



## Arboriculture Research Note

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### Lime Trees and Aphids

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#### Summary

Many lime trees in urban situations have proved susceptible to aphid attack. The honeydew deposits produced by these aphids can be potentially troublesome and hazardous, Methods of controlling aphid populations are considered and the susceptibility of lime species available from the nursery trade is reviewed.

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#### Introduction

1. Loss of many elms from lowland Britain has emphasised the importance of tall deciduous trees as landscape features; the common lime has similar lofty dimensions and apart from being used as a major specimen tree was often planted in avenues in the past. Common lime (*Tilia x europaea* (= *x vulgaris*) together with the small leafed lime (*T. cordata*) and large leafed lime (*T. platyphyllos*) are all susceptible to the lime aphid (*Eucallipterus tiliae*) that produces the sticky deposits of honeydew characteristic of this insect. In urban areas honeydew can lead to pressure on tree managers to remove lime trees or to exclude them from planting programmes.
2. Recent tests on a range of species and named varieties of the genus *Tilia* carried out under controlled conditions have shown some species have resistance to the lime aphid and should be considered as alternatives for amenity planting to avoid honeydew problems.

#### Honeydew

3. Lime aphids use their stylet mouthparts to pierce the phloem cells (colours red in figures 1-4) in the veins of the underside of the leaves. These phloem cells contain the soluble products of photosynthesis and metabolic processes from which the aphids extract sugars and amino acids. Phloem sap contains only a low concentration of amino acids (,1%) so the aphid has to ingest a large volume of sap to extract the quantity of amino acids necessary for growth. As a consequence, the aphid excretes a dilute sugar solution as a liquid waste. Honeybees sometimes gather honeydew as it has similar sugar composition to nectar. Indeed, in some parts of Europe honeydew is regarded as valuable resource for honeybees.
4. Honeydew deposits are greatest in hot, dry weather when the aphids are feeding and growing rapidly; the sugary waste then falls and accumulates on surfaces under the tree's canopy. Under such climatic conditions honeydew frequently becomes colonised by sooty moulds which grow on the sugar-rich waste. It is then that honeydew becomes unpleasantly sticky and troublesome especially on pedestrian areas (pavements, park seats) as well as car parks and buildings. Some paved surfaces coated with this honeydew deposit can become very slippery after a light shower of rain.

#### The Aphid life cycle

5. The lime aphid does not feed on or colonise any other plant genera. Eggs are the overwintering stage and can often be found on the 2 year old twigs. They are usually laid singly in the lenticels and are covered with a greyish wax deposit. They are relatively late in hatching, so it is not until the leaves are expanded in early summer that the aphids first become apparent. During the summer the adult aphids are exclusively winged females (*alate virginoparae*); their numbers increase by parthenogenesis over several generations until the autumn months. Then males and egg laying females are produced to complete the life cycle.

#### Control of the Aphid

6. It is probable that most of the contact insecticides will control aphid numbers, but winged adult females can reinvade trees throughout the summer. Persistent insecticide are not a good choice for urban populated areas where the aphid problem is often more troublesome. Some systemic insecticides have been tried, but these chemical must be in a form that can be accepted and translocated by the tree. The earlier rather crude methods of injecting or implanting concentrates have caused undesirable necrotic areas in the bark. Implanting the systemic insecticide Acephate in the stems of the trees to control lime aphid has shown some promising results in trials carried out in The Netherlands. However there are currently no insecticides approved for injecting into amenity trees in Britain. Furthermore, implant treatments may create bark lesion problems especially with repeated use.
7. A more enlightened approach to this aphid problem would be to make greater use of those limes shown to be resistant especially when planting trees in urban areas. Furthermore, their susceptibility to aphids is likely to be lessened by selecting planting sites with a good rooting environment.

