INSECTS PRODUCING HONEYDEW EXPLOITED BY BEES IN GREECE

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SUMMARY

More than 65 % of the honey in Greece derives from honeydew of insects. In a research work, started in 1977 and continued until now, 32 species of insects have been identified which produce honeydew exploited by bees.

All these insects belong to the order Hemiptera: Homoptera and to the superfamilies Aphidoidea, Coccoidea, Psylloidea and Aleyroidea. Among these 32 species, the most important from the point of the honey production, are: The coccids Marchalina hellenica (Gen.) and Physokermes hemicyrphus Dalm. and the aphids Cinara confinis (Koch.) Cinara pectinatae Nördl. and Mindarus abietinus Koch.

INTRODUCTION

Honeys are derived from flower nectar, from plants which have nectaries elsewhere (extrafloral nectaries) and from the honeydew.

« The utilisation of honeydew by bees has long been recognized and honeys derived from it have considerable economic value in some parts of the world » (AUCLAIR 1963).

From statistical data of honey market of the years 1975-1976 it is obvious that more than 65 % of honey production in Greece is based on honeydew. This honeydew honey according to the same statistical data, is derived from Pinus spp. (60 %) and Abies spp. (5 %) (SELIANAKIS 1978).

The honeydew honey has a low percentage of invert sugar (glucose and fructose) high percentage of saccharose and other polysaccharides high pH (4,8-5,1) and it shows no crystallization during the storage.
The main difference, between *Pinus* and *Abies* derived honey is based on the colour and flavour. Thus the Abies-honey is clear, and viscous and with good flavour while the Pine-honey is muddy and with inferior flavour (CODOUNIS 1962).

There is also a honeydew which seems to be excreted straight from plants and appears in very small quantities usually early in spring and some times late in autumn. At these times there is frequently lack of nectar and bees exploit this honeydew, but as this is excreted in low quantities and only for a short duration its contribution to honey production is negligible.

NICOLOPOULOS (1959) refers to about twenty plant species which seem to excrete directly honeydew. Recently three plants have been observed to give such honeydew which is exploited by bees, that is: *Abies* spp. which give honeydew during the spring, *Ceratonia siliqua* L. and *Quercus sessiliflora* Sm. in autumn. The honey derived from the honeydew of the two last plants is not good in quality and as reserves for the overwintering of the colonies, they create very serious problems to the beecolonies. This has been observed to the areas of Crete and Phokis and we have not concluded yet the explanation of this phenomenon. The whole subject is under investigation.

All honeydew producing insects belong to the order Hemiptera: Homoptera (Rhynchota). This group includes a large number of Coccoidea, all Aleyroidea and Psylloidea and most of the Aphidoidea and Cicadoidea (MAURIZIO, 1976).

Greek beekeepers often make use of abundant honeydew by bringing their hives at the proper season into host-plants which are infested by these honeydew producing insects.

Very little was known concerning these insects of Greece prior to study by NICOLOPOULOS (1965), SANTAS (1979 and 1981). In recent years a great deal of research has been done in Greece on the insects and some of the data which have accumulated are reported here.

**METHODS**

During the years 1977-1981 a country-wide survey was carried out in Greece (Fig. I). The honeydew producing insects on which the bees were observed to forage, were collected and identified. Plant hosts of these insects were also collected and identified.

The survey was done in two steps: first extensive sampling of the plants to all migratory beekeeping areas in Greece was made to obtain information on the honeydew producing insects on which bees may forage, and second, detailed observations were carried out on the plants infested with honeydew producing insects to see bees to forage on honeydew.

The survey carried out in the main beekeeping areas and some times after information and suggestions of skilful beekeepers on biotopes which are used in the migratory and usual beekeeping areas.

These surveyed areas are:

1) North part of the Euboea island, Thassos island, Chalkidiki district and South East of Crete the main Pinus-honey producing areas, in August, September, October and March.
2) The mountain of Parnis, Parnassos, Oiti, Tymphrytos Mainalon, Enos, Parnon and Ide, the main Abies-honey producing areas, in May and June.

