

## SUMMARY

Worldwide, apple is one of the most important fruit species, being cultivated on all continents. In world fruit production, apples have a special place, and together with bananas and oranges represent 2/3 of the total annual harvest. In the climatic conditions of Romania, due to higher yields obtainable per unit area, apple culture is one of the most profitable crops.

Regarding the culture systems and the types of orchards, in the second half of the century. XX has increasingly accentuated the tendency of intensification of the tree culture, which has led to new ways of conducting, directing and maintaining the crown, to cope with the increase of the density of trees per hectare.

The creation of new varieties has also evolved in many directions: ensuring high density, increased productivity, biochemical and organoleptic qualities, new consumer tastes, resistance to imported diseases such as rapeseed, etc.

Modern apple-growing, however, has implicitly led to the use of pesticides, fertilizers and other chemically active substances, the shortcomings of which we are well aware of, to the extent that the environment and health cannot be tolerated. In this context, of the pollution of the environment with pesticides and fertilizers, fruit growing occupies one of the main places.

There are currently more obvious manifestation of global attitudes towards the environment and to human health, the sustainable use of natural resources and especially agriculture as a key factor in changing environment.

Phytosanitary protection is a key link in apple cultivation technology, with an important role in achieving high and constant productions, being known that the production potential of these horticultural systems can be reduced by 20-30%, or sometimes total compromise due to the attack of diseases and pests.

The purpose of the research carried out was to determine the useful and harmful entomofauna of beetles that affected apple tree plantations in the northern area of Moldova, more precisely in the municipality of Fălticeni.

Thesis on "Research on the structure, dynamics and ecological indices of the population of epigeous beetles from apple orchards" bears the comparative study on the epic entomofauna depending on the vegetal carpet between the rows of trees; knowledge of the current state of research on the harmful fauna of beetles and useful in apple orchards; identification of the

epigeous entomofauna from apple orchards; calculating the main ecological indicators.

The paper covers 200 pages and according to the regulations in force and it consists of 2 parts, namely: the first part entitled "The current state of knowledge at national and international level" which comprises 30 pages and the second part entitled "Own researches" , which includes 170 pages, 41 tables and 15 figures.

The current state of knowledge includes two headings, namely, Chapter 1 entitled, "The current state of research on apple culture, its pests, useful fauna, as well as the prevention and control measures applied, in which they are presented. with reference to the subject section of the document and to which it was intended to be used for the purpose of interpreting it and to keep it in view the "research" was prepared and Chapter 2 entitled "Characterization of the natural environment" in this chapter was presented in the form of information about the situation, when it was broken.

Part of II- "Preliminary research", is in two cases. The chapter presents the purpose of the course, the course, the course and the course of study.

#### **Proposed objectives:**

1. To know the current state of research on the harmful fauna of beetles and useful in apple orchards.
2. Identification of the epigeous entomofauna from apple orchards.
3. Comparative studies on the epigeous entomofauna depending on the vegetal carpet between the rows of trees.
4. Calculation of ecological parameters such as: abundance (A), constancy (C), dominance (D) and ecological significance index (W).

In order to reach the proposed objectives, several activities were carried out, namely:

- the bibliographic study of the literature in the field, both on a global level and in our country;
- designing in the field the working schemes and establishing the surfaces of each working variant;
  - location of soil traps in the field;
  - periodic observations in the experimental field taking samples, carrying out specific analyzes for calculating the values of some indicators, such as: frequency of attack (F%), intensity of attack (I%), with its two expressions (quantitative and qualitative), degree of damage (GD%), partial and total damage (P%) etc.
  - periodic collection of biological material using different methods;
  - labeling of the collected material from the experimental field;
  - preparing the material in order to identify the collected species;

- analysis of biological material collected, species determination and calculation of ecological indices of pest populations and useful fauna.
- calculating the main ecological indicators: abundance (A), dominance (D), constancy (C), ecological significance index (W), etc.

**The IV "Results and discussion" section** presents the structure, dynamics and abundance of the beetle species collected in apple plantations, as well as the calculation of ecological indices. In order to carry out the research, it was planned that the apple plantations would be harvested, and would be utilized for the month of May until September, in May.

