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TWO SPECIES OF SAISSETIA (HOMOPTERA: COCCIDAE)  
INJURIOUS TO OLIVE IN ISRAEL AND THEIR NATURAL ENEMIES

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A B S T R A C T

The black scale, Saissetia oleae (Bernard), and the hemispherical scale, S. coffeae (Walker), have become serious pests of olive in Israel following repeated applications of non-selective pesticides, mainly against the olive fruit fly, Dacus oleae (Gmelin). Populations of both pests were sampled in monthly surveys.

S. oleae develops 2 annual generations on irrigated olive in the southern coastal plain, 2-3 in the Yizre'el (Jezreel) Valley, and is attacked by 5 primary parasites, 5 hyperparasites, and several predators. Parasitism builds up to a steep peak at the beginning of summer.

S. coffeae develops 3-4 annual generations on irrigated olive in the southern coastal plain, and is attacked by 7 primary parasites, one hyperparasite, and a few predators. Parasitism in the populations of this host reaches its peak in late fall.

The parasite fauna associated with these two soft scale insects in Israel is rather poor. Larvae of both species are virtually free of parasites. The introduction of additional natural enemies is therefore highly recommended.

The black scale, Saissetia oleae (Bernard), and the hemispherical scale, Saissetia coffeae (Walker) [= S. hemisphaerica (Targ.-Tozz.)], are polyphagous species, widely distributed over the tropical and subtropical regions of the world, and in greenhouses in temperate regions (see Borkhsenius, 1957; Avidov and Harpaz, 1969). Both species infest numerous olive groves in Israel and may cause serious damage by the copious accumulation of honeydew and sooty mold, as well as by the direct effects of mass feeding. Heavy outbreaks have been caused in recent years by the upsetting of the natural balance in olive groves by indiscriminate application of non-selective pesticides directed chiefly against the olive fruit fly, Dacus oleae (Gmelin). Although

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such infestations are often severe and may be of significant economic importance, relatively scant information has been available regarding these two important pests and their natural enemies on olive in Israel.

Efforts are currently being made in Israel to develop biological and integrated pest control programs on various agricultural crops, including olive groves (see Harpaz and Rosen, 1971). A study of the populations of black and hemispherical scales and their natural enemies on olive was deemed pertinent in this context. The present study, initiated in December 1967 and based on a countrywide survey, was therefore intended to provide data on the distribution, phenology and natural enemies of S. oleae and S. coffeae on olive in Israel.

## METHODS

A preliminary survey was carried out in practically all the olive groves of Israel, in order to determine the distribution and abundance of Saissetia spp. Twenty groves infested with S. oleae and six groves infested with S. coffeae were selected for further sampling. Of these, eight groves heavily infested with black scale, representing various bioclimatic regions, and two groves heavily infested with hemispherical scale, were sampled monthly. All other groves were sampled at longer intervals or irregularly.

Five to ten heavily infested trees were selected in each of the sampling groves. The sampling units consisted of infested twigs, 10 - 30 cm long, that were cut off the sampling trees and brought into the laboratory.

The seasonal history of the two species was studied by counting 500 scales in each monthly sample (except crawlers, which were counted separately and their numbers added to the total) and segregating them into the following age groups:

- "Ovipositing" = dark, mature females, with eggs beneath their body.
- "Rubber stage" = mature but preovipositing scales; noticeably convex, mostly greyish.
- "Larvae" = pale, flat, smaller scales; anal plates not bearing conspicuous apical setae. This group may have included small mature females.
- "Crawlers" = small first-instar larvae; anal plates bearing a pair of conspicuous, long apical setae.

Samples of up to about 300 scales were kept in the laboratory, usually with small portions of leaves or twigs onto which they were attached, for parasite emergence. Only scales that did not exhibit exit holes of parasites were included in the samples. Whenever possible, the various age groups were kept separately. The parasites that issued from such samples were identified to species, and their numbers, as well as the number of scales in each sample, were recorded.

Predators were collected whenever encountered in association with Saissetia spp. on olive. Predacious thrips were sometimes reared from the scale samples that were kept for parasite emergence.

#### THE BLACK SCALE

Saissetia oleae is a serious pest of olive and citrus in many subtropical countries. According to Bodenheimer (1951) the black scale apparently originated in tropical Africa ("the Sudano-Decanian region of Africa" in his words), and wild Olea spp. were presumably its original hosts. However, G. De Lotto (personal communication) is of the opinion that the species has its origin in the Cape province of South Africa. Several biologically distinct "strains" are known to exist, differing in their host preferences as well as in the specific parasite fauna associated with them (see Bartlett, 1960). Although all the material collected in Israel to date has been identified as S. oleae, it is possible that several cryptic species may be hidden under this name.

Peleg (1965) recorded the development of one annual generation of S. oleae in Israel on citrus and non-irrigated olive, as opposed to two overlapping generations on irrigated olive. In recent years two annual generations have been observed to develop in certain citrus groves. This lends some support to an assumption that more than one species may now be involved, though no morphological distinguishing characters could so far be detected.

