hazelnut (Corylus avellana L.) cultivars and to evaluate the ecological importance of the dominant pest species under field conditions. The research was conducted on three hazelnut cultivars (Tonda Genetic, Nohichone, and Tonda Romana) through two visual inspections performed on 15 and 25 May 2025. The identified arthropods were evaluated using ecological indices, including abundance (A), dominance (D), constancy (C), and ecological significance (W). The results showed that Myzocallis coryli and Parthenolecanium corni were the dominant phytophagous species in all cultivars, exhibiting the highest values of dominance and ecological significance. Myzocallis coryli reached the highest dominance in Tonda Romana (71.99%), whereas Parthenolecanium corni showed high ecological importance, particularly in Nohichone (46.14%) and Tonda Genetic (36.41%). Other pest species, including Curculio nucum, Bycticus betulae, Tipula spp., and Tapinoma sessile, displayed considerably lower ecological relevance. Beneficial arthropods, including Coccinella septempunctata, Coccinella bipunctata, Bulaea lichatschovi, Eresus sp., and Xysticus kochi, were recorded at low abundance and constancy throughout the monitoring period. Assessment of pest pressure indicated moderate infestation levels, with a slight reduction in Tonda Genetic and Nohichone between the two assessment dates, whereas Tonda Romana maintained stable or slightly increasing pest pressure. Overall, the study highlights the ecological importance of M. coryli and P. corni in hazelnut agroecosystems and demonstrates the usefulness of ecological indices for characterizing arthropod communities and supporting integrated pest management.*

Keywords*: Parthenolecanium corni*, hazelnut pests, cultivar susceptibility, agroecosystem, entomofauna, pest monitoring, biodiversity

INTRODUCTION

Hazelnut (*Corylus avellana* L.) is one of the most important fruit species in the Betulaceae family, its fruits being widely used in the chocolate, confectionery and bakery industries. SILVESTRI et al. (2021) highlight that the expansion of the crop to new regions of the world has been accompanied by the development of modern cultivation and plantation management technologies, aimed at ensuring high and quality production. From a nutritional point of view, KRÓL and GANTNER (2020) show that hazelnuts are distinguished by their high lipid content, favorable fatty acid profile and significant concentration of tocopherols and other bioactive compounds, characteristics that explain the growing interest in expanding this crop.

The expansion of cultivated areas has also been followed by an increase in the importance of phytosanitary management, since numerous arthropod species can affect plant development, production and fruit quality. GANTNER (2005) shows that although the fauna associated with hazelnut cultivation is very diverse, only a small number of species cause significant economic losses. Under the conditions of the plantations investigated in Poland, the most important phytophagous species were the hazelnut weevil (*Curculio nucum* L.), the bud

http://doi.org/10.59463/RJAS.2026.2.51

mite (*Phytoptus avellanae* Nal.), the hazelnut aphid (*Myzocallis coryli* Goetze) and the European fruit scale (*Parthenolecanium corni* Bouché) (TRABAND et al., 2023). The same author highlights the existence of significant differences between cultivars in terms of susceptibility to attack by these pests, concluding that the use of more resistant genotypes can contribute to reducing the application of insecticides and to the development of effective integrated pest management programs.

In recent years, the concept of integrated pest management has directed research towards assessing the structure of arthropod communities in agroecosystems, since the effectiveness of control measures depends on the knowledge of dominant species and on the understanding of the relationships between phytophagous organisms and beneficial entomofauna. PEDIGO and RICE (2014) emphasize that systematic monitoring of pest populations is the basis of modern integrated management programs, as it allows the establishment of the optimal moment of intervention and reduces the unjustified use of insecticides. At the same time, the conservation of beneficial organisms contributes to maintaining the biological balance of agroecosystems and can limit the development of populations of some phytophagous species.

Characterization of arthropod communities is frequently achieved by using ecological indices of abundance, dominance, constancy and ecological significance, which allow the assessment of community structure and the relative importance of each species in the ecosystem studied (SOUTHWOOD and HENDERSON, 2000; MAGURRAN, 2004). The use of these indicators provides objective information on the dominant species and the stability of insect communities and constitutes an important tool for the substantiation of phytosanitary protection strategies.

