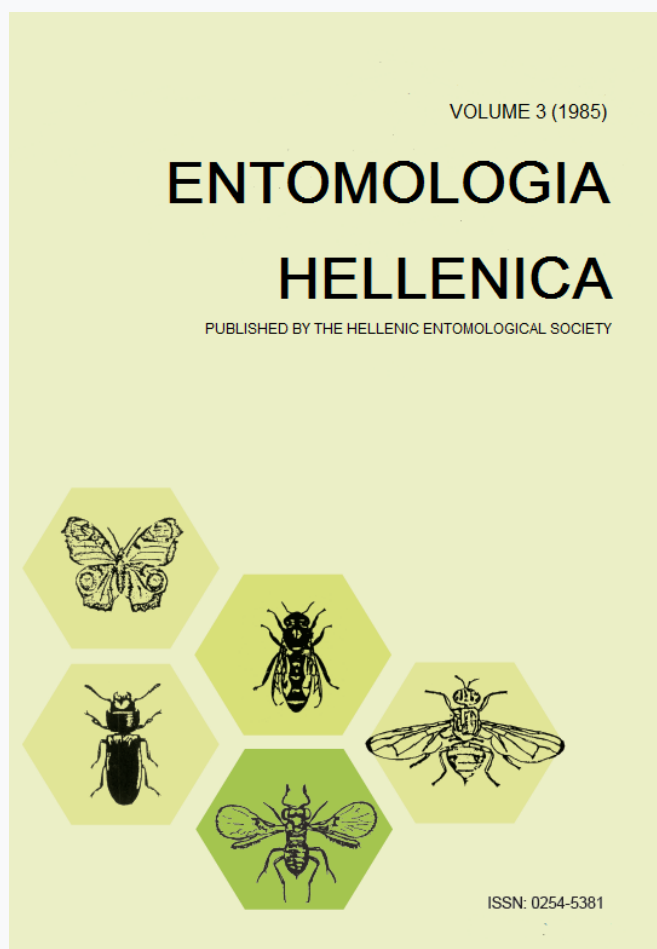


ENTOMOLOGIA HELLENICA

Vol 3 (1985)



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doi: [10.12681/eh.13920](https://doi.org/10.12681/eh.13920)

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To cite this article:

Santas, L. (1985). *Parthenolecanium corni* (Bouche), an orchard scale pest producing honeydew foraged by bees in Greece. *ENTOMOLOGIA HELLENICA*, 3, 53–58. <https://doi.org/10.12681/eh.13920>

Parthenolecanium corni (Bouché) an Orchard Scale Pest Producing Honeydew Foraged by Bees in Greece¹

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ABSTRACT

The soft scale *Parthenolecanium corni* (Bouché), a pest of filbert tree and other hosts, is a useful insect for apiculture in Greece. It excretes honeydew which is exploited by honeybees in April, May and early June. The scale has one generation per year, and overwinters as a second instar nymph. Adults appear early in April and crawlers in the middle of June. From mid June to mid July, the population of *P. corni* consists mainly of crawlers and/or first instar nymphs. The second instar nymphs appear in mid July and by the end of October all the scale population is in this stage. The period from July to February, is long enough to permit the application of insecticides to control the scale, without causing any harm to the bees.

Introduction

Parthenolecanium corni (Bouché) (Hem. Hom.: Coccidae), the well known plum or brown scale, is widely distributed all over the world. It has been found in almost all European countries, in Turkey, Lebanon, Russia, Algeria, Libya and New Zealand (Commonwealth Institute of Entomology 1979). It has long been known in North America (Ebeling 1938). The distribution in Greece is not well known, but it has been found in Central and Northern Greece. It is a polyphagous scale insect and has been known to live on Rosaceae and numerous other plants (Habib 1955). In Greece its honeydew is exploited by bees (Santas 1983). In the spring of 1984, a severe infestation of filbert trees (*Corylus avellana* L.) by *P. corni* appeared in the Grevena area and the farmers started applying insecticides in May. At that time, the bees were foraging on the honeydew, and a high mortality of honey-bees occurred. The apiarists

were against those insecticide applications but the farmers wanted to protect their groves. Thus, a judicial conflict started between filbert-tree farmers and apiarists.

