

חאוֹבִּיבְדִּיטָה עֵבְרִית בִּירוּשָׁלַיִם

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On the relationships between ants and parasites of coccids and aphids on citrus

With 6 textfigures

Introduction

The fascinating trophobiotic interrelations between ants and honeydew-producing Homoptera have long drawn the attention of biologists (see WHEELER (1926) and more recent reviews by NIXON (1951) and WAY (1963)). Of special interest to biological-control workers have been the relations between certain ants and the natural enemies of Homopterous pests (FLANDERS, 1951, 1958; BARTLETT, 1961; a. o.). Ants attending colonies of Homoptera may directly attack certain predators of these pests, whereas the effectiveness of certain parasites may be reduced mainly through the interference of ants. Host-feeding, slow-ovipositing and easily irritable species of parasites are especially susceptible to disturbance by ant activity in the colonies of their hosts. Natural enemies of pests which do not exude honeydew, such as armoured scale insects or mites, may likewise be adversely affected by honeydew-seeking ants (FLANDERS, 1945; DE BACH et al., 1951).

In Israel, the relations between ants and aphids were discussed in some detail by BODENHEIMER and SWIRSKI (1957). BODENHEIMER (1951) also listed several species of ants known to visit coccids on citrus in Israel. Associations between Jehovah's ant, *Crematogaster jehovae* FOREL, and certain coccids were described by KLEIN (1936) and HARPAZ (1963).

Some further observations on the association of ants with citrus-infesting Homoptera in Israel are reported in the present article.

Methods

The coccids and aphids infesting citrus in Israel were studied in a series of country-wide, extensive surveys. Samples of these pests were regularly collected in many citrus groves and kept in the laboratory for parasite emergence (see ROSEN, 1962, 1967). Particular attention was given during these surveys to the ants attending colonies of honeydew-producing pests. Such ants were collected and identified.

Results and Discussion

Colonies of the soft brown scale, *Coccus hesperidum* LINNAEUS, the citrus mealybug, *Planococcus citri* (RISSE), and the black citrus aphid, *Toxoptera aurantii* (BOYER), were frequently found to be under regular ant attendance. The ants involved are listed, according to their relative abundance, in Table 1.

Table 1

Ants associated with the soft brown scale, the citrus mealybug, and the black citrus aphid on citrus in Israel

Ant species	Trophobiont		
	<i>Coccus hesperidum</i>	<i>Planococcus citri</i>	<i>Toxoptera aurantii</i>
<i>Plagiolepis pallescens ancyrensis</i> SANTSCI	+	+	+
<i>Tapinoma israelis</i> FOREL	+	+	+
<i>Tapinoma simrothi phoenicium</i> EMERY	+		+
<i>Crematogaster jehovae</i> FOREL	+		+
<i>Crematogaster jehovae mosis</i> FOREL	+	+	+
<i>Crematogaster inermis</i> MAYR	+		
<i>Nylanderia jaegerskjoeldi</i> (MAYR)			+
<i>Paratrechina longicornis</i> LATREILLE		+	+
<i>Camponotus compressus thoracicus fellah</i> EMERY	+		
<i>Tetramorium punicum</i> SMITH			+
<i>Cardiocondyla bicolor</i> DONISTHORPE		+	

An additional species, *Camponotus lateralis rebecca* FOREL, was occasionally found visiting the cottony-cushion scale, *Icerya purchasi* MASKELL, on citrus. Still another ant, *Monomorium subopacum phoenicium* EMERY, was recorded by BODENHEIMER (1951) as associated with citrus coccids in Israel.

The amount of protection given by different ant species to their Homopterous trophobionts depends to a large extent on the aggressiveness of the ants in question. The species of ants recorded on citrus in Israel have never been particularly notorious for their aggressiveness, and indeed no serious ant-induced outbreaks of Homopterous pests were observed on citrus in the present study. Parasites and predators were usually very active in heavily ant-attended colonies of the soft brown scale and the black citrus aphid, eventually exterminating such colonies. The citrus mealybug, although regularly attended by ants, only rarely approached serious pest proportions.

No direct association was observed between ants and the Florida wax scale, *Ceroplastes floridensis* COMSTOCK, although the honeydew excreted by this common pest of citrus is reportedly acceptable to ants (BODENHEIMER, 1951).

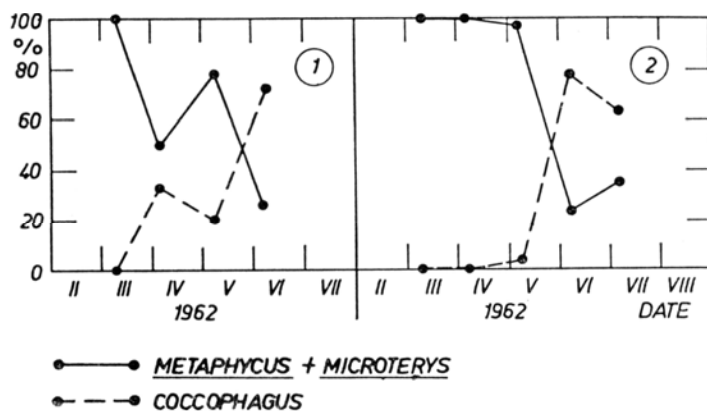
The specific composition of the parasite fauna supported by the soft brown scale was found to be drastically altered in the presence of ants. Populations of

this pest were very sparse throughout winter. Small colonies usually appeared on citrus at the end of winter, attaining their peak during April or May, at which period they were attended by ants at increasing frequency. Usually such colonies were exterminated by parasites during May or June. Rarely very dense, localized, heavily ant-attended colonies persisted through July, only to be completely destroyed by heavy parasitism not later than August (ROSEN, 1967).