Compared to the literature available for the main hazelnut producing countries, the number of published studies on the structure of arthropod communities associated with hazelnut plantations in Romania is low. In this context, the evaluation of the entomofauna structure and the intensity of attack produced by the main phytophagous species can provide useful information for adapting integrated management measures to local conditions.

Therefore, the aim of the present study was to characterize the entomofauna associated with the *Corylus avellana* crop within the experimental plantation of the "King Mihai I" University of Life Sciences in Timișoara, by identifying the main phytophagous species and the associated entomofauna, evaluating the ecological structure of the community using indices of abundance, dominance, constancy and ecological significance, as well as the comparative analysis of the intensity of attack produced by the dominant phytophagous species on the main investigated varieties.

MATERIAL AND METHODS

The research was conducted in 2025, in the hazelnut teaching plantation of the "King Michael I" University of Life Sciences in Timisoara. The plantation includes several varieties of *Corylus avellana*, and the varieties Tonda Genetic, Nohichone and Tonda Romana were selected for the comparative analysis.

The monitoring of the entomofauna was carried out through direct visual observations, using a random sampling method. For each variety, five trees were analyzed, considered representative for the studied plantation. For each specimen, the leaves, shoots and branches located in different areas of the crown were examined, monitoring the presence of phytophagous species, useful entomofauna and characteristic symptoms of attack.

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The assessments were carried out on May 15, 2025 and May 25, 2025. Arthropod species were identified based on morphological characters and symptoms produced on plants.

The species *Parthenolecanium corni*, *Myzocallis coryli*, *Curculio nucu*m and *Bycticscus betulae* were included in the ecological analysis. The structure of the arthropod community was characterized by calculating the abundance (A), dominance (D), constancy (C) and ecological significance index (W), according to the methodology described by BUBURUZ (2013).

Dominance was calculated with the relationship:

$$D(\%) = \frac{N_A}{N_t} \times 100$$

where N_A represents the number of individuals of the species analyzed, and N_t the total number of individuals recorded.

Constancy (C) was calculated using the relationship:

$$C(\%) = \frac{N_{pA}}{N_p} \times 100$$

where N_{pA} represents the number of samples in which the analyzed species was identified, and *Np* represents the total number of samples examined.

The ecological significance index was calculated as follows:

$$W(\%) = \frac{D \times C}{100}$$

The intensity of the attack produced by *Parthenolecanium corni* and *Myzocallis coryli* was visually assessed for each of the five trees analyzed from each variety, using a rating scale with values ranging from **0 to 5**, where the value 0 indicated the absence of attack, and increasing values corresponded to progressive levels of infestation.

RESULTS AND DISCUSSIONS

During the monitoring period carried out in the experimental hazelnut plantation of the "King Mihai I" University of Life Sciences in Timișoara (USVT), four phytophagous arthropod species associated with hazelnut were identified, belonging to the orders Hemiptera and Coleoptera (Table 1).

Table 1.

Damaging arthropod species identified in the hazelnut agroecosystem

Scientific name	Family	Order
Parthenolecanium corni	Coccidae	Hemiptera
Myzocallis coryli	Aphididae	Hemiptera
Curculio nucum	Curculionidae	Coleoptera
Bycticscus betulae	Attelabidae	Coleoptera

Representative individuals of the identified pest species and the characteristic symptoms observed on hazelnut plants are presented in Figure 1.

The results obtained are in line with the literature, which mentions *Myzocallis coryli* and *Parthenolecanium corni* among the most frequent and important phytophagous species associated with hazelnut cultivation in Europe. *Myzocallis coryli* forms numerous colonies on

http://doi.org/10.59463/RJAS.2026.2.51

the underside of leaves, where it feeds on plant sap, causing a reduction in photosynthetic activity and, in the case of heavy infestations, a quantitative and qualitative decrease in production (GANTNER, 2005). Similarly, *Parthenolecanium corni* is considered one of the characteristic species of hazelnut plantations, being frequently encountered in commercial orchards and monitored due to its economic impact and its relationships with the entomophagous complex (TRABAND et al., 2023). *Curculio nucum* is recognized as one of the most important pests of hazelnut fruits, producing significant economic losses through the attack on the fruits, but its economic importance depends on the population density and local pedoclimatic conditions (SHANOVICH and AUKEMA, 2022).

