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THE DETERMINATION OF ATTRACTIVENESS IN TWO SEMIOCHEMICALS FOR BENEFICIAL HYMENOPTERA

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Summary. Several aspects (optimal distances placement, beneficial hymenopteran' families composition, used compound volume per season) of two semiochemicals - phenylethanol and methyl salicylate' attractiveness for beneficial hymenopterans were discussed.

Keywords: *semiochemicals, phenylethanol, methyl salicylate, hymenopterans, parasitic wasps, plum, orchard*

Introduction. The modern agriculture relies strongly on pesticides us in order to satisfy enormous needs of constant growing population. On the other hand, fresh water shortening, aridity, desertification, soil erosion, salinization and organic substances decline - a consequence of rapid climatic changes coupled with noxious species development and anthropogenic influence take an important amount of arable land out of usage. Thus, aridity influence ~40% of arable lands (14 million km^2 on a global scale). Soil erosion takes out of arable land usage another ~20% [1]. All of these factors lead to a land degradation. On the remaining arable lands pesticides, used against the pests, put the strong pressure on both food quality and consuming safety threatening sustainable agriculture development. Thus, approximately 3 billion kg of pesticides are used on a global scale every year spending roughly 40 billion USD for them [2].

Semiochemicals are the chemical compounds in plant – insect or insect – insect interactions as alternatives to pesticides for integrated pest management (IPM) programmes. They are much less toxic than traditional pesticides and are more gentle to ecosystems, crops and environment overall. In this paper the attractiveness of two semiochemicals – phenylethanol (PE; found in different

essential oils) and methyl salicylate (MeSA; produced by numerous species of plants, e. g. wintergreens, compound widely used in plant protection) for parasitic hymenopterans was studied.

Hymenoptera is a very large order of Insecta, which is represented by many important species of bees, wasps, ants, sawflies and parasitic wasps. The latter are very useful insects as they are parasitoids that directly affect the pests' development.

Materials and methods. The goal of this paper was the attempt to analize the attractiveness (optimal distances placement, beneficial hymenopteran' families composition, used compound volume per season) of two semiochemicals – phenylethanol (PE) and methyl salicylate (MeSA).

The experimental plot is situated in a plum orchard in Frumușica village (com. Băcioi) Chișinău environs, Republic of Moldova. The experiment took place in May – September 2022 period. The varieties of plum are Cacanska rana and Stanley. The orchard was sprayed with pesticides. The centre of the plum orchard was used in order to reduce margins effect on a experiments' result. The experiment consists of three variants – PE, MeSA and control separated by 18 m. distance in order to prevent different odours' mixing. It is known that MeSA is manifesting its influence on a radius of 12 m. [3]. For semiochemicals' spreading a special dispenser was used. Every experimental variant (except control) is consisting from the plum tree (tree 0) where the dispenser with respective experimental compound was hung. Around the dispenser the yellow sticky traps on the respective trees were hung on two, four and six meters distance from the tree 0. The dispenser for PE is consisting of an Eppendorf test tube (1.5 ml.) with an open lid. PE is evaporating from the surface of that liquid. The MeSA dispenser is more complex and consists of an Eppendorf test tube (1.5 ml.) with a closed, but perforated lid and a wick that evaporates the MeSA being threaded through the lids' orifice. Thus, there are three variants and four repetitions on 0, 2, 4 and 6 meters. Once in two weeks the yellow sticky traps were collected and examined in the laboratory. Hymenopterans were keyed using "Hymenoptera of the World: An Identification Guide to Families" [4]. There were nine data collections from May to September.

Results and discussion. The three experimental variants showed more or less different results. The greatest difference in results' numbers had PE variant.

PE showed that 47.8% of biomaterial being collected from the tree 0 (with a dispenser on it). Four meters distance gathered 30.43% of beneficial hymenopterans. Six meters showed the result of 13.04% and two meters manifested with a weakest result of just 8.69% of beneficial hymenopterans. In the practical usage of PE the latter must be utilized just as auxiliary that attracts several specific parasitic wasps' families. MeSA showed more smooth distribution by distances. So, the optimal distance for the MeSA attraction of parasitic wasps and beneficial hymenopterans overall is two meters – 29.50%, 0 meters showed the result of 27.86%, four meters – 26.22% and six meters – 16.39%. MeSA must be placed on orchards' margins attracting the main number of the parasitic wasps. PE will be more useful in the centre of the orchard collecting some specific parasitic wasps' species. Control results showed smoother than MeSA distribution.

The total of 165 exemplars from 16 families of beneficial hymenopterans were collected. Generally, 2022 was a very dry year and biomaterial was weak represented in the yellow sticky traps. PE had 27.87% from the total biomaterial collected, MeSA and control had 39.39%. The mean number of beneficial hymenopterans for MeSA and control was 1.69 exemplars/trap. For PE this result was 1.27 exemplars/trap. Again, PE proved to be efficient just on small distances, collecting some specific families. The overall top families of beneficial hymenopterans were as follows: Mymaridae (24.84%), Platygastridae (23.63%), Ceraphronidae, Encyrtidae (both 11.51%), Torymidae (6.06%) and Aphelenidae (4.84%). All of them, with an exception of some phytophagous Torymidae are important families for biological control. Minor differences appear in families' distribution by variants. Thus, Mymaridae and Platygastridae appear in the leading positions both in PE and MeSA. Platygastridae and Mymaridae are on the first and second place respectively in the control. Other families of hymenopterans collected are Bethylidae, Megaspilidae, Trichogrammatidae, Eulophidae, Formicidae (just in MeSA), Cynipidae (just in control), Braconidae (*Apanteles* sp.), Ichneumonidae, Diapriidae (just in control), Eupelmidae (just in MeSA). Just one family of all collected is pure phytophagous – Cynipidae. The generations of hymenopterans develop more or less uniformly with peaks at I decade of June and III decade of July and with depressions when pesticide treatments were done in III decade of June. Encyrtidae and, especially, Mymaridae tend to grow rapidly in September when the pesticides were not used anymore.

