POLLINATING INSECT ASSEMBLAGES OF SEED ONION FIELDS AT THE TRADITIONAL ONION GROWING AREA OF MAKÓ

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Summary: *Regular surveys were made on the pollinating insect assemblages on seed onion fields of the Onion Research Unit of the Cereal Research Institute, Szeged near two settlements, Makó and Kiszombor in three consecutive years. During this period we collected 2263 wild bees, 24 specimens of non-Apoid Hymenopteraand 152 specimens of Brachycerous Diptera and analysed them considering different aspects. While processing the material 56 Apoid species, 11 other non-apoid Aculeate Hymenoptera and 21 Brachycerous Diptera species were registered. Pollination was done mainly by wild bees and also by honey bees.*

During these three years the Andrena flavipes Pz. (35.97%) was dominant species, while the Bombus terrestris (L.) (16,66%) and the Loasioglossum malachurum (K.) (13.74%) were subdominant species. Additional species were the Halictus simplex (Blüthg), Andrena carbonaria (L.), Andrena thoracica (F.), Lasioglossum calceatum (Scop), Bombus lapidarius (L.), Halictus quadricinctus (F.), Halictus maculatus Sm., Andrena tibialis (K.), Halictus veneticus Ebmer. Among Brachycerous Diptera Eristalis tenx L., Eristalis arbustourm L,. Stratiomys longicornis Scop and some Lucilia species were the most frequent visitors on onion inflorescence.

During the experiment we observed that it was the Apoid Hymentoptera species that effectively carried out the pollination on the flowering onion fields. Our data present convincing proof of our previous findings that onion inflorescence does not have a range of specialised, determinate insect species visitors, although the long years of onion production traditions in the region of Makó would have been enough for some species to settle and spread. We observed that the most important in the pollination of the onion flower is the wild bee species with a wide plant spectrum and there are also some additional bumblebee and other insects species with a wide plant spectrum, depending on the place.

Pollinating wild bee densities were 321.33 bee/ha in 2005, 858.60 bee/ha in 2006, 1837.34 bee/ha in 2007, on average of the three years 1005,76 bee/ha.

Pollinating wild bee densities were decisively influenced by the temperature and the diversity of the bees was influenced by the existence of ruderal and direct close-to-natural areas around the flowering onion fields. All these factors resulted in the great density of seed setting wild bees on set soil in 2007. There is a positive correlation between the seed yield of the years and the density of the pollinating agents. In 2007 there was an outstanding seed set of 3243.06 kg/ha in the Makói Bronz type.

The seed set quantity is mostly type-dependent, but the year and other ecological factors (like the soil and climate parameters as well as resistance characteristics) can also have an influence on it.

Key words: onion, wild bees, honeybees, flower visiting, diptera, flower visiting, pollen analysis
Kulcs szavak: vöröshagyma, vadméhek, mézelő méhek, legyek, viráglátogatás. pollen analízis

INTRODUCTION

A number of observations have already proved that on the flowering onion fields on different territories of Europe and North-America the various species of several insects such as wild bees, honey bees, bumble bees, diptera, bugs etc. are regular visitors (LEDERHOUSE et al. 1968, BOHART et al. 1970, BENEDEK et GAÁL 1972, BENEDEK 1974, BENEDEK 1975, BENEDEK et al. 1980).

This research was carried out on territories where onion production has no long traditional backgrounds. Studies have been published recently, where the diversity, density and nutrition conditions of flower visiting insect species of onion fields at traditional onion

growing regions have been examined (TANÁCS et al. 2007, 2008). In this paper we wish to sum up these results and also to complete the synthesis of our previous data with the results of the analysis of the pollen collected by the most important insects (wild bees and honey bees) regularly visiting the onion fields. This work was completed with the help of the application OTKA KO-1083 (2004-2007).

MATERIALS AND METHOD

The research was carried out on the onion fields of the Onion Research Unit of the Cereal Research Institute, Szeged near two settlements, Makó and Kiszombor. In 2005 flowering onions species were *Makói Bronz, Makói Fehér, Makolor and Makométa*, while in 2006 *Makométa, Makolor, Makói Bronz* and in 2007 *Makói Bronz.*

The places and times of the collection were: Makó, 2005. VII. 5., 6., 7., 8., 18.; Kiszombor, 2005. VII. 5., 6., 7., 8., 18.; Makó, 2006. VI. 27., 28., VII. 5. 6., 8.; Kiszombor, 2006. VII. 7., 8., 17, 18.; Kiszombor, 2007. VI. 19., 23., 24., VII. 1., 3.