3) The valleys of Phthiotis, Thessaly and Kopais the main glover and cotton producing areas.

The observations took place when the hives were in those places by the author and another skilful beekeeper.

The collected insects were transferred to the laboratory and some of them were identified by the author and other were sent to other specialists for identification. A quite large number of samples were sent to us by skilful beekeepers who had observed bees to forage on the honeydew.
In addition, attempts were made to find out the contribution of each of the honeydew producing insects, in the honey production of Greece.

Thus a number of insects were found to produce honeydew exploited by bees. From these species many are probably not of great importance because the mere fact that some bees are found foraging on honeydew does not prove that they contribute significantly to the honey production.

RESULTS AND DISCUSSION

Thirty two species of insects producing honeydew were found to be exploited by bees in our country (Tabl. 1).

<table>
<thead>
<tr>
<th>Superfamily, Family</th>
<th>Subfamily and Species</th>
<th>Host-Plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aphidoidea - Aphididae*</td>
<td></td>
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<tr>
<td>Aphidinae</td>
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</tr>
<tr>
<td>1. Acrthosiphon pisum Harr.</td>
<td></td>
<td>Trifolium sp.</td>
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<td>2. Aphis craccivora Koch</td>
<td></td>
<td>Trifolium sp. Medicago sativa L.</td>
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<td>3. Aphis fabae Scopoli</td>
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<td>Gossypium hirsutum L.</td>
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<tr>
<td>4. Aphis gossypii Glover</td>
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<td>Gossypium hirsutum L.</td>
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<td>5. Aphis pomi De Geer</td>
<td></td>
<td>Malus sylvestris Miller</td>
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<tr>
<td>6. Brachycoccus cardui (L.)</td>
<td></td>
<td>Cydonia oblonga Miller</td>
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<td>7. Hyalopterus pruni (Goeff.)</td>
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<td>Carduus spp.</td>
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<tr>
<td>8. Myzus persicae (Sulzer)</td>
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<td>Prunus dulcis (Miller) D. A. Webb.</td>
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<td>9. Rhopalosiphum padi (L.)</td>
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<td>Prunus persica (L.) Batsch</td>
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<tr>
<td>10. Pterocomma populeum (Kalt.)</td>
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<td>Zea mays L.</td>
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<td>Thelaxinae</td>
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<td>Populus spp.</td>
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<tr>
<td>11. Mindarus abietinus Koch</td>
<td></td>
<td>Abies cephalonica Loud.</td>
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<td></td>
<td></td>
<td>Abies borisii - regis Mattf.</td>
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<tr>
<td>Phyllaphidinae</td>
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<tr>
<td>12. Callaphis juglandis Goeze</td>
<td></td>
<td>Juglans regia L.</td>
</tr>
<tr>
<td>13. Eucallipterus tiliae (L.)</td>
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<td>Tilia sp.</td>
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<tr>
<td>Chaitophorinae</td>
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<tr>
<td>15. Chaitophorus populeti (Panz.)</td>
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<td>Populus spp.</td>
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<tr>
<td>Lachninae</td>
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<tr>
<td>18. Cinara pectinatae (Nördl.)</td>
<td></td>
<td>Pinus halepensis Miller</td>
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<td>19. Cinara close pini</td>
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<td>Pinus silvestris Miller</td>
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</tbody>
</table>

Tabl. 1. — Honeydew producing insects, useful to apiculture in Greece.
This number is small compared with that found in central Europe (58 known) (KUNKEL and KLOFT, 1977).

These species may be divided into two groups. The first group comprises all those insects which have a great contribution to honey production in Greece. These are all the species which actually are exploited in Greece by beekeepers who transfer the hives to their biotopes. These are: Marchalina hellenica, Physokermes hemicryphus, Cinara confinis, Cinara pectinatae, and Mindarus abietinus.

