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HIBERNATING ARTHROPODS' COMPLEX IN THE PLUM TREE ORCHARD UNDER THE INFLUENCE OF GREEN MANURES AND NECTARIFEROUS PLANTS

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Abstract. *The work represents the highlighting of the arthropod complex, which populates and hibernates in the cardboard trap belts of the plum orchard influenced by green manures and nectariferous crops. This complex is composed of phytophagous, saprophagous, predators and parasites. In the trapping belts, polyphagous species of five families of spiders dominated, which constituted an average of 33.5% of the total individuals highlighted, and coccinellids (seven species) - an average of 6.5%.*

The parasitoid Scambus inanis achieved a degree of parasitism of moth larvae in average 29.4%. The highest percentage was recorded in the standard and experimental variants (46.0% and 35.3%) respectively.

Keywords: nectariferous plants, green manures, predators, parasites, plum.

INTRODUCTION

Currently, in plant protection systems, the attention is no longer paid to the reserve of the pest complex and their natural regulators that have gone into hibernation. The hibernation in natural environments exposes arthropods to drastic eradications. The hibernation in artificial environments such as cardboard trap belts is more successful. The percentage of parasitism of pests by parasites from the order Hymenoptera and other orders in the autumn-spring period depends on the degree of additional feeding that nectariferous and sidereal plants, which have long flowering periods such as *Lobullaria maritima* or regeneration periods such as grasses from spontaneous flora, can provide.

Chemical treatments against pests in perennial crops are ending with the period of fruit ripening, which also coincides with the dry period, where the natural flowering grass carpet is poor and beneficial insects lack additional food, considering that they have a vital activity until the second decade of November.

Investigations aimed at determining the complex of arthropods that hibernate in artificial environments began decades ago. However, trap belts were mostly used as a method of controlling moths and other pests of fruit crops, without taking into account the other beneficial taxa present, thus sometimes destroying them as well. Later, the belts were modified, being used as a more ecological method of protecting beneficial fauna [1]. Some difficulties during the eight years period of investigations in plum cultivation were observed regarding the integrity of the trap belts used, often being destroyed by birds and mammals. The modification of their protection in which the arthropod complex hibernates is obvious. Based on this, the purpose of the investigation was to highlight the complex of arthropods hibernating in plum tree traps belts against the background of green manure and nectariferous crops.

MATERIALS AND METHODS

The research materials were individuals of arthropod species from various taxa groups of different ontogenetic stages from solitary eggs, eggs in the nest inside the cocoon, larvae without and in the cocoon, free and in the cocoon pupae, free and in the cocoon adults. This biological material was obtained from the trap belts, placed around the trunk of model plum trees, in the second decade of July, when the migration to the summer diapause of plum borer larvae took place. The new type of trap belts were mounted at a height of five centimeters from the ground level, which corresponds to the requirements for plum borer. The extraction of the belts was carried out in the third decade of January, their analysis in the third decade of February, which lasted until the first decade of April. The collected belts, placed in bags and labeled, were kept at temperatures below +5°C to stop the reactivation of the biological material. To fix the belts to the model tree trunks, double corrugated cardboard was used, using different types of fixing supports: polyester fiber mesh with Velcro, adhesive tape and palisade thread. And, to obtain individuals for diagnosis up to taxa, the eggs found were activated at temperatures above +10 °C. Later, when the predator larvae appeared, they were fed with individuals of the aphids *Aphis gossypii*, *Schizaphis graminum*, the mite *Tetranychus urticae* and bean weevil eggs in their diet. To determine the percentage of parasitism of the hibernating moth larvae of the Tortricidae family, the cutting was carried out along with portions of cardboard for larvae in the cocoon. The selected larvae were introduced into the Florinschii test tube. Females of *Pseudoccocus comstoki* parasitized by *Stemmatosteres bohemicus* were introduced into the Ulinguta test tubes for parasite flight for further analysis.

The exemplars of the Cicadellidae family, found dead in the belts, were used for the preparation of wings and genitals. The material was introduced into a 40% lactic acid solution for decolorization and was subsequently used for the fabrication of temporary preparations and identified under Optika and Euromex digital microscopes. Exemplars of the order Aranea, after extraction from the belts, were placed into 70% ethyl alcohol. Spiders from the cocoons were hatched under uncontrolled conditions and subsequently fed with aphids till their development to the adults. The species keying was carried out according to special classical guides [2, 3, 4, 5] and current ones [6, 7, 8].

