THE SUPERFAMILY APOIDEA (*HYMENOPTERA, APOIDEA*) - POLLINATORS OF CULTIVATED IN MOLDOVA AROMATIC PLANTS

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Rezumat

La 16 specii de plante etero-oleaginoase de cultură au fost înregistrate 84 specii de apoide-polenizatori sălbatice. În lucrare este prezentată descrierea acţiunii condiţiilor biocenozei funcţional-integrale asupra dezvoltării şi menţinerii efectivului speciilor de apoide-polenizatori.

Cuvinte cheie: Apoidea, plante etero-oleaginoase, polenizatori

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Introduction

The aromatic plants have been used from the ancient times. During 4 millennia until our era the Egyptians used these plants as spices to make tea, flavored drinks, to perform massages.

In India, Egypt, Ceylon and other ancient centers of civilization developed the industry of obtaining essential oils, which gradually spread throughout the world.

Nowadays essential oils have a wide use in food, medicine, cosmetics, in engineering and in high precision measuring instruments lubrication.

The raw material for obtaining these oils are species of odoriferous plants which can be grown. The number of plants that contain oils and aromatic ethers, include about thousand of species. But among this diversity of species only 10 of them are used in production of essential oils and are cultivated on large surfaces. In the recent past, the plantations of these aromatic plants, in Moldova covered about 16500 ha, representing 7.4% of the area occupied by all the agricultural crops in the country.

In Moldova such plants as: *Salvia sclareia, Lavandula angustifolia*, *Mentha piperata*, *Foeniculum vulgare, Anethum graveolens*, *Coriandrum sativum*, *Dracocephalum moldavica* and *Rosa crimeia* are cultivated on large areas. But the below listed plants are ussually cultivated on smaller areas. They are *Chamomila recutata*, *Sedum acra*, *Achilea coartata*, *Hyssopus officinalis*, *Symphitum officinale*, *Melissa officinalis* and *Hypericum perforatum*.

In present days the development rhythm of cosmetic, medical, alimentary and technical industries that use the essential oils in different spheres has considerable increased.

That is why it is necessary to increase the production of high quality raw material, that can be obtained from the cultivation of the aromatic plants. The cultivation of these plants need profound studies of their biological and ecology, use of performant technologies for their cultivation, along with study and identification of economic important species of insects-pollinators.

Most species of pollinating insects (about 90%) of aromatic plants are the wild bees and honey bees, which belong to the superfamily Apoidea.

The recording of species spectrum and the composition of pollinating Apoidea complexes, studying the role and their efficiency, will help in optimizing and directing them in the pollination of aromatic plants. The results of the research will be applied in practice to prepare recommendations for increasing amount of the harvests and quantitative and qualitative raw material with high content of active ingredients and aromatic plant cultivated.

Materials and methods

Materials included in this work were obtained in the process of the research of Apoidea fauna during the 1987-1994 mainly on the territory of Station of aromatic plant cultivation and partly on sectors with aromatic plants in the Botanical Garden of A.S.M. There were collected 1045 specimens of wild bees and there were revealed the dominant and supradominant species.

Apoidea were collected during the growing seasons using entomological manual method from the flowers of aromatic plants. Collecting samples took 2 hours in the middle of each plantation area with certain species of plant. Each sample was collected from the surface of 10 m^2 during 10 minutes. The samples from the flower sectors of Botanical Garden were collected for 30 min. Species identification of Apoidea was based upon the keys of Osinchiuk, Panfilov and Ponomariova [1].

Results and Discussion

The territory of Station of odoriferous plant cultivation, where the study of Apoidea was performed is located in the south-east of Chisinau, at the periphery. In the southeastern part, this territory is limited by a forest belt and in the south-west it borders the road route, linking the city with the airport and in the east with the road Chisinau-Tighina.

The relief of the territory represents non-homogeneous ground, crossed by many ditches, hollows and hills. Both of these slopes, the edge, the intermittent land of the forest belt and small oases have a definite condition of their exposure – southern and south-western. They are warmed by the sun, becoming favorite places for nesting and colony forming of Apoidea, beneficially contributing at shelters formation, ensuring sustainable colonies' existence.

These colonies have a specific biology, that is characterized by a relatively stable order through combining abiotic and biotic environmental factors. They were mutually adjusted over several years of the Station territory of cultivating aromatic plants existing. This agrosistem's base is formed on the natural stations and the flavoured cultures cultivation. Natural colonies of apoidea represents a necessary component of nature, because it is the source of providing the effective spieces of Apoidea with individuals, that are the main pollinators of all the entomophilous plants of biota.

The diversity of Entomophilous plant species: annual and perennial trees and shrubs that grow on the Station's territory and bloom every year, creates a permanent basis of food during the vegetal season for Apoidea and keeping them in these places.

