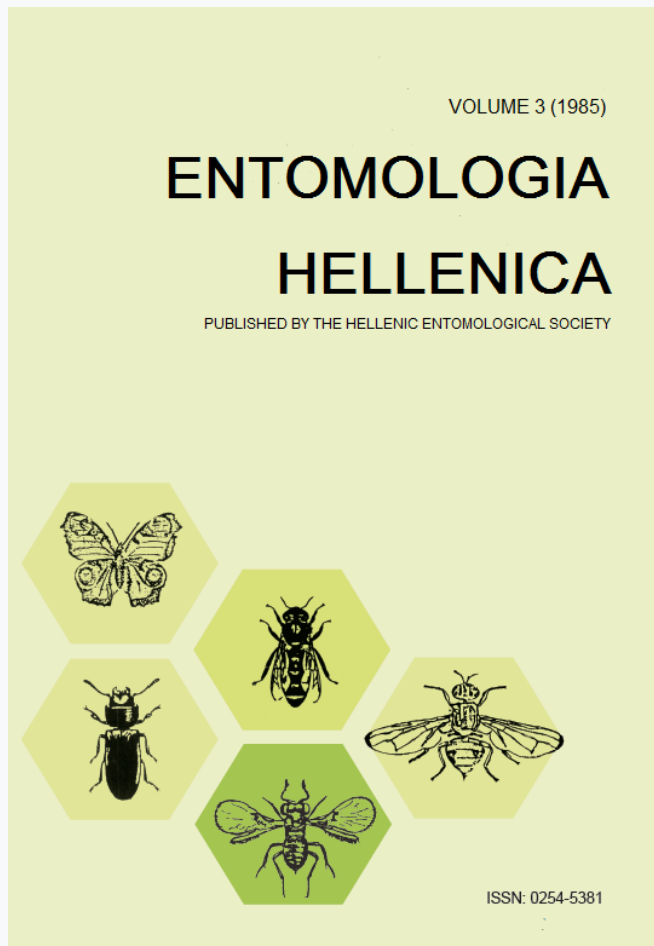


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***Anapulvinaria pistaciae* (Bod.), a Pistachio Tree Scale Pest Producing Honeydew Foraged by Bees in Greece¹**

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ABSTRACT

The soft scale *Anapulvinaria pistaciae* (Bod.), a pest of pistachio, excretes honeydew which is exploited by honeybees. The scale has one generation per year. Adults appear early in spring and crawlers in May. From mid-May to mid-June the population of *A. pistaciae* consists mainly of crawlers and/or first stage nymphs. The second stage nymphs appear early in fall, this is the over-wintering stage, from which the adults of the next generation will emerge the following year.

Introduction

The soft scale *Anapulvinaria pistaciae* (Bodenheimer) (Homoptera: Coccidae) is a common pest of pistachio tree (*Pistacia vera* L.). It is native to the Eastern Mediterranean countries (Greece, Cyprus, Turkey), to Iran, Iraq and South Russia (Georgia and other areas), where the pistachio tree is cultivated (Anagnostopoulos 1939, Bodenheimer 1953, Borchenius 1957, Abu Yaman 1970, Lodos 1982). This scale insect attacks mainly *Pistacia vera*, but Bodenheimer (1953) recorded it also on *Pistacia palestina* Boiss. In Greece, it was found only on *P. vera*, in Attiki, Biotia and Phtiotida, without causing any damage to this tree. Davatchi (1958) records that *A. pistaciae* cause damage to pistachio tree in Iran, and Abu Yaman (1970) that the scale is a major pest on this host.

Little is known about this scale in Greece (Anagnostopoulos 1939). Its honeydew was found to be foraged by honeybees and the present study was undertaken on the scale phenology, parasitization, the period of hon-

eydew production as well as the period during which the bees forage on it.

Materials and Methods

All the experimental work was carried out in the pistachio orchard of the University College of Agricultural Sciences of Athens, at Votanikos, Athens. Ten unsprayed male and female pistachio trees, infested by *A. pistaciae*, were used. Observations on the phenology and parasitism of *A. pistaciae* were conducted according to the method of Vasseur and Schvester (1957), by taking samples at certain time intervals, from January 1979 to December 1981. The samples consisted of infested twigs, each approximately 20 cm in length, with or without leaves, flowers and fruits, according to the season. In November, December and January, samples were taken once a month, while from February to November about once every two weeks. The various developmental stages of the insect, the parasites, the degree of parasitism and the scale mortality were recorded during each laboratory examination of the samples. The parasitized scales were kept in small vials until adult emergence. In each sample 500 to 1000 live scales and a varied number of dead ones were examined. Observations were also made on the honeydew excretion and on the period during which the bees exploited it. The method of Gary and Lorenzen (1976) was used to find if and when bees forage on *A. pistaciae* honeydew.