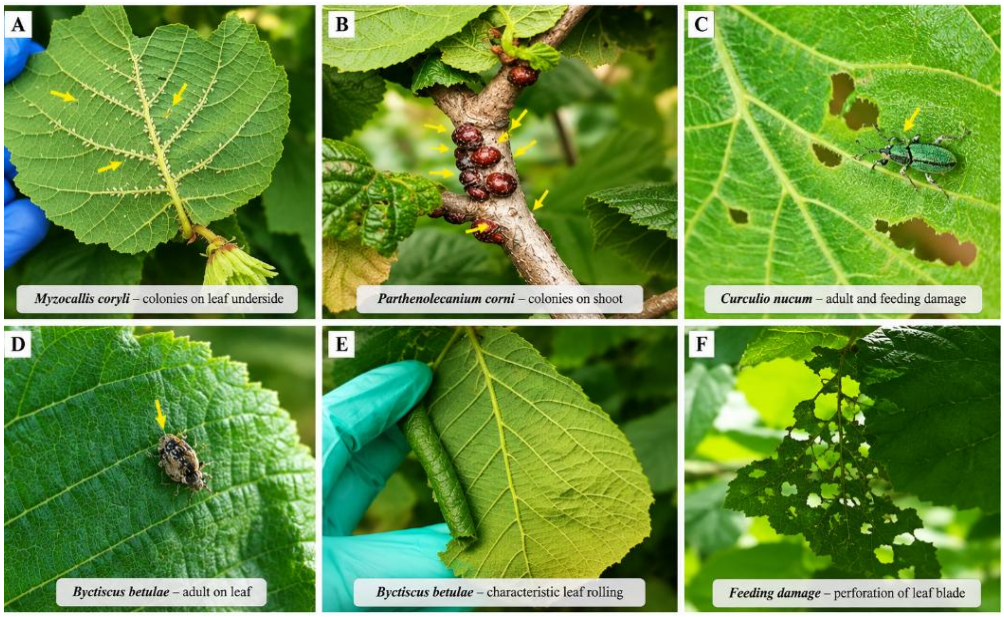

Figure 1. Representative pest species and characteristic damage observed in the hazelnut agroecosystem during the monitoring period. (A) *Myzocallis coryli* colonies on the abaxial leaf surface; (B) *Parthenolecanium corni* colonies on young shoots; (C) adult *Curculio nucum*; (D) adult *Byctiscus betulae*; (E) leaf rolling caused by *Byctiscus betulae*; (F) feeding damage on hazelnut leaves.

Species from the order Coleoptera, namely *Curculio nucum* and *Byctiscus betulae*, were also identified during the observations, but their presence was lower compared to that of the hemipteran species, which suggests a secondary contribution to the structure of the pest community under the conditions of the analyzed agroecosystem.

In addition to the phytophagous species, several useful or neutral arthropod species were also reported during the observations, such as *Coccinella septempunctata*, *Coccinella bipunctata*, *Bulaea lichatschovi*, *Eresus* sp., *Xysticus kochi*, *Tipula* spp. and *Tapinoma sessile*. These were encountered sporadically, with low abundance and without a significant contribution to the structure of the arthropod community during the analyzed period. For this reason, the comparative ecological analysis was carried out exclusively on the dominant phytophagous species.

The comparative analysis of the ecological indices revealed clear differences in the structure of the pest arthropod community among the three investigated hazelnut cultivars

http://doi.org/10.59463/RJAS.2026.2.51

(Table 2). In all cultivars, *Myzocallis coryli* and *Parthenolecanium corni* represented the dominant hytophagous species, whereas *Curculio nucum* and *Byctiscus betulae* exhibited considerably lower ecological importance.