The second group consists of those species which only partially contribute to honey production or those which are not very important to the honey production, being incidental foraged for the bees. These are the rest twenty seven species of Tabl. 1.

It is quite possible that this division does not give an accurate estimate of the importance of these species with respect to the honey production since the bees are capable of changing their forage if the principal source is not available. Nevertheless the five aforementioned species must be regarded as important source of forage for bees.

(*) The classification of Aphidoidea has been based in some case on the work of R. J. Blackman (1980), and in some other cases on some other works.
As it was estimated that the honeydew honey produced from the coniferous trees forests accounts for the 60-65 % of honey production in Greece while the contribution of broad-leaved trees and other host plants has not been estimated yet.

In our country, the different species of *Pinus* are the main host plants for the most important honeydew producing insects useful to honey production. The insects which produce honeydew on *Pinus* are: *M. hellenica*, *C. palaestinensis* and *C. close pini*. Taxonomically this species is not yet clear. Dr. G. REMAUDIERE of Inst. Pasteur, Paris, is on the way to make a detailed analysis. It will appear from our study that *M. hellenica* (Fig. 2, 3) is the main source of forage for the bees since 55-60 % of honey production in our country is from this scale insect (SANTAS, 1979).

This species is widely distributed in almost all pine forests all over Greece and supports the bulk of migratory beekeeping. The time of excretion of this insect is from June to following spring but the bees, depending on the area, forage on that honeydew in August, September, October and to a smaller extent in March and April (SANTAS, 1979, 1981).

![Fig. 2. — A pine-twig infested by Marchalina hellenica (Genn.).](image-url)
The exact contribution to honey production of *C. palaestinensis* and *C. close pini* is not known, as the infestation of *Pinus* by these aphids is not in large areas but in plantches here and there.

Yet the infestation by these insects do not appear every year. This depends on the weather, entomophagous insects and other factors.

Second in importance as host-plants of honeydew producing insects are the different *Abies* species, as they contribute, 5-10% of all the honey produced in Greece. The insects which produce honeydew on *Abies* trees are: The scales *Ph. hemicryphus, E. sericeum* and the aphids *C. confinis, C. pectinatae* and *M. abietinus*, with *Ph. hemicryphus* being the most important. The infestation of *Abies* trees by this scale appears more or less in large *Abies* forests. The beekeepers bring their hives to these *Abies* forests as most of the foraging is done in May-June and early July (SANTAS, 1981) but the exact time depends on the altitude of the forests and on the weather.

The scale *E. sericeum* appeared in patches on the *Abies* trees in the forest, although sometimes a whole tree may be infested. Nevertheless its contribution to honey production appeared to be negligible. The time of excretion of this insect was from October to June-July, but the bees exploit it only during May to July (SANTAS, 1981).

The aphids, *C. confinis, C. pectinatae* and *abietinus* appeared in our *Abies* forests, but their contribution to honey production is unknown. In some areas and in some years the population of one species is higher than the other two for some undetermined reasons.
It is known however that there are many factors, biotic and abiotic, which influence the population of insects, such as available host plants, parasites predators, altitude, weather conditions, etc. (Uranov, 1931; Smith, 1935; Pechhacker, 1977).

The time of excretion of these insects starts in May-June and continues until September.

In the years with high population of *C. confinis*, the honeydew is available in large quantities and can cover the leaves, twigs, trunks and even the ground under the infested *Abies* trees.

Since beekeepers know the irregularity in the appearance of these insects, they will survey the forage areas before transferring their hives in these areas.

Another forage area in Greece is the chestnut tree forests. The chestnut tree is a very well known honey plant and an important source of honeydew. This tree flourishes in late May and June and provides good forage for bees with nectar, pollen and honeydew. The honeydew is excreted by the *Myzocallis castanicola* which is appears in high population levels in the underside of leaves. The production of honeydew is very abundant from May to July and later on.

