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THE USE OF ARTIFICIAL CONSTRUCTIONS FOR THE ACCUMULATION OF ENTOMOPHAGES IN BIOCENOSIS FOR BIOLOGICAL PLANT PROTECTION PURPOSES

Alla Gladcaia, Tudor Nastas

Key words: *biological protection of plants, artificial construction, entomophages*

INTRODUCTION

The perspective of the sustainable agriculture development in the Republic of Moldova is based on the promotion of the extensive use of integrated plant protection, planning and taking measures for the effective management of pests and vectors of their spread. The criteria for integrated plant protection are established by conducting scientific research aimed at: a) studying the types of beneficial insects (entomophages, predatory mites, bugs, other groups of parasites) used in the development of biological methods for plant protection; b) updating the economic threshold of harmfulness depending on the prevailing climatic conditions in order to increase the efficiency and reduce the number of phytosanitary treatments (1).Currently, adaptive landscape land use is aimed at achieving a more harmonious interaction between man and nature in the process of agricultural production.The fight against individual harmful species at the population level will sooner or later be replaced by the methodology of interrupting biocenotic processes that reduce productivity (epiphytophagic, epiphytotic) with the help of supporting beneficial processes (entomophagic) from the "natural biomethod" arsenal. A positive example of the implementation of this principle can be the creation of constructions for wintering, special micro-reserves (crops of nectarifers) in order to preserve the biodiversity of plant species and invertebrates. Thanks to such biological methods, it becomes possible to reduce the number of chemical treatments and restore the number of natural populations of natural enemies (2).

The aim of our research was to develop a method that includes the elaboration and placement of artificial constructions filled with certain materials in the agrocenosis to attract, monitor and accumulate entomophages for wintering in the agrocenosis for biological plant protection.

MATERIALS AND METHOD

The object of the study was artificial constructions placed in various agrocenoses. The first information about trap nests belongs to the French naturalist Jean-Henri Fabre, who studied mason bees nesting in the reed thatch of the roof. The construction of bee hotels (trap-nest) began in the 1950s, when paper and wood blocks with straw and drilled holes were experimentally installed to house the alfalfa leaf cutter bee *Megachile rotundata* (Fabricius, 1787) in portable and stackable containers. For the first time, nesting structures were described in detail in 1967 (Karl V. Krombein, 1967).This book has sparked numerous studies, especially on natural history and the management of bees for crop pollination. Later, in the 1990s, the possibilities of trap nests were implemented to study communities of various insect species (Figure 1).

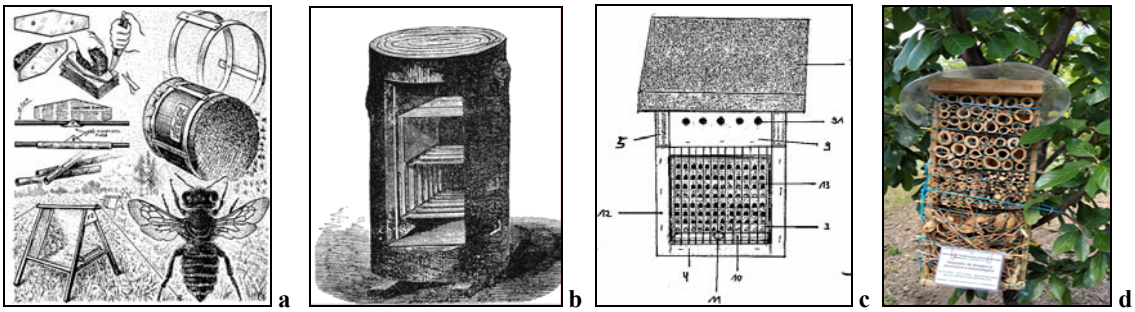


Figure 1. Historical prototypes of the nest trap: a) hive Fabre (Grebennikov, 1997); b) a deck for bees (a collapsible beehive of Butlerov); c) a modern prototype nest trap (front view of the Wild Bee Hotel (3); d) an artificial construction designed by Gladkaya A., 2021

The research was carried out in 2021-2022 on the experimental fields of the Institute of Genetics, Physiology and Plant Protection. At the first stage of research, we were engaged in the collection of natural materials for building nests for insects (reed, straw, tubular stems, etc.). We designed a wooden frame and filled the sections with various types of fillers, while providing the structure with a waterproof roof.

In the second stage of research, we developed methods for placing artificial constructions in various agrocenoses. Traps began to be placed in the spring at different heights (1-2m), in different cardinal directions.

At the third stage of research, we collected artificial constructions at the end of the season and stored them in a cold room so as not to disturb the behavior of insects. Accounting for insects allowed us to determine the most attractive types of materials for beneficial insects, the optimal placement height and direction to the cardinal points.

