ABSTRACT

The cultivation of fruit and ornamental shrubs has seen a considerable expansion globally, supported by contemporary trends in the direction of sustainability and ecology. The study of arthropods in these plantations is a complex field of research, given the significant influence of these organisms on plant development and crop productivity. In recent years, research in this area has intensified, reflecting a deepening understanding of the multiple roles that arthropods play in agricultural and ornamental ecosystems.

The doctoral thesis entitled "**Research on arthropods collected in some fruit and ornamental shrub plantations**" analyses the diversity, dynamics, abundance and ecological impact of arthropod populations in fruit and ornamental shrub plantations, contributing to scientific progress in the field.

The aim of the work is to fully understand the functional role of arthropods and the trophic relationships within the two ecosystems: chokeberry plantation and boxwood plantation. The results obtained will contribute to the development and implementation of sustainable integrated pest management strategies, by providing substantiated analyses from fruit and ornamental shrub plantations, exploited in ecological and conventional systems.

The doctoral thesis totals 200 pages, being structured in two parts and comprising five chapters to which the bibliographic part and appendices are added. They include a number of 107 tables, 46 figures and 170 bibliographic titles.

Part I of the paper, "The current state of knowledge", includes two chapters in which the documentary research of the specialized literature highlights the evolution and recent trends in the study of arthropods from fruit and ornamental shrub plantations.

Chapter I analysed the fundamental theoretical concepts and methodologies used in previous research. Insect biodiversity provides a number of indispensable services in agricultural production, including pollination, nutrient re-introduction to the soil and natural pest control (Herea et al., 2020). Constant efforts are needed to conserve and identify insects and elucidate their role in ecosystem functioning. Intensive research, constant surveillance, early detection and rapid response are essential to deal with emerging pest and disease threats to crop production.

Chapter II describes the natural, organizational and institutional framework in which the research was carried out, highlighting the geographical, climatic and administrative specificities of the experimental locations, as well as the organizational and institutional structures that facilitated the research. The research within the doctoral thesis was undertaken and carried out in collaboration with two units specialized in research-development and production of dendrological material from Iași county: Research Station for Fruit Growing Iași and Forest Nursery Tree Galata.

Part II of the thesis includes "Own contributions" and consists of chapters III, IV and V followed by bibliography and appendices.

Chapter III presents the purpose and objectives proposed for carrying out the research, identifying and establishing the research methods used, organizing the experience and establishing the biodiversity of arthropods in the plantations of fruit and ornamental shrubs.

In order to achieve the proposed goal, several specific objectives were established to identify and evaluate the diversity of arthropods, as well as the analysis of the ecological relationships within the two ecosystems:

1. Identification and classification of arthropod species existing in the two plantations;
2. Evaluation of the diversity and abundance of arthropods encountered in the two stations:

3. Investigation of community structures and dynamics of arthropod populations in chokeberry and boxwood plantations, in relation to seasonal variations;

4. Establishing the dynamics of harmful species, their density and control measures;

5. Establishing the biodiversity of existing arthropods within the plantations of fruit and ornamental shrubs;

6. Study on the ecological relationships of arthropods within the ecosystem.

The collection of entomological material was achieved by using and integrating various methods to ensure a representative and specific capture of arthropods: Barber-type soil traps, pheromonal traps, optical traps.

The analysis of arthropod diversity in the two plantations was carried out by evaluating the effectiveness of different cultural practices of treatment and irrigation, the experiences being organized with multiple variants.

In the aronia plantation, the experience was organized in 4 distinct variants:

- V1 - aronia in ecological system;
- V2 - aronia in irrigated ecological system;
- V3 - aronia in conventional system;
- V4 - chokeberry in conventional irrigated system.

Each variant was monitored separately to observe the combined impact of treatments and irrigation on plant health and arthropod diversity.

In the boxwood plantation, the experience was organized in three variants to compare the effects of organic and conventional treatments:

- V1 – untreated variant;
- V2 – ecologically treated variant;
- V3 – conventionally treated variant;

This experimental structure allowed the analysis of the effectiveness of each type of treatment in the management of arthropod structures within the ecosystem.

