Seasonal Abundance of *Acyrthosiphon pisum* (Harris) (Homoptera: Aphididae) and *Therioaphis trifolii* (Monell) (Homoptera: Callaphididae) on Lucerne in Central Greece[1]

D. P. LYKOURESSIS and CH. P. POLATSIDIS

Laboratory of Agricultural Zoology and Entomology,
Agricultural University of Athens,
75 Iera Odos, GR 118 55 Athens, Greece

ABSTRACT

Acyrthosiphon pisum (Harris) and *Therioaphis trifolii* (Monell) were the most abundant aphid species on lucerne at Kopais, Co. Boiotia in central Greece from April 1984 to November 1986. Population fluctuations for *A. pisum* showed two peaks, the first during April-May and the second in November. Low numbers or zero were found during summer and till mid October as well as during winter and March. The abundance of this species during the year agrees generally with the effects of prevailing temperatures in the region on aphid development and reproduction. *T. trifolii* also showed two population peaks but at different periods. The first occurred in July and the second from mid September to mid October. The first peak was higher than the second. The sharp decline in population densities that occurred in early August and lasted till mid September is not accounted for by adverse climatic conditions, but natural enemies and/or other limiting factors are possibly responsible for that population reduction. Numbers were zero from December till March, while they kept at low levels during the rest of spring and part of June as well as from mid October till the end of November.

Introduction

Several aphid species are known to attack lucerne. Among them, *Acyrthosiphon kondoi* Shinji, *Acyrthosiphon pisum* (Harris), *Therioaphis trifolii* (Monnel), and *Aphis craccivora* Koch are considered as the most important.

A. kondoi, the blue alfalfa aphid, is known to occur in Japan and Manchoukuo (Shinji and Kondo 1938, Takahashi 1965), India (David and Ghorpade 1974), Asia (Afganistan and Iran), U.S.A., Mexico and Argentina (González et al. 1978) and New Zealand and Australia (Carver 1989). This species has not been recorded yet from the Mediterranean basin.

A. pisum, the pea aphid, is a cosmopolitan species occurring quite frequently on lucerne in temperate regions. This species is more widespread than *A. kondoi* (González et al. 1978), and it is very common in the Mediterranean basin (Aeschlimann 1981). It is a palaearctic species known in north America, since the end of last century, as a serious pest of lucerne and peas. This species was first found in new Zealand and Australia in 1976 and 1979, respectively (Carver 1989).

T. trifolii, the spotted alfalfa aphid, is a species of old world origin including the Mediterranean basin, all Europe, the Middle East and Asia as far as India (Carver 1978). This species invaded south-western U.S.A. in 1953 (van den Bosch et al. 1959), and Australia and New Zealand in 1977 and 1982, respectively (Carver 1989). In Australia, after the introduction and

[1] Received for publication December 7, 1990.

successful establishment of the parasitoid *Trioxys complanatus* Quilis, this species is now no longer a major pest of lucerne (Hughes et al. 1987).

A. pisum and *T. trifolii* can cause considerable damage to lucerne grown for forage and seed production (García 1974, Machain 1978, Cuperus and Radcliffe 1983). In peas, *A. pisum* may cause yield losses of up to 30% when the crop is infested in the five-leaf stage (Hinz and Daebeler 1984).

A. pisum has been recorded from lucerne in northern Greece by Stathopoulos et al. (1965), and Santas (1980) has found it not on lucerne but on three other host-plants. Aeschlimann (1981) reported this species on lucerne in various regions of Greece when he collected and forwarded the parasitoids of *A. pisum*, *Aphidius ervi* Haliday and *Praon barbatum* Mackauer, to Australia in an attempt at biological control of the recently introduced *A. kondoi*. *T. trifolii* has been recorded on lucerne in Greece by Aeschlimann (1981) and Lykouressis et al. (1985).

Apart from those records, no other information concerning aspects of the biology and ecology of *A. pisum* and *T. trifolii* are known in Greece. The present work was undertaken to study the phenology of these species, as they are the most abundant aphid species on lucerne in that region. This work is a part of a major study of the most important pests of lucerne, in an attempt to develop an integrated pest management programme.

Materials and Methods

Sampling was carried out in a lucerne (*Medicago sativa* L.) field located at the farm of the Agricultural University of Athens at Kopais region. It took place for three consecutive years commencing from April 1984, when the lucerne was three years old, till November 1986 when the end of plantation occurred.