To determine an effective way for the control of this pest without hurting the bees, a study was carried out by the author, in which the biology, honeydew excretion, time the bee forages on this honeydew, parasitization, and bee mortality were investigated.

Materials and Methods

The experimental work was carried out in a ten-strema (10,000 m²) unsprayed filbert grove with 300 trees at "Kanalía" locality close to the town of Grevena in Northwestern Greece. This grove was about two km far from other filbert groves and received no insecticide treatment during this work. Vegetables and grains were cultivated close and around this grove. Twenty filbert trees infested by *P. corni* were used. Samples of two-year-old infested twigs were taken at intervals from April 1984 to August 1985 and were examined according to Vasseur and Schwester (1957). Observations on the phenology, parasitism, and mortality were conducted according to a method used previously (Santas 1985). In November, De-

¹ Received for publication December 24, 1985.

ember and January, samples were taken once a month, while from February till November once every two weeks. In each sample, at least 500 (some times 1000) live scales and a varied number of dead ones were examined. The insect stages, parasites, degree of parasitism and scale mortality were recorded. Parasitized scales were kept in small vials until adult emergence. The method of Gary and Lorenzen (1976) was used to find out if and when bees forage on *P. corni*.

Results and Discussion

P. corni was found to live on *Prunus persica* L., *Prunus armeniaca* L. and *Crataegus* spp. (San-

tas 1983) and *Corylus avellana* L. almost all over Greece.

a. General appearance

Adult female convex, outline from nearly circular to ovoid, reddish or brown in colour, often with whitish dust. Length about 3 to 5 mm. Eggs oval and white in colour when newly oviposited, but turning brownish before hatching. Crawlers and newly first instar nymphs turning to dark brown.

b. Phenology

P. corni has one generation per year (Table 1).

TABLE 1. Percentage of *P. corni* individuals in each stage observed in Grevena during 1984 and 1985.

Collection date	Live scales	Percentage in each stage			
		Preoviposition adult	Ovipositing adult	First instar nymph	Second instar nymph
1984					
10.4	561	5	—	—	95
25.4	612	88	—	—	12
6.5	580	80	20	—	—
15.5	601	43	57	—	—
1.6	503	—	100	—	—
14.6	610	—	20	80	—
22.6	1000	—	2	98	—
2.7	1000	—	—	100	—
14.7	1000	—	—	96	4
29.7	1000	—	—	81	19
7.8	1000	—	—	76	24
19.8	1000	—	—	69	31
30.8	1000	—	—	62	38
15.9	790	—	—	30	70
28.9	810	—	—	14	86
16.10	920	—	—	8	92
31.10	720	—	—	2	98
1985					
12.1	562	—	—	—	100
10.2	550	—	—	—	100
26.2	587	—	—	—	100
10.3	508	—	—	—	100
25.3	514	8	—	—	92
4.4	602	19	—	—	81
15.4	580	71	—	—	29
3.5	548	91	9	—	—
21.5	500	5	95	—	—
8.6	1000	—	90	10	—
20.6	1000	—	5	95	—
3.7	1000	—	2	98	—
14.7	1000	—	—	94	6
2.8	1000	—	—	91	9
27.8	950	—	—	49	51

The scale overwinters as second instar nymph along the full length of the new twig. In Spring, development is rapid and the first adult females appear early in April. The young adults grow very quickly and start ovipositing early in May. The eggs are usually covered with a thin layer of a white wax secretion, which prevents their sticking together.

During the oviposition period, different stages of the scale such as crawlers, white and yellowish eggs and egg shells, can be found under the adult body, while the adult is live and has its ovaries full of eggs ready to be laid. The number of eggs varied, but in 1985 there were 700-1100 per scale in one hundred adults examined (Table 2).

TABLE 2. Number of eggs found in one hundred mature *P. corni* in June 6, 1985.