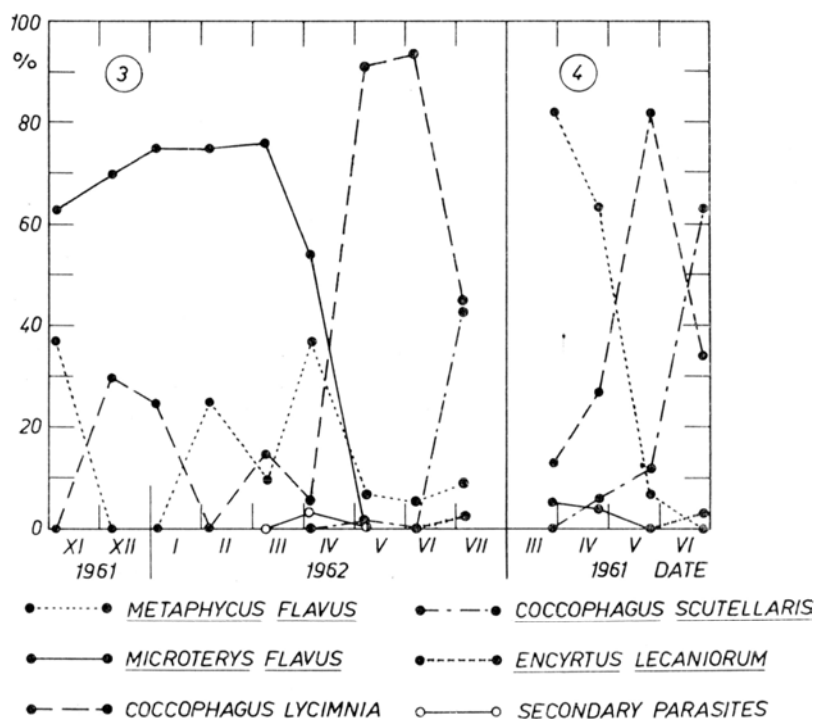
The most important primary parasites of the soft brown scale in Israel are *Metaphycus flavus* (HOWARD), *Microterys flavus* (HOWARD), *Coccophagus lycimnia* (WALKER) and *Coccophagus scutellaris* (DALMAN) (ROSEN, 1962, 1967). Whereas the *Metaphycus* and *Microterys* were by far the dominant parasites in sparse populations of the scale, the species of *Coccophagus* were dominant in dense, ant-attended colonies. This difference was most strikingly apparent when the scale population was observed during its transition from sparse to dense colonies in the spring. The *Metaphycus* and *Microterys* were invariably replaced by *Coccophagus* spp. during this change (Figs. 1–6).

The *Metaphycus* and *Microterys* are apparently the more efficient parasites of the soft brown scale in Israel, and the species of *Coccophagus* are unable to compete with them at low host-densities. The *Metaphycus* and *Microterys*, on the other hand, are apparently much more sensitive than the *Coccophagus* spp. to disturbance by ants. Similar differences in the sensitivity of species of *Metaphycus* and *Coccophagus* to ant interference were reported by FLANDERS (1951).

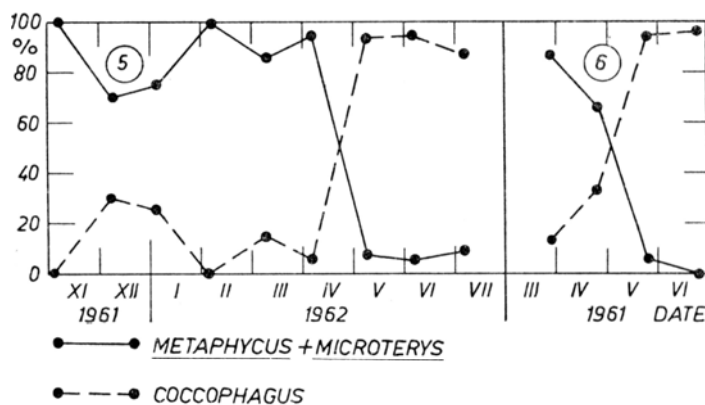
Of the two species of *Coccophagus*, *C. scutellaris* appeared to benefit even more than *C. lycimnia* from the presence of ants, and was usually the last species to appear in the scale colony, whereas *C. lycimnia* was sometimes present also in lower host-densities (Figs. 3, 4).



