The phenology and natural enemies of *Aspidiotus nerii* BOUCHÉ* in Central Greece

L.C. ARGYRIOU and A. L. KOURMADAS**

EVOLUTION ET ENNEMIS NATURELS
D'*ASPIDIOTUS NERII* BOUCHE EN GRECE CENTRALE
L.C. ARGYRIOU et A.L. KOURMADAS
Fruits, oct. 1980, vol. 35, n° 10, p. 633-638.

RESUME - L'évolution d'*Aspidiotus nerii* BOUCHE a été étudiée sur des variétés d'olives de table dans deux régions de Grèce centrale. De trois à quatre générations chevauchantes ont été enregistrées en une année. L'Insecte était actif presque toute l'année.
Quatre prédateurs, *Chilocorus bipustulatus* L., *Lindorus lophanthae* BLAISD., *Scymnus* sp. (Col. Coccinellidae) et *Chrysopa carnea* STEPHENS (Neur. Chrysopidae) furent observés se nourrissant de cette Cochenille. Des parasites *Aphytis chilensis* HOWARD et *Aspidiotiphagus citrinus* CRAW. (Hym. Aphelinidae) furent élevés à partir d'*Aspidiotus nerii*.

INTRODUCTION

The scale *Aspidiotus nerii* BOUCHE is widespread in Greece and feeds on a large number of host plants (2, 3). It has caused economically significant damage in Greece to citrus trees (2) and olive trees, particularly in recent years (1972-1977) when it became one of the most serious problems affecting major olive - growing regions, as in Crete (1,2) and especially in Central Greece where table varieties are grown.

This report contains information about the biology of the scale and its parasitism on varieties of table olives in two areas of Central Greece - Molos and Avlaki, near Lamia - during the years 1975-1977. The financial consequences of *A. nerii* infestation of table varieties are serious. The fruit is stained with spots by the scale-and in the worst cases entirely covered by it-which makes the olives totally unfit for canning ; the growers are compelled to sell their product to the olive oil industry at substantial financial loss.

In the main, the insect infests the leaves (particularly the underside) and the fruit, and to a lesser degree the shoots. Infestation occurs in clusters on and between the trees.

MATERIALS AND METHODS

The observations were conducted in olive groves severely infested by the scale *A. nerii* at Molos and Avlaki. In each grove we selected five of the most heavily infested trees,

* - Homoptera : Diaspididae.
** - ARGYRIOU - Benaki Phytopathological Institute, Kiphissia, Athens, Greece.
KOURMADAS - UNDP/FAO Development of Pest Management systems for olive culture. Benaki Phytopathological Institute, Kiphissia, Athens, Greece.

from which we took samples at near-regular 15-day intervals. The samples were at a height of 1,20 to 1,80 m. Four, 20 cm long, shoots were cut from each tree and removed to the laboratory where the leaves were cut off and mixed together. Random samples of the leaves were taken and examined under the stereoscopic microscope. In the course of the examination we identified the insects stages of development and the various parasites or predators we found, as described by ARGYRIOU (1976). The examination continued until it had covered 1000 live insects (not counting the crawlers). The larvae and pupae of the parasite *Aphytis* spp. were placed in glass vials. These were plugged with cotton wool and placed in an incubator at temperature 25±2°C and relative humidity 60±5 %. The parasites that emerged were either identified in our own laboratory or sent to specialists abroad for identification.

Many Coccinellidae were collected by shaking the branches of olive trees infested by the scale over white sheets spread underneath the trees.

RESULTS

Biology.

General.