The study plot, from which samples were taken, was approximately 1,000 m^2 and received the usual cultural treatments such as: P. fertilizer in February and November each year. No other chemicals were applied. Harvest of the aerial part of the plants occurred on the following dates: 4 May, 6 June, 3 July, 7 August, 7 September and 4 October in 1984; 16 May, 10 June, 9 July, 6 August, 16 September and 24 October in 1985, and 26 April, 20 June, 16 July, 20 August, 15 September and 15 November in 1986.

During the whole period of the study, a total of 49 samplings occurred, almost at fortnight intervals in spring, summer and autumn and monthly in winter each year. On each sampling date, 12 samples were taken. The first one was taken from about the center of the plot, while the subsequent samples were taken 16 meters apart, walking on five rows parallel with the side of the plot.

Each sample comprised 6-10 stems, depending on the height of the plants; they were cut almost at ground level with the minimum of disturbance. Each sample was put separately in a plastic bag and brought to the laboratory without delay. The aphids were collected from the plants and put in small glass vials with preservative fluid consisting of 2 volumes 90-95% ethyl alcohol and 1 volume 75% w/w lactic acid (Eastop and van Emden 1972), for subsequent slide making and identification into species (Stroyan 1977, 1984, Blackman and Eastop 1985), separation and counting.

Results and Discussion

A. pisum and *T. trifolii* were found to predominate during the course of this study. These species are considered separately. *A. craccivora* occurred at very low numbers.

Acyrthosiphon pisum

A. pisum was found on 11, 14 and 11 out of 15, 20 and 14 sampling occasions during the first, second and third years of this study, respectively. Fig. 1 shows the population trends of this species during the three sampling periods.

Population densities were kept very low from mid December till the end of March. Numbers increased during April till mid May, but then started to decline and reached zero levels by the end of June. Higher numbers were observed on two sampling dates, 26 April and 10 May 1986, than those of the precedent years. The same also happened during November of that year. From the end of June till about mid October the population remained at zero or very low densities, while subsequently it increased and attained its maximum during November in all three years. The highest population densities occurred on 10, 25 and 1 November in 1984, 1985 and 1986, respectively, with values equal to 82 ± 18, 332 ± 46 and 818 ± 292 individuals per 100 gr dry weight. The results of the population fluctuations of this species clearly showed the existence of two periods at which

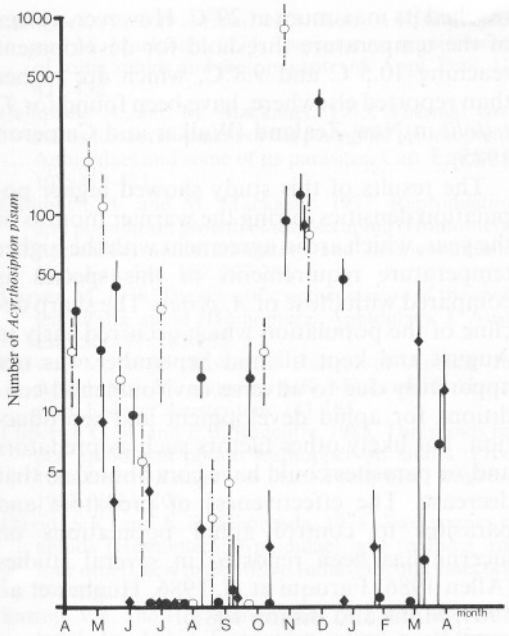

FIG. 1. Seasonal fluctuations of the mean numbers (±S.E.) of *Acyrthosiphon pisum* per 100 gr dry wt recorded from an old-established lucerne field at Kopais, Boiotia during the period April 1984-March 1985 (–◆–), April 1985-March 1986 (–●–) and April 1986-November 1986 (–·–○–·–).

aphid densities were kept at zero or low levels. The first started from about mid December and lasted till the end of March and the second from the end of June till mid October.

A. pisum may have a slow development and possibly reproduce at a low rate during winter at Kopais region, because quite a few individuals were found in samples during winter in both 1984 and 1985. Mean monthly minimum temperatures in December, January and February in both years ranged between 2 and 5°C. Those temperatures are near to the lower limit for development of this species which has been found to be 3.2°C (Siddiqui et al. 1973), 5.1, 5.6 and 4.0°C (Campbell et al. 1974), 5.5°C (Campbell and Mackauer 1975) and 2.73° (Hutchison and Hogg 1984) in different regions and for different biotypes. The lower temperature threshold for development in the biotype studied is very likely to differ from those referred above, as has been pointed out to happen with several aphid species (Lykouressis 1985). Nevertheless, the published thresholds give an indication of the range in or near which the threshold of this biotype lies, and hence slow development may occur under the temperatures prevailing during winter at Kopais.