### Resistant and susceptible species

8. One unsubstantiated suggestion for avoiding the lime honeydew problem has been to plant the less common native species *T.cordata* instead of *R. x europea* or *T. platyphyllos*, but when tested *T.cordata* has been found to be attacked. The idea may have arisen from observation that the lime aphid is rarely found when *T. cordata* is growing naturally within mixed broadleaved woodland. Clonal material from the same *T. cordata* when grown in isolation away from its natural habitat can become highly susceptible to aphids. *T cordata* lacks the protective mechanisms against aphids (Fig.1) found on leaves of some exotic resistant *Tilia* species.
9. It is when individual limes are growing in towns or when they have been engulfed by urban development that they are most prone to aphid population increase. The inevitable honeydew deposits from these aphids and the sooty mould growths that follow therefore make any of the three native species a poor choice for urban situations.
10. Two of the European silver limes (*T.tomentosa* and *T.tomentosa* var.*petiolaris*) appear to have no aphid problems. Experimental tests have shown this is because the aphids cannot get access to the veins to feed because of the dense pubescence on the underside of the leaves (Fig.2). Adult aphids can sometimes reach the larger veins; the young newly born aphids have much shorter mouthparts, therefore cannot reach the phloem to feed. It is only if the hairs are removed that young aphids can feed and grow on these species.
11. The Asian silver limes (e.g. *T.oliveri*, *T.tuan* var. *chinensis* and *T. maximowicziana*) have double protection of dense pubescence and also, alongside the leaf veins, some pigmented microscopic glands (Fig.3) which appear to be associated with an antifeeding reaction in the aphid.
12. There is a third type of resistant lime that has glabrous leaves (e.g. *T.mongolica* and *T. x euchlora*). These lack the pubescent barrier but they do have microscopic glands that appear to be linked with antifeeding, distributed along the veins (Fig 4). When lime aphids were confined to these leaves in experimental tests, they failed to live longer than 5 days. The Causican lime (*T.x euchlora*) has been promoted in nurseryman's catalogues on account of its partial resistance to the lime aphid. It is however, a somewhat heavy and pendulous branching habit with dark green leaves creating an altogether different growth form to the three species commonly grown in Britain. It has two other disadvantages in that it may suffer severe leaf discoloration die to leafhopper damage and it is also susceptible to stem canker problems.
13. Those species that have been tested by the author, for susceptibility to the lime aphid, are summarised below, however, the exotic material tested is that which is available form the nursery trade and arboreta in Britain and is mostly vegetatively propagated or even perhaps just one clone and so does not represent the natural variability within each species. There could be differences in susceptibility within a species if a wider range of genetic material is tested. Similarly there appear to be at least two distinct types of common lime in the older avenues in England and Wales that have been propagated vegetatively; one of these has been observed to be more prone to aphid attack than the other (Pigott, pers.comm).

Summary of resistance to the Lime aphid (*Eucallipterus tiliae*) from tests on twelve species of *Tilia* derived form nursery stock available in Britain.

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Tilia sp.	Resistant ( r)	pubescence	glands	type of
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	or susceptible (s)	on ventral leaf surface	along veins	resistance to aphids
cordata	s	absent	absent	none
platyphyllos	s	slight	sparse	none
x europaea	s		sparse	none
americana	s	absent	sparse	none
tomentosa var				
petiolaris	partially r	dense	sparse	Pubescence
tomentosa	r	dense	numerous	Pubescence
euchlora	r	absent	present	Glands
dasystyla	partially r	absent	sparse	Glands
oliveri	r	dense	sparse	Pubescence (and glands)
tuan var.				
chinensis	r	dense	sparse	Pubescence (and glands)
mongolica	r	absent	sparse	Glands
maxiowicziana	r	dense	present	Pubescence (and glands)

### Conclusion

14. Future aphid problems may be significantly reduced by restricting new plantings in urban areas to the resistant forms of lime. Limes appear to be more troubled with aphids, leafhoppers and scale insects in urban areas with a poor rooting environment. The risk of honeydew becoming a problem is less likely in rural areas and woodlands so endemic and historically appropriate planting stock should be used in those situations.

### Reference

Bean, W.J. (1976) Trees and shrubs hardy in the British Isles. John Murray , London.

Piggott, D. the clones of common lime (*Tilia x vulgaris* Hayne) planted in England during the seventeenth and eighteenth centuries. (In preparation).

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