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IMPROVEMENT OF THE NEST DEVICES APPLICATION METHOD FOR WINTERING BENEFICIAL INSECTS IN BIOCENOSES

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Summary. Pests, distributed on the Republic of Moldova territory, annually, depending on climatic conditions, can cause significant damage to agricultural crops, amounting to about 25-30% of the expected yield. The purpose of our research was to evaluate the effectiveness of nesting devices, located in various biotopes, for wintering and attracting entomophages. The most significant potential biological plant protection agents, belong to the orders Neuroptera, Coleoptera, Hymenoptera (parasites and predators). The percentage of lacewing species was determined - the species *Chrysopa carnea* (86,4%) was dominant. The main factors, influencing the number of entomophages, attracted to wintering with the help of nesting devices, were established types of filler materials and location height.

Keywords: *biological protection of plants, nest structures for wintering insects, entomophages of the fam. Chrysopidae and fam. Coccinellidae.*

Introduction. Pests, distributed on the Republic of Moldova territory, annually, depending on climatic conditions, can cause significant damage to agricultural crops, amounting to about 25-30% of the expected yield. Sustainable agricultural development involves development, that is compatible with the natural environment, in order to avoid negative impacts on future generations [1]. The conducted research led to the conclusion, that it is necessary to form a set of complementary biological agents, and, if necessary, their combination with pesticides. Then the integrated program becomes multivariate, able to protect the crop in any conditions [2].

The purpose of our research was to evaluate the effectiveness of nesting devices, located in various biotopes, for wintering insects and attracting

entomophages, depending on the filler materials and the height of their exposure.

Materials and methods. The objects of research were entomophages of crop pests, belonging to the orders Neuroptera (Linnaeus, 1758), Coleoptera (Linnaeus, 1758) and Hymenoptera (Linnaeus, 1758), which are the most significant natural resources of biological plant protection potential agents (parasites and predators). Most of the Chrysopidae (Schneider, 1851) family adults feed exclusively on pollen, nectar, or honeydew, but all lacewing larvae are predators and prey on small insects (aphids, coccids, mites). Due to the large number of pests destroyed, lacewing larvae are useful insects in agriculture and forestry. One lacewing larva for the entire period of development destroys 500-600 aphids, or over 11 thousand spider mites. Most representatives of the Coccinellidae (Latreille, 1807) family, attracted to nesting devices for wintering, are predators. Beetles and larvae exterminate aphids, psyllids, coccids. The Hymenoptera order contains approximately 200,000 species. Approximately half of the families, that have entomophages in their composition, belong to parasitoids and predators, mainly used in classical programs of biological suppression of harmful insects.

The subject of the research were nesting devices, located on the territory of various biotopes. The first information about trap nests belongs to the French naturalist Jean-Henri Fabre, who studied mason bees. Nesting devices were first described in detail in 1967 [3]. Our research was carried out in 2022 on the territory of a) the Botanical Garden (Institute), b) an orchard and c) a plot of mixed cultivation of fruit and essential oil crops in the experimental fields of the Institute of Genetics, Physiology and Plant Protection (Chisinau, Republic of Moldova).

The first stage of research preparation was the collection of natural filler materials for building nests for insects (reed, straw, tubular stems). The second stage was the placement of nest devices in the spring, at a certain research site (geolocation), attaching them at different heights (10cm, 1m, 2m) above the ground in the south direction. The third stage - at the end of the vegetation period, we disassembled the nest devices and stored them in a cold place, so that the insects would not come out of diapause. As a result of sample analysis, we have established the types of nest devices materials, most attractive to beneficial insects and the preferred height of their placement.

Results and disscusions. As a result of the data analysis, obtained in 2022, it was found, that representatives of the spider order Araneae (Clerck, 1757), Arthropoda (von Siebold, 1848) and insects, belonging to 6 orders (Neuroptera (Linnaeus, 1758); Coleoptera (Linnaeus, 1758); Hymenoptera (Linnaeus, 1758); Hemiptera (Linnaeus, 1758); Lepidoptera (Linnaeus, 1758); Diptera (Linnaeus, 1758)) were involved in the developed nesting devices. Based on the results, the ratio of insect's quantity in various types of biocenoses, was compiled. The Botanical Garden had the maximum number of the Hemiptera order (70,3%), Hymenoptera order (62,0%) and Coleoptera order (35,0%) insect populations. The maximum number of Neuroptera order (58,3%), Lepidoptera order (77,3%) and Diptera order (83,5%) populations, accumulated in the agrocenosis of the orchard. The population of the Coccinellidae family entomophages was evenly distributed among the three studied biocenoses.

Different groups of insects, attracted to nest devices, prefer different filler materials for wintering. As a result of research analysis, in various types of biotopes, the average values of the percentage of insects, that prefer wintering in materials of a certain type, were obtained: a) Neuroptera: Chrysopidae entomophages prefer to winter in rhubarb stems (70,4%) and walnut shells (28,1%); b) Coleoptera: Coccinellidae entomophages prefer to winter in the walnut shell (73,2%); Hymenoptera order entomophages overwinter in reed stems (55,7%). The walnut shell attracted insects of the Hemiptera (60,6%) and Diptera (38,7%) orders for wintering (Table 1).