The absence or the presence of very low numbers of *A. pisum* during summer months and September is probably connected more with the adverse effects of high temperatures on development and reproduction than other possible limiting factors such as harvest, interspecific competition and natural enemies. Mean monthly temperatures during summer months ranged from 24 to27°C. These values are similar to those of the upper limit for development which have been found experimentally to be 26.2°C (Kilian and Nielson 1971), about 27.5°C (Siddiqui et al. 1973), about 28°C (Campbell and Mackauer 1977) and 26.02°C (Hutchison and Hogg 1984), but the effects of maximum temperatures, reaching 35°C or higher during summer, may be detrimental to aphid development. Reproduction is also negatively affected by the temperatures prevailing at Kopais during that period, which are much higher than the optimal range of 10-20°C for this species (Campbell and Mackauer 1977). Temperatures that occurred during the second half of October and in November favour the development and reproduction of *A. pisum*. This factor is likely the most responsible for higher population densities.

The data on the seasonal fluctuations of the population obtained in the present study agree generally with those found by Bournoville (1978) in central France. Differences were found at the time when the two peaks of the population occurred. In central France the first peak was observed towards the end of May and the second in September-October, which means about one month later in spring and earlier in autumn, respectivelly, if compared with the population peaks of this study. These discrepancies are well explained by the different prevailing temperatures between the two regions.

Therioaphis trifolii

T. trifolii was found on 9, 14 and 12 out of 15, 20 and 14 sampling occasions during the first, second and third year of this study, respectively. Fig. 2 shows the population trends of this species during the three sampling periods.

Population densities were zero during winter and March, while they were kept at very low levels from April till almost the end of June. July was the month when *T. trifolii* attained the

highest population densities during the course of this study. They occurred on 19, 18 and 18 of that month in 1984, 1985 and 1986, respectively, with values of 192 ± 52, 2654 ± 816 and 92 ± 48 individuals per 100 gr d.w. After the peak of July, numbers sharply declined and were kept at very low levels during August and the first fortnight of September. A second population peak followed from mid September till mid October, but numbers were generally lower than those found during the first. Then, population densities declined again and reached very low levels by the end of October onwards. *T. trifolii* is favoured by higher temperatures than *A. pisum*. Graham (1959) has reported successful development at a constant temperature of 35°C. Messenger (1964) found that the temperature limits for development are between 6°C and 32.5°C with optimum at 26-29°C, while the intrisic rate of increase for this species reached its maximum at 29°C. However, values of the temperature threshold for development reaching 10.5°C and 9.8°C, which are higher than reported elsewhere, have been found for *T. trifolii* in New Zealand (Walker and Cameron 1985).

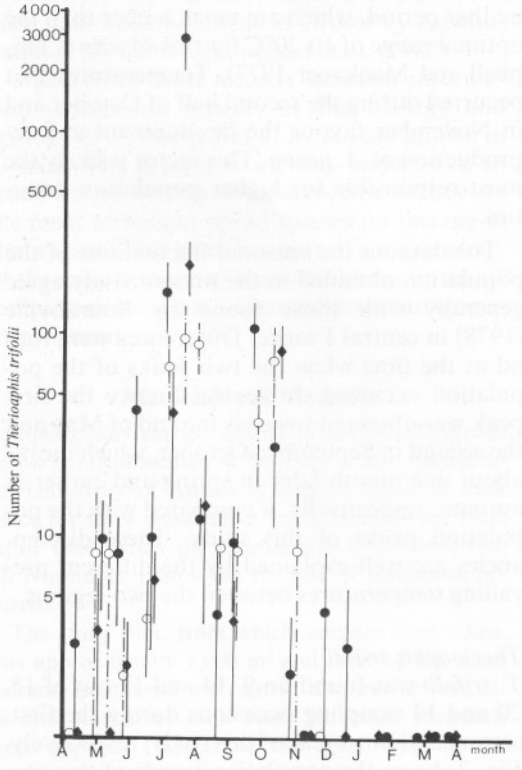

FIG. 2. Seasonal fluctuations of the mean numbers (± S.E.) of *Therioaphis trifolii* per 100 gr dry wt recorded from an old-established lucerne field at Kopais, Boiotia during the period April 1984-March 1985 (−◆−), April 1985-March 1986 (−●−) and April 1986-November 1986 (-·-○-·-).