In the present survey, the black scale was found to infest most of the irrigated olive groves in all regions of Israel, except the hot Jordan and Bet She'an Valleys. Infestations were found to be considerably heavier in irrigated as compared to non-irrigated groves, and on dense as compared to open, sparsely foliated trees. Olive trees with a relatively dense and spherical crown, such as those of the Uovo di piccione or Merhavia varieties, appeared to be preferred by the scale to other trees. Infestations usually declined sharply following severe pruning, or after irrigation had been discontinued for a long period. Olive trees of all varieties were found to be relatively free of black scale when planted singly or in single rows.

All this evidence appears to indicate that irrigation, solar radiation, and possibly wind, are among the main factors governing black scale population densities on olive in Israel.

The black scale infests mostly young twigs and leaves, up to one year of age. In very heavy infestations, scales were found even on branches up to 5 cm in diameter. Most of the larvae were found on leaves, whereas most of the mature females inhabit the young twigs. Migration apparently takes place in the larval period, whereas mature scales rarely change their place. When mature scales infested leaves, they were usually found on the lower surface, on or near the midrib.

Seasonal History

The seasonal history of black scale on irrigated olive at 'En-Zurim, in the southern coastal plain, is presented in Figure 1. Two distinct annual generations are clearly evident, with ovipositing females appearing mostly in spring and fall. A mixture of all stages was present in the grove during winter, whereas in mid-summer the population consisted of crawlers and larvae only.

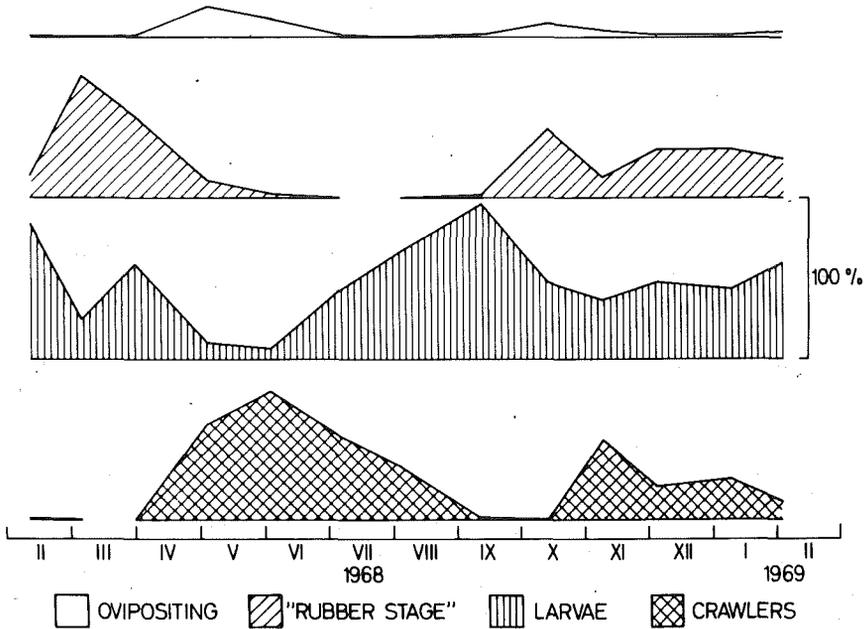


Figure 1. Composition of black-scale population on irrigated olive at 'En Zurim, southern coastal plain.

Figure 2 presents the seasonal history of black scale on irrigated olive in Yizre'el, in the interior Yizre'el (Jezreel) Valley. Sampling in that grove had to be discontinued in the fall of 1968, when the scale infestation in the sampling rows declined very sharply following the uprooting of the rest of the grove. The development of three overlapping annual generations is indicated.

