The lime aphid in New Zealand (Hemiptera: Aphididae): a first record

N. D. BARLOW*
Department of Botany and Zoology, Massey University, Palmerston North

Abstract

The first observation of the lime aphid *Eucallipterus tiliae* Linnaeus in New Zealand is recorded, and a brief outline given of its ecology and population dynamics based on studies in Britain.

Keywords: Hemiptera; Aphididae; lime aphid; *Eucallipterus tiliae;* New Zealand; new record.

OBSERVATIONS

The lime aphid, *Eucallipterus tiliae* L., was found for the first time in New Zealand on leaves of the common lime or linden, *Tilia* × *vulgaris* Hayne, at Massey University on 26 March 1979. The aphid was also found in large numbers in the City Square, Palmerston North, where on 15 April a mean density of 38/100 cm^2 of abaxial leaf surface was recorded on one tree; this included a number of oviparae. Specimens were noted on limes in Picton shortly afterwards, so the lime aphid appears to be established in New Zealand.

Specimens of alate viviparae have been deposited in the N.Z. Arthropod Collection at Entomology Division, DSIR, Auckland.

DISCUSSION

This tree-infesting aphid, host-specific to members of the genus *Tilia,* probably originated from Central Europe, and is now widespread in Europe, Asia Minor, and North America. It has formed the basis for an intensive and long-running population study, so that a good deal is now known about its ecology and behaviour.

The aphid itself is quite small, weighing about 0.6 mg as an adult. First generation adults (fundatrices) are 50% heavier since they develop during the spring on growing leaves rich in amino-nitrogen. There are 4 nymphal instars, and all parthenogenetic adults (viviparae) are winged. Development takes about 3 weeks, and in Britain the aphid has 4 to 5 overlapping generations each year, with increasing numbers of sexuals appearing towards the end of the season. The wingless sexual females (oviparae) mate with winged males and lay overwintering eggs in crevices in the bark.

The lime aphid is a pest where it infests urban shade trees in high numbers, mainly because of the copious quantities of sticky honeydew falling upon pavements and parked cars. Under these conditions the leaves become characteristically blackened by sooty mould growing on the honeydew. Parasites have been introduced in an effort to limit aphid numbers in Berkeley, California (Olkowski et al. 1974), but the success of this has yet to be demonstrated.

In the natural ecosystem where limes generally appear in a mixture of deciduous species, the rain of honeydew provides a rapid feedback of nutrients to the decomposers. Llewellyn (1972) studied the energetics of the aphid and calculated that consumption on trees in Glasgow is of the order of 3672 k cal/m^2/year. Not only is this an extremely high feeding rate, compared with that of other herbivores, but aphid feeding differs in 2 other important respects: 90% of consumption is accounted for by excretion; and the photosynthetic machinery of the tree is not destroyed (Llewellyn 1972). The effect on the tree is to drain about 20% of net annual production (Llewellyn 1975), to arrest root growth in saplings, and to cause changes in the size and composition of leaves and the time at which they are shed (Dixon 1971a).

---

*Author's present address: Agricultural Research Division, MAF, Private Bag, Palmerston North.

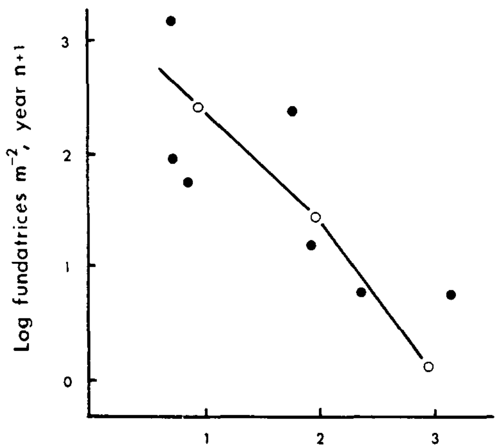

Fig. 1. The inverse relationship between fundatrix numbers in successive years. ● = observed, combined result for 2 trees in one year; -o- = generated by the model.

Population densities of lime aphids may vary over a hundredfold from year to year. A convenient index of abundance for any one season is provided by the number of fundatrices in spring, and in Scotland these have ranged from 10/m^2 of leaf to 1000/m^2. From the fundatrices numbers build up to a single peak each year then decline. The peak is attained earlier in the year if fundatrices numbers are high than if they are low (Dixon 197lb), and the decline from high numbers can be extremely rapid.

There is a pattern underlying the variation in numbers from year to year. Dixon (197lb) found an inverse relationship between fundatrix densities in successive years, which 4 subsequent years of sampling have confirmed. This overcompensation to changes in density occurs during summer rather than during winter, since there is also an inverse relationship between peak densities of fundatrices and oviparae within each season (Dixon 197lb).

A simulation model of the aphid population has been developed in an attempt to understand and account for its behaviour (Barlow & Dixon 1980). The model is based on a number of population processes studied quantitatively in the field and laboratory, including: predation by the 2-spot coccinellid *Adalia bipunctata* L., and by the black-kneed capsid, *Blepharidopterus angulatus* Fall.; other, 'background' mortality; egg-hatching; reproduction and morph determination; development; and flight. The model generates a pattern of population behaviour similar to that observed, including the inverse relationship between fundatrix numbers in successive years (Fig. 1). Moreover, it suggests that this relationship is due to coccinellid predation at medium fundatrix densities (100/m^2) and to an interaction between coccinellid predation and density-related flight when the fundatrix density is high (1000/m^2).

REFERENCES

BARLOW, N. D.; DIXON, A. F. G. 1980: Simulation of lime aphid population dynamics. Pudoc, Wageningen (Simulation monographs).

DIXON, A. F. G. 1971a: The role of aphids in wood formation II. The effect of the lime aphid, *Eucallipterus tiliae* L. (Aphididae), on the growth of the lime, *Tilia* × *vulgaris* Hayne. *Journal of applied ecology 8*:393-399.

——— 1971b: The role of intra-specific mechanisms and predation in regulating the numbers of the lime aphid, *Eucallipterus tiliae* L. *Oecologia (Berl.) 8*:179-193.

LLEWELLYN, M. 1972: The effects of the lime aphid, *Eucallipterus tiliae* L. (Aphididae) on the growth of the lime *Tilia* × *vulgaris* Hayne. 1. Energy requirements of the aphid population. *Journal of applied ecology 9*:261-282.

——— 1975: The effects of the lime aphid (*Eucallipterus tiliae* L.) (Aphididae) on the growth of the lime (*Tilia* × *vulgaris* Hayne) II. The primary production of saplings and mature trees, the energy drain imposed by the aphid population and revised standard deviations of aphid population energy budgets. *Journal of applied ecology 12*:15-23.

OLKOWSKI, W.; OLKOWSKI, H.; VAN DEN BOSCH, R.; HOM, R. 1976: Ecosystem Management: A Framework for Urban Pest Control. *Bioscience 26*:384-389.