¹ Received for publication May 7, 1985.

Results and Discussion

a. General appearance

Adult female approximately broad circular with raised short oval central area and transverse wrinkles. Length 2.8-3.4 mm. Colour light to dark brown, ovisac "cottony" white, length 4-5 mm width 3-4 mm. The egg is oval and light green in colour, crawlers and first instar nymphs are also green, but second instar nymphs turn to red brown.

b. Phenology

A. pistaciae infests only species of the genus *Pistacia* and has only one generation per year. This agrees with previous reports from Greece (Anagnostopoulos 1939), Turkey (Bodenheimer 1953), Iran (Davatchi 1958) and Iraq (Abu Yaman 1970). It overwinters as second instar nymph on twigs, mainly on those of the first year, around the buds. In the spring, scale development is rapid and the first females appear in March. They start forming the ovisac early in May, and the first eggs are laid at about

the same period. Within May, almost all scales become ovipositing adults (Table 1), infesting young twigs, leaves, petioles of flowers and fruits (Figs. 1,2). The first crawlers appear in early June and egg hatching continues until the first 10 days of July. After hatching, the crawlers wander for 2-3 days before settling down on both leaf surfaces, mainly along the veins or on fresh green twigs but never on the one-year-old ones. During August, a low percentage of the scale population enters the second stage of its development. The change of stage continues gradually and by the end of October all scales are in the second stage. *A. pistaciae* overwinters in this stage, on the annual growth twigs.

A. pistaciae, as all unarmoured scales, tends to migrate within the same host. This behaviour is induced by an unknown stimulus and it is provision to obtain a permanent food supply, mainly in the case of deciduous trees as the pistachio tree (Ebeling 1959). Thus, the second instar stage migrates from the leaves to twigs in autumn and the preoviposition adults from twigs to leaves in spring upon appearance of

TABLE 1. Percentage of *Anapulyvaria pistaciae* stages observed from February to September during 1979-1981.

Stage	Collection dates in 1979																	
	10/2	26/2	15/3	28/3	10/4	20/4	27/4	8/5	18/5	30/5	7/6	19/6	28/6	10/7	27/7	18/8	30/8	12/9
Preoviposition adult	-	-	-	20	44	76	93	100	89	10	3	-	-	-	-	-	-	-
Oviposition adult	-	-	-	-	-	-	-	-	11	90	96	80	1	-	-	-	-	-
First larva	-	-	-	-	-	-	-	-	-	-	1	20	99	100	95	92	72	38
Second larva	100	100	100	80	56	24	7	-	-	-	-	-	-	-	5	8	28	62
Stage	Collection dates in 1980																	
	8/2	23/2	15/3	29/3	10/4	19/4	28/4	9/5	19/5	31/5	7/6	19/6	28/6	10/7	26/7	18/8	30/8	13/9
Preoviposition adult	-	-	3	37	52	69	94	93	72	5	-	-	-	-	-	-	-	-
Oviposition adult	-	-	-	-	-	-	-	5	28	91	89	72	-	-	-	-	-	-
First larva	-	-	-	-	-	-	-	-	-	4	11	28	100	96	90	89	61	41
Second larva	100	100	97	63	48	31	6	2	-	-	-	-	-	4	10	11	39	59
Stage	Collection dates in 1981																	
	10/2	28/2	15/3	30/3	10/4	20/4	28/4	9/5	18/5	30/5	8/6	20/6	29/6	10/7	27/7	17/8	29/8	12/9
Preoviposition adult	-	3	10	8	58	80	88	98	100	84	5	-	-	-	-	-	-	-
Oviposition adult	-	-	-	-	-	-	-	-	-	9	88	98	92	-	-	-	-	-
First larva	-	-	-	-	-	-	-	-	-	7	7	2	8	100	98	91	81	70
Second larva	100	97	90	92	42	20	12	2	-	-	-	-	-	-	2	9	19	30