RESULTS AND DISCUSSIONS

The biological material accumulated in the trap belts was quite varied and consisted of groups of phytophagous, predatory and parasitic arthropods.

In the plum crop, under the climatic conditions of 2024, phytophagous arthropods were represented by a number of species, which varied from 12 in the experimental variant and 17 in the standard and control, respectively. The dominant species were the tortricid moths, larvae and adults of unidentified coleopterans. Therefore, the larvae of the moths detected belong to the plum fruit moth, the oriental fruit moth, the coddling moth and an unknown species of moth. The number of larvae on average of 5.7 specimens per belt was noted in the experimental variant, 1 in the standard and 1.5 in the control, respectively.

The pest species, such as the previously found *Pseudococcus comstoki* in the 2024 was represented by eggs, ovipositing females, males and first instar larvae with a low average number per belt of 3 specimens in the experimental variant, 1.4 in the standard and 2.3 in the control. *Zignia flamigera* was also noted in the belts. The larval exuviae of the *Metcalfa pruniosa*, which was present in the plantation during three years were not found. The invasive species, the oak leaf beetle *Corythucha arcuata*, was also found in the belts, being present during six years there. In 2024 it was observed in small numbers, thus being located more in the experimental and standard variant. The average number per belt was 1.5 in experimental variant and 2.2 individuals in standard and 1 in the control. Therefore, phytophagous and saprophagous were the larvae of the *Partenolecanium corni*, individuals of the Ptiliidae family, *Phalacrus fimetarius* (Phalacridae), which is often found in composite inflorescences, the mycophagous *Anthelephila pedestris* (Anthicidae), *Roglius alboacuminatus* (Rhyparochromidae) and three species of unidentified Coleoptera.

The group of predators in the belts was represented by thrips from the family Phlaeothripidae, larvae in and without the cocoons of neuropters from the families Coneopterigidae and Chrysopidae (*Chrysopa carnea* and *Chrysopa ciliata*, species from the family Coccinellidae such as: *Chilocorus bipustulatus*, *Scimnus suturalis*, *Stethorus punctillum*, *Coccinella septembunctata*, *Cryptolaemus monthozerei*, *Oenopia* sp., *Tytthaspis sedecempunctata*, the carabid *Microlestes minutulus* and the staphylinid *Platystethus nodifrons*. The anthocorid predatory bug *Amphyareus obscuriceps* was also found in single specimens, primarily females.

Of the total taxa analyzed, the largest number were predators from the order Araneae represented by more than five families. However, the dominant species were the species from the families Thomisidae and Phylodromidae, which constituted 45.7% of the total number of spiders. The families that followed were: Salticidae – 22.0%, Dictynidae and other species of 11.0-11.7% respectively; Clubionidae and Gnaphosidae of 7.3 and 2% respectively. As can be seen from Figure 1, the highest number of them was noted in plot two (standard) influenced by the green manures culture (*Medicago sativa* + *Eruca sativa*) and in the one influenced by the conventional plant protection system plot one (control). Totally, the araneids were 5.0% less in plot three (experimental variant). In both the control and standard, the litter was planted with grasses from the spontaneous flora.

Of the spider species previously noted on plum trees, in 2024 in the belts *Cheiracanthium* sp. (Cheiracanthiidae), *Aphantaulax trifasciata* (Gnaphosidae), *Erigone atra* (Linyphiidae), *Leptorchestes berolinensis*, *Sinageles dalmaticus* (Salticidae), *Pistius truncatus* (Thomisidae) were noted. Cocoons with spider eggs of an unidentified species were also noted, which require time to obtain adults. In a cocoon there were from 20 to 40 eggs found, which can later change the dominance position of the aforementioned ones. As a result, the phytophagous: predator ratio was 1:1 in the control and standard and 1.3:1 in the experimental variant.