Traps were placed in an experimental group with the following work:

- V1 - existing plant carpet (control);
- V2 - vegetal carpet overlaid with pods (*Lotus corniculatus*);
- V3 - vegetal carpet overlaid with white clover (*Trifolium repens*);
- V4 - vegetable carpet covered with red clover (*Trifolium pratense*);
- V5 - vegetable carpet overlaid with alfalfa (*Medicago sativa*);
- V6 - vegetal carpet overlaid with a mixture of the four vegetables species;
- V7 - black field.

**Structure, dynamics and abundance of beetle species collected in apple plantations in 2017.**

The collection of material from Barber-type soil traps was performed on the following dates from may to september.

**Structure, dynamics, abundance and ecological indices of beetle species in V1 variant, existing plant carpet (control).** They were made a total of 10 collections of entomological material in 2017 was collected 338 samples of beetles belonging to 21 species.

Abundance (A), Constance (C), Dominance (D) and Ecological Significance Index (W) were calculated for the collected species.

- the highest abundance of the species was *Harpalus calceatus*, *Anysodactylus binotatus*, *Harpalus tenebrosus*, *Harpalus pubescens*.
- constancy (C) of the species collected and had values between 2 and 30.
- domain (D) had a value between 35.79 and 0.29.
- The ecological significance (W) values have increased by more than 1.00 to a number of 5 species.

**The structure, dynamics, abundance and ecological indices of the beetle species in the V2 variant, plant carpet covered with pebbles (*Lotus corniculatus*),** were made a number of 10 harvests, with a total of 319 beetle specimens belonging to 25 species.

Ecological index values:

- the greatest abundance of the species was *Harpalus calceatus*, *Harpalus pubescens*, *Anysodactylus binotatus*, *Harpalus tenebrosus*, *Harpalus distinguendus*, *Otiorrhynchus pinastri*, *Harpalus griseus*.
- constancy of the collected species had values ranging from 2.38 to 26.19. Species with the highest values were: *Harpalus calceatus*, *Harpalus pubescens*, *Anysodactylus binotatus*, *Harpalus tenebrosus*, *Harpalus distinguendus*, *Otiorrhynchus pinastri*, *Harpalus griseus*.
- the domains (D) have had the most species: *Harpalus calceatus*, *Harpalus pubescens*, *Anysodactylus binotatus*, *Harpalus tenebrosus*, *Harpalus distinguendus*, *Otiorrhynchus pinastri*, *Harpalus griseus*.
- the ecological significance index (W) had a value between 20,1504 and 0,0074.

**Structure, dynamics, abundance and ecological indices of the beetle species in V3 variant, vegetal carpet covered with white clover.**

In experimental version 3, a number of 21 species of beetles were collected, totaling 319 copies. Ecological index values:

- the abundance (A) that most of the species had: *Harpalus calceatus*, *Anysodactylus binotatus*, *Harpalus tenebrosus*, *Otiorrhynchus pinastri*, *Harpalus pubescens*, *Harpalus distinguendus*, *Harpalus griseus*, *Harpalus tardus*.
- constancy (C) of the species collected and had values ranging from 2.38 to 23.81.
- the dominance, depending on the calculated percentage value, had a value between 26.90 and 0.34.
- the ecological significance index (W) had values between 0.0081 and 25.6196.

**Structure, dynamics, abundance and ecological indices of the beetle species in V4 variant, vegetal carpet overlaid with red clover.**

In the V4 variant a number of 21 species of beetles were collected, totaling 403 copies.

You will receive the same fees, when you turn 4, as follows:

- the abundance (A) that most species have had: *Harpalus calceatus*, *Anysodactylus binotatus*, *Harpalus tenebrosus*, *Harpalus distinguendus*, *Harpalus pubescens*, *Harpalus griseus*, *Otiorrhynchus pinastri*.
- constancy (C) of the species collected and had values ranging from 2.38 to 26.19.
- the domains (D) had the most species: *Harpalus calceatus*, *Anysodactylus binotatus*, *Harpalus tenebrosus*, *Harpalus distinguendus*, *Harpalus pubescens*, *Harpalus griseus*, *Otiorrhynchus pinastri*, *Harpalus tardus*.
- The ecological signs (W), had values between 0.0060 and 20.0484.

**Structure, dynamics, abundance and ecological indices of the beetle species at V5, vegetal carpet overgrown with alfalfa;** a number of 10 collections of the entomological material were made, 20 species of beetles were collected, totaling 261 copies. The ecological values will be presented in the year V5, in the year 2017, in the framework of the experimental group, as follows:

- the abundance (A) that most of the species had: *Harpalus distinguendus*, *Harpalus calceatus*, *Harpalus tenebrosus*, *Anysodactylus binotatus*, *Harpalus griseus*, *Harpalus pubescens*, *Otiorrhynchus pinastri*, *Aleochara ruficornis*, *Amara crenata*, *Cianirys cianea*, *Harpalus aeneus*.