In early spring in the fields and forests appear the flowers of ephemeral plant species: Cornus mas, Scilla bifolia, Coridalis cava, Oxalis acetosella, and on fallow ground - Primula vulgaris, Crocus hibrides, in April on the river slopes appear some

species of Salix sp. In May, some species of flowering trees: Prunus armenica, Erasius avium, Prunus fructicoza, Pirus malus and some shrub species. Apoidea species that have wintered, collect pollen and nectar from the flowers of these plants, depositing it in the galleries of nests located in the soil and in the cavities of dried stems of herbaceous plants from the previous year and lay eggs which will develop and increase brood up adults of the first generation of wild bees. The result of this process, the number density of effective Apoidea species in colonies increases.

In summer, basic forage for wild bee colonies in the Station territory is the pollen and nectar of the **aromatic** plants. Several species of flavoured plants (sown at different times of the vegetal season) in early June start to bloom at a time until the end of the season. As a result these plants create a specific conveyor for producing pollen and nectar, fully supplying food for Apoidea that simultaneously participates in flavoured plants pollination. Note that all species of wild bees that inhabit the station in the summer develop second generation, and will spend the winter in the larval stage.

The investigation of pollinating Apoidea was performed during several years in the flowering period of cultivated species of plants, by taking samples during the vegetal season from flowers of each species separately. Investigations were subjected to 16 odoriferous plant species (tab. 1).

According to the obtained data, scientists had identified the spectrum of pollinator Apoidea species (84 spieces), that several years visited flavoured plants, cultivated on the Station territory.

Analizing the complexes of Apoidea in acordance with their forming at studied spieces of plants , they can be devided into 4 groups.

First group has a big number of Apoidea species in one complex: *Anethum graveolens* - 29 species; *Coreandrum sativum* - 19 species; *Salvia sclareia* - 18; *Foeniculum vulgare* -18.

The second group has an average number of spieces: *Dracocephalum moldavica* - 13 species; *Camomilla recutata* -12; *Achilea coretata* - 11; *Hyssopus officinalis* - 9.

The third group- a small number of spieces: *Agastache foeniculum*, *Lavandula angustifolia* and *Monarda sp.* have in their complexes 7 spieces of wild bees.

The fourth group of flavoured plants that have formed no complex: *Mentha piperata*, *Sedum acra*, *Anemone sylvestris* and *Ruta graveolens* are visited by 3-4 species of Apoidea.

The variety of viziting grades depends on their adaptation in coevolution process and on the amount and the concentration of ethers in flavoured plants.

In general to 10 spieces of aromatic plants are assigned 84 spieces of Apoidea.

Dominant and subdominant species of Apoide, that populate different places, are the following: *Megachile eritrocerum*, *Halictus quadricinctus*, *H. morbilosus*, *Lasioglossum politum*, *L. malachurum*, *Andrena flavipes*, *A. nitiduscula, A. dorsata, A. nitiduscula, A. chrisosceles, A. hedikae, Bombus lucorum, B. lapidarius, B. terrestris, B. silvarum, B. lucorum*. Among these the superdominant species are: *Bombus lapidarius, B. lucorum, A. flavipes* and *A. nitiduscula*.

Table 1. Apoidea-pollinators of odoriferous plants from the Station of aromatic plant cultivation, Chişinău city

Nr.	Apoid species	Anethum graveolens	Agastache foeniculum o. Kunze	Anemone sylvestris L.	Sedum acrel	Achilea coretata payr	Chamomila recutata (L.) Rauchert	Coreandrum sativum L.	Calamenta nepeta (L.) Savi	Dracocephalum mol-davica L.	Foeniculum vulgare Mill.	Hysspopus officinalis L.	Lavandula angustifolia Mill.	Monarda sp.	Mentha piperata L.	Ruta graveolens L.	Salvia sclareia L.	Number of plant species visited by one species of Apoidea
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*
1	Colletes fodiens Gef.					+												1
2	C. succintus L.					+												1
3	Hylaeus anularis Kby	+																1
4	H. cornuta Smith.	+																1
5	H. minuta F.											+						1
6	H. striaca Först	+																1
7	H. variegata F.	+																1
8	Andrena atrata Fr.	+																1
9	A. alfkenella Perk.	+																1
10	A. bimaculata Kby.	+																1
11	A. chrysosceles Kby.						+	+			+							3
12	A. chysopiga Schensk	+						+										1
13	A. combella Nar						+											1
14	A. dorsata Kby.						+	+			+							3
15	A. enslinella Stök.							+										1
16	A. falsifica Perk						+				+							2
17	A. figurata F. Mor.							+										1
18	A. flavipes F.	2					+	+	+	+	+							6
19	A. floricola Alfken	+				+					+							3
20	A. forsterella Alfken	+																1