From the data yielded by the Molos and Avlaki observations (fig. 1) we see that no clear distinction between each of the insect's generations and the next exists because they overlap ; and all growth stages of the insect occurred throughout the year at a greater or lesser rate. To determine the number of generations, we noted those stages which in their maximal phases define the appearance of a generation. Accordingly, basing our observations on the occurrence peaks of the males (larvae and pupae) and also of the adult females in the oviposition stage, we can determine the variation in the behaviour of most of the population. It would also be possible to define the generations by determining the occurrence peaks of the larvae or first-stage pupae ; but the difficulty often encountered in counting them accurately and obtaining a percentage rate (because they are so numerous and have a higher mortality rate) made us choose the males and oviposition-stage females, which are the more characteristic and more accurately countable

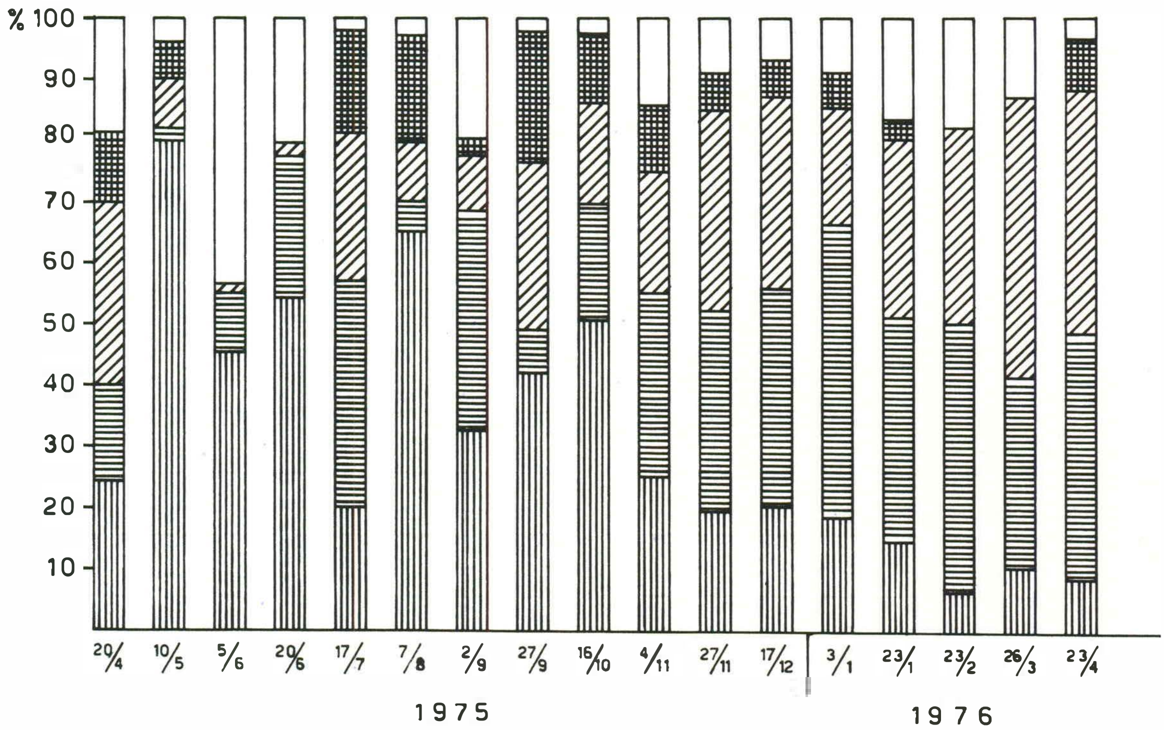

Fig. 1: Composition of Aspidiotus nerii population in Molos area

stages.

From April to October the insect in both observation areas had three oviposition peaks, each of which denotes the appearance of a new generation. At Avlaki we also observed (in 1977, mainly) that the insect was particularly active during the winter. This means that during the winter months a large number of insects produced a fourth generation. The hibernal activity of the scale at Molos was less pronounced than at Avlaki, but there too we observed crawlers and ovipositing adult females throughout the winter (fig. 1). At Avlaki the presence of crawlers in January 1977 (when observations commenced) and throughout the rest of the winter was very pronounced, giving a picture of the insect in full activity (fig. 2). This hibernal activity means that the insect was capable of producing four generations a year at Avlaki. The fact that the insect continues to be considerably active during the winter increases the probability of its producing serious spots and peaks of infestation.