The flower coverage of each row was approximately 50 wide. Proceeding slowly (at a speed of 100m/5minute) along the rows the insects were caught by a butterfly net. This was repeated ten times on territories of 50 m^2 each time. Thus we collected flower visiting pollinating insects on 500 m^2 each time. On each experimental day in 2005 and 2006 the collection was done on three different flowering onion fields near Makó and Kiszombor between 9 am. and 2 p.m. In 2007 the last collection was done only on a 10,8 ha onion field near Kiszombor as the other fields were ceased due to the closedown of the Onion Research Unit of Makó. This last field was kept for onion seed production. The field was divided into three parts and going diagonally in the different places of the collection area we collected pollinating insects three times a day between 9 a.m. and 2 p.m. in order to determine their diversity and density.

We made collections 5 days each year. Then we mathematically averaged the number of insects collected during these 15 times and diverted it with the application of a relation-factor into 10000 m^2 and determined the wild bee density data both yearly and in the three-year period in pl/ha dimension.

We determined the nutritional correlation of the wild bees by studying and analysing the pollen loads of the collected species. The pollen collected by the bees can be easily removed. It was only in case of the bumblebee that the pollen loads were mixed with nectar, and they are easy to put on a slide to analyse them. Next, if we put a drop of water on the slide and cover it, the analysis can be done under a microscope. Out of the pollen loads we examined an amount of several field-of vision, that is several thousand pollens. The pollution-pollens were determined by estimation based on calculations. To determine the pollens we used a handbook for honey examinations, studies about recent pollens and pollen-collections gathered within several years.

RESULTS AND DISCUSSION

We managed to collect a total of 2263 *Apoidea*, 24 other *Aculeata* species, as well as 152 diptera species on the onion flowers. When processing the data on the insects 56 Apoid 11 other non-apoid *Aculeate Hymenoptera* and 21 *Brachycerous Diptera* species were registered. The pollination of the onion was done mainly by wild bees and also by honeybees.

The dominance analysis (both yearly and mean) was based on the ratio, more precisely on the percentage of the species collected on the onion flowers.

During these three years the *Andrena flavipes Pz.* was dominant species, while the *Bombus terrestris (L.)* and the *Loasioglossum malachurum (K.)* were subdominant species. (Figure 1).

Additional species were *Halictus simplex (Blüthgen), Andrena carbonaria (L.), Andrena thoracica (F.), Lasioglossum calceatum Scopoli, Bombus lapidarius (L.), Halictus quadricinctus (F.), Halictus maculatus Sm., Andrena tibialis (K.), Halictus veneticus Ebmer.*

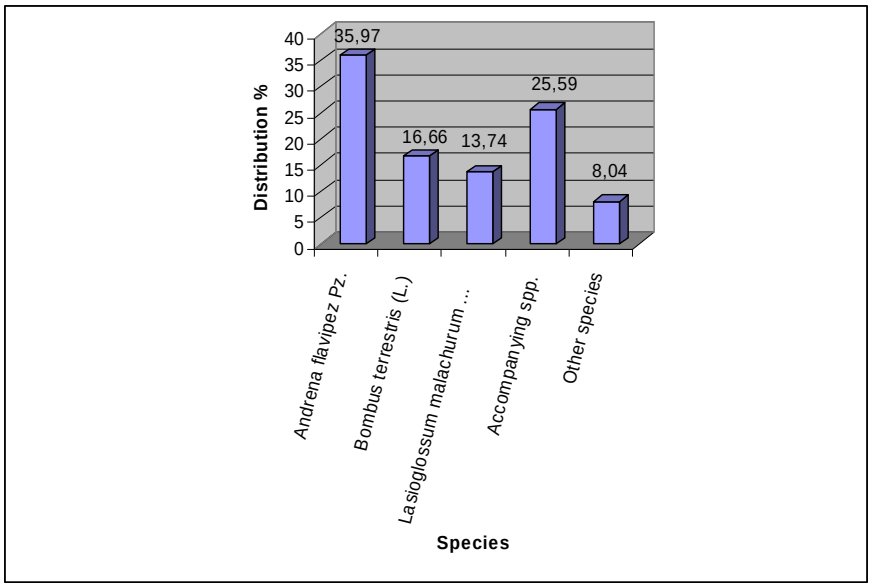

Figure 1. Dominance of wild bees on onion fields in the Makó region during a four-year period