Establishing the diversity of arthropods in fruit and ornamental shrub plantations is necessary to understand the ecological and functional complexity within the two agroecosystems. Analysis of trophic relationships and dynamism of arthropod populations in fruit and ornamental shrub plantations will be established by calculating alpha (α) and beta (β) diversity indices.

Biodiversity indicators alpha (α) are measures used to assess the diversity of species in a specific habitat or location. These indicators are fundamental to understanding the ecological complexity and health of ecosystems. The following diversity indices were calculated during the research in the paper: *Shannon Index*, or Shannon-Weaver Index, *Simpson Diversity Index*, *Dominance Index*, *Menhinick Index*, *Margalef Index*, *Buzas & Gibson Index*.

Biodiversity indicators beta (β) quantify the differences in the taxonomic composition of two different habitats, or locations, and allow the assessment of regional spatial variation of biodiversity.

In the work, the biodiversity of the two ecosystems of fruit and ornamental shrubs was compared by calculating the following diversity indices (β): J*accard Similarity Index*, *Sørensen Similarity Index*, *Whittaker Diversity Index*, *Routledge beta-R Index*, *Bray-Curtis Index* and *Mountford index*.

Chapter IV, through its 6 sub-chapters, highlights "Results and discussions" obtained in the stations studied.

During the research carried out in the period 2022-2023, arthropods from fruit and ornamental shrub plantations were collected using various research methods in the two stations analyzed: the Barber soil trap

method, the pheromonal trap method and the optical trap method. The established methodology allowed obtaining a representative sample of arthropods, contributing to a detailed assessment of biodiversity and species distribution in these ecosystems.

In the year 2022 in the aronia plantation, following the 9 harvests carried out in the May-September research period, 3502 specimens of arthropods were collected with the help of Barber-type soil traps. The dominant categories belonged to the orders Coleoptera (953 specimens), Hymenoptera (879 specimens) and Hemiptera (524 specimens). Diptera (49 specimens), orthoptera (70 specimens) and myriapods (129) were in a smaller number. The species found accidentally in the samples were from the orders Lepidoptera (3 specimens) and Dermaptera (12 specimens).

The specific diversity of the populations of the Coleoptera order in the chokeberry plantation in 2022 was made up of 62 species, totaling 953 specimens collected. The most abundant species include Harpalus distinguendus (187 specimens), Opatrum sabulosum (184 specimens) and Dermestes laniarius (90 specimens).

The distribution of the total number of arthropods by experimental variant was as follows: the ecological system (V1) had 1137 specimens, the irrigated ecological system (V2) recorded 1145 specimens, the conventional system (V3) had 561 specimens, and the conventional irrigated system (V4) collected 659 copies.

In the boxwood plantation, in the year 2022, 2468 specimens of arthropods were collected following the 9 harvests with the help of Barber-type soil traps. The dominant categories belonged to the orders Coleoptera (775 specimens), Hymenoptera (612 specimens) and the class Arachnida (348 specimens). Diptera (56 specimens), myriapods (30) and orthoptera (95 specimens) were in a smaller number. The species found accidentally in the samples were from the orders Lepidoptera (5 specimens) and Dermaptera (10 specimens).

Regarding the structure of the beetles collected in 2022 from the boxwood plantation, 776 specimens from 57 different species were identified. The most abundant species include *Harpalus distinguendus* Duftschmid with 232 specimens, *Dermestes laniarius* Illiger with 134 specimens and *Opatrum sabulosum* L. with 86 specimens.

Analyzing the number of arthropods from the perspective of the experimental variants, in 2022, the untreated variant recorded the highest number of specimens collected, with a total of 1121. This was followed by the ecologically treated variant, which collected 775 specimens, and the treated variant conventional, with 552 samples.