Number of eggs/scale	Scales
700- 900	40
901-1000	43
1001-1100	17

The first nymphs appear in the middle of June and egg hatching continues until the end of that month. The crawlers were comparatively active and settled on the underside of leaves. Very few of them settled on the shoots. The first molting to the second instar occurred about the middle of July and by the end of October all the scale population was in the second nymphal instar. This is the overwintering stage during which the insects remain fixed until next spring. A migration of scales was observed from leaves to year

old twigs (the growth of previous year) in September. Yet, fallen leaves still had a number of second instar nymphs, which perished. Wardlow and Ludlam (1975) refer that some of those nymphs were found on old wood on the lower parts of the hosts.

Very few males were observed in the samples of this study, estimated at about 5% of the population. In March, a few second instar nymphs looked comparatively longer and narrower than the majority of the population. A few days later, at about the end of March, the puparium was formed under which they moulted to pupae and adults. The emergence of males took place in early May (Table 3).

c. Mortality

Mortality of eggs and crawlers was, in general, very high. Adult scales bearing dead eggs were found very often in summer. Some eggs, accumulated underneath the adult like a mass, melted and did not hatch, some other eggs dried and also did not hatch. The above egg mortality during summer was observed in 15-20% of adults in oviposition. Dead crawlers were found underneath the parent scales and on the leaves (Table 4). The natural mortality is also high among the settled nymphs of first and second instars. In 1984 it ranged between 62 to 95% and 52 to 72%, respectively. Natural mortality of preoviposition adult scales was lower, ranging between 0-3% (Table 4).

d. Parasites and predators.

Some parasites and predators were reared from samples of *P. corni* from filbert trees in Grevena area, during this study. Two parasites, five predators and two hyperparasites were found

TABLE 3. Male population of *P. corni* on filbert trees in Grevena during 1985.

Collection date	Number of scales	Males			
		Nymphs	Pupae	Total	% of total scales
10.3.85	508	1	0	1	0.19
25.3.85	514	2	3	5	0.97
4.4.85	602	4	1	5	0.83
15.4.85	580	18	11	29	5.00
3.5.85	548	4	26	30	5.40

TABLE 4. Mortality in the different stages of *P. corni* during April 1984 to March 1985.

Collection date	Percent dead scales			
	First instar nymph	Second instar nymph	Preoviposition adult	Ovipositing adult
1984				
10.4	—	0	0	—
25.4	—	0	2	—
6.5	—	—	3	15
15.5	—	—	3	15
1.6	—	—	—	19
14.6	95	—	—	20
22.6	92	—	—	0
2.7	94	—	—	—
14.7	91	0	—	—
29.7	94	0	—	—
7.8	91	54	—	—
19.8	89	61	—	—
30.8	84	67	—	—
15.9	87	72	—	—
28.9	62	60	—	—
16.10	0	61	—	—
31.10	0	62	—	—
1985				
12.1	—	52	—	—
10.2	—	54	—	—
26.2	—	59	—	—
10.3	—	0	—	—
25.3	—	0	0	—

(Tabl. 5). The parasites *Coccophagus lycimnia* and *Metaphycus insidiosus* are endoparasites in the second and early third nymphal instars of the host. Often, the emergence of parasites takes place in the adult stage of the host. The parasitized scales continue to produce eggs. *C. lycimnia* is polyphagous (Ferriere 1965) and very common in the fauna of Greece and it has been recorded in many cases as parasite on several soft scales (Santas 1985). The rate of active parasitism for both of them was low, not more than 10%, but it remained steady from August to March. A rise of the parasitism (more than 20%) was observed after March (Fig. 1). Although parasitism was high during spring, the scale's population was not reduced. The population of *P. corni* in the summer of 1985 was quite high.

Scutellista cyanea, a common predator of *Saissetia oleae* (Olivier) and *Ceroplastes rusci* L. in Greece, is a cosmopolitan egg-predator and facultative ectoparasite. In the present study

TABLE 5. Parasites, predators and hyperparasites of *P. corni* found in Grevena during this work.