Myzocallis coryli recorded the highest ecological significance among the identified species, with dominance values (D) of 48.39% in Tonda Genetic, 47.16% in Nohichone, and 71.99% in Tonda Romana. The species was present in all observations (C = 100%) irrespective of cultivar, resulting in the highest values of the ecological significance index (W). These findings indicate that *Myzocallis coryli* was the dominant component of the pest community, particularly in the cultivar Tonda Romana, which appeared to provide more favorable conditions for aphid population development.

Similarly, *Parthenolecanium corni* exhibited high ecological importance, with dominance values ranging from 16.58% in Tonda Romana to 46.14% in Nohichone. The species was recorded with a constancy of 100% in all cultivars, confirming its permanent occurrence throughout the monitoring period. Although its abundance varied among cultivars, the consistently high constancy suggests that this scale insect is a stable component of the hazelnut pest complex.

Table 2.

Comparative ecological indices of the dominant pest arthropods associated with the three hazelnut cultivars

Species	Tonta Genetic				Nohichone				Tonda Romana			
	A	D (%)	C (%)	W (%)	A	D (%)	C (%)	W (%)	A	D (%)	C (%)	W (%)
Parthenolecanium corni	78.00	36.4	100.0	36.41	128.86	46.14	100.00	46.14	62,33	16.58	100.0	16.58
Myzocallis coryli	105.00	48.39	100.0	48.39	131.71	47.16	100.00	47.16	270.67	71.99	1000	71.99
Curculio nucum	3.00	1.38	100.0	1.38	3.40	0.87	71.43	0.62	4.00	0.35	33.33	0.12
Byctiscus betulae	5.00	1.15	50.00	0.58	2.33	0.36	42.86	0.15	0.00	0.00	0.00	0.00

In contrast, the coleopteran species showed considerably lower ecological indices. *Curculio nucum* reached maximum dominance values of only 1.38%, while its constancy decreased from 100% in Tonda Genetic to 33.33% in Tonda Romana. Likewise, *Byctiscus betulae* occurred sporadically, with low abundance and ecological significance, and was completely absent from the cultivar Tonda Romana. These results indicate that both coleopteran species played only a minor role in shaping the pest community during the study period.

The predominance of *Myzocallis coryli* and *Parthenolecanium corni* observed in the present study agrees with previous investigations conducted in European hazelnut orchards, where these hemipteran species have been consistently reported among the most frequent and economically important pests of *Corylus avellana* (GANTNER, 2005; BOŠNJAK et al., 2011). The continuous occurrence of both species throughout the monitoring period also supports previous observations indicating that aphids and soft scales are well adapted to hazelnut agroecosystems and may establish stable populations under favorable environmental conditions (VIGGIANI, 1994; TRABAND et al., 2023).

Although *Curculio nucum* is recognized as one of the most destructive pests of hazelnut fruits in Europe, its ecological indices were relatively low in the present study. Similar observations have been reported by MORAGLIO et al. (2009), who emphasized that population density of this weevil varies considerably among orchards and years depending on climatic conditions, cultivar susceptibility and orchard management practices. Likewise, Shanovich and AUKEMA (2022) highlighted that the abundance of *Curculio* species is strongly influenced by

http://doi.org/10.59463/RJAS.2026.2.51

synchronization between adult emergence and fruit development, which may explain the reduced ecological importance recorded during the present monitoring period.

Overall, the ecological indices indicated that *Myzocallis coryli* and *Parthenolecanium corni* were the most ecologically important pest species in the investigated orchard. These findings highlight the importance of prioritizing the monitoring and integrated management of these hemipteran species under the environmental conditions of western Romania.

The comparative analysis of the attack intensity revealed differences between the three hazelnut varieties in terms of the evolution of the populations of the two dominant pest species during the monitoring period (Table 3, Figures 1 and 2).

Table 3.