In the aronia plantation, in the year 2023, 5160 specimens of arthropods were collected, following the 10 harvests, with the help of the Barber-type soil traps. The dominant categories belonged to the orders Coleoptera (1928 specimens), Hymenoptera (785 specimens) and the class Arachnida (676 specimens). In a smaller number were myriapoeds (92), dipterans (101 specimens) and orthopterans (108 specimens). The species found accidentally in the samples were from the orders Lepidoptera (4 specimens), Thysanoptera (4 specimens) and Dermaptera (12 specimens). Regarding the number of arthropod specimens in the samples, the most were collected on June 6 (619 specimens), July 26 (526 specimens) and July 1 (449 specimens).

The structure of the coleoptera collected in the year 2023 in the aronia plantation was highlighted by 85 species of coleoptera, with a total number of 1928 specimens collected. The most abundant species include *Harpalus distinguendus* Duftschmid with 587 specimens, *Opatrum sabulosum* L. with 258 specimens and *Dermestes laniarius* Illiger with 126 specimens.

In 2023, the total number of specimens collected increased compared to the previous year. Thus, 1620 specimens were collected in the ecological system (V1), 1417 specimens in the irrigated ecological

system (V2), 922 specimens in the conventional system (V3), and 1201 specimens in the conventional irrigated system (V4).

In the boxwood plantation, in 2023, 5848 specimens of arthropods were collected. The dominant categories belonged to the orders Coleoptera (2778 specimens), Hymenoptera (1291 specimens) and Hemiptera (543 specimens). Diptera (64 specimens) and orthoptera (68 specimens) were in a smaller number. The species found accidentally in the samples were from the orders Lepidoptera (1 specimen), Dermaptera (1 specimen) and Thysanoptera (5 specimens). Regarding the abundance of arthropods in the samples, the most were collected on May 20 (1059 specimens), June 16 (1209 specimens) and July 28 (860 specimens).

The beetles collected in 2023 in the boxwood plantation totaled 2778 collected specimens, classified into 102 species. The most abundant species include *Opatrum sabulosum* L. with 820 specimens, *Harpalus distinguendus* Duftschmid with 257 specimens and *Dermestes laniarius* Illiger with 215 specimens.

In 2023, all experimental variants showed a significant increase in the number of specimens collected. The untreated variant continued to record the highest number of copies, with a total of 2548, followed by the ecologically treated variant, with 1875 copies, and the conventionally treated variant, with 1425 copies.

In the chokeberry plantation in the 2022-2023 research years, the research methodology also included the use of pheromonal attractants to monitor the presence and activity of the species *Epicometis hirta* Poda.

In 2022, collections began in the third decade of March, with 23 copies. Activity increased significantly in the first decade of April, reaching 113 copies, and continued to increase in the second and third decades of the same month, with 203 and 275 copies respectively. In May, the number of specimens decreased, registering 104 specimens in the first decade and only 21 in the second decade. The total number of specimens collected in 2022 was 739.

In the year 2023, collections showed a different pattern. In the third decade of March, the number of specimens was significantly lower, with only 4 specimens. Activity increased in the first decade of April to 50 copies, followed by 118 and 214 copies in the second and third decades of April. In May, unlike the previous year, a significant increase was observed, with 262 specimens in the first decade and 37 in the second decade. The total number of specimens collected in 2023 was 685.

In the boxwood plantation, pheromonal traps were used to monitor and capture the species *Cydalima perspectalis* Walker, in the greenhouse and in the production fields, during the research period 2022-2023. In 2022, 169 specimens were collected in the greenhouse and 319 specimens in the production fields, resulting in a total of 488 specimens collected. In 2023, the number of specimens collected increased, recording 204 specimens in the greenhouse and 346 in the production fields, totaling 550 specimens for that year. In total, during the two years of study, 1038 specimens were collected.

The monitoring of entomofauna in the boxwood fields was intensified using colored traps as the main method of detection and control after the visual identification of the species *Monarthropalpus flavus* Schrank in some plots of boxwood. Colored traps, especially yellow ones, have been shown to be effective in attracting and capturing a wide range of insects. Complementing the yellow traps, the blue traps were placed to ensure more comprehensive monitoring and effective management of insect populations. In 2022, the collection of arthropods using yellow traps took place between the months of May and August and totalized 1916 specimens. In 2023, collection of arthropods took place in a period similar to the previous year, totalized 929 specimens. This decrease in the total number of arthropods collected in 2023 compared to 2022 is reflected by variations in the ecological conditions of the stationary.

