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AN ANNOTATED LIST OF THE SOFT SCALE INSECTS
(HOMOPTERA: COCCIDAE) OF ISRAEL

by

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Very little was known concerning the soft scale insects (Homoptera: Coccidae) of Israel* prior to Bodenheimer's studies of this family within his treatment of the superfamily Coccoidea (1924, 1926, 1927, 1929, 1935). Subsequently Bodenheimer (1937) noted the occurrence of 22 species of soft scale insects in Palestine. Since then several additional local records of this family were published by various entomologists as noted hereunder while discussing the relevant species.

During the years 1966-1971 I carried out a country-wide survey of the soft scale insects in Israel. The data which thus accumulated enabled me to revise some concepts of the systematics, distributions and host plants of the various recorded species. Some Coccidae hitherto unrecorded from Israel were also collected.

This annotated compilation is thus intended to sum up the present knowledge on the status of the soft scale insects of Israel.

The family Coccidae is a large group of phytophagous insects which includes several species of economic importance in the world as well as in Israel. Despite its economic significance this family is at present inadequately known (see discussions by Steinweden, 1929, De Lotto, 1965 and

* Formerly Palestine in Bodenheimer's publications up to 1948.

Gilomee, 1967). The present generic classification is particularly unsatisfactory. Although about 120 to 130 genera were proposed (De Lotto, 1965) only a few attempts have been made to classify them on a world-wide basis and the keys published (e.g. Steinweden, 1929; Hodgson, 1969b) were adequate only for the identification of a part of the total described genera. Even the key presented by Borkhsenius (1957), considered to be a relatively comprehensive one (37 genera) is based on characters of the fully grown female which in my opinion are unreliable or of minor taxonomic value. No keys for the separation of genera or species are therefore presented in this paper.

Various changes have been proposed during recent years in the generic grouping and in various specific names within this family. Such changes include the splitting of the genera Eulecanium and Pulvinaria by Borkhsenius (1957). Pending the future revision of the family, the local representatives of these genera are recorded herein under their formerly accepted names. Borkhsenius' proposals are however noted while discussing the relevant species.

Acantholecanium haloxyloni (Hall)

Originally described from Egypt (Hall, 1926) this species was later recorded from Trans Jordan (Bodenheimer, 1935) and various USSR regions (Borkhsenius, 1957).

This species was transferred from Ctenochiton, to which it was assigned by Hall, and proposed as type species of the genus Acantholecanium Borkhsenius 1949.

It was found to infest roots of Hamada (= Haloxylon) salicornicum (Moq.) Bge (Chenopodiaceae) at the Sinai peninsula, Nahel, 15.1.1970, U. Gerson.

Bodenheimera rachelae (Bodenheimer)

An aberrant form in the Coccidae. This genus and species were originally described from Israel (Bodenheimer, 1924). Its taxonomic status was recently revised by Ben-Dov (1969).

The recorded and apparently only host plant of B. rachelae is Vitex agnus-castus L. (Verbenaceae). Former records were obtained from the Lower Jordan Valley (Bodenheimer, 1924) and the Central Jordan Valley (Ben-Dov, 1969). Additional collections revealed that it is widely distributed in Israel: Upper Jordan Valley- Gonen, 23.7.69; Ayyelet Hashahar, 23.7.69. Golan Heights- Nahal Devora, 30.11.70, J. Halperin. Coastal Plain- Gezer, 14.9.69.

B. rachelae is a biparental species. The female is oviparous, depositing the eggs in a cavity beneath its body. The young female is flat, oval in shape. Along its dorsum are two broad brownish-red stripes running from about the eyes to the operculum. Fully grown females are highly convex, dorsum strongly sclerotic, colour black, covered all over with a thin white wax secretion. The male prepupa and pupa develop within a scale, constructed of white waxy threads, which envelop the male all around.