Parasites

Coccophagus lycimnia (Wlk.) (Hym.: Aphelinidae)
Metaphycus insidiosus (Merc.) (Hym.: Encyrtidae)

Predators

Scutellista cyanea Motsch. (Hym.: Pteromalidae)
Leucopis alriceps Czerny (Dipt.: Chamaemyiidae)
Eublema scitula (Ramb.) (Lep.: Noctuidae)
Chrysoperla carnea (Stephens) (Neur.: Chrysopidae)
Chilocorus bipustulatus (L.) (Col.: Coccinellidae)

Hyperparasites

Pachyneuron concolor (Först) (Hym.: Pteromalidae)
Marietta picta (André) (Hym.: Aphelinidae)

it was collected in small numbers from *P. corni* during May and June. Six specimens of another egg-predator, *Eublema scitula*, were also

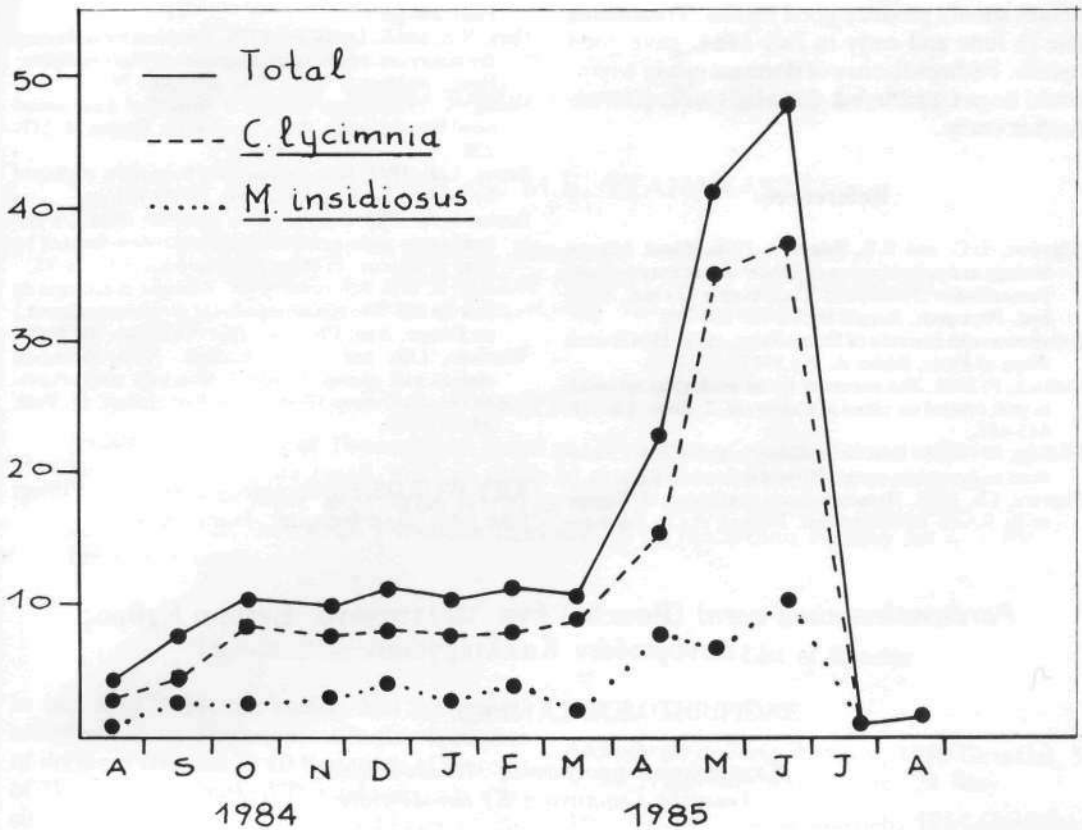


FIG. 1. Percent parasitism of *Parthenolecanium corni* by *Coccophagus lycimnia* and *Metaphycus insidiosus* in the Grevena area.

collected. *Leucopis alticeps*, which attacks mainly the young instars, was found in small numbers. Nine larvae of this predator were found on *P. corni* in the samples examined during this study (Table 1). The last two predators *Chrysoperla carnea* and *Chilocorus bipustulatus* were collected in big numbers during spring and summer. They prey on all instars of the soft scale, but being widely polyphagous were unable to suppress the population of the host (DeBach 1951).