- constancy (C) - the specimens collected and had values ranging from 88.10 to 2.38.

- dominance (D), depending on the calculated percentage value, the species are distributed in the following classes: species are sub-dominant, 4 species are receding, 1 species is sub-dominant, 1 species is dominant and 5 species are e-dominant.

- The ecological signs (W) of which have the following classes: 13 species are accidental, 1 species is accessory with values 0.1-1%, 2 species are accessories with values between 1.1-5.0%, 1 species is characteristic with values between 5.1-10.0%, 3 species are characteristic with values over 10.0%.

**The structure, dynamics, abundance and ecological indices of the beetle species in the V6 variant, vegetal carpet covered with a mixture of the four vegetables species.**

In experimental version 6, a number of 19 species of beetles were collected, totaling 430 specimens. For a more in-depth analysis of the obtained results, a series of more important ecological indices such as:

- abundance (A) which has the most species: *Harpalus calceatus*, *Anysodactylus binotatus*, *Harpalus tenebrosus*, *Harpalus pubescens*, *distinguendus*, *Harpalus griseus*, *Harpalus tardus*, *Otiorrhynchus pinastri*.

- constancy (C) of the species collected and had values ranging from 2.38 to 21.43.

- domain (D) had the most species: *Harpalus calceatus*, *Anysodactylus binotatus*, *Harpalus tenebrosus*, *Harpalus pubescens*, *Harpalus distinguendus*, *Harpalus griseus*, *Harpalus tardus*, *Otiorrhynchus pinastri*, *Oxypora vittata*, *Scymnus auritus*.

- the ecological significance index (W) depending on the calculated percentage value, the species are distributed in the following classes: 9 species are accidental species, 4 species of beetles are accessories with values between 0.1-1%, 2 species are accessories with values between 1.1-

5.0%, 2 species are characteristic with values between 5.1-10.0%, 2 species are characteristic with values over 10.0%.

**The structure, dynamics, abundance and ecological indices of the beetle species in the V7 variant, black field.**

In variant 7, a number of 22 species of beetles were collected, totaling 571 copies. The following questions will be provided to you in the V7 year 2017:

- abundance (A) which has the most species: *Harpalus calceatus*, *Harpalus tenebrosus*, *Anysodactylus binotatus*, *Harpalus distinguendus*, *Harpalus pubescens*, *Harpalus aeneus*, *Harpalus tardus*, *Hister purpurascens*.

- constancy (C) - depending on the value of this indicator, the species are distributed in the following classes: 15 species are accidental, 2 species are accessory, 2 species are accessories with the value between 50.1-75%, 2 species are euconstant.

- dominance (D) according to the calculated percentage value, the species are distributed in the following classes: 11 species are sub-dominant, 3 species are receding, 3 species are sub-dominant, 1 species is dominant, 4 species are e-dominant.

- the ecological significance index (W) represents the relationship between the structural indicator (C) and the productive indicator (D) and had values between 0.0043 and 21.0194.

**The observations regarding the structure, dynamics, abundance and ecological indices of the beetle species collected at the 7 experimental variants in 2017 highlight the following aspects:**

- V1 - existing plant carpet (control), totaled 338 beetle specimens;
- V2 - vegetal carpet overlaid with pebbles (*Lotus corniculatus*), totaled a number of 319 beetle specimens;
- V3 - vegetable carpet covered with white clover (*Trifolium repens*) totaled 290 copies of beetles;
- V4 - red carpet planted with red clover (*Trifolium pratense*) totaled 403 beetle specimens;
- V5 - vegetal carpet covered with alfalfa (*Medicago sativa*) totaled 261 beetle specimens;
- V6 - vegetal carpet, sown with a mixture of the four legume species, totaled 430 beetle specimens;
- V7 - black field, totaled 571 beetle specimens.

**Structure, dynamics and abundance of beetle species collected in apple plantations in 2018.**

In 2018, the collection of material from Barber type soil traps has been done since 25.05. until 26.09.2018.