RESULTS AND DISCUSSIONS

The proposed method of using artificial constructions made it possible to accumulate and identify entomophages alive, in a state of diapause, suitable for further study, transportation and use.As a result of the analysis of studies in 2021, it was found that the insects attracted to wintering by our artificial structure belong to 6 orders:

Order: Neuroptera (Linnaeus, 1758) - 73%;
Order: Coleoptera (Linnaeus, 1758) - 1%;
Order: Hymenoptera (Linnaeus, 1758) - 4%;
Order: Hemiptera (Linnaeus, 1758) - 7%;
Order: Lepidoptera (Linnaeus, 1758) - 3%;
Order: Diptera (Linnaeus, 1758) - 11%.

The most attractive artificial constructions were for the entomophages of the genus *Chrysopa* (73%) (Figure 2).

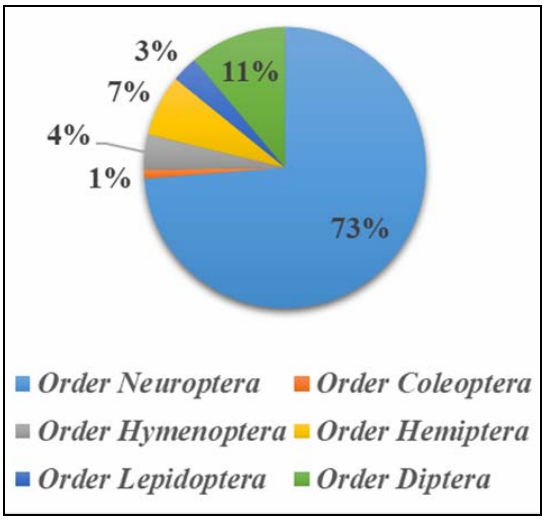
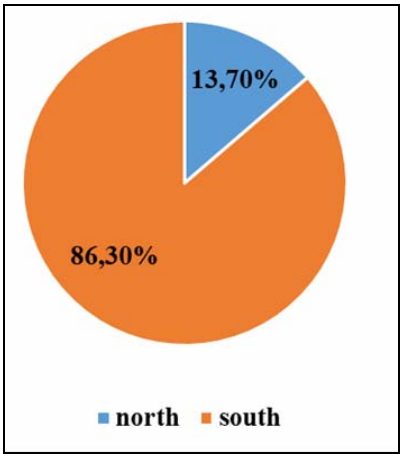


Figure 2. Quantitative ratio of taxonomic groups of insects attracted by artificial constructions for wintering (2021)

As a result of the analysis of the attractiveness of artificial constructions for entomophages, depending on the direction to the cardinal points (north, south), it was found that this factor is decisive. The vast majority of entomophages of the genus *Chrysopa* (83.3%) choose south-facing nest structures for wintering, located in well-lit areas (Figure 3).

We have found that different groups of insects prefer different nest materials for wintering: Arachnida (Lamarck, 1801) prefer cones and straw; Hemiptera - branches; Lepidoptera - straw. The most attractive types of materials for wintering lacewing were identified. These are walnut shells, hollow rhubarb stalks and straw (Figure 4).



a)

b)

Figure 3. a) The ratio of the number of genus *Chrysopa*entomophages wintering in artificial constructions, depending on the direction to the cardinal points; b) lacewing entomophages (Neuroptera: *Chrysopidae*) accumulated with the help of artificial constructions (2021)

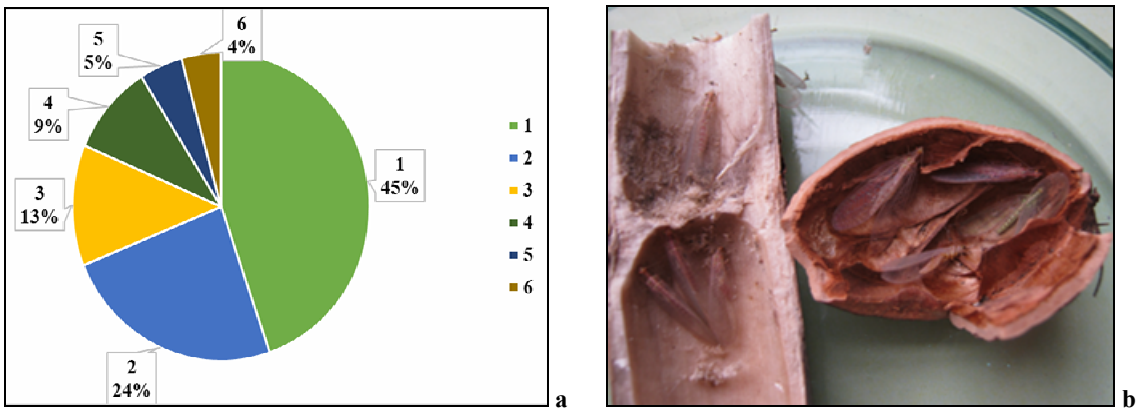


Figure 4. a) Types of materials used in artificial constructions in terms of their attractiveness for entomophages of the genus *Chrysopa*: 1. walnut shell; 2. rhubarb stalks; 3. straw; 4. branches; 5. hollow reed stems; 6. bumps. b) wintering lacewingsin diapause (2021)

In the experiments of 2022, artificial constructions were installed at various heights (1 and 2 meters above the ground) in an orchard in which a chemical method of plant protection was used. According to the results of the research, it was proved that the number of entomophages of the genus *Chrysopa* (29%) was attracted significantly less than in 2021 (73%).