Following are further details on the biology of the scale in each of the two observation areas :

Molos.

Observations were conducted at Molos from April 1975 to June 1976.

The peak occurrences of males at Molos were (fig. 3) : 1) late May to mid-June, 2) mid-August, 3) late October. The males of the first mass occurrence fertilized the females that would oviposit in July-August. The males of the second mass occurrence fertilized the females that would oviposit in September/October. The males of the third mass occurrence fertilized the females that would oviposit the following spring. A few of these females oviposited earlier, during the winter, producing a fourth generation. The insect's greatest oviposition activity was observed in the May and September/October periods.

Avlaki.

Observations were conducted at Avlaki from January through November 1977.

As mentioned above, the insect's activity in the period from January to March was remarkable. During this period a substantial part of the population was in the oviposition stage, and at the same time a large number of larvae and first-stage individuals were observed. The insect's hibernal activity was slightly less than its activity in the spring and summer. The table of mean temperatures for the Lamia area (Table 1) shows that the mean temperatures in December 1976, January, February and March 1977 were, respectively, 9,1-7,8-12,6 and 12,0°C, which means that at these temperatures the insect's activity is normal.

Fluctuations of the population of males and ovipositing females are shown in Fig. 2. We see that the peak occurrence of males were 1) March, 2) late May/early June, 3) September. The peak occurrences of ovipositing females were 1) late April/early May, 2) July/August, 3) October. As already pointed out, more than 10 % of the population was almost constantly in the oviposition stage ; in the peak oviposition periods the rate rose to 15-23 % of the total population.

This means that the fluctuation in the rate of the oviposition stage was comparatively small. By contrast the fluctuation in the male population was more pronounced during the year and provides a clearer picture of the alternating generations. Thus, basically, three generations can be

TABLE 1 - Mean monthly temperatures in the Lamia area during the years 1975-1977.

Months	temperatures (°C)		
	1975	1976	1977
January	7,0	8,3	7,8
February	6,1	6,4	12,6
March	12,2	9,2	12,0
April	15,2	14,4	15,2
May	20,2	18,4	20,8
June	23,1	22,9	25
July	26,1	25,2	27,9
August	24,3	23,2	26,8
September	24,1	21,7	21,1
October	17,1	17,2	15,9
November	11,3	12,2	14,3
December	7,8	9,1	6,7