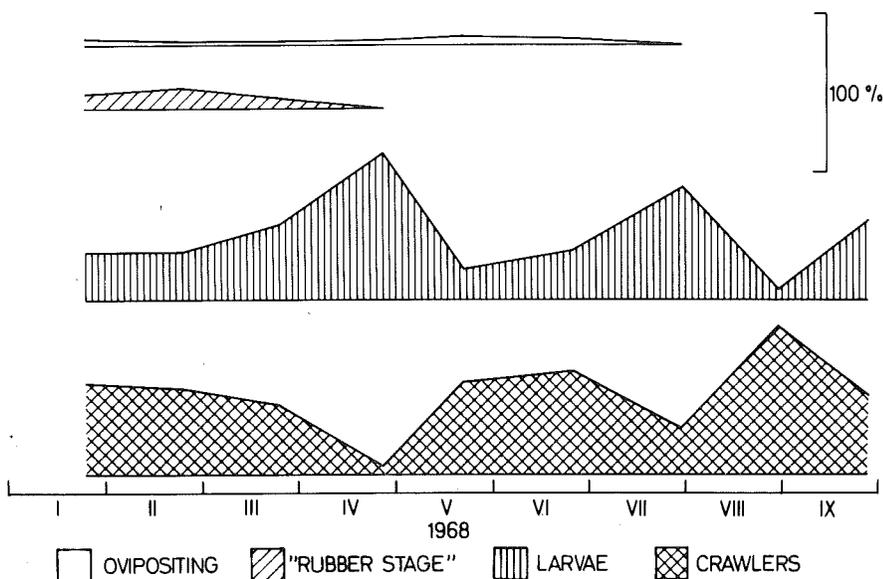


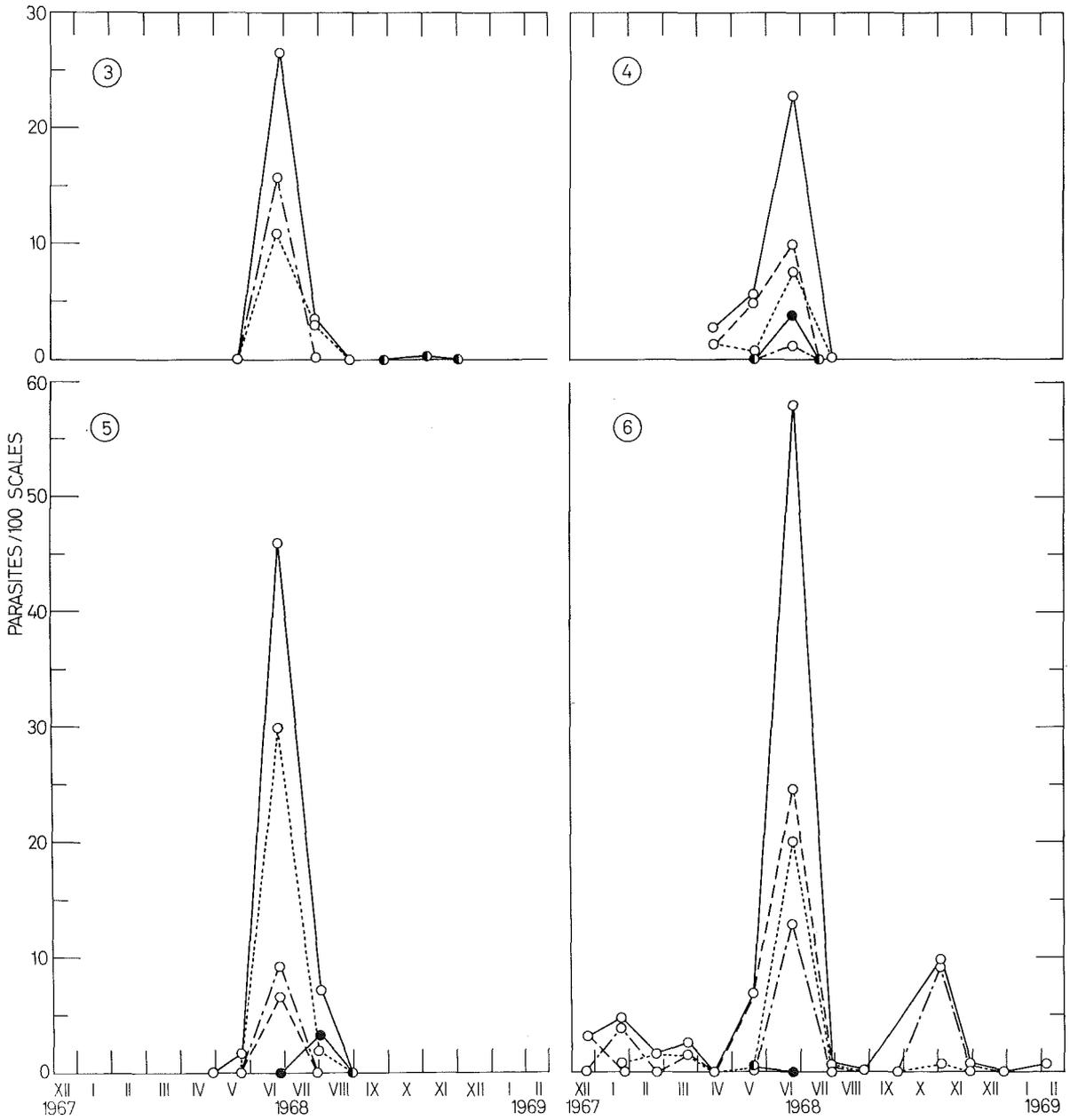
Figure 2. Composition of black-scale population on irrigated olive at Yizre'el, Yizre'el Valley.