B. rachelae develops in Israel two annual generations. The reproducing females of the summer generation oviposit during September-October before the leaf-drop of the host plant. The newly-hatched crawlers of this generation migrate to the twigs and settle around the buds. The settled first instar larvae remain at these sites without resuming development during winter until March-April. Following the spring flush of new growth of the host plant, the larvae migrate to the underside of the leaflets, on which their development is completed. Oviposition of the winter generation females takes place during May-June.

The females generally infest the underside of the leaflets. At the termination of the female's development, each infestation site on the leaflet turns into a rounded necrotic area measuring roughly the female's dimensions. The eggs of B. rachelae are preyed upon by the larvae of Hyperaspis sp. (Coccinellidae), beneath the female's body. These larvae pupate under the convex, empty bodies of the post-reproducing females. The larvae and pupae of this coccinellid were found to be parasitized by Homalotylus flaminus (Dalman), (Encyrtidae). Generally 2-3 adults develop and emerge from one larva or pupa.

Ceroplastes rusci (L.)

Israeli specimens of this species, collected in the course of the present survey, from about 20 species of host plants, agree very closely with the redescription prepared by Hodgson (1969a), whereas they differ in important respects from the redescription presented by Ezzat and Hussein (1967).

Following the recent revision of the wax scales genera (De Lotto, 1969, 1971), the fig wax scale should be retained in the genus Ceroplastes Gray.

Data regarding the distribution, host plants and parasites of the fig wax scale in Israel were presented by Ben-Dov (1970d).

Cerostegia floridensis (Comstock)

Some recently-published papers have contributed to an improved understanding of this cosmopolitan wax scale, which is a serious citrus pest in this country. It was redescribed by Ben-Dov (1970c) and about the same time transferred by De Lotto (1969) to a new genus Cerostegia. The morphology of its developmental stages was presented by Amitai (1969).

This citrus pest develops in Israel two annual generations in all the regions where this crop is cultivated, i.e. the mild Coastal Plain as well as in the hotter Jordan Valley. The first generation develops from June through August and the second from August-September through May-June (Ben-Dov, 1970b). The distribution, range of host plants and a list of parasites of the Florida wax scale in this country were presented by Ben-Dov (1970d).

Coccus elongatus (Signoret)

First recorded in Israel by Bytinski-Salz (1954) on Acacia sp. in the Negev. A recent survey (Ben Dov, 1970a) revealed that this species is widely distributed in the country infesting various host plants as follows: Annonaceae- Annona sp., Rehovot, 17.6.69. Caesalpiniaceae- Ceratonia siliqua L., Bet She'an, 10.6.69; Nahariya, 6.10.69; Ben Shemen, 6.2.70. Moraceae- Ficus benghalensis L. Rehovot, 27.4.69; Mikve Israel, 27.11.69. Ficus lyrata Warb., Rehovot, 21.4.70. Ficus retusa L., Lod, 28.4.69; Rehovot, 18.9.69; Tel-Aviv, 6.11.69. Morus alba L., Rehovot, 3.10.69. Rutaceae- Citrus reticulata Blanco, Rehovot, 2.3.69.

Coccus hesperidum L.

The biology and economic importance of the soft brown scale were discussed by Bodenheimer (1951) and Avidov and Harpaz (1969). It is one of the most polyphagous soft scale insects in Israel, where it is common throughout the country. The following list of host plants, which comprises 57 species belonging to 29 families, is based upon the one presented by Avidov and Harpaz (1969) and on additional records made during the present survey.