Table 1. The degree of the different materials for wintering insect's attractiveness (2022)

Taxonomic group of insects (order)	Nutshell, %	Cane stalks, %	Rhubarb stalks, %
Neuroptera	28,1	3,2	**70,4**
Coleoptera	**73,2**	17,6	8,2
Hymenoptera	32,3	**55,7**	12
Hemiptera	**60,6**	24	15,4
Lepidoptera	38,7	10	**51,3**
Diptera	**38,7**	22,5	**38,8**

We noted, that the percentage of different taxonomic groups of insects, in accordance with the characteristics of their biology, was influenced by the height of nesting devices above the ground. We determined, that the insects of the orders Lepidoptera (72,2%) and Neuroptera (35,9%) chose nesting devices, placed at a height of 2m. Nesting devices, placed at a height of 1m, were preferred by entomophages Coleoptera: Coccinellidae (53,8%), Neuroptera: Chrysopidae (59,4%), Hymenoptera (75,7%), Diptera (51,8%). Nesting devices, placed directly above the ground (10 cm), attract insects of the orders Hemiptera (51,9%) and Coleoptera: Coccinellidae (23,1%) (Table 2).

Table 2. The degree of attractiveness of the nesting devices for wintering insects depending on the exposure height (2022)

	Taxonomic group of insects	**10см,%**	**1м, %**	**2м,%**
1	Neuroptera: Chrysopidae	4,7	**59,4**	35,9
2	Coleoptera: Coccinellidae	23,1	**53,8**	23,1
3	Hymenoptera	0	**75,7**	24,3
4	Hemiptera	**51,9**	34,7	12,5
5	Lepidoptera	16,7	11,1	**72,2**
6	Diptera	27,7	**51,8**	20,4

We determined the percentage of the genus *Chrysopa* (Leach, 1815) species, attracted to nesting devices for wintering in 2022: the dominant species were *Ch. carnea* (86,4%). The lacewing economic importance is based on its predation.

Species, wintering in nesting devices, include such entomophages, from the Coleoptera order, as: *Coccinella septempunctata* (Linnaeus, 1758), *Harmonia axyridis* (Pallas 1773), *Calvia quatuordecimguttata* (Linnaeus, 1758), *Adalia bipunctata* (Linnaeus, 1758).

Insects from the Hymenoptera order, attracted for wintering to nesting devices in the botanical garden, belong to the families: Braconidae (Nees von Esenbeck, 1819), Ichneumonidae (Haliday, 1838), Chalcididae (Latreille, 1817), Pompilidae (Fabricius, 1798), Sphecidae (Latreille, 1802), Vespoidae (Latreille, 1802), Formicidae (Latreille, 1802). Most representatives of these families are entomophages (parasitoids and predators).

As a result of research data systematization, the main conditions for improving nesting devices, were determined for each taxonomic group of entomophages, involved in biological plant protection:

A) in order to attract Hymenoptera entomophages, nesting devices should be placed at a height of 1m and 2m on free-standing, well-lit supports. Hymenoptera representatives preferred reed stems (0,6-0,8 mm in diameter) for wintering;

B) in order to attract Chrysopa entomophages, nesting devices should be placed at a height of 1,5-2m, on separate, well-lit supports. Chrysopidae representatives preferred rhubarb stems and walnut shells for wintering;

C) in order to attract Coccinellidae entomophages, nesting devices should be placed at a height of 10cm - 1m; representatives of Coccinellidae preferred walnut shells and reed stems for wintering.

Thus, the technical result of the use of nesting devices, as a way to attract beneficial insects for a comfortable wintering, is the activation of the natural biological protection of plants, through the accumulation of entomophages in the corresponding biocenoses. The advantage of collecting insect's method, using nesting devices is, that the insects are caught alive, full-fledged, in a state of diapause, suitable for their study, transportation and use. In addition, after the end of the seasonal diapause, beneficial insects fill up the biocenoses and participate in the biological protection of plants.

Conclusions. Nesting devices were developed and tested with various types of filler materials, placed at different heights, to attract a variety of entomophages to wintering. We have identified the most significant potential biological plant protection agents related to the orders Neuroptera, Coleoptera, Hymenoptera (parasites and predators). The percentage ratio of lacewing species, attracted for wintering in nesting devices, was determined - *Chrysopa carnea* (86,4%) species was dominant.

The main factors, affecting the entomophagy's quantity, attracted to wintering, with the help of nesting devices, were established: a) *types of materials*: Hymenoptera entomophages prefer reed stalks for wintering (89,8%), Chrysopidae entomophages prefer to winter in rhubarb stalks (67,5%) and walnut shells (31,4%), Coccinellidae entomophages prefer to winter in walnut shells (79,0%); b) *location height*: Hymenoptera entomophages preferred to winter at a height of 1 m (75,7%) and 2 m (24,3%), Chrysopidae entomophages preferred to winter at a height of 1 to 2 m, Coccinellidae entomophages preferred to winter at a height of up to 1 m.

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