It appears that MeSA attracts hymenopterans better in the period of maximal temperatures (III decade of June - July) twice bigger than control. MeSA and PE represents additional sources of water in the heat period. Besides, MeSA attracted hymenopterans better throughout September comparing to control. PE also attracts hymenopterans better in September when compared to control. Besides, PE also showed better attraction in II decade of August, I and II decades of September comparing to MeSA. Dispensers with PE and MeSA represent a good source of flower odours in the autumn for hymenopterans, when flowers are not as typical as they used to be in the spring and summer.

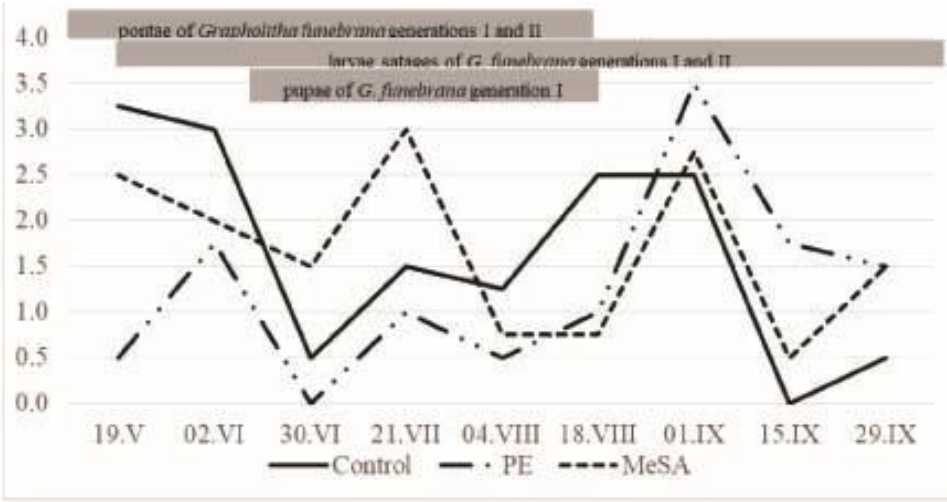

Fig. Hymenoptera exemplars' mean number dynamics in the plum orchard by variants.

PE show two significant peaks in I decade of June when hymenopterans evolve dynamically and I decade of September when pesticides are not used anymore. Small peak is in II decade of July also. MeSA has two peaks in II decade of July and I decade of September – periods without pesticides influence. Control had one peak in II decade of July, after that between II decade of August and I decade of September lies wide plateau. The specimens manifestation in both PE and MeSA is much more dynamic comparing to control. Figure presents also plum fruit moth pests' dynamics in comparison to that of hymenopterans.

Below, the statistical analysis of the hymenopterans collected is presented.

Table. The exemplars' number dynamics of Hymenoptera in the plum orchard

Variants	X May	X June	X August	X September
Control	3.25±1.51	2.25±1.21	1.75±0.11	1.0±0.78
PE	0.5±1.28	0.75±0.01	0.83±1.03	3.0±0.51
MeSA	2.5±0.71	3.0±0.21	1.5±0.98	1.58±0.18

DEM 0.95 = 1.391704

The difference is not essential, there is not a big difference between variants.

The PE advantage is in its low volume used throughout the vegetation season of just 1.5 ml./1 dispenser/6 plum trees. It can be placed just once at the beginning of the season. Mean MeSA usage is around 4.5 ml./1 dispenser/6 plum trees. MeSA is much more efficient than PE, but utilize more volume of substance per season.

Conclusions.

1. In the practical usage of PE the latter must be utilized just as auxiliary that attracts several specific parasitic wasps' families. PE will be more useful in the centre of the orchard.
2. The optimal distance for the MeSA attraction of parasitic wasps and beneficial hymenopterans overall is two meters.
3. The overall top families of beneficial hymenopterans were as follows: Mymaridae, Platygastridae, Ceraphronidae, Encyrtidae, Torymidae and Aphelenidae. All of them, with an exception of some phytophagous Torymidae are important families for biological control.
4. It appears that MeSA attracts better hymenopterans better in the period of maximal temperatures (III decade of June - July) twice bigger than control. MeSA and PE represents additional sources of water in the heat period. Dispensers with PE and MeSA represent a good source of flower odours in the autumn for hymenopterans, when flowers are not as typical as they used to be in the spring and summer.
5. The PE advantage is in its low volume used throughout the vegetation season of just 1.5 ml./1 dispenser/6 plum trees. It can be placed just once at the beginning of the season. Mean MeSA usage is around 4.5

ml./1 dispenser/6 plum trees. MeSA is much more efficient than PE, but utilize more volume of substance per season.

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