Comparative pest infestation intensity recorded on the three hazelnut cultivars during the monitoring period

Cultivar	Pest species	Evaluation 15 May 2025	Evaluation 25 May 2025	Variation
Tonda Genetic	*Parthenolecanium corni*	2.50	2.30	↓ 0.20
	Myzocallis coryli	2.80	2.50	↓ 0.30
Nohichone	*Parthenolecanium corni*	2.80	2.53	↓ 0.27
	Myzocallis coryli	2.87	2.80	↓ 0.07
Tonda Romana	*Parthenolecanium corni*	2.13	2.33	↑ 0.20
	Myzocallis coryli	3.20	3.20	0.00

Values represent the mean infestation intensity recorded during the two assessment dates.

In the case of the species *Parthenolecanium corni*, the average attack intensity recorded a slight decrease in the varieties Tonda Genetic, from 2.50 to 2.30, and Nohichone, from 2.80 to 2.53, indicating a moderate reduction in the populations between the two assessments. In contrast, in the variety Tonda Romana a slight increase in the attack intensity was observed, from 2.13 to 2.33, suggesting the maintenance of the activity of the populations during the analyzed period.

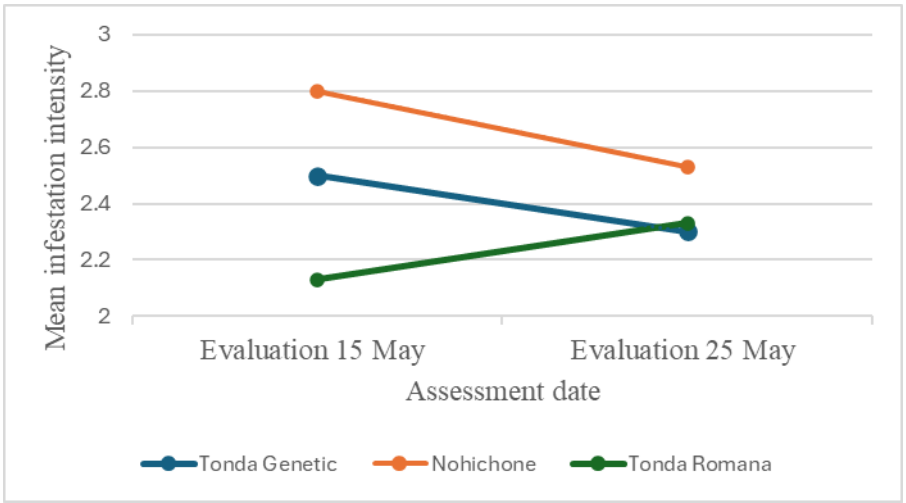

Figure 2. Temporal variation in the mean infestation intensity of *Parthenolecanium corni*

A different evolution was observed in the case of the species *Myzocallis coryli*. The intensity of the attack decreased in Tonda Genetic (from 2.80 to 2.50) and very slightly in

http://doi.org/10.59463/RJAS.2026.2.51

Nohichone (from 2.87 to 2.80), while in the Tonda Romana variety the value remained constant (3.20) in both determinations. These results confirm that *Myzocallis coryli* represented the dominant species in the analyzed plantation and that the Tonda Romana variety favored the maintenance of high populations throughout the monitoring period.

The results obtained are consistent with those reported by GANTNER (2005), which highlights the fact that aphids represent one of the main groups of hazelnut pests, the population density being influenced by both the particularities of the variety and the climatic conditions. ALSO, GÜNCAN and GÜMÜŞ (2017) showed that the development of *Myzocallis coryli* colonies is dependent on the genetic characteristics of the cultivar and the environmental conditions, which may explain the differences observed between the three investigated varieties.

The slight decrease in the intensity of the attack in the Tonda Genetic and Nohichone varieties can be associated both with the natural dynamics of the populations and with the action of the beneficial entomofauna observed in the plantation. During the monitoring, several species of natural predators were identified, such as *Coccinella septempunctata*, *Coccinella bipunctata* and various species of spiders, which may contribute to limiting the development of aphid and European fruit scale populations.