It was also found that these entomophages were more attracted to artificial constructions placed at a height of 2 m above the ground (17%) than at a height of 1 meter (12%). At the same time, entomophages of the genus *Coccinella* did not colonize constructions at a height of 2 meters (0%) at all, but wintered in constructions located at a height of 1 meter above the ground (8%). Beneficial insects from the order Hymenoptera also preferred artificial constructions located at a height of 1 meter above the ground (8%) (Figure 5).

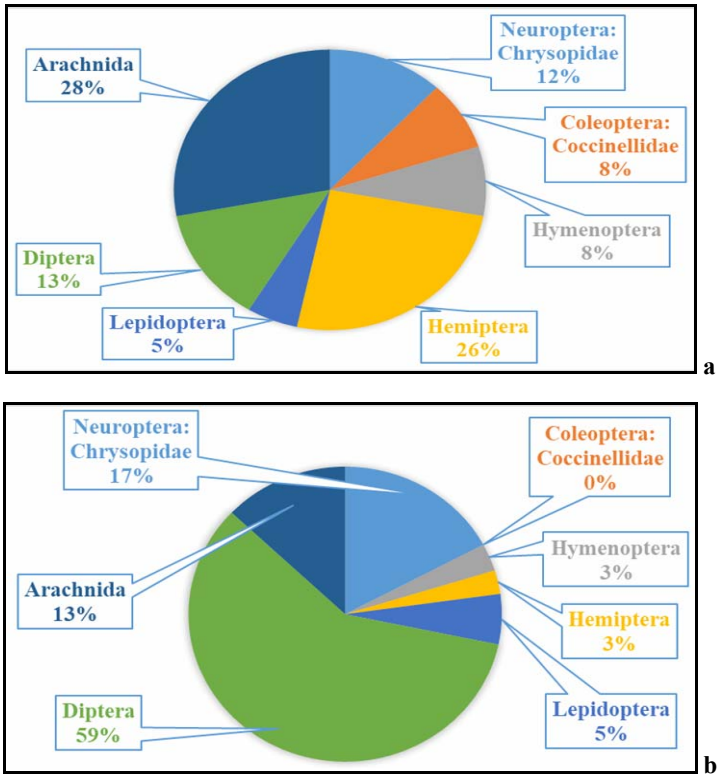


Figure 5. Quantitative ratio of taxonomic groups of insects attracted for wintering, depending on the height of the placement of artificial constructions above the ground: a) 1m; b) 2m (2022)

Thus, we have proved that for all wintering insects, artificial constructions located with a facade to the south, in a well-lit place, in environmentally friendly agrocenoses are more attractive.However, the height of traps placement has a multifunctional effect: a) to attract and monitor entomophages of the genus *Chrysopa*, the height of constructions should be 2 m above the ground; b) to attract representatives of the orders Hymenoptera and *Coccinellidae*, the height of the structures should be 1 m above the ground and below.

The advantage of the method of collecting insects using artificial structures is that the insects are captured alive, in a state of diapause, suitable for their study, transportation and use. The developed method of research makes it possible to transfer entomophages living in a state of diapause to gardens, fields, greenhouses and laboratories with the possibility of their further use in artificial breeding, in order to implement biological protection of plants. The data obtained will be used in further research, which should contribute to the improvement of artificial constructions.

CONCLUSIONS

Artificial constructions for entomophages were developed and applied for research purposes. The constructions are collapsible, contain various types of filler materials and do not contain synthetic materials.The main factors affecting the number of beneficial insects attracted to wintering with the help of artificial constructions were established: a) the vast majority of entomophages of the genus *Chrysopa* choose south-facing nest structures for wintering in well-lit places (86%).

The height of the traps placement has a multifunctional effect: a) to attract and monitor entomophages of the genus *Chrysopa*, the height of the constructions should be 2 m above the ground surface; b) to attract representatives of the order Hymenoptera and fam. *Coccinellidae*, the height of the artificial constructions should be 1 m above the ground and below.

The materials that have demonstrated the best results in attracting entomophages of the genus *Chrysopa* for wintering are walnut shells and rhubarb stalks.

ABSTRACT

Currently, adaptive landscape land use is aimed at achieving a more harmonious interaction between man and nature in the process of agricultural production. The fight against individual harmful species at the population level will sooner or later be replaced by the methodology of interrupting biocenotic processes that reduce productivity (epiphytophagic, epiphytotic) with the help of supporting beneficial processes (entomophagic) from the "natural biomethod" arsenal. A positive example of the implementation of this principle can be the creation of structures for wintering, special micro-reserves (crops of nectarifers) in order to preserve the biodiversity of plant species and invertebrates. Thanks to such biological methods, it becomes possible to reduce the number of chemical treatments and restore the number of natural populations of natural enemies.

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AUTHORS' ADDRESS

GLADCAIA ALLA, NASTAS TUDOR - USM, Chisinau, Republic of Moldova, Institute of Genetics, Physiology and Plant Protection, e-mail address: allagladcaia@mail.ru.