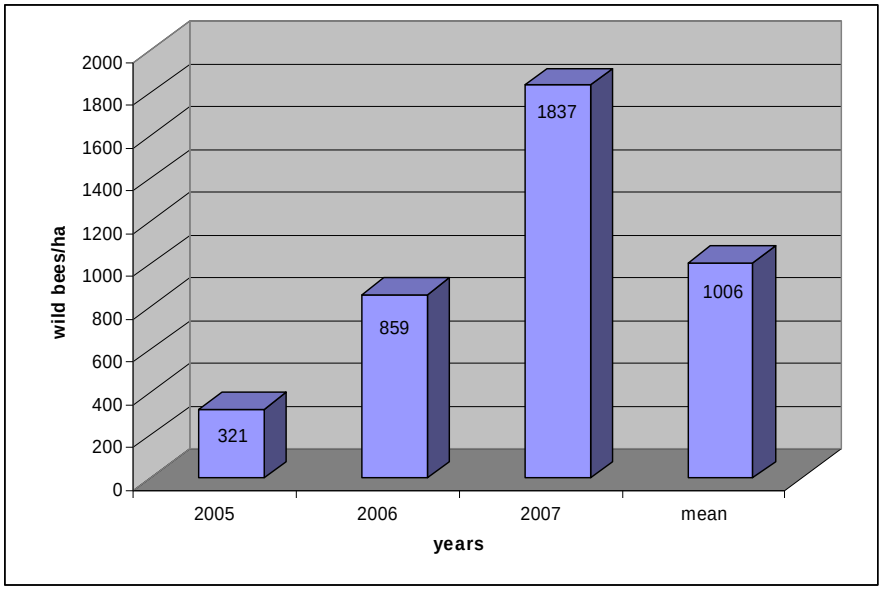

Figure 2. Density of wild bees on onion fields in four consecutive years in the Makó region

During the years of the experiment the significant bee/ha data difference can be due to the various weather conditions and the different characteristics of the area surrounding the onion fields. Another reason is that the fields at the time of the collections were situated in ruderal and close-to-nature areas near Kiszombor region in the years of 2006-2007. The two factors resulted in a significantly larger wild bee density in 2006 but particularly in 2007. Besides the ample pollen and nectar source the undisturbed soils of the ruderal and close-to-nature areas near the flowering onion fields could resulted in a great wild bee density.

In the species evaluation (bee/ha/year) the density of the *Andrena flavipes Pz.* proved to be the greatest with a value of 271,33 pl/ha/year (Table 1). Besides this species the *Bombus terrestris (L.)* (125,67 bee /ha/year) and the *Lasioglossum malachurum (K.)* (103,67 bee/ha/year) were the most important visitors on the onion flowers.

During the three years a small number of 11 other Non-apoid species could be seen present on the onion flowers (Table 2.). These species have no significance in the onion flower visiting or the seed set.

The activity of the Diptera species complete the work of the wildbees and honeybees in pollinating the onion. Within the Diptera species the *Eristalis tenax L.* (30,91 %), *Eristalis arbustorum L.* (19,07 %), *Stratiomys longicornis Scopoli* (7,90 %) *Eristalis aeneus S.* (7,24 %) and the *Pollenia ssp.* 6,58 % were the most significant (Table 3). The ratio of the additional species was 23.02%, while the ratio of other species was 5.28%.

Table 1.

Density of wild bees at onion fields (wild bees/ha/year) at the Makó region in 2007

Dominance	Species	Wild bees/ha/year	Per cent ratio (%) of species (2007)
Dominant species	Andrena flavipes Pz.	271,33	27,00
Subdominant species	Bombus terrestris (L.)	125,67	12,50
	Lasioglossum malachurum (K.)	103,67	10,32
Accompanying species	Halictus simplex (Blüthg.)	59,00	5,87
	Andrena carbonaria (L.)	33,67	3,35
	Andrena thoracica (F.)	24,00	2,39
	Lasioglossum calceatum (Scop.)	22,67	2,26
	Bombus lapidarius (L.)	21,67	2,16
	Halictus quadricinctus (F.)	12,00	1,19

Table 2.

Non-Apoid flower visiting Hymenoptera gathered at seed onion fields at the Makó region in the years of 2005-2007.

Species	Number of specimens gathered at			Total number of specimens (2005-2007)	Per cent ratio (%) of species (2005-2007)
	Makó and Kiszombor (2005)	Makó and Kiszombor (2006)	Kiszombor (2007)		
Scolioidea					
Scolia insubrica (Scopoli)	1	-	2	3	12,50
Scolia sexmaculata Müller	2	-	-	2	8,33
Scolia hirta (Schrk.)	-	-	2	2	8,33
Vespidae					
Polistes dominulus (Christ, 1791)	1	-	6	7	29,16
Polistes nimpha (Christ, 1791)	1	-	-	1	4,17
Ancistrocerus claripennis Thomson	1	-	-	1	4,17
Bembix rostrata (Linnaeus)	1	-	-	1	4,17
Tachytes panzeri Dufour	1	-	-	1	4,17
Sphecidae					
Philanthus triangulum (F.)	-	-	4	4	16,66
Bembix rostrata (L.)	-	-	1	1	4,17
Pompilidae					
Cryptocheilus versicolor (Scop.)	-	-	1	1	4,17
Total	**8**	**-**	**16**	**24**	**100,00**

Table 3.