### Parasites

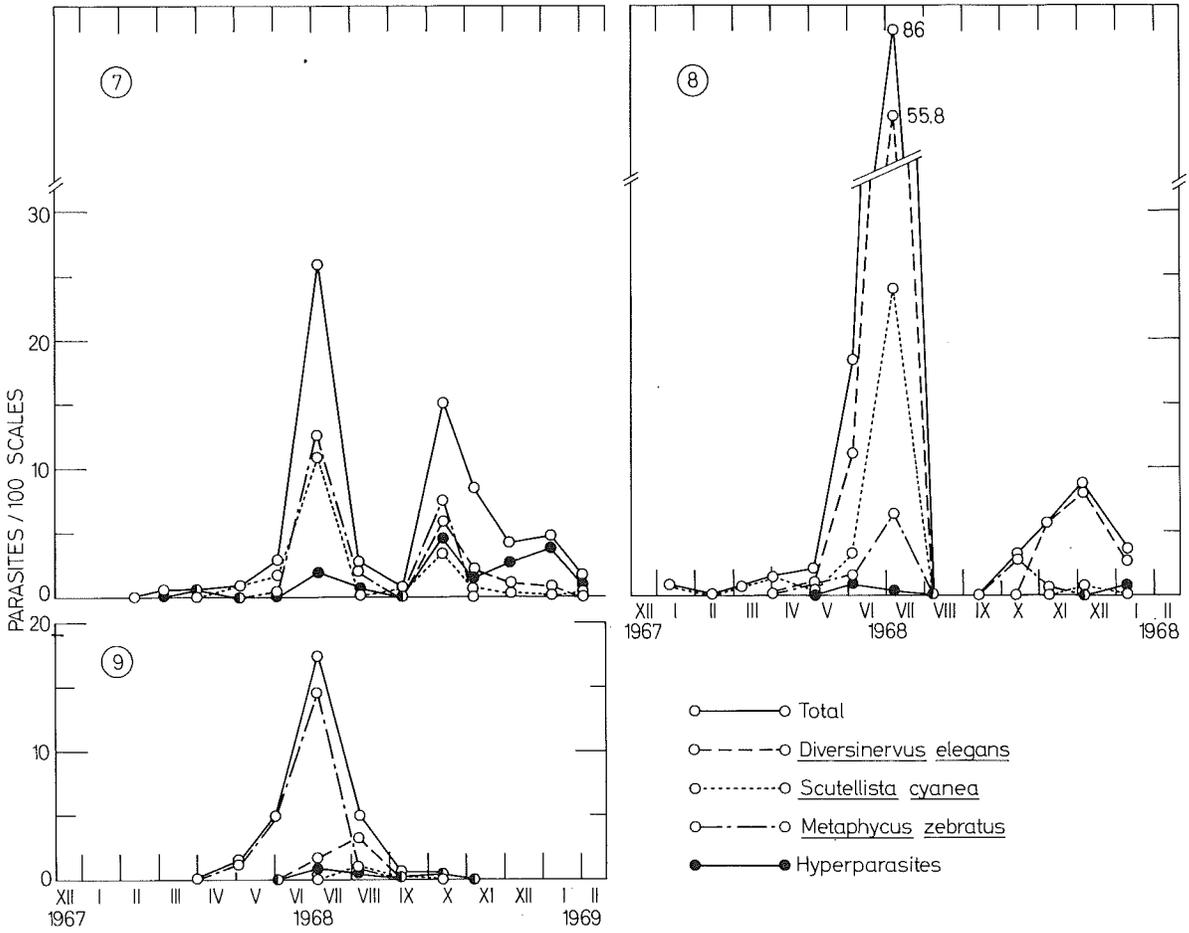
Five species of primary and 5 species of secondary parasites were reared from samples of black scale collected on olive in the present study. These are listed below according to their relative abundance.

Primary parasites: Diversinervus elegans Silvestri  
Scutellista cyanea Motschulsky  
Metaphycus zebratus (Mercet)  
Metaphycus flavus (Howard)  
Microterys flavus (Howard)

Hyperparasites: Marietta exitiosa Compere  
Pachyneuron siculum Delucchi  
Cheiloneurus paralia (Walker)  
Tetrastichus ceroplastophilus Domenichini  
Cheiloneurus claviger Thomson



Figures 3-6. Black Scale: Annual pattern of parasitism by major parasite species on olive in the Yizre'el Valley (3. Daverat; 4. Geva; 5. Yizre'el; 6. 'En Harod).



Figures 7-9. Black scale: Annual pattern of parasitism by major parasite species on olive in the southern coastal plain (7. 'En Zurim; 8. Zelafon; 9. Qedma).

D. elegans and S. cyanea were by far the most abundant primary parasites. M. zebratus was also rather common. All three were obtained from mature, "rubber stage" and ovipositing scales only. Metaphycus flavus and Microterys flavus were very rare. Hyperparasites were generally rare, apparently of no economic significance.

The number of parasites reared from a sample of black scale does not necessarily reflect the actual percentage of parasitism, as the three most abundant parasites may develop gregariously. The fluctuation in the numbers of parasites obtained from successive samples may, however, indicate the changes in the relative abundance of parasites in black scale populations. Representative trends are shown in Figures 3-9.

Parasitism always attained its steep annual peak at the beginning of summer. Thus, parasites appeared to be most active when the susceptible mature scales constituted a relatively small section of the scale population, and most of the larvae of the summer generation have already been produced (see Figures 1, 2). A second, considerably lower peak was sometimes observed in fall. Hyperparasites were usually fairly common during, or immediately after, the peak of primary parasite abundance.

The parasite complex associated with black scale in Israel is rather poor, being very similar to, and only slightly richer than, the complex attacking that pest on citrus (see Rosen, 1967a). D. elegans and S. cyanea, the dominant parasites on olive as well as on citrus, both confine their attacks to mature scale females. Thus, larvae of the black scale are almost entirely free of parasites in Israel, and may be regarded as representing an unexploited ecological niche. As noted by Rosen (1967a), this poor parasite fauna stands in marked contrast to the rich fauna associated with black scale in Africa. The importation into Israel of several additional parasites, especially larval parasites, of black scale therefore appears to be highly desirable.