Amaryllidaceae- Agave americana L. Anacardiaceae- Mangifera indica L.; Schinus molle L.; Pistacia palaestina Boiss. Apocynaceae- Nerium oleander L.; Thevetia peruviana Schum.; Vinca major L. Araceae- Zantedeschia aethiopica Spreng.; Monstera deliciosa Liebm.; Pothos nithens Bull. Araliaceae- Hedera helix L.; Dizygotheca veitchii N. Taylor. Asclepiadaceae- Calotropis procera (Willd.) R. Br. Bignoniaceae- Tecomaria capensis Spach. Cactaceae- Echinocactus sp. Caesalpiniaceae- Bauhinia variegata L.; Ceratonia siliqua L. Compositae- Gazania sp.; Chrysanthemum sp. Cruciferae- Matthiola bicornis DC. Lauraceae- Laurus nobilis L.; Persea americana Mill. Loranthaceae- Viscum cruciatum Sieb. Lythraceae- Lawsonia inermis L. Malvaceae- Abutilon grandifolium (Willd.); Althaea rosea Cav. Moraceae- Ficus benghalensis L.; F. carica L.; F. obliqua Forst.; F. retusa L.; F. sycomorus L.; Morus alba L. Myrtaceae- Myrtus communis L.; Psidium guajava L. Nyctaginaceae- Bougainvillea spectabilis Willd.; Mirabilis jalapa L. Oleaceae- Olea europea L. Papilionaceae- Robinia pseudacacia L. Platanaceae- Platanus orientalis L. Polypodiaceae- Adiantum capillus-veneris L.; Platyterium

alcicorne (Willemet) Desr. Rosaceae- Cotoneaster pannosa Franch.; Cydonia oblonga Mill.; Eriobotrya japonica Lindl.; Prunus amygdalus Batsch; P. armeniaca L.; P. persicae (L.) Batsch; P. salicina Lindl.; Pyrus communis L.; Pyrus malus L.; Raphiolepis umbellata Makino. Rutaceae- Citrus spp. Salicaceae- Populus alba L. Solanaceae- Solanum villosum (L.) Lam. Styracaceae- Styrax officinalis L. Vitaceae- Vitis vinifera L. Verbenaceae- Duranta repens L.

Coccus mangiferae (Green)

The mango shield scale was recorded for the first time in this country by Avidov and Zaitzov (1960), who noted that it was found to infest mango and avocado for the first time at about 1948. At present this species is distributed in the vicinity of Mikve Israel and Rehovot (Central Coastal Plain), where frequently it is a serious mango pest. During the period covered by the present survey C. mangiferae was not found in other regions of the country where mango and avocado are cultivated, i.e. the southern part of the Coastal Plain (Nir Yitzhak), Central and Upper Jordan Valley and the Western Galilee (Rosh Haniqra, Kabri).

In addition to the list of its host plants presented by Avidov and Harpaz (1969), C. mangiferae was found to infest Thevetia peruviana Scum., Rehovot, 12.1.68.

Eriopeltis festucae (Fonscolombe)

Eriopeltis lichtensteinii Signoret

E. festucae was once recorded by Bodenheimer (1926), and the second species was mentioned by Bodenheimer (1935). No further collections of these soft scales were made by me.

Eulecanium coryli (L.) sensu Marchal nec Sulc

Bodenheimer (1935) noted the occurrence of this species under the specific name Physokermes coryli. In the course of the present survey it was found to infest Pistacia palaestina Boiss., En-Hemed, 2.3.70; Jerusalem, 15.2.71.

This soft scale develops in Israel one annual generation, the reproducing females appearing during March-April.

Bytinski-Salz and Sternlicht (1967) recorded this species on Quercus calliprinos Webb. and on Q. ithaburensis (Decne) Boiss.

Eulecanium persicae (F.)

This species was recorded by Avidov and Ben-Haim (1950) under the specific name E. berberidis Signoret. No additional collections were made of this coccid.

Eulecanium pulchrum Reh.

According to Bytinski-Salz and Sternlicht (1967) this species infests Quercus ithaburensis in this country.

Euphilippia olivina Berlese e Silvestri

Bodenheimer (1924) noted that this olive infesting soft scale insect is common in various areas of the country. At present it is rather a rare species, recorded only once in recent years on Olea europea L., Hodiyya, 1.4.68, M. Samish.

Filippia ephedrae Newstead

This soft scale was first recorded by Bodenheimer (1926) from Asparagus stipularis Forsk. An additional recent record is from Ephedra sp., Wadi El-Hawa (Golan Heights), 7.4.68, M. Samish.