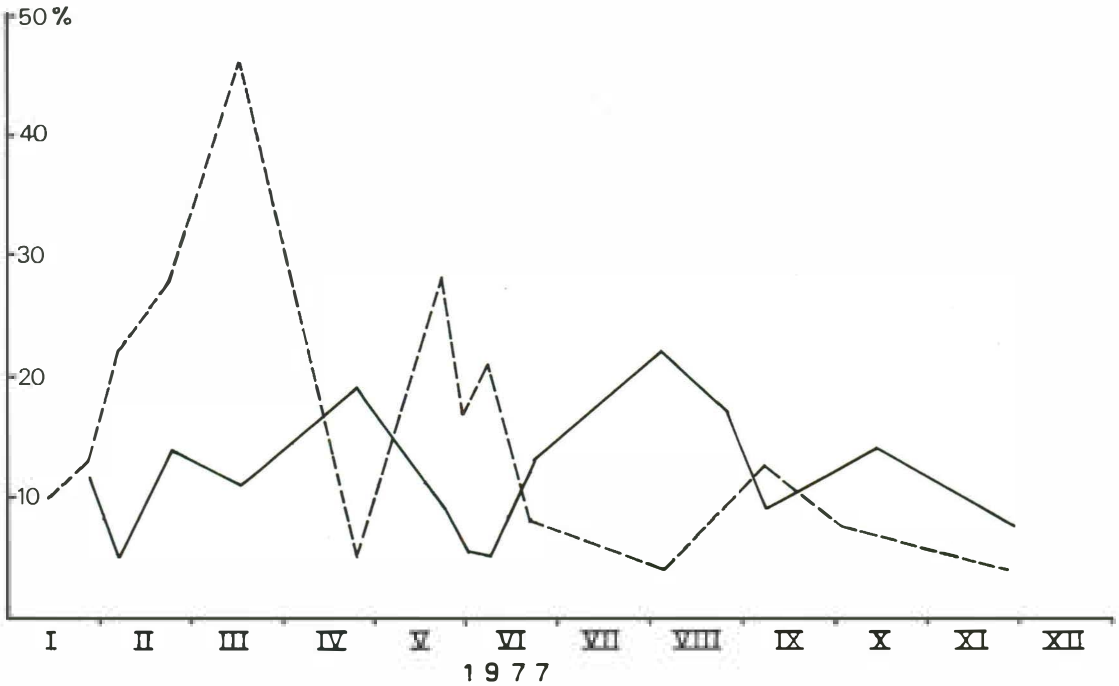

Fig. 2 : Aspidiotus nerii Bouché : Percentages of ovipositing females (——) and males (----) on olive trees in Avlaki area

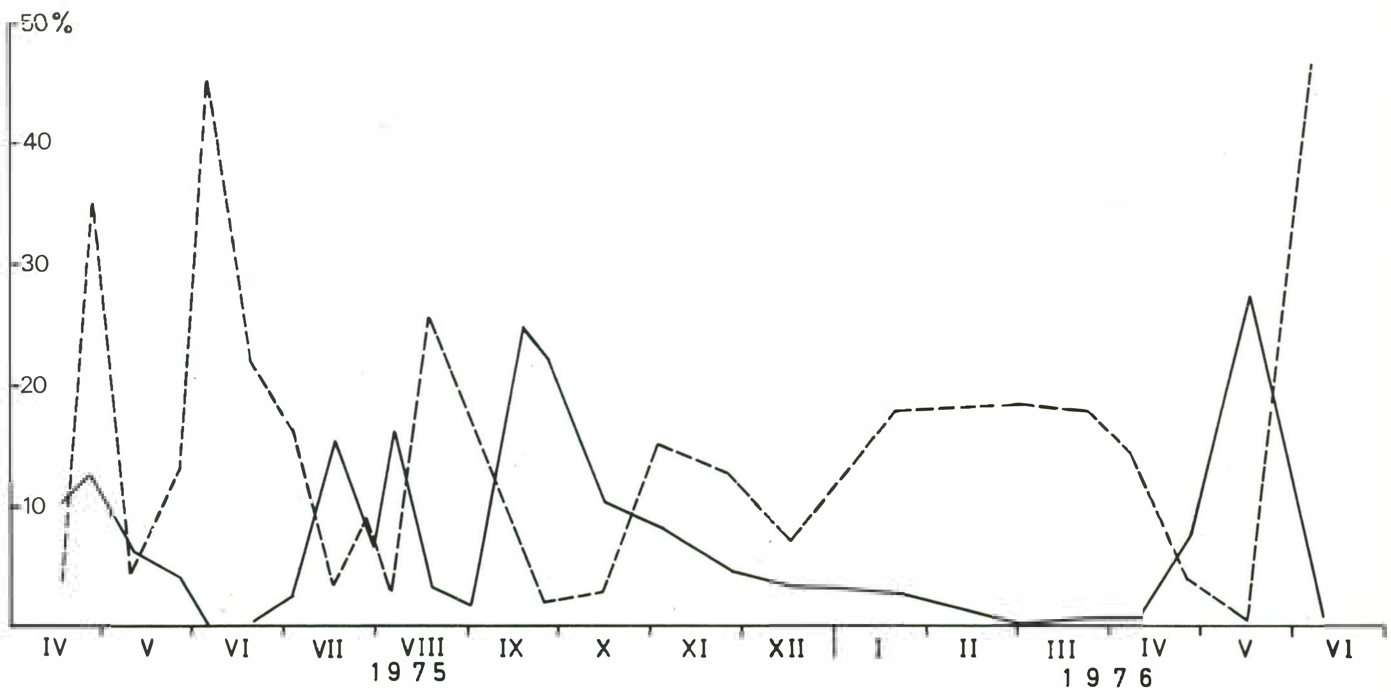

Fig. 3 : Aspidiotus nerii Bouché : Percentages of ovipositing females (——) and males (----) on olive trees in Molos area.