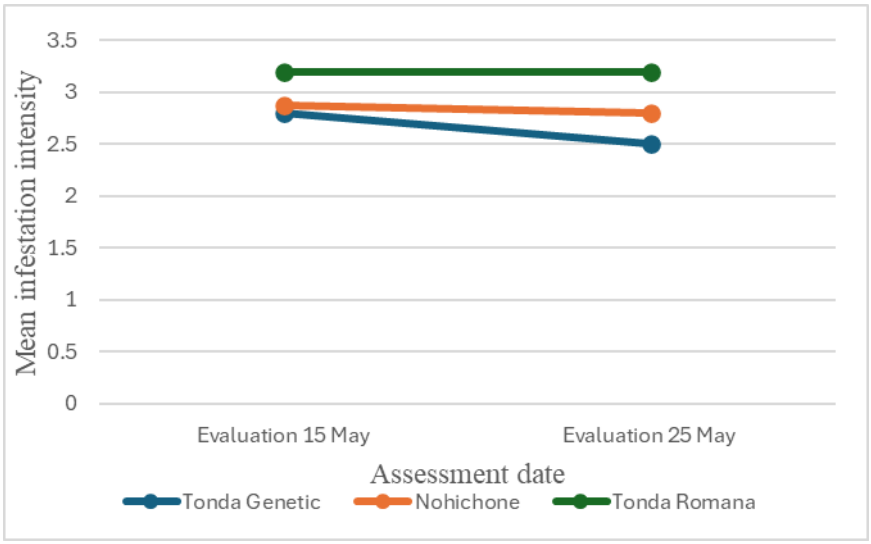

Figure 3. Temporal variation in the mean infestation intensity of *Myzocallis coryli* on the three hazelnut cultivars during the monitoring period

The importance of these organisms in the biological regulation of pest populations has also been highlighted by TRABAND et al. (2023), who underline the role of conserving beneficial entomofauna in integrated pest management programs. In the case of the species *Parthenolecanium corni*, the slight variation in attack intensity between the two assessment dates is consistent with the biological characteristics of the species. European fruit scale generally develop more slowly than aphids, and population variations are less pronounced over short monitoring intervals (KOSZTARAB and KOZÁR, 1988; TRABAND et al., 2023).

Overall, the results highlight that Tonda Romana presented the highest level of infestation with *Myzocallis coryli*, while in the Tonda Genetic and Nohichone varieties a slight

http://doi.org/10.59463/RJAS.2026.2.51

decrease in the intensity of the attack was observed for both monitored species. These differences suggest the existence of particularities in the response of the varieties to the pest attack and underline the importance of periodic monitoring of populations in order to apply integrated control measures at the optimal time.

Figure 3 highlights the differences between hazelnut varieties in terms of the dominance of harmful arthropod species identified during the monitoring period. It is observed that *Myzocallis coryli* was the dominant species in all three investigated varieties, recording the highest dominance index value in the Tonda Romana variety (71.99%), followed by Tonda Genetic (48.39%) and Nohichone (47.16%). These results confirm the high capacity of this species to colonize the hazelnut crop and to become the dominant element of the phytophagous arthropod community.

In the case of the species *Parthenolecanium corni*, the dominance index values were lower than those recorded for *M. coryli*, but high enough to place it among the dominant species of the agroecosystem. The highest value was recorded for the Nohichone variety (46.14%), followed by Tonda Genetic (36.41%), while for Tonda Romana the dominance was considerably lower (16.58%).