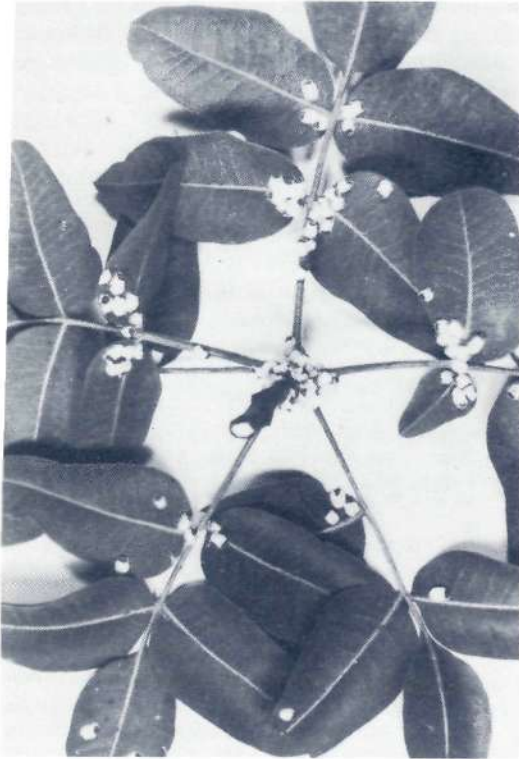


FIG. 1. Adults in oviposition stage on twigs, leaf-petioles and leaves.

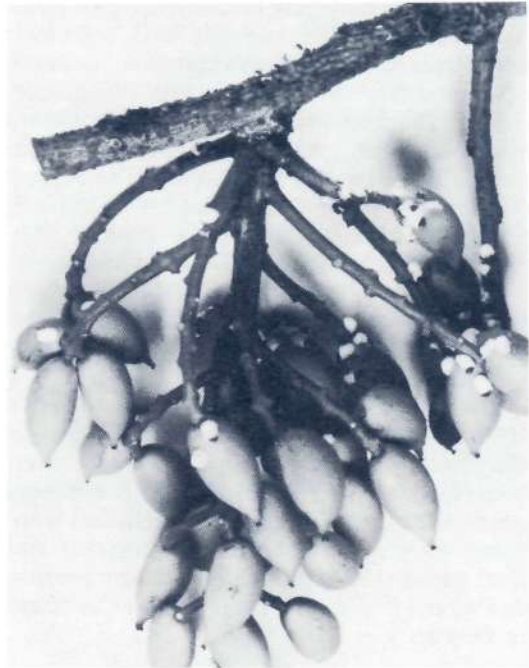


FIG. 2. Adults in oviposition stage on fruit - stalks and fruits.

young shoots. *A. pistaciae* settles on shoots early in April, on leaves around the middle of April, on petioles after the appearance of the flowers and then on fruits. Nevertheless, 10% of the population does not migrate but remains and grows on the previous year's twigs.

c. Mortality

A. pistaciae is not a serious pest of pistachio in Greece, because it is always found at low population levels. During its life cycle the scale suffers high mortality which could be attributed mainly to abiotic but also to biotic factors. Although natural mortality occurred in all stages of the insect (Table 2) it was more pronounced among the crawlers. The degree of mortality in the latter stage, however, has not been determined.

Scale populations are significantly reduced by the winter oil sprays and the sprays applied late in spring and early in summer, every year, against *Thrips* sp. (Thysanoptera: Thripidae),

Thyrsostoma guerini (Stainton) (Lep.: Gelechiidae), *Eurytoma plotnikovi* Nikolskaya (Hym.: Eurytomidae) and *Megastigmus balles-treri* (Rond.) (Hym.: Callimonidae) (Pelekassis 1984).

TABLE 2. Mortality in the different stages of *A. pistaciae*.

Month	% dead scales*			
	First stage	Second stage	Adults	Total
August	95	—	—	95
September	90	5	—	95
October	79	7	—	86
November	—	92	—	92
December	—	95	—	95
January	—	98	—	98
February	—	95	—	95
March	—	92	—	92
April	—	—	5	5
May	—	—	6	6

* Average of 3 years

d. Parasitization

While examining *A. pistaciae*, any parasites

and predators emerging from the samples were also collected. The parasitic and predatory fauna from *A. pistaciae* was quite poor because of the sprays with insecticides mentioned above. The endoparasite *Coccoplagus lycimnia* Wilk. (Hym.: Aphelinidae) parasitized the second stage nymphs of the scale. The degree of parasitism was not more than 5% on the live population of the scale during autumn. This parasite being polyphagous, has been also recovered from other scales (Kattoulas and Evagelopoulos 1967). A second Encyrtid endoparasite, which has not yet been identified, was less abundant.