### Predators

Several species of predators were collected in association with black scale on olive trees, or were reared from samples of black scale taken on olive. These are listed below in alphabetical order.

- Coleoptera: Coccinellidae: Chilocorus bipustulatus (L.)  
Exochomus quadripustulatus (L.)  
Lindorus lophanthae (Blaisdell)  
Pharoscyrnus pharoides Marseul  
Scymnus pallidivestis Mulsant  
Scymnus subvillosus (Goeze)  
Stethorus punctillum Weise
- Neuroptera: Chrysopidae: Chrysopa carnea Stephens
- Thysanoptera: Phloeothripidae: Haplothrips andresi Priesner  
Watsoniella flavipes (Jones)

Although most of the coccinellids listed above are known to be predators of scale insects (see Kehat, 1967), their presence on black-scale infested trees may have been accidental and does not necessarily indicate that they actually prey on the scale. Thus, Scymnus subvillosus has been recorded in Israel as a predator of aphids (Bodenheimer and Swirski, 1957), and Stethorus punctillum is a well-known predator of mites (Plaut, 1965).

Larvae of Chrysopa carnea readily preyed upon young larvae of black scale in the laboratory. All stages of this highly polyphagous predator were collected on black-scale infested olive trees in all regions of Israel. Adults were present throughout the year, but were most abundant in (April-June).

The two species of thrips were first reported from Israel by Rivnay (1933). W. flavipes (then recorded as Karnyothrips longisetis) is an oligophagous coccid feeder, whereas H. andresi is a widely polyphagous predator (see Priesner, 1960). In the present survey they were found in all black-scale infested groves, practically throughout the year, sometimes in rather dense populations. Thus, as many as 355 thrips were found under 283 scale bodies in a sample taken on olive at Beror Hayil in April, 1968. Up to eight mature thrips were sometimes found under the body of a single scale. W. flavipes was more abundant than H. andresi.

#### THE HEMISPHERICAL SCALE

Saissetia coffeae has been recorded on olive, coffee, ornamentals and numerous other hosts in many subtropical and tropical countries, but is mostly known as a greenhouse pest. It is usually considered less injurious than S. oleae. In fact, serious economic injury to olive has apparently not been reported elsewhere. In Israel, severe infestations were found in the present survey to be limited mainly to several chemically-upset olive groves in the southern coastal plain.

Mature females of hemispherical scale were usually found on the underside of olive leaves, near the leaf margins, towards the tip. Young leaves in the lower parts of the tree appeared to be preferred. Only in very heavy infestations were the scales found in large numbers also on young twigs. Unlike black scale, the hemispherical scale is capable of considerable movement also in the "rubber stage".

Populations of hemispherical scale, like those of black scale, were observed to decline sharply following discontinuation of irrigation.

#### Seasonal History

Figure 10 presents the seasonal history of hemispherical scale in the olive grove of Yavne, where heavy infestations have been recorded since 1958. The development of 3-4 annual generations was indicated, and all stages were present in the grove at practically all times.

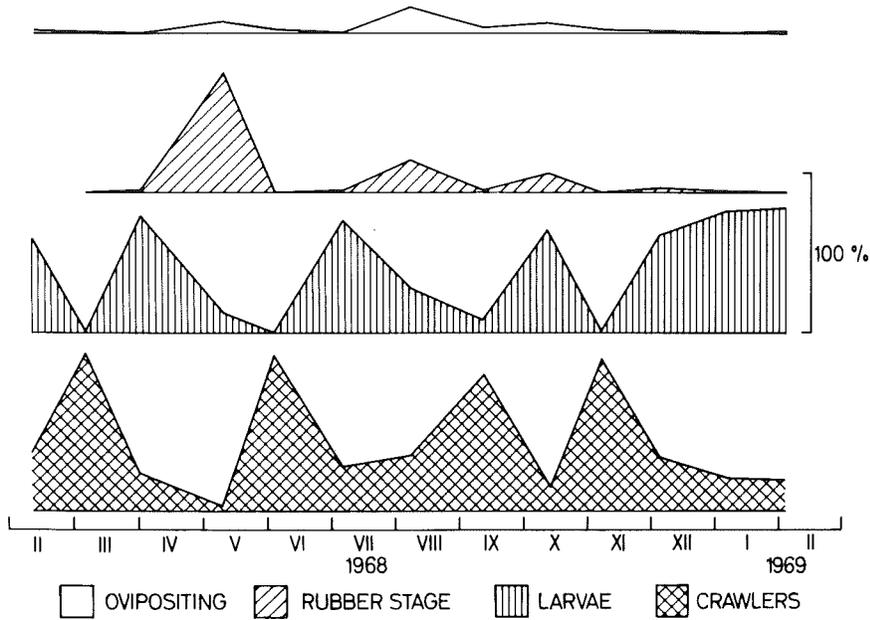


Figure 10. Composition of hemispherical-scale population on irrigated olive at Yavne, southern coastal plain.

### Parasites

Seven species of primary parasites and one secondary parasite were reared from samples of hemispherical scale collected on olive in the present study. These are listed below according to their relative abundance.