Borkhsenius (1957) transferred this species to the genus Stozia Marchal.

Filippia oleae Costs

Only once recorded in this country, where it was found to infest olive (Bodenheimer, 1935). This species was not collected during a recent country-wide survey on olive (Samish, 1970).

Lecanopsis formicarum Newstead

This species was mentioned by Bodenheimer (1935) to infest the roots of a graminaceous host plant. No additional collections of this soft scale were made in Israel.

Palaeolecanium bituberculatum (Signoret)

This record is an addition to the soft scales fauna of Israel. It was collected on Crataegus aronia L. (Rosaceae), Majdal-Shams, 24.7.69.

This species was assigned to Palaeolecanium Sulc, 1932, a subgenus of Lecanium, which had been raised to generic rank by Borkhsenius (1957).

Parasaissetia nigra ((Nietner)

This species was assigned to be the type species of Parasaissetia Takahashi, 1955, an amendment accepted by De Lotto (1965).

It was first recorded by Bodenheimer (1924), under the specific name Lecanium (Saissetia) nigrum, who collected it on Magnolia sp. (Magnoliaceae), on Ficus carica and on F. sycomorus at the Lower Jordan Valley (Jericho). Recent collections showed that its distribution is wider, i.e. in the Arava (on F. carica, Yotvata, 1.12.56, I. Harpaz) and in the Upper Jordan Valley (on F. carica, En-Teo, 22.10.69).

Pulvinaria artemisiae Signoret

Since Bodenheimer (1935) recorded this species on Artemisia sp., no further records have been made.

The species was transferred by Borkhsenius (1957) to the genus Rhizopulvinaria.

Pulvinaria sp. nr. longisqua (under study)

This is an undescribed species, currently under study by Mr. G. De Lotto (Pretoria, South Africa), which is closely related to P. longisqua De Lotto, 1966.

So far this species was found to infest in Israel the leaves of Sorghum sp. (Gramineae), Rehovot, 9.3.70, R. Kenneth.

Pulvinaria mesembryantheri (Vallot)

This species was first reported by Bytinski-Salz (1966). In the present survey it was found at various localities in this country infesting Mesembryanthemum spp. (Aizoaceae) as follows: Rehovot, 10.5.66; Tel Aviv, 11.4.69; Jerusalem, 20.5.68.

Pulvinaria pistaciae Bodenheimer

This species was originally described from Israel by Bodenheimer (1926). Recently it was redescribed by Davatchi (1958). It was assigned as type-species of the genus Anapulvinaria by Borkhsenius (1952).

At present this species is known in Israel to infest Pistacia palaestina Boiss. (Anacardiaceae) in the Upper Galilee, as follows: Mt. Kena'an (type-locality), Bodenheimer (1926); Mt. Meron, 31.3.70; Montfort, 31.3.70.

This soft scale develops in Israel one annual generation. The larval instars and young females develop on the twigs during summer and winter. At about April-May, following the spring new growth of the host plant, the young females migrate to the leaves, on which they reproduce.

Outside Israel, this soft scale insect is also known to infest only Pistacia spp. in East-Mediterranean and Central Asian countries (Borkhsenius, 1957).

Pulvinaria retamae Hall

This species was described by Hall (1923) from Egypt. Hereunder it is recorded for the first time from the Sinai peninsula, where it was collected on roots of Linaria sp. (Scrophulariaceae), Nahel, 15.1.70, U. Gerson.

Borkhsenius (1957) transferred this species from Pulvinaria to the genus Rhizopulvinaria.

Saissetia coffeae (Walker)

The hemispherical scale was first recorded by Bodenheimer (1924) under the specific name Lecanium (Saissetia) hemisphaericum Targ. More recently it was pointed out by Williams (1957) that the name Saissetia coffeae (Walker) should be used in place of S. hemisphaerica.