The results for arthropods collected using blue traps showed both seasonal and annual fluctuations. In 2022, 1793 specimens were collected in the boxwood plantation, the maximum peak of activity being recorded on May 30 (427 specimens captured). In 2023, 765 specimens were collected, most being recorded on July 3 (155 specimens).

In the aronia plantation, the alpha (α) diversity index values of the arthropods collected during the research period were as follows:

- The Simpson index had the value of 0.0961 in 2022 and 0.0711 in 2023;
- The dominance index (D) had the value of 0.9038 in 2022 and 0.9288 in 2023;
- The Shannon index (H') had the value of 4.192 in 2022 and 4.394 in 2023;
- The Shannon index (H) had the value of 2.906 in 2022 and 3.046 in 2023;
- The Shannon index had the value of -1.262 in 2022 and -1.323 in 2023;
- The Menhinick index had the value of 1.267 in 2022 and 1.585 in 2023;
- The Buzas and Gibbson index had the value of 0.2437 in 2022 and 0.6643 in 2023;
- The equity index had the value of 0.673 in 2022 and 0.6643 in 2023;
- The Berger-Parker dominance index had the value of 0.251 in 2022 and 0.1521 in 2023;
- The Margalef index had the value of 9.067 in 2022 and 11.35 in 2023;

In the boxwood plantation, the alpha (α) diversity index values of the arthropods collected during the research period were as follows:

- The Simpson index had the value of 0.0996 in 2022 and 0.0899 in 2023;
- The dominance index (D) had the value of 0.9003 in 2022 and 0.9100 in 2023;
- The Shannon index (H') had the value of 4.093 in 2022 and 4.375 in 2023;
- The Shannon index (H) had the value of 2.837 in 2022 and 3.032 in 2023;
- The Shannon index had the value of -1.232 in 2022 and -1.317 in 2023;
- The Menhinick index had the value of 1.409 in 2022 and 1.517 in 2023;
- The Buzas and Gibbson index had the value of 0.2438 in 2022 and 0.1788 in 2023;
- The equity index had the value of 0.6678 in 2022 and 0.6379 in 2023;
- The Berger-Parker dominance index had the value of 0.2479 in 2022 and 0.2208 in 2023;
- The Margalef index had the value of 8.833 in 2022 and 13.26 in 2023

The alpha (α) diversity index values of the coleopterans collected from chokeberry and boxwood plantations during the research period were as follows:

- The Simpson index had the value of 0.06 in 2022 and 0.0679 in 2023;
- The dominance index (D) had the value of 0.94 in 2022 and 0.9321 in 2023;
- The Shannon index (H') had the value of 4.921 in 2022 and 4.877 in 2023;
- The Shannon index (H) had the value of 3.411 in 2022 and 3.38 in 2023;
- The Shannon index had the value of -1.481 in 2022 and -1.468 in 2023;
- The Menhinick index had the value of 2.862 in 2022 and 2.434 in 2023;
- The Buzas and Gibbson index had the value of 0.2546 in 2022 and 0.1759 in 2023;
- The equity index had the value of 0.7137 in 2022 and 0.6605 in 2023;
- The Berger-Parker dominance index had the value of 0.1342 in 2022 and 0.1742 in 2023;
- The Margalef index had the value of 15.83 in 2022 and 19.63 in 2023.

The values of the beta diversity indices (β) of the coleopterans collected from chokeberry and boxwood plantations during the research period were as follows:

- The Sørensen index had the value of 0.3697 in 2022 and 0.3952 in 2023;
- The Jaccard index had the value of 0.2933 in 2022 and 0.93267 in 2023;

- The Routledge beta-R index had the value of 86.88 in 2022 and 119.7 in 2023;
- The Mountford index (%) had the value of 0.98 in 2022 and 0.85 in 2023;
- The Bray-Curtis difference index had the value of 0.6303 in 2022 and 0.6048 in 2023;
- The number of common species was 22 in 2022 and 33 in 2023.