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https://doi.org/10.12681/eh.13916

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To cite this article:

Santas, L. (1985). Anapulvinaria pistaciae (Bod.), a pistachio tree scale pest producing honeydew foraged by bees in Greece. ENTOMOLOGIA HELLENICA, 3, 29-33. doi:https://doi.org/10.12681/eh.13916
Anapulvinaria pistaciae (Bod.), a Pistachio Tree Scale Pest Producing Honeydew Foraged by Bees in Greece

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ABSTRACT

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, Borchenuus 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 Phthiotida, 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 honeydew 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 (Bodenhimeir 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 Anapulvinaria pistaciae stages observed from February to September during 1979-1981.

| Stage          | Collection dates in 1979 | 1979 | 1980 | 1981 |
|----------------|-------------------------|------|------|------|
| Preoviposition | 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 |
| adult          | - - - - | 20 44 76 93 | 100 89 10 3 | - - - - - - |
| Oviposition    | - - - - | 11 90 96 80 | 1 - - - - - |
| First larva    | - - - - | 1 20 99 100 | 95 92 72 38 |
| Second larva   | 100 100 100 80 36 24 7 | - - - - - - | 100 97 90 92 42 20 12 2 | - - - - - - | 2 9 19 30 |

| 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    | - - - - | 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 | - - - - - - | 100 97 90 92 42 20 12 2 | - - - - - - | 2 9 19 30 |

| 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    | - - - - | 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 | - - - - - - | 100 97 90 92 42 20 12 2 | - - - - - - | 2 9 19 30 |
FIG. 1. Adults in oviposition stage on twigs, leaf-petioles and leaves.

young shoots. *A. pistaciae* settles on shoots early in April, on leaves around the middle of April, on petiols 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),

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

| Month       | 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           | 5      | 92    |
| April       | -           | -            | 5      | 5     |
| May         | -           | -            | 6      | 6     |

*Average of 3 years

| Month       |  |
|-------------|---|
| August      | 95|
| September   | 95|
| October     | 86|
| November    | 92|
| December    | 95|
| January     | 98|
| February    | 95|
| March       | 92|
| April       | 5 |
| May         | 6 |

| Month       | First stage | Second stage | Adults | Total |
|-------------|-------------|--------------|--------|-------|
| August      | 95          | -            | -      | 95    |
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| November    | -           | 92           | -      | 92    |
| December    | -           | 95           | -      | 95    |
| January     | -           | 98           | -      | 98    |
| February    | -           | 95           | -      | 95    |
| March       | -           | 92           | 5      | 92    |
| April       | -           | -            | 5      | 5     |
| May         | -           | -            | 6      | 6     |

* Average of 3 years

d. Parasitization

While examining *A. pistaciae*, any parasites

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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. (Horn.: 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

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Anapulvinaria pistaciae (Bod.)

Éνα Μελιτογόνο Έντομο της Φιστικιάς

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ΠΕΡΙΛΗΨΗ

Το κοκκοειδές Anapulvinaria pistaciae (Bod.) προσβάλλει τη φιστικιά (*Pistacia vera* L.) και...
μερικές φαρές, κυρίως στους ημιεγκατελειμμένους φιστικιώνες προκαλεί σοβαρές ζημίες στα δέντρα. Το κοκκοειδές αυτό εκκρίνει μελίτωμα που σύμφωνα με παρατηρήσεις μας, οι μέλισσες εκμεταλλεύονται. Η συνεισφορά αυτού του μελιτώματος στη συνολική παραγωγή μέλιτος στις χώρες 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 φιστικίας. Κατά τη διάρκεια αυτής της περιόδου, το A. pistaciae είναι στη μορφή της έρπουσας και πρώτου σταδίου, στάδια πολύ ευαίσθητα στις φυτοφάρμακα. Έτσι, αυτοί οι μελισσοκόμοι διατηρούν το κοκκοειδές σε χαμηλό επίπεδο πληθυσμού.

Κατά τη διάρκεια αυτής της έρευνας διαπιστώθηκε ότι το κοκκοειδές αυτό στην Κ. Ελλάδα έχει μια γενιά το χρόνο. Διαχειμάζει στο δεύτερο στάδιο. Τα ακμαία εμφανίζονται νωρίς την άνοιξη και οι πρώτες έρπουσες παρατηρούνται το Μάιο. Οι θαυμασικές 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.