The results of this study showed higher population densities during the warmer months of the year, which are in agreement with the higher temperature requirements of this species as compared with those of *A. pisum*. The sharp decline of the population which occurred early in August and kept till mid September was not apparently due to adverse environmental conditions for aphid development and reproduction, but likely other factors such as predators and/or parasites could have contributed to that decrease. The effectiveness of predators and parasites to control aphid populations on lucerne has been reported in several studies (Allen 1986, Faruqui et al. 1986, Hughes et al. 1987, Milne and Bishop 1987).

The data obtained in the present study on the phenology of *A. pisum* and *T. trifolii* as well as those from previous work on three curculionids on lucerne (Lykouressis and Emmanouel in press) are necessary elements in the development of an integrated pest management programme. However, more information is certainly needed about the occurrence as well as the effects of various biotic mortality factors on lucerne aphid populations in the field.

Acknowledgment

The authors thank Professor G. Remaudière, Institute Pasteur, Paris, for the identification of *A. pisum* and *T. trifolii* and Mr G. Papadoulis and Mrs Ch. Samartzidou for their help in collecting some of the field data.

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KEY WORDS: *Acyrthosiphon pisum, Therioaphis trifolii*, Lucerne

Εποχιακή Διακύμανση των Πληθυσμών των Ειδών *Acyrthosiphon pisum* (Harris) και *Therioaphis trifolii* (Monell) σε Μηδική στην Κεντρική Ελλάδα

Δ. Π. ΛΥΚΟΥΡΕΣΗΣ και Χ. Π. ΠΟΛΑΤΣΙΔΗΣ

Εργαστήριο Γεωργικής Ζωολογίας και Εντομολογίας,
Γεωργικό Πανεπιστήμιο Αθηνών,
Ιερά Οδός 75, 118 55 Αθήνα

ΠΕΡΙΛΗΨΗ

Τα είδη *Acyrthosiphon pisum* (Harris) και *Therioaphis trifolii* (Monell) βρέθηκαν να έχουν τους μεγαλύτερους πληθυσμούς σε μηδικεώνα στην Κωπαΐδα Βοιωτίας στην παρούσα μελέτη, η οποία διήρκεσε από τον Απρίλιο 1984 έως τον Νοέμβριο 1986, όταν η καλλιέργεια καταστράφηκε. Το *A. pisum* παρουσίασε δύο πληθυσμιακά μέγιστα κατά τη διάρκεια του έτους. Το πρώτο παρατηρήθηκε Απρίλιο-Μάιο και το δεύτερο κατά το Νοέμβριο. Μικροί πληθυσμοί ή ακόμα και μηδενικοί βρέθηκαν κατά τις περιόδους από Ιούνιο έως μέσα Οκτωβρίου και από Δεκέμβριο έως Μάρτιο. Οι διακυμάνσεις που παρατηρήθηκαν κατά τη διάρκεια του έτους συμφωνούν βασικά με την επίδραση των επικρατουσών θερμοκρασιών στην περιοχή, πάνω στο ρυθμό ανάπτυξης και αναπαραγωγής του είδους αυτού. Το *T. trifolii* παρουσίασε επίσης δύο πληθυσμιακά μέγιστα, το πρώτο κατά τον Ιούλιο και το δεύτερο από μέσα Σεπτεμβρίου έως μέσα Οκτωβρίου. Το πρώτο ήταν υψηλότερο από το δεύτερο. Η απότομη μείωση του πληθυσμού που παρατηρήθηκε στην αρχή του Αυγούστου και διήρκεσε έως τα μέσα Σεπτεμβρίου δεν πρέπει να είναι αποτέλεσμα μη ευνοϊκών κλιματικών συνθηκών, αλλά πιθανώς των φυσικών εχθρών ή και άλλων περιοριστικών για τον πληθυσμό παραγόντων. Ο πληθυσμός ήταν μηδενικός από το Δεκέμβριο έως το Μάρτιο, ενώ κρατήθηκε σε χαμηλά επίπεδα από τον Απρίλιο έως τα μέσα Ιουνίου και από μέσα Οκτωβρίου έως τέλος Νοεμβρίου.