distinguished from April to October, but a substantial part of the population gives birth to a fourth generation during the months following. This is the conclusion drawn, as we mentioned earlier, from our observation of the insect's very active state during the winter months, when the young larvae observed in January and February were additional to the three generations produced between April and October.

Natural Enemies.

Predators.

The predators *Chilocorus bipustulatus* L., *Lindorus lophanthae* BLAISD. and *Scymnus sp.* (family Coccinellidae) were found preying on *A. nerii.* Also found preying on the scale was the neuropter *Chrysopa carnea* STEPHENS (family Chrysopidae). The number of these predators was considerable at Avlaki during April/May but very small during the rest of the year. The largest population was *L. lophanthae* followed by *C. bipustulatus.*

These predators were found at Molos too ; also at Avlis, District of Boeotia, and elsewhere (ARGYRIOU, 1976).

The role played by the predators was not evaluated ; in these areas it appears to be subsidiary to that of the parasites.

Parasites.

At both Molos and Avlaki and in samples from other parts of the country the ectoparasite *Aphytis chilensis* HOWARD was found feeding on *A. nerii.* The endoparasite *Aspidiotiphagus citrinus* CRAW was found, in limited number, in a sample from the Skaloma area.

A. chilensis feeds mainly on adults and ovipositing adults, and sometimes, but not often, on second-stage individuals.

Fig. 4 shows the rate of *A. chilensis* parasitism on the scale at Molos from April 1975 to June 1976. We see that

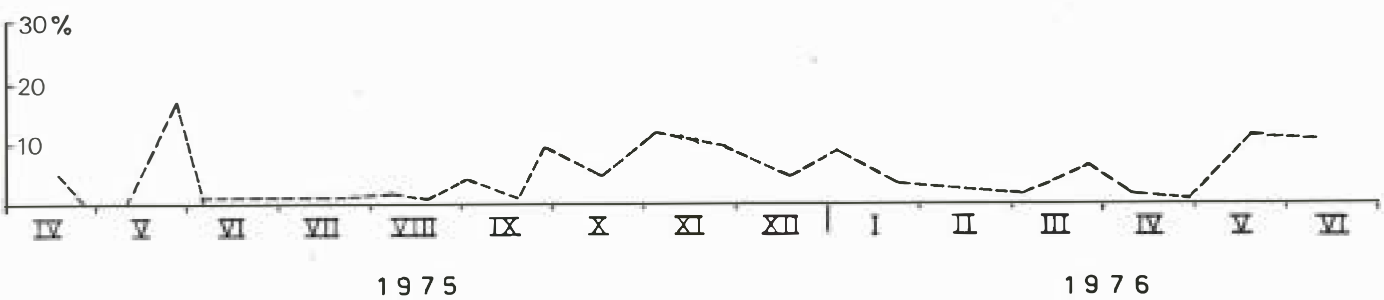

Fig. 4 : Aspidiotus nerii Bouché : Percentage of parasitized scales in the total population, by Aphytis chilensis Howard in the Molos area.