### **Structure, dynamics, abundance and ecological indices of beetle species in V1 variant, existing plant carpet (control)**

In this experimental variant, a number of 61 species of beetles were collected, totaling 511 specimens. For a more in-depth analysis of the obtained results, a series of more important ecological indices such as:

- abundance (A) which has the most species: *Anysodactylus binotatus*, *Harpalus distinguendus*, *Dermestes lanarius*, *Harpalus calceatus*, *Harpalus tenebrosus*, *Otiorrhynchus pinastri*, *Colodera aethiops*, *Onthophagus semicornis*, *Paramalus paralepeticus*, *Hister purpurascens*.
- constancy (C) - depending on the value of this indicator, the species are distributed in the following classes: 54 species are accidental, 3 species are accessory with the value between 25.1-50%, 2 species are accessories with the value between 50, 1-75%, 1 species is euconstant.
- dominance (D) according to the calculated percentage value, the species are distributed in the following classes: 45 species are sub-dominant, 5 species are receding, 5 species are sub-dominant, 2 species are dominant, 3 species are e-dominant.
- the ecological significance index (W) represents the relationship between the structural (C) and the productive (D) indicators and had values between 14.5964 and 0.0048.

### **Structure, dynamics, abundance and ecological indices of the beetle species at V2, vegetal carpet overlaid with pebbles.**

In experimental version 2, a number of 57 species of beetles were collected, totaling 412 specimens.

For a more in-depth analysis of the obtained results, a series of more important ecological indices such as:

- the abundance (A) that most species have had: *Anysodactylus binotatus*, *Harpalus distinguendus*, *Dermestes lanarius*, *Otiorrhynchus pinastri*, *Harpalus tenebrosus*, *Metabletus truncatulus*, *Harpalus calceatus*, *Onthophagus semicornis*, *Amara aenea*, *Colodera aethiops*, *Harpalus tardus*, *Valgus hemipterus*.
- constancy (C) - depending on the value of this indicator, the species are distributed in the following classes: 54 species are accidental, 2 species are accessory with the value between 25.1-50%, 1 species is accessory with the value between 50, 1-75%, 1 species is euconstant.
- dominance (D) according to the calculated percentage value, the species are distributed in the following classes: 40 species are sub-dominant, 5 species are receding, 9 species are sub-dominant, 1 species is dominant, 3 species are e-dominant.
- the ecological significance index (W) depending on the calculated percentage value, the species are distributed in the following classes: 40

species are accidental, 14 species are accessories with values between 0.1-1%, 2 species are accessories with values between 1.1-5.0%, 2 species are characteristic with values over 10.0%.

**Structure, dynamics, abundance and ecological indices of the beetle species in V3 variant, vegetal carpet covered with white clover.**

In this experimental variant, a number of 60 species of beetles were collected, totaling 451 specimens. For a more in-depth analysis of the obtained results, a series of more important ecological indices such as:

- abundance (A) which has the most species: *Anysodactilus binotatus*, *Harpalus distinguendus*, *Dermestes lanarius*, *Tachyusa coarctata*, *Harpalus tenebrosus*, *Oxypora vittata*, *Otiorrhynchus pinastri*, *Harpalus calceatus*.
- constancy (C) - depending on the value of this indicator, the species are distributed in the following classes: 55 species are accidental, 3 species are accessory with the value between 25.1-50%, one species is accessory with the value between 50, 1-75%, a species is euconstant.
- dominance (D) according to the calculated percentage value, the species is distributed in the following classes: 48 species are sub-dominant, 4 species are receding, 5 species of beetles are sub-dominant, 1 species is dominant, 3 species are e-dominant.
- the ecological significance index (W) represents the relationship between the structural (C) and the productive (D) indicators, having values between 24.6739 and 0.0052.

**Structure, dynamics, abundance and ecological indices of the beetle species in V4 variant, vegetal carpet overlaid with red clover.**

In experimental version 4, a number of 21 species of beetles were collected, totaling 403 copies. For a more in-depth analysis of the obtained results, a series of more important ecological indices such as:

- abundance (A) which is the most abundant of the species: *Anysodactilus binotatus*, *Harpalus distinguendus*, *Dermestes lanarius*, *Otiorrhynchus pinastri*, *Harpalus tenebrosus*.
- constancy (C) - had values between 69.05 and 2.38.
- dominance (D) according to the calculated percentage value, the species are distributed in the following classes: 23 species are sub-dominant, 5 species are recurrent, 8 species are sub-dominant, 2 species are dominant, 2 species are e-dominant.
- the ecological significance index (W) had values between 0.0105 and 20.8048.