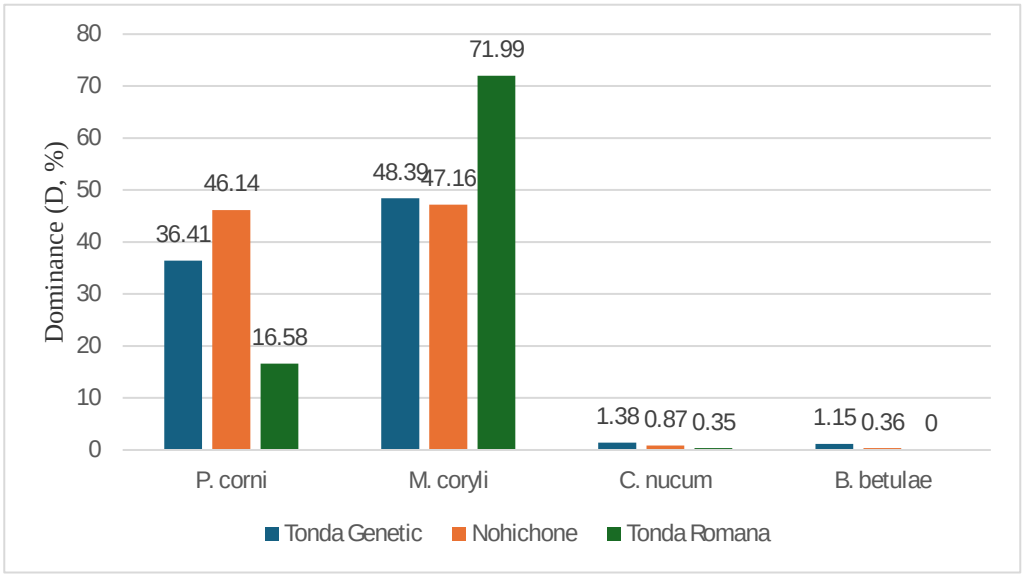

Figure 4. Comparative dominance (D, %) of the pest arthropod species associated with the three hazelnut cultivars

In contrast, the species *Curculio nucum* and *Byctiscus betulae* presented very low values of the dominance index, below 2% in all the analyzed variants, and *Byctiscus betulae* was not identified in the Tonda Romana variety. These results indicate that, under the experimental conditions of the analyzed plantation, the contribution of the two species to the structure of the pest community was reduced compared to that of the species of the order Hemiptera.

The results obtained are consistent with those reported by GANTNER (2005), who highlighted the predominance of aphids and European fruit scale in the structure of the pest communities in European hazelnut plantations. Also, BOŠNJAK et al. (2011) showed that

species of the order Hemiptera represent, in most commercial hazelnut plantations, the phytophagous group with the highest frequency and economic importance, while coleoptera usually appear with lower densities and with significant variations from one year to the next. Similarly, TRABAND et al. (2023) point out that sedentary species, such as *Parthenolecanium corni*, can maintain stable populations in hazelnut plantations, but their level of dominance is influenced by climatic conditions, the presence of beneficial entomofauna and the management measures applied.

Overall, the distribution of dominance index values confirms that the structure of the arthropod community in the experimental plantation was strongly influenced by the species *Myzocallis coryli* and *Parthenolecanium corni*, while the coleopteran species had a secondary ecological importance. These results support the need to focus monitoring activities and integrated control measures mainly on the two dominant species.

CONCLUSIONS

The present study provided a comprehensive characterization of the arthropod fauna associated with three hazelnut cultivars cultivated under the environmental conditions of western Romania. Four phytophagous arthropod species belonging to the orders Hemiptera and Coleoptera were identified, together with several beneficial arthropods that occurred at low abundance throughout the monitoring period.

The ecological analysis demonstrated that *Myzocallis coryli* and *Parthenolecanium corni* were the dominant components of the pest community, exhibiting the highest values of dominance, constancy, and ecological significance in all investigated cultivars. In contrast, *Curculio nucum* and *Byctiscus betulae* displayed low ecological importance, indicating a limited contribution to the overall pest complex under the conditions of the present study.

Differences among cultivars were evident in both ecological indices and infestation intensity. The cultivar Tonda Romana supported the highest populations of *Myzocallis coryli* and maintained the greatest infestation pressure throughout the monitoring period, whereas Tonda Genetic and Nohichone showed a slight reduction in infestation intensity between the two assessment dates. These results suggest cultivar-dependent differences in susceptibility to pest attack.

The application of ecological indices proved to be an effective approach for characterizing arthropod communities and identifying the species of greatest phytosanitary importance. The findings provide valuable baseline information for the development of integrated pest management strategies in hazelnut orchards and emphasize the importance of regular monitoring of *Myzocallis coryli* and *Parthenolecanium corni* to support timely and sustainable pest control under local growing conditions.

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