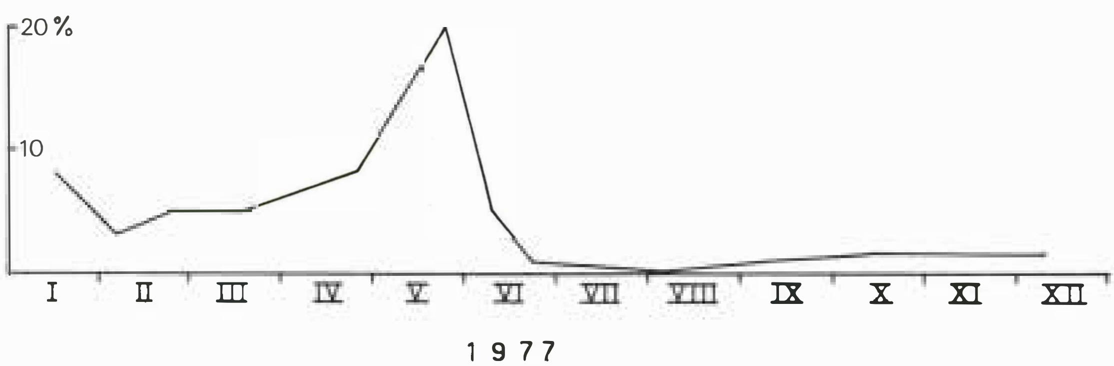

Fig. 5 : Aspidiotus nerii Bouché : Percentage of parasitized scales in the total population, by Aphytis chilensis Howard in the Avlaki area

during most of the year the parasitism rate remained low, rising for a brief spell to 17 % in late May 1975. The rate then fell drastically to 1-2 % until September. It rose to 11 % in early November and subsequently fluctuated between 3 % and 8 % until February 1976. In April the rate dropped to 0-2 % but rose again this year, up to 11 % in May and June.

At Avlaki, *A. chilensis* parasites were in considerable number during the winter ; however, because the scale population was extremely numerous the rate of active parasitism was relatively low, e.g. in a sample containing roughly 2000 scales on 23 olive leaves on 17 January 1977 we found 172 *A. chilensis* parasites (mostly pupae and to a lesser extent larvae and adults at the moment of emergence).

Fig. 5 shows the parasitism rate at Avlaki. Its fluctuations were similar to those noted at Molos. The rate was 5-8 % during the winter months, rose to a peak of 20 % in May, then dropped to 1-2 %, becoming almost nil in August and thereafter standing at approx. 2 % through the autumn.

DISCUSSION

Following are the salient points of the information obtained in the course of this project :

A. nerii produces three to four generations annually, which testifies to its great vitality and its capability of creating serious outbreaks of infestation in a short time.

The insect's generations overlap and all of its growth stages are present throughout the year.

The insect remains markedly active during the winter months, continuing its oviposition and egg-hatching. At Avlaki in particular, the insect's hibernal activity was intensive - only slightly less so than its summer activity. At Molos its activity during the winter was less pronounced but there were always ovipositing females and young larvae present.

The ectoparasite, *A. chilensis*, which was found feeding on *A. nerii*, is quite active during the winter months. This activity rose to a peak (up to 20 %) in May, then gradually dropped to almost zero in July/August. So the parasite was most active during the winter, reaching in a peak in May.

No other *Aphytis* spp. parasites were encountered in this area ; nor did we find *Aspidiotiphagus citrinus* CRAW.

The most numerous of the predators at Avlaki was *Lindorus lophanthae*. The presence of this and other predators was most pronounced in April and May. The *Chilocorus bipustulatus* population at Avlaki was smaller than that of *L. lophanthae*. However, the efficacity of these two species in terms of controlling the scale population is not known. At Molos the population of these predators was negligible.

The role and potential effectiveness of these predators in controlling the *A. nerii* population must be further researched.

REFERENCES

1. **ALEXANDRAKIS (V.), NEUENSCHWANDER (P.) and MICHELAKIS (S.). 1977.**
   Influence d'*Aspidiotus nerii* BOUCHE (Hom. Diaspididae) sur la production de l'olivier.
   Fruits, vol. 32, p. 412-417.
2. **ARGYRIOU (L.C.). 1976.**
   Some data on biology, ecology and distribution of *Aspidiotus nerii* BOUCHE (Hom. Diaspididae) in Greece.
   Annls Inst. Phytopath. Benaki (N.S.). 11, 209-218.
3. **KORONEOS (J.). 1934.**
   Les Coccidae de la Grèce. I.- Diaspinae.
   Athènes, 1934.