Following is a list of its host plants hitherto recorded in Israel:
Acanthaceae- Thunbergia grandiflora Roxb. Amaryllidaceae- Agave americana L. Anacardiaceae- Mangifera indica L. Apocynaceae- Carissa grandiflora A. DC. Compositae- Santolina chamaecyparissus L.; Senecio sp. Cycadaceae- Cycas revoluta Thunb. Liliaceae- Asparagus plumosus Baker. Myrtaceae- Myrtus communis L.; Psidium guajava L. Oleaceae- Olea europea L. Polypodiaceae- Platyterium alcicorne (Willemet) Desv. Rosaceae- Eriobotrya japonica Lindl. Rubiaceae- Coffea arabica L. Rutaceae- Citrus spp. Sapotaceae- Achras sapota L. Verbenaceae- Duranta repens L.

Saissetia oleae (Bernard)

The black scale, a polyphagous soft scale, is a serious pest of citrus and olive in Israel. It infests citrus mainly in the Coastal Plain, whereas olive was found to be infested throughout the country, as shown by Samish (1970). In the Judean Hills and the Upper Galilee (700-800 meters above sea level) it is frequent on Pistacia palaestina.

So far, *S. oleae* was found to infest in Israel the following host plants: Anacardiaceae- Mangifera indica L.; Pistacia atlantica Desf.; P. palaestina Boiss. Apocynaceae- Carissa grandiflora A. DC.; Nerium oleander L. Compositae- Chrysanthemum sp. Cycadaceae- Cycas revoluta Thunb. Lauraceae- Laurus nobilis L.; Persea americana Mill. Liliaceae- Asparagus aphyllus L. Loranthaceae- Viscum cruciatum Sieb. Malvaceae- Hibiscus rosa-sinensis L. Myoporaceae- Myoporum laetum Forst. f. Myrtaceae - Myrtus communis L.; Psidium guajava L. Punicaceae- Punica granatum L. Rosaceae- Cotoneaster pannosa Franch.; Eriobotrya japonica Lindl.; Prunus armeniaca L.; P. persicae (L.) Batsch. Rubiaceae- Coffea arabica L. Rutaceae- Citrus spp.

Sphaerolecanium prunastri (Fonscolombe)

This widely-distributed pest of rosaceous fruit trees was recorded for the first time in Israel by Ben-Dov (1968). Recently it was found to infest Prunus ursina Ky., Majdal Shams (Golan Heights), 24.7.69. So far this species was found in localities restricted to the northern borders of the country.

Waxiella mimosae (Signoret)

Former records of this species from Israel were under different scientific names as follows: Ceroplastes mimosae Signoret (Bodenheimer, 1926, 1927) and C. africanus Green (Bytinski-Salz, 1954). De Lotto (1965) synonymized C. africanus Green with C. mimosae Signoret and placed the latter in the genus Gascardia. However, in a recent revision of wax scales genera, this species was assigned to the genus Waxiella De Lotto, 1971.

Recently it was found to infest Tamarix sp, Beer Sheva, 12.4.71, D. Gerling.

Recorded species of doubtful occurrence in Israel.

Two Ceroplastes species, namely C. actiniformis Green and C. sinensis Del Guercio were recorded by Bodenheimer (1927, 1951). However, these species were not found in the course of a special country-wide survey (Ben-Dov, 1970d).

The tessellated scale, Eucalymnatus tessellatus (Signoret) was recorded by Avidov and Ben-Haim (1950). This species was not found ever since in this country. Moreover, I had the opportunity to examine a few slides labeled "Coccus tessellatus, on Mango, Avocado (leaves), Nes Ziyona, 28.2.1947", deposited in the collection of the Department of Entomology, Faculty of Agriculture, Rehovot. The specimens mounted on these slides were identified as Coccus mangiferae (Green). Thus it is assumed that former records of E. tessellatus from Israel were misidentifications of C. mangiferae.

In his first treatment of the Coccidae of Palestine Bodenheimer (1924) recorded a Pulvinaria sp., which he subsequently named P. subterranea (Bodenheimer, 1935, 1937). However, since no taxonomic description of this species was ever published, this name should be regarded a nomen nudum.

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