Table 1 (Continued)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
21	A. hedikae Jaeger							+			+							2
22	A. hystrix rufilatra Shm.										+							1
23	A. impunctata Péres										+							1
24	A. lepida Schenck	+									+							2
25	A. minutula Kby.	+						+			+							3
26	A. minutuloides	+						+			+							3
27	A. morawitzi Thomps.										+							1
28	A. nanaeformis Nosk.	+																1
29	A. nitidiuscula Schenck.	+						+			+							3
30	A. propinqua Schenck.	+									+		+					3
31	A. saundersella Perk.	+																1
32	A. subopaca Nyl.	+						+										2
33	A. tibialis Kby.				+			+										2
34	A. trimerana Kby.	+																1
35	A. tringa War.							+			+							2
36	Halictus euri-gnathus Blüt.					+	+	+		+								4
37	H. geminatus Rossi					+												1
38	H. kessleri Bramson											+						1
39	H. maculatus Smith	+				+	+	+		+					+	+		7
40	H. morio F.																+	1
41	H. quadricinctus F.	+				+	+		+				+					5
42	H. saioi Blüthgen																+	1
43	H. scabiose Rossi													+				1
44	H. sexcinctus F.								+									1
45	H. subauratus Rossi					+	+											2

Table 1 (Continued)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
46	H. tumulorum L.											+						1
47	H. varipes F. Mor											+						1
48	Lasioglossum calceatum Sc.	+													+		+	3
49	L. laticeps Schenck																+	1
50	L. leucozonium Schrenck									+								1
51	L. linearis Schenck					+	+											2
52	L. lucidulum Schenck			+														1
53	L. malachurum Kby.					+	+	+		+								4
54	L. morbilosus Kby.									+								1
55	L. nigripes Lep.																+	1
56	L. politum Schenck	+						+				+		+				4
57	L. trichopigum Blüt.						+							+			+	3
58	L. tricinctus Schenck																+	1
59	L. xantopum Kby.					+												1
60	L. setulosus Rossi																+	1
61	Sphecodes pellucidus Smit															+		1
62	S. monilicornis Kby.	+																1
63	Megachila euri-cetorum Lep.																+	1
64	Melitta leporina Pz.														+			1
65	Chalcodoma ponticum Alfken								+								+	2
66	Anthidium mon-tanum F. Mor.								+								+	2
67	Hoplitis bi-dentata F. Mor.											+						1
68	H. parvura Duf. et Perez.	+						+										2
69	Nomada diversipes Latr.											+						1

Table 1 (Continued)

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*
70	**N. flavopicta Kirby.**										+							1
71	**N. mutica Nock**							+										1
72	**N. zonata Pz.**	+																1
73	**Heliophila bimaculata Alf.**		+						+	+		+	+				+	6
74	**Habropoda tarsata Spin.**																+	1
75	**Eucera chriso-pyga Peréz.**																+	1
76	**Xilocopa valga L.**										+							1
77	**Bombus hortorum L.**				+					+								2
78	**B. lapidarius L.**	+	+		+				+	+		+	+	+			+	9
79	**B. lucorum L.**	+	+	+	+				+	+	+		+	+		+	+	11
80	**B. maculidorsis Skor.**		+							+								2
81	**B. ruderatus F.**		+											+				2
82	**B. silvarum L.**		+	+					+					+			+	5
83	**B. terrestris L.**		+						+	+			+				+	5
84	**B. muscorum L.**									+			+		+			3
No of apoid species vs plant species		29	7	3	4	11	12	19	10	13	18	9	7	7	4	3	18	
Collecting period		22.VI-21.VII	28.VII-24.VIII	28.VII	23.VI-1.VII	7.VI-28.VII	7.VI	10.VI-6.VII	6.VII-24.VII	9.VIII-24.VIII	8.VI-24.VII	5.VII	22.VI-28.VII	5.VII	9.VIII	28.VI	29.V-5.VII	

For keeping the relative stability of the species spectrum of wild bees that pollinate all the entomophilous plants and for optimizing their division process, we suggest the following measures for protection of natural resources and complexes:

1. To improve the forest composition by planting trees, bushes and nectar giving plants that are missing. These will contribute in increasing insects diversity and number.
2. Keeping steppe fallow areas close to the ditches, hollows. They will help in avoiding erosions and will serve as places for forming wild bee colonies and pollinators attracted.
3. Integrate implementation of plants protection with minimalization or exclusion of toxic substances by use of agrotechnical and biological methods.
4. Locating the sown fields near the natural and artificial stations with slopes that are tipped to the south and southwestern exposure, where during several years exist colonies of wild bees.

The collected species of Apoidea, identified by us are kept the Museum of Institute of Zoology, Academy of Sciences of Moldova.

Conclusions

1. The information presented in this work represents a scientific novelty in studying the Apoidea fauna - pollinators of **aromatic** plants cultivated in Moldova.
2. In the Republic of Moldova for the first time was studied the fauna of apoid-pollinators of 16 species of cultivated **aromatic** plants, being identified 84 species of wild bees.
3. It was established the formation of apoid-pollinators complexes of each cultivated plant species and the dominant and subdominant bee species were emphasized.

References

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