There are some other forage areas with plants which do not form forests but which are scattered or are growing in clusters.

Among them the different species of *Populus* are planted in clusters for timber, along the roads or for windbreaks for ornamental reasons or scattered.

The most important species found in Greece are: *Populus canadensis* Moench, *Populus nigra* L., *Populus thevestina* Dode and *Populus alba* L. Besides pollen those trees provide bees honeydew in the spring. This honeydew is excreted by the aphids *Chaitophorus populeti*, *Chaitophorus leucomelas*, and *Pterocomma populeum*. The forage time is late May until early June. The quantity of honeydew honey produced is sometimes high but there are no accurate data on the contribution to honey production.

In the same group is the *Tilia* sp. which provides a good quality honey from nectar and honeydew. The honeydew is produced by the aphid *Eucallipterus tiliae* (L.) which lives in the underside of the leaves. This insect produces large quantities of honeydew in May and June. The *Tilia* sp. are scattered in the northern parts of the country.

On *Crataegus* spp., which are grown almost all over Greece two species of insects produce honeydew on which the bees have been observed to forage: the coccid *P. corni* and the psyllid *Psylla* sp. On *Fraxinus* sp. by the aphid *Prociphilus bumeliae* (Schrk.) large quantities of honeydew on which the bees forage are produced.

Honeydew is also produced on *Quercus* spp. by the coccid *Kermes quercus* (L.). The infestation on *Quercus* spp. by this insect was found to be very low.
Bees have also been observed to forage honeydew produced on cultivated trees, plants and weeds (Tabl. I).

It is also worth mentioning the contribution of honeydew production from cotton, clover and maize.

The beekeepers transport their colonies to the cotton and clover plantations from July to August for the flowers. At the same time if there is a honeydew production, the bees forage on it. The honeydew in cotton plants is produced by *Aphis craccivora*, *Aphis fabae*, *Aphis gossypii* and *Bemisia tabaci* and in clover plants by *Acyrtosiphon pisum* and *Aphis craccivora*.

Generally in the case of cultivated plants, the farmers usually apply insecticides against those insects and for that reason there is no data on the accurate contribution to honey production.

ACKNOWLEDGMENTS

We wish to express our sincere thanks to Mr V. PAPAGEORGIOU, président of « Melissokomiki » co-operative union of beekeepers associations and to all agriculturists and skilful beekeepers for their help during this work.

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RÉSUMÉ

LES INSECTES QUI PRODUISENT UN MIELLAT BUTINÉ PAR LES ABEILLES EN GRÈCE


Parmi les 32 espèces rencontrées les plus importantes du point de vue de la production de miel sont les coccides *Marchalina hellenica* (Genn.) et *Physokermes hemicyphus* (Dalm.) et les aphides *Cinara confinis* (Koch.), *Cinara pectinatae* (Nördl) et *Mindarus abietinus* Koch.

Il ressort de notre étude que *M. hellenica* est l’insecte producteur de miellat le plus important; c’est lui qui est à l’origine du miel de pin de Grèce. D’après les statistiques ce miel représente 55-60 % de la production globale du pays. *M. hellenica* se rencontre sur diverses espèces de *Pinus* et dans la plupart des forêts de pin de Grèce. Les sécrétions de miellat commencent en juin et se poursuivent jusqu’au printemps suivant, mais les abeilles le butinent essentiellement en août, septembre et octobre et, à un moindre degré, en mars et avril.
Les insectes qui vivent sur les diverses espèces d’Abies viennent en deuxième position avec une contribution de 5 à 10 % à la production annuelle de miel. Dans les forêts de sapins nous avons trouvé 5 espèces qui sécrètent du miellat, Physokermes hemicryphus étant la plus importante.

Au printemps les agriculteurs transhument dans les forêts de sapins mais les abeilles n’exploitent le miellat qu’en mai, juin et début juillet.

REFERENCES