Primary parasites: Scutellista cyanea Motschulsky  
Diversinervus elegans Silvestri  
Metaphycus flavus (Howard)  
Scutellista nigra (Mercet)  
Coccophagus lycimnia (Walker)  
Microterys flavus (Howard)  
Metaphycus zebratus (Mercet)

Hyperparasite: Pachyneuron siculum Delucchi

Additionally, an undescribed species of *Diversinervus* was recorded by Ben-Dov (1970) from hemispherical scale on coffee, and the hyperparasite *Marietta exitiosa* Compere was reared in the present study from that host on ornamentals.

*S. cyanea* was by far the dominant parasite of hemispherical scale on olive. *D. elegans* was much less common, whereas all the other species were very rare.

Figure 11 presents the trend of parasitism in hemispherical scale populations on olive at Yavne. Parasite activity was rather low during spring and summer, reaching a marked peak in late fall. Hyperparasites were insignificant.

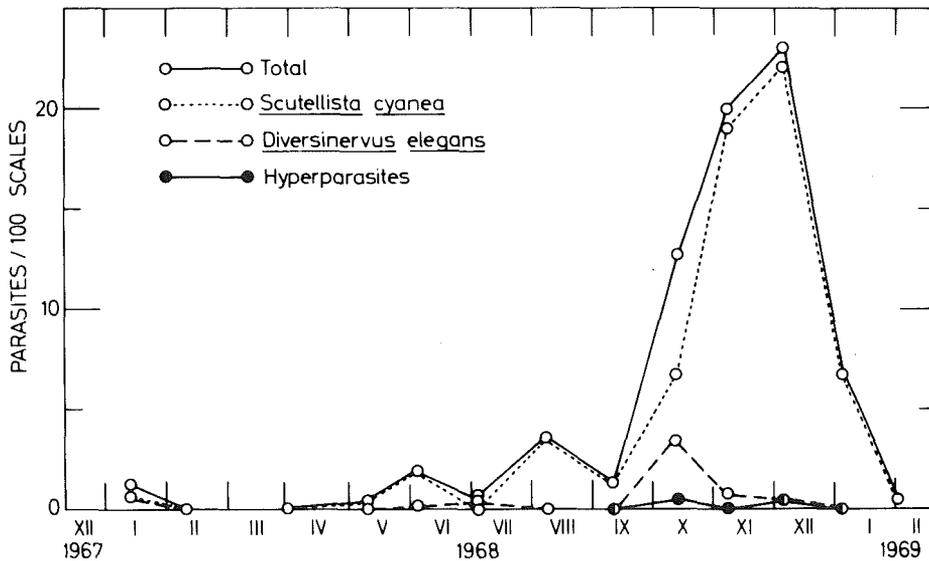


Figure 11. Hemispherical scale: Annual pattern of parasitism by major parasite species on olive at Yavne, southern coastal plain.

The parasite complex attacking hemispherical scale in Israel is obviously inadequate, the dominant species, *S. cyanea*, being a rather ineffective egg predator. As is the case with black scale, larvae of hemispherical scale are virtually free of parasites. The importation of additional natural enemies is therefore highly recommended.

#### Predators

The following predators were collected in association with hemispherical scale on olive in the present survey.

- Coleoptera: Coccinellidae: *Chilocorus bipustulatus* (L.)  
*Exochomus quadripustulatus* (L.)  
*Scymnus interruptus* (Goeze)

- Neuroptera: Chrysopidae: Chrysopa carnea Stephens  
Thysanoptera: Phloeothripidae: Haplothrips andresi Priesner  
Watsoniella flavipes (Jones)

#### DISCUSSION OF INDIVIDUAL PARASITE SPECIES

All the hymenopterous parasites mentioned in the previous paragraphs will be discussed below in alphabetical order. All dates pertain to the collection of host samples. For a more detailed discussion of these species see Rosen (1962, 1966, 1967a, 1969).

##### Cheiloneurus claviger Thomson (Encyrtidae)

This species is known as a hyperparasite of soft scale insects in Europe (Claridge, 1958; Sugonjaev, 1962) and Japan (Tachikawa, 1963). It was previously recorded in Israel as a very rare hyperparasite of brown soft scale, Coccus hesperidum L., on citrus (Rosen, 1967a).

In the present study, only two specimens of C. claviger were reared from a sample of black scale on olive (1♀, 1♂, Kefar HaNasi, 26.IV.1968).

##### Cheiloneurus paralia (Walker) (Encyrtidae)

This Palearctic species is a rather common hyperparasite of brown soft scale and a rare hyperparasite of Florida wax scale, Ceroplastes floridensis Comstock, along the coastal plain of Israel (Rosen, 1967a). A few specimens were obtained in the present study from samples of black scale collected on olive (3♀♀, Zelafon, 3.IV.1968; 1♀, 3♂♂, Qedma, 5.VII.1968).