The general predators *Leucopis alticeps* (Dipt.: Chamaemyiidae), *Chrysoperla carnea* (Stephens) and *Anisochrysa flavifrons* (Brauer), both Neuroptera: Chrysopidae, and *Exochomus quadripustulatus* L. (Col.: Coccinellidae) were found to prey on *A. pistaciae*. Argyriou and Kourmadas (1977) reported *L. alticeps* preying on *Filippia follicularis* Targ. (Hom.: Coccidae) in Greece.

e. Honeydew

The honey bees forage the honeydew of *A. pistaciae*, visiting infested twigs of pistachio. Bees, examined after a visit on infested pistachio trees, were found to have the honey stomach full of honeydew. Honeydew excretion starts early in April and continues until the middle of June. After an interruption in July, it starts again in August and continues until the end of October. Honeydew is exploited by bees only during spring and early summer, and mainly from May to the middle of June. The contribution of this honeydew to the total honey production of Greece is difficult to be estimated as the beekeepers do not exploit it systematically. This is due to the fact that they do

not move their beehives to the pistachio groves during forage period, because the pest control program includes several sprays of the pistachio tree at this time.

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KEY WORDS: *Anapulvinaria pistaciae*, Pistachio pests, Bee forage, Coccidae, Honeydew

Anapulvinaria pistaciae (Bod.) ένα Μελιτογόνο Έντομο της Φιστικιάς

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ΠΕΡΙΛΗΨΗ

Το κοκκοειδές *Anapulvinaria pistaciae* (Bod.) προσβάλλει τη φιστικιά (*Pistacia vera* L.) και

μερικές φορές, κυρίως στους ημιεγκατελειμμένους φιστικιώνες προκαλεί σοβαρές ζημιές στα δένδρα. Το κοκκοειδές αυτό εκκρίνει μελίτωμα που σύμφωνα με παρατηρήσεις μας, οι μέλισσες εκμεταλλεύονται. Η συνεισφορά αυτού του μελιτώματος στη συνολική παραγωγή μελιού στη χώρα μας είναι δύσκολο να εκτιμηθεί, αφού οι μελισσοκόμοι δεν εκμεταλλεύονται συστηματικά αυτά τα μελιτώματα γιατί στους εντατικά καλλιεργημένους φιστικιώνες ο πληθυσμός αυτού του εντόμου είναι πολύ χαμηλός. Αυτό οφείλεται κυρίως στο εντατικό πρόγραμμα καταπολέμησης, το οποίο εφαρμόζεται αργά την άνοιξη και νωρίς το θέρος κατά των άλλων εχθρών της φιστικιάς. Κατά τη διάρκεια αυτής της περιόδου, το *A. pistaciae* είναι στη μορφή της έρπουσας και πρώτου σταδίου, στάδια πολύ ευαίσθητα στα φυτοφάρμακα. Έτσι, αυτοί οι ψεκασμοί διατηρούν το κοκκοειδές σε χαμηλό επίπεδο πληθυσμού.

Κατά τη διάρκεια αυτής της έρευνας διαπιστώθηκε ότι το κοκκοειδές αυτό στην Κ. Ελλάδα έχει μία γενιά το χρόνο. Διαχειμάζει στο δεύτερο στάδιο. Τα ακμαία εμφανίζονται νωρίς την άνοιξη και οι πρώτες έρπουσες παρατηρούνται το Μάιο. Οι φαινολογικές παρατηρήσεις δείχνουν ότι μεταξύ μέσων Μαΐου και μέσων Ιουνίου ο πληθυσμός του *A. pistaciae* είναι κυρίως στο στάδιο της έρπουσας «νύμφης» και πρώτου σταδίου. Οι πρώτες «νύμφες» του δεύτερου σταδίου εμφανίζονται ενωρίς το φθινόπωρο και στη συνέχεια όλος ο πληθυσμός βαθμιαία εισέρχεται στο δεύτερο στάδιο και διαχειμάζει.