Flower visiting Diptera gathered at seed onion fields at the Makó region in the years of 2005-2007

Species	2005	2006	2007	Total number of specimens (2005-2007)	Per cent ratio (%) of species (2005-2007)
1. Eristalis arbustorum L.	6	22	1	29	19,07
2. Eristalis abusiva Coll.	-	1	-	1	0,66
3. Eristalis tenax L.	-	42	5	47	30,91
4. Eristalinus aeneus Scopoli	2	9	-	11	7,24
5. Eristalinus sepulchralis L.	1	2	-	3	1,97
6. Stratiomys cenisia Meigen	1	-	-	1	0,66
7. Stratiomys longicornis Scopoli	4	8	-	12	7,90
8. Stratiomys equestris Meigen	1	1	1	3	1,97
9. Stratiomys singularior (Harris)	-	-	1	1	0,66
10. Spilomyia saltuum F.	1	-	-	1	0,66
11. Syritta pipiens L.	-	1	-	1	0,66
12. Lucilia silvarum Meigen	2	-	-	2	1,32
13. Lucilia pilosiventris Kramer	-	1	-	1	0,66
14. Lucilia richardsi Collin	-	1	-	1	0,66
15. Lucilia illustris Meigen	-	-	6	6	3,95
16. Lucilia sericola Meigen	-	-	5	5	3,29
17. Chrysops viduatus Fabricius	-	-	7	7	4,60
18. Atylotus rusticus (Linné)	-	-	4	4	2,63
19. Heptatoma pellucens Fabricius	-	-	1	1	0,66
20. Sarcophagidae ssp.	2	-	3	5	3,29
21. Pollenia ssp.	4	3	3	10	6,58
Total	**24**	**91**	**37**	**152**	**100,00**

During the three years the yield of the seed onion showed different values (Table 4), the reasons of which is diverse. On the one hand it depended on the type, on the other hand the ecological conditions such as the soil and the year proved to be different.

Table 4.

Seed yield at the experimental onion fields

Year	Cultivar	Size of fields (ha)	Total yield of qualified seed (kg)	Seed yield (kg/ha)
2005.	Makói Bronz	5	860	172
	Makométa	1	80	80
	Makolor	1	60	60
	Makói fehér	1	70	70
2006.	Makói Bronz	4	400	100
	Makométa	1	60	60
	Makolor	1	30	30
2007.	Makói Bronz	10,8	2625	243,06

The data indicated that in all the three years the yield of the *Makói Bronz* were the best. Some positive correlation showed between the density of the wild bee populations and the amount of the yields. The amount of yields is influenced by the type, the year, the onion density, the disease and the winter resistance, the planting depth, the temporary and partial spring water coverage, the temperature in the production period as well as the acceptable distribution of light and heat.

The females of the wild bee species collected pollen in the onion flowers. All the solitaire and semi-social wild bees collected pollen. In *Bombus* species we could find nectar-collecting species. The ration in the *Bombus terrestris (L.)* species was between 20-50 %.

CONCLUSIONS

We found that in pollinating the onion flowers several polilectic species (with wide plant pollen spectrum) wild bee species are the most significant followed by several other, also

polilectic bees and other insects, mostly Diptera, their numbers and composition depending on the place.

The seed yield is influenced particularly by the type of the onion as well as the year and other ecological factors.

It was clear that the insect density was affected by the temperature, while the diversity of the Apoids by the vicinity of the ruderal and close-to-nature areas near the onion fields. The types of the onions *(Makói bronz, Makói fehér, Makométa, Makolor)* had no effect on the composition and density of the Apoids.

The results of the pollen analysis indicate that the onion flower do not represent a primary pollen source. The frequent presence of the pollutant pollen species denotes relations towards *Compositae, Papilionaceae, and Umbeliferae* families.

In those places where the wild bees occasionally appear in great numbers, it is a significant fact in onion pollination that the bees generally collect pollen and in their pollen loads there is almost always some onion pollen as well. Onion flower visiting bees actively contribute to the pollination, even if the onion is not always their primary pollen source.

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