##### Coccophagus lycimnia (Walker) (Aphelinidae)

C. lycimnia is a cosmopolitan, polyphagous parasite of soft scale insects. Females develop as primary parasites, whereas the males are obligatory hyperparasites. This species is an important parasite of brown soft scale in Israel, dominating the parasite complex in dense, ant-attended colonies of that host on citrus (Rosen, 1967a, 1967b). It was also recorded in Israel as a very rare parasite of Florida wax scale and fig wax scale, Ceroplastes rusci (L.) (Rosen, 1967a; Ben-Dov, 1970).

Only two specimens of C. lycimnia were reared in the present study from hemispherical scale collected on olive (2♀♀, Yavne, 13.X.1968). Additional material was obtained from samples of that host collected on golden dewdrop (Duranta repens L. var. variegata Bailey) (8♀♀, Yavne, 10.XI.1967; 2♀♀, 10♂♂, Yavne, 18.IV.1968).

This Palearctic species is a rather common hyperparasite of brown soft scale and a rare hyperparasite of Florida wax scale, Ceroplastes floridensis

Diversinervus elegans Silvestri (Encyrtidae)

This important Ethiopian species is a well-known gregarious endoparasite of mature black scale and other soft scale insects. Its biology was recently studied in some detail by Bartlett and Medved (1966).

In Israel, D. elegans has been recorded as the dominant parasite of black scale, on citrus as well as on olive. It is also a rare, insignificant parasite of Florida wax scale on citrus. Occasional specimens were recorded also from brown soft scale and from the hemispherical scale (Rosen, 1967a).

In the present study, this species was found to be the most abundant parasite of S. oleae and a rather rare parasite of S. coffeae on olive, attacking only "rubber stage" and ovipositing females of these hosts.

A total of 1007 specimens were obtained from black scale, about 2/3 of which were females. Most of them were reared from scale samples collected in June-July (Figures 4, 6, 7), but considerable numbers were sometimes obtained also in the fall (Figures 7, 8). The species was absent from the black scale population in the olive grove of Daverat (Figure 3).

D. elegans appears to be an insignificant parasite of hemispherical scale in Israel. Altogether, only 15♀♀ and 11♂♂ were obtained from that host in the present study. The parasite was present in small numbers at Yavne (Figure 11) early in summer and in the fall.

Marietta exitiosa Compere (Aphelinidae)

This Ethiopian species has been recorded in Israel as a rather polyphagous hyperparasite of various soft and armored scale insects (see Rosen, 1965, 1967a).

In the present study, M. exitiosa was found to be the most abundant hyperparasite of black scale on olive. It was obtained in small numbers from samples of that host collected in all regions of Israel all the year round. A total of 78♀♀ and 66♂♂ were reared from S. oleae, nearly one half of them from June through August.

A single male was reared from hemispherical scale on golden dewdrop (Yavne, 18.IV.1968). This appears to constitute a new host record for M. exitiosa.

Metaphycus flavus (Howard) (Encyrtidae)

M. flavus, a cosmopolitan parasite of various soft scale insects, has been recorded in Greece as an important natural enemy of black scale (Argyriou, 1967; Argyriou and DeBach, 1968). In Israel it is the most abundant parasite of brown soft scale on citrus, but only an insignificant parasite of black and hemispherical scales (Rosen, 1967a).

In the present study, the parasite was found to be present in small numbers in black scale populations on olive in all regions of Israel. A total of 2900 and 1000 were reared from that host, all of them from April through June.

Only 5 specimens of M. flavus were reared from hemispherical scale on olive (10, 10, Yavne, 1.XII.1967; 10, Beror Hayil, 3.V.1968; 200, Yavne, 3.II.1969).

#### Metaphycus zebratus (Mercet)(Encyrtidae)

This Mediterranean species has been previously recorded from Israel as a very rare parasite of Ceroplastes spp. (Rosen, 1967a; Ben-Dov, 1970). In the present study, it was found to be a rather common parasite of black scale, and a very rare parasite of hemispherical scale, on olive.

Altogether, 28100 and 12100 were reared from black scale. Most of them obtained from samples collected in June and July, but a considerable number was reared also in the fall (Figures 6-9). Apparently only "rubber stage" and ovipositing females of the scale served as hosts of this species. M. zebratus was present in all regions of Israel. It was the most abundant parasite of black scale at 'En Zurim (Figure 7) and Qedma (Figure 9), on the southern coastal plain.

A single female of M. zebratus was reared from hemispherical scale on olive (Yavne, 11.IX.1968).

Saissetia spp. appear to be new host records for M. zebratus.

#### Microterys flavus (Howard) (Encyrtidae)

M. flavus is a cosmopolitan parasite of various soft scale insects (see Rosen 1967a). Its developmental biology was discussed in detail by Bartlett and Ball (1964). Several geographical strains of this species are known to occur, differing in their host preferences. One of these strains, lately introduced from Pakistan into California, was reported to develop freely in black scale (Bartlett and Lagace, 1961). The local Israeli strain of M. flavus was previously recorded as an abundant parasite of brown soft scale and as a rather common parasite of Florida wax scale and the mango shield scale, Coccus mangiferae (Green), but has not hitherto been known to attack Saissetia spp. (Rosen, 1967a).