Figs. 1–2. Percentage of *Metaphycus + Microterys* versus *Coccophagus* spp. from the total population of primary parasites of the soft brown scale in two citrus groves



Figs. 3-4. Composition of populations of soft-brown-scale parasites in two citrus groves



Figs. 5-6. Percentage of *Metaphycus + Microterys* versus *Coccophagus* spp. from the total population of primary parasites of the soft brown scale.

(Figs. 5 and 6 refer to the same groves of Figs. 3 and 4, respectively)

Small incrustations of the California red scale, *Aonidiella aurantii* (MASKELL), were occasionally observed near ant-attended colonies of the soft brown scale. However, from information so far available, it may be concluded that ants do not seem to be an important factor in the encouragement of citrus coccids and aphids in Israel.

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Summary

The species of ants associated with honeydew-producing scale insects and aphids on citrus in Israel are listed. No notoriously aggressive species of ants have been encountered, and no serious ant-induced outbreaks of Homopterous pests have been recorded. Natural enemies usually exterminated ant-attended colonies of these pests. The composition of the parasite fauna supported by the soft brown scale, *Coccus hesperidum* LINNAEUS, was found to be drastically altered in the presence of ants; species of *Metaphycus* and *Microterys*, dominant in sparse populations of the scale, were invariably displaced by *Coccophagus* spp. in dense, ant-attended colonies.

Zusammenfassung

Die Ameisenarten, die mit Honigtau produzierenden Schild- und Blattläusen an Citrus in Israel verbunden sind, werden verzeichnet. Keine offenkundig aggressive Ameisenart wurde angetroffen, und keine ernstlichen von Ameisen hervorgerufenen Massenvermehrungen von Homopteren-Schädlingen wurden festgestellt. Natürliche Feinde rotteten gewöhnlich Kolonien dieser Schädlinge aus, die von Ameisen besucht wurden. Die Zusammensetzung der Parasitenfauna, die sich an *Coccus hesperidum* LINNAEUS entwickelt, wurde durch die Anwesenheit von Ameisen drastisch verändert: Arten von *Metaphycus* und *Microterys*, die in schwachen Schildlaus-Populationen vorherrschten, wurden immer in dichten, von Ameisen besuchten Kolonien durch *Coccophagus* spp. verdrängt.

Резюме

Отмечаются те виды муравьёв, которые связаны с черепашками и тлями, которые выделяют мёдный сок. Не нашёлся агрессивный вид и не отмечались серьёзные массовые размножения вредителей, вызванные муравьями. Природные враги обыкновенно уничтожают население этих вредителей, которых посещают муравьи. Состав паразитической фауны, которая развивается у *Coccus hesperidum* LINNAEUS, резко изменилась при присутствии муравьёв. Виды *Metaphycus* и *Microterys*, которые в маленьких популяциях вредителя возникали в большинстве были усторонены *Coccophagus* spp. в больших популяциях, которых посещали муравьи.

References

- BARTLETT, B. R., The influence of ants upon parasites, predators and scale insects. Ann. Entomol. Soc. Amer., **54**, 543—551; 1961.
BODENHEIMER, F. S., Citrus entomology in the Middle East. W. JUNK Publishers, The Hague, 663 p.; 1951.
BODENHEIMER, F. S. & SWIRSKI, E., The Aphidoidea of the Middle East. The WEIZMANN Sci. Press, Jerusalem, 378 p.; 1957.

- DEBACH, P., FLESCHNER, C. A. & DIETRICK, E. J., A biological check method for evaluating the effectiveness of entomophagous insects. *Journ. Econ. Entomol.*, **44**, 763—766; 1951.
- FLANDERS, S. E., Coincident infestations of *Aonidiella citrina* and *Coccus hesperidum*, a result of ant activity. *Journ. Econ. Entomol.*, **38**, 711—712; 1945.
- , The role of the ant in the biological control of homopterous insects. *Canad. Entomol.*, **83**, 93—98; 1951.
- , The role of the ant in the biological control of scale insects in California. *Proc. Xth Internat. Congr. Entomol.*, Montreal 1956, **4**, 579—584; 1958.
- HARPAZ, I., An association between Jehovah's ant, *Crematogaster jehovae* FOR. (Hym.: Myrmicidae), and the fig wax-scale, *Ceroplastes rusci* L. (Rhynchota: Coccidae), on grapevines in Israel. *Entomol. Bericht.*, **23**, 44—45; 1963.
- KLEIN, H. Z., Citrus mealy bugs and ants on grapefruit. *Hadar*, **9**, 42—43; 1936.
- NIXON, G. E. J., The association of ants with aphids and coccids. *Commonw. Inst. Entomol.*, London, 36 p.; 1951.
- ROSEN, D., An annotated list of hymenopterous parasites of citrus soft scales in Israel. *Entomophaga*, **7**, 349—357; 1962.
- , The hymenopterous parasites of soft scales on citrus in Israel. *Beitr. Ent.*, **17**, 251—279; 1967.
- WAY, M. J., Mutualism between ants and honeydew-producing Homoptera. *Ann. Rev. Entomol.*, **8**, 307—344; 1963.
- WHEELER, W. M., *Ants, their structure, development and behaviour*. Columbia Univ. Press, N.Y., 663 p.; 1926.