It is known that, in each family of parasitoids from the suborders Ichneumonoidea, Chalcidoidea, there are families within which there are also genera of phytophagous insects such as the family Pteromalidae can be found. In order to detect the presence of these useful species, it is important to use the method of individual hatching of parasitoid species from the larvae of phytophagous moths. As a result, the flight of adults of *Scambus inanis* (= *annulatus*) adults out of them was observed. Exposure of moth larvae to individual hatching brought to their parasitism at a level of 46.0% in the standard, 35.3% in the experimental variant and 7% in the control. The difference of 10.7% between the experimental variant and the standard can be explained by the vegetative activity of the green manures and a resistance to the drought conditions of the year. The percentage of parasitism obtained cannot be attributed to a specific moth species, given that in addition to the plum fruit moth, the oriental fruit moth, the coddling moth and an unkeyed species of moth were also present. In such diagnostic investigations it is vitally important to correctly attribute the percentage of parasitism by *S. inanis* to the certain species. This can only be achieved by diagnosing the residues left after parasitation, such as the cephalic capsules of the larvae left after the activities of both internal and external parasites.

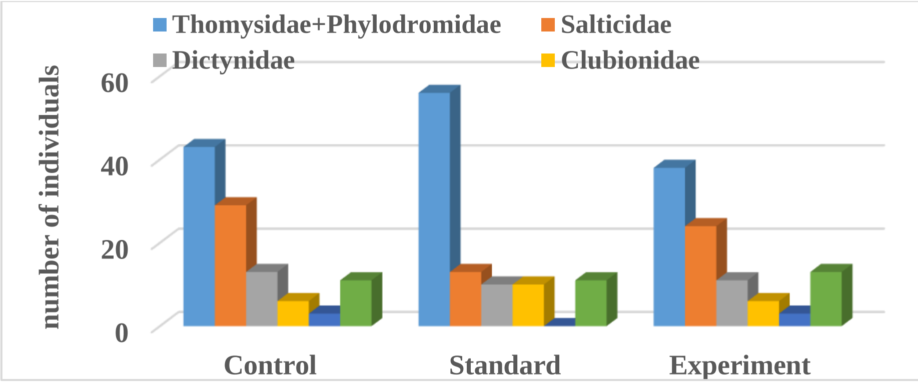

Figure 1. Distribution of araneids by plum tree variants in trap belts, year 2024.

Another group of parasitoids were those from the suborders Chalcidoidea and Bethyloidea, which were represented by individuals from the families Scelionidae, Platigastridae and Bethylidae.

Figure 2 (in original). Predators and parasites in the winter reserve of plum:
1- Scimnus suturalis; 2 - larva of Malachius bipustulatus; 3 - adult of the Scelionidae family; 4 - spider Aphantaulax trifasciata; 5 - tachina fly hatched from the puparium; 6 - spider eggs nest; 7 - larva of Coniopterygidae Conwetzia sp.

As a result, the phytophagous:parasitoid ratio was 5:1 in the control, 4.5:1 in the experimental variant and 1:1.5 in the standard. The most numerous were the scelionid individuals with an average number per belt of two in the experimental variant, four in the standard and one in the control. However, we note the fact that they are parasitic species of eggs of pests and also of some predators. These are parasitoids of eggs of praying mantises, crickets, harvestmen, locusts, the harmful beetle *Zabrus tenebrioides*, eggs of predatory carabids from the *Amara* and *Harpalus* genera. Several specimens of the genus *Telenomus* are parasitoids of true bugs eggs. There are also, the eggs of species from the orders Lepidoptera and Neuroptera (Chrysopidae). Therefore, it is important to key these specimens to species level.

CONCLUSIONS

It was observed that the most effective fixation for the trap belts preservation for maintaining the arthropod complex in field conditions is the one with double corrugation and holes of different diameters equipped with polyester thread mesh with Velcro.

The arthropod complex hibernating in the modified trap belts had quite significant quantities, where polyphagous predators (arachnids) from the families Thomysidae and Phylodromidae dominated to a large extent, which constituted 45.7%.

The predators of aphids, mites and mealybug *Psedoccocus comstoki* were represented by 15 species from three orders Neuroptera, Coleoptera and Thysanoptera.

The percentage of parasitism of *Scambus inanis* on moth larvae hibernating in the belts was determined on variants where it was established that the difference of 10.7% between the standard and the experimental variant was influenced by the vegetative period of the green manure.

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