In the present study, M. flavus was for the first time reared from S. oleae and S. coffeae on olive in Israel. A few specimens were obtained from samples of black scale collected on the southern coastal plain (10, Zelaon, 1.IV.1968; 10, 'En Zurim, 25.IV.1968; 400, Zelaon, 3.VI.1968, 300, 'En Zurim, 3.VI.1968; 300, 10, Beror Hayil, 3.VI.1968; 10, 'En Zurim, 5.VII.1968; 10, Qedma, 5.VII.1968). A single male was reared from hemispherical scale (Yavne, 5.VII.1968). M. flavus is obviously an insignificant parasite of these pests in Israel.

Pachyneuron siculum Delucchi (Pteromalidae)

This Palearctic species has been recorded from Israel as a widely polyphagous hyperparasite of soft scale insects, mealybugs and coccinellid larvae (Rosen, 1967a).

A few specimens of this hyperparasite were obtained in the present study from samples of black scale collected on olive (1♀, Kefar Menahem, 11.II.1968; 1♂, Beror Hayil, 5.III.1968; 1♀, Geva', 25.IV.1968; 1♀, En Harod, 21.V.1968; 3♀♀, 2♂♂, Qedma, 5.VII.1968; 1♂, Geva', 24.XII.1968; 1♂, Bet HaShitta, 24.XII.1968). Two males were obtained from hemispherical scale on olive (Yavne, 5.XII.1968).

The economic importance of P. siculum as a hyperparasite of Saissetia spp. in Israel is apparently negligible.

Scutellista cyanea Motschulsky (Pteromalidae)

S. cyanea is a well-known, cosmopolitan egg-predator and facultative ectoparasite of various soft scale insects, apparently of Oriental origin. It was recorded in Israel in the past from both the black and hemispherical scales (see Rosen, 1967a).

In the present study, S. cyanea proved to be a very common natural enemy of black scale, second in abundance only to D. elegans in the populations of that pest on olive. It was reared only from "rubber stage" and ovipositing females of the scale. A total of 557 specimens were obtained, 47.1 per cent of which were females. The species was present in black scale populations all the year round, but was by far most abundant in samples collected in June and July (Figures 3-9).

S. cyanea was found to be the most abundant parasite of hemispherical scale on olive. Altogether, 214 specimens were obtained from that host in the present study. Only 30 per cent of these were females. The species was most abundant in samples of hemispherical scale collected in the fall (Figure 11).

Being an egg-predator, S. cyanea is usually a rather ineffective natural enemy. Some of the eggs laid by a "parasitized" scale insect usually hatch, and the larvae are often able to escape.

Scutellista nigra (Mercet) (Pteromalidae)

Until recently, this Mediterranean egg-predator was placed under the now-suppressed genus Enargopelte Förster (see Graham, 1969). It was recorded from Israel as a very rare natural enemy of Florida wax scale (Rosen, 1967a).

Three specimens of S. nigra were reared in the present study from hemispherical scale on olive (2♀♀, 1♂, Beror Hayil, 3.VI.1968). Incidentally, this appears to be a new host record for this species.

Tetrastichus ceroplastophilus Domenichini (Eulophidae)

This Mediterranean species was first described by Domenichini (1965) as a hyperparasite of Ceroplastes spp. It was recorded from Israel as the most abundant hyperparasite of Florida wax scale and fig wax scale, and as an occasional hyperparasite of brown soft scale (Rosen, 1967a, as "Tetrastichus sp."; Ben-Dov, 1970).

Six specimens of T. ceroplastophilus were obtained in the present study from samples of black scale collected on olive (1♀, Zelafon, 5.VII.1968; 1♂, Beror Hayil, 5.VII.1968; 1♂, 'En Zurim, 5.VII.1968; 1♂, 'En Zurim, 5.VII.1968; 1♂, Qedma, 13.X.1968; 1♂, Daverat, 4.XI.1968; 1♂, Yizre'el, 6.II.1969). This appears to constitute a new host record for this hyperparasite.

#### DISCUSSION

Both S. oleae and S. coffeae are typical "upset pests", assuming serious pest proportions following the decimation of their natural enemies by frequent, indiscriminate application of non-selective pesticides. This seems to be especially true with regard to the hemispherical scale. All the olive groves found to be heavily infested with this pest had annually received about five cover sprays of methoxychlor or dieldrin (see Avidov et al., 1955, 1958), and in later years dimethoate (Peretz and Gurevich, 1965), against the olive fruit fly. In recent years, the situation regarding soft scale insects has been greatly alleviated following the replacement of cover sprays against the fly by bait spot sprays (Harpaz and Rosen, 1971). Such bait sprays, consisting of a protein hydrolysate and malathion (Nadel and Golan, 1966), are apparently much less harmful to the natural enemies of soft scale insects than the full-coverage sprays.

However, the parasite fauna associated with both species of Saissetia in Israel is rather poor, comprising mainly species that attack mature females of the scale insects. Larvae of both Saissetia spp. are virtually free of parasite attack in Israel. The absence of efficient natural enemies obviously contributes to the serious pest status of S. oleae and S. coffeae on olive in Israel. The introduction into Israel of additional natural enemies is therefore highly recommended.

#### ACKNOWLEDGMENTS

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