Pachyneuron concolor has been recorded as hyperparasite of *Sphaerolecanium prunastri* Fonscolombe (Argyriou and Paloukis 1976). In the present study it was the most abundant hyperparasite of *P. corni* on filbert trees. It was obtained in high numbers from samples collected in the Grevena area in May and June. The hyperparasite *Marietta picta* was obtained in low numbers from the same host. Both of them

are hyperparasites of soft scales (Ferriere 1965) but it was not confirmed through what parasite.

e. Honeydew

P. corni as all species of the family Coccidae excretes honeydew. Honeydew excretion occurs from April to mid June and again from August to late October. Honey bees forage on this honeydew on infested filbert trees in April, May and early June. The use of insecticides in the above period caused high mortality to the bees. At that time, the scale insects were in the preoviposition and oviposition adult stages, highly resistant to insecticides. From then on, the first and second nymphal instars are found on the filbert trees from July until February. These two instars are the most vulnerable to insecticides and this period of about eight months is suitable for an application to control *P. corni*. If applied soon after hatching has ended, insect-

ticides should produce good results. Treatments late in June and early in July 1984, gave good results. Perhaps the use of dormant oils in winter could be preferable but the whole matter needs further study.

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KEY WORDS: *Parthenolecanium corni*, Filbert tree pest, Bee foraging, Honeydew

Parthenolecanium corni (Bouché) ένα Μελιτογόνο Έντομο Εχθρός Δενδρώδων Καλλιέργειών

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ΠΕΡΙΛΗΨΗ

Το κοκκοειδές *Parthenolecanium corni* (Bouché) προσβάλλει και προκαλεί ζημιές σε πολλές δενδρώδεις καλλιέργειες στη χώρα μας. Το έντομο αυτό παράγει μελιτώδεις εκκρίσεις που οι μέλισσες τις εκμεταλλεύονται. Έχει επισημανθεί στη χώρα μας σαν μελιτογόνο έντομο πάνω στα φυτά *Prunus persica* (L.) Batch., *Prunus armeniaca* L., *Crataegus* spp. και *Corylus avellana* L. Η συνεισφορά όμως του μελιτώματος αυτού στην παραγωγή μελιού προέρχεται κυρίως από την προσβολή του εντόμου πάνω σε καλλιέργειες της φουντουκιάς, σ' ορισμένες περιοχές όπως στην περιοχή των Γρεβενών. Στην περιοχή αυτή το *P. corni* εμφανίζει μια γενεά τον χρόνο και διαχειμάζει στο δεύτερο στάδιο νύμφης. Τα ακμαία εμφανίζονται από τις αρχές Απριλίου και οι εκκολάψεις των ωών αρχίζουν από τα τέλη Μαΐου και τελειώνουν μέσα στον Ιούνιο. Οι μελιτώδεις εκκρίσεις αρχίζουν από τον Απρίλιο με αρχές Μαΐου και οι μέλισσες βόσκουν πάνω σ' αυτές μέχρι τα μέσα Ιουνίου.

Επέμβαση εναντίον του κοκκοειδούς που έγινε στα τέλη Ιουνίου (στην περίοδο αυτή όλος ο πληθυσμός του κοκκοειδούς βρίσκεται στο πρώτο στάδιο νύμφης) είχε άριστα αποτελέσματα, ενώ αντίθετα δεν προκάλεσε κανένα πρόβλημα στις μέλισσες οι οποίες εκείνη την εποχή είχαν παύσει να επισκέπτονται τις φουντουκίες.

Δύο παράσιτα τα *Coccophagus lycimnia* (Walker), (Hym.: Aphelinidae) και *Metaphycus insidiosus* (Mercet.) (Hym.: Encyrtidae), πέντε αρπακτικά τα *Scutellista cyanea* Motsch. (Hym.: Pteromalidae), *Leucopis alticeps* Czerny (Dipt.: Chamaemyiidae), *Eublema scitula* (Rambur) (Lep.: Noctuidae), *Chrysoperla carnea* (Stephens) (Neur.: Chrysopidae) και *Chilocorus bipustulatus* (L.) (Col.: Coccinellidae), καθώς και δύο υπερπαράσιτα τα *Marietta picta* (André) (Hym.: Aphelinidae) και *Pachyneuron concolor* (Först) (Hym.: Pteromalidae) βρέθηκαν να παρασιτούν ή να θηρεύουν στους πληθυσμούς του *P. corni* στις φουντουκίες της περιοχής Γρεβενών.