**The structure, dynamics, abundance and ecological indices of the beetle species at V5, vegetal carpet overlaid with alfalfa.**



In this variant, a number of 62 species of beetles were collected, totaling 618 specimens.

- abundance (A) which has increased its species: *Anysodactilus binotatus*, *Harpalus distinguendus*, *Dermestes lanarius*, *Otiorrhynchus pinastri*, *Pterostichus punctilis*, *Harpalus calceatus*, *Coccinella 7 punctata*.
- constancy (C) – a avut valori cuprinse între 59,52 și 2,38.
- dominance (D) according to the calculated percentage value, the species are distributed in the following classes: 34 species are sub-dominant, 6 species are receding, 8 species are sub-dominant, 8 species are dominant, 5 species are e-dominant.
- the ecological significance index (W) represents the relationship between the structural indicator (C) and the productive indicator (D) and had values between 0.0090 and 28.9624.

**The structure, dynamics, abundance and ecological indices of the beetle species in the V6 variant, vegetal carpet overlaid with a mixture of the four vegetables species.**

In variant 6, a number of 64 species of beetles were collected, totaling 414 specimens.

The values of the ecological indices were:

- abundance (A) which has increased its species: *Anysodactilus binotatus*, *Dermestes lanarius*, *Harpalus distinguendus*, *Harpalus tenebrosus*, *Otiorrhynchus pinastri*, *Metabletus truncatulus*.
- constancy (C) - had values between 57.14 and 2.38.
- dominance (D) according to the calculated percentage value, the species is distributed in the following classes: 45 species are sub-dominant, 5 species are receding, 5 species are sub-dominant, 2 species are dominant, 3 species are e-dominant.
- the ecological significance index (W), depending on the calculated percentage value, the species are distributed in the following classes: 44 species are accidental, 15 species are accessories with values between 0.1-1%, 1 species is accessory with values Between 1.1-5.0%, 4 species are characteristic.

**The structure, dynamics, abundance and ecological indices of the beetle species in the V7 variant, black field.**

In experimental version 7, a number of 22 species of beetles were collected, totaling 571 specimens. The values of the ecological indices were:

- abundance (A) which is the most abundant of the species: *Dermestes lanarius*, *Harpalus distinguendus*, *Anysodactilus binotatus*, *Otiorrhynchus pinastri*.
- constancy (C) - depending on the value of this indicator, the species are distributed in the following classes: 38 species are accidental, 1 species is

accessory with the value between 25.1-50%, 3 species are accessories with the value between 50.1- 75%.

- the dominance (D) according to the calculated percentage value, the species is distributed in the following classes: 25 species are sub-dominant, 8 species are receding, 4 species of beetles are sub-dominant, 1 species is dominant, 3 species are eudominant

- the ecological significance index (W) had values between 17.6146 and 0.0107.

**The observations regarding the structure, dynamics, abundance and ecological indices of the beetle species collected at the 7 experimental variants in 2018** highlight the following aspects:

- V1 - existing vegetable carpet (control), totaled 511 beetle specimens;
- V2 - vegetal carpet covered with pebbles (*Lotus corniculatus*), totaled 412 beetle specimens;
- V3 - vegetal carpet covered with white clover (*Trifolium repens*) totaled 451 beetle specimens;
- V4 - vegetal carpet covered with red clover (*Trifolium pratense*) totaled 229 beetle specimens;
- V5 - vegetal carpet covered with alfalfa (*Medicago sativa*) totaled 618 beetle specimens;
- V6 - vegetal carpet overlaid with a mixture of the four legume species, totaled 414 beetle specimens;
- V7 - black field, totaled 223 beetle specimens.

**In 2017, in all the 7 experimental variants and in all 10 harvests**, a number of 2616 specimens of beetles belonging to 51 species were collected.

They had a variable number of specimens ranging from 1 to 636. A number of 12 species each had a copy.

**In 2018, in all 7 experimental variants and in all 10 harvests**, a number of 2826 beetles belonging to 138 species were collected.

They had a variable number of specimens ranging from 1 to 566. A number of 44 species each had a copy.

**In the two years of research, in all the 7 experimental variants and in all the 10 harvests**, a number of 5441 specimens of beetles belonging to 152 species were collected. They had a variable number of copies ranging from 1 to 1000.