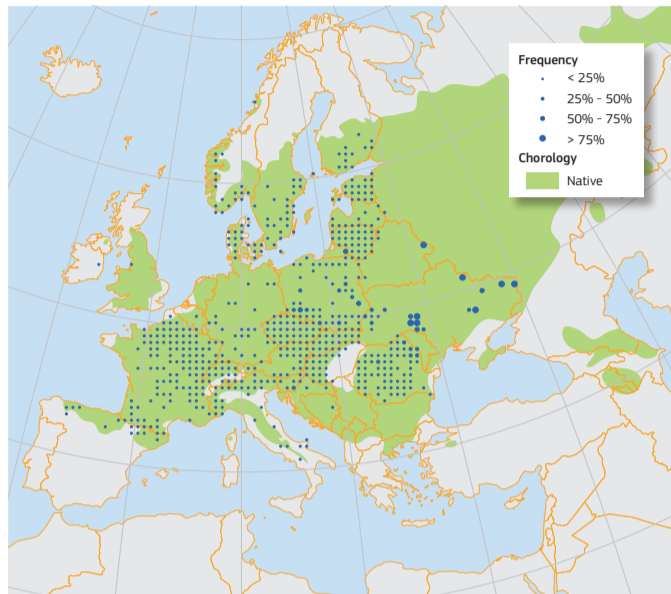


Tilia cordata, Tilia platyphyllos and other limes in Europe: distribution, habitat, usage and threats

E. Eaton, G. Caudullo, D. de Rigo

Tilia cordata Mill., known as small-leaved lime, and *Tilia platyphyllos* Scop., known as large-leaved lime, are very similar trees, both native to Europe and preferring warmer climates. Growing into large trees, they occur from southern Finland to southern Italy, and from the Caucasus to north-west Spain and Wales. Limes prefer lowlands to higher elevations, and have been a component of European woodlands for six millennia. Coppicing has been a common form of management for limes, as they produce long straight poles and can be very long-lived (>2000 years) in this form. Lime wood is much valued for carving, as it is soft and resistant to splitting.

Small-leaved lime (*Tilia cordata* Mill.) and large-leaved lime (*Tilia platyphyllos* Scop.) are large-sized deciduous broad-leaved trees. They are long-lived, able to survive more than 1000 years even if coppiced^{1, 2}. *T. cordata* is the more common species in Europe, whilst *T. platyphyllos* extends farther south. Both species can reach 30–40m in height with straight trunks up to around 1m in diameter which are largely free of suckers and epicormic growth, unlike their hybrid *Tilia x europaea* (common lime). Their crowns tend to be quite neat and narrow, becoming untidier as they age, although the high crown can allow a branch-free bole of 10–15m. Despite their common names, the leaves of these two species are very similar: both are often around 9cm long, with *T. platyphyllos* up to 15cm; pointed tips to the leaves are common to both, as are a cordate base, which is more irregular in form in *T. platyphyllos*, a finely-toothed leaf margin, and a dark green shiny upper surface with the underside paler³. *T. cordata* has hairs in the vein axils on the lower surface of its leaves, whereas *T. platyphyllos* is only sometimes hairy on its underside. Both species flower profusely in June and July. The white or pale flowers, which are insect-pollinated, are fragrant and occur in clusters of 4 to 5. Seeds are first produced around 30 to 40 years of age, and every 2–3 years trees produce a reasonable crop of seeds. The seeds of *T. cordata* are smaller than those of *T. platyphyllos*: there are 7500 *T. platyphyllos* seeds per kilogram, compared to 29000 *T. cordata* seeds per kilogram⁴.



Map 1-A: Plot distribution and simplified chorology map for *Tilia cordata*. Frequency of *Tilia cordata* occurrences within the field observations as reported by the National Forest Inventories. The chorology of the native spatial range for *T. cordata* is derived after EUFORGEN and Afonin *et al.*^{26, 27}.

and the Alps lime stands and forests were much more abundant before the expansion and intensification of agriculture 7000–5000 years ago¹⁰. *T. cordata* can grow on calcareous soils, podzols, and brown earths, and can compete with oaks on stagno-gley soils, whilst *T. platyphyllos* is more usually found on rendzinas formed from limestone or basic igneous rocks. If the mean annual precipitation is greater than 850mm, *T. cordata* can also move onto more lime-rich soils⁴, but it is quite drought tolerant¹¹. Neither species is much affected by spring nor autumn frosts, as flushing is relatively late and buds set early¹¹. However, both species require some warmth, being limited in the north of their ranges by temperature. This is particularly true for the production of fertile seed, as in colder regions (such as northern Britain) it is often too cold for the pollen tube to grow following pollination¹². As such, opportunities for limes to spread in such areas only occur following particularly warm summers. Given its relative drought-tolerance and its preference for warmer temperatures, the range of this species may increase in a warming climate¹¹. *T. cordata* and *T. platyphyllos* are both tolerant of shade and tend to grow in close proximity to other species in dense woodlands. Both species show substantial regenerative abilities and have been grown as coppice for millennia. Individual coppice stools may form rings

16m in diameter and may be up to 2000 years old, although precise dating is difficult as the heartwood may have rotted away long ago¹³. Whilst neither *T. cordata* nor *T. platyphyllos* is as susceptible to aphid infestation as *Tilia x europaea*, it has been said that the soils underneath lime trees may receive up to 1 kg per square metre of sugars from honeydew. This nutrient input is thought to stimulate nitrogen-fixing bacteria in the soils, enriching them with nitrogen and phosphorus¹⁴.

Importance and Usage

Both the main lime species in Europe produce a wood that is light in colour and soft enough to carve, but resistant to splitting⁴. Some of the earliest uses of lime wood includes bows and shields, as well as “bast”, which is a tough fibrous material derived from the inner bark and used for rope and clothing. Coppicing of *Tilia* has long been practiced, as the trees are capable of producing long, straight poles⁴. As the wood of both *T. cordata* and *T. platyphyllos* can be worked easily, it has been a highly favoured material for carving since the Middle Ages, as well as for musical instruments, clogs, beehives, and cuckoo clocks^{15, 16}. Honey from the flowers of lime trees is also much valued, and a tea made from the flowers (Tilleul) has long been thought to have anti-inflammatory properties¹⁷. One of the common uses of lime trees has been as a street tree in much of Europe, notably along Unter den Linden in the centre of historic Berlin¹⁸.



Isolated small-leaved lime (*Tilia cordata*) in Leskova Dolina (South Slovenia). (Copyright Stefano Zerauscek, www.flickr.com: AP)



Inflorescences of white-yellowish fragrant flowers arranged in clusters of 4-5. (Copyright Giovanni Caudullo: CC-BY)

Distribution

T. cordata and *T. platyphyllos* are native to much of Europe, with their ranges extending from southern Finland to southern Italy and the Caucasus. *T. cordata* is the more abundant of the two species and its core region is central and eastern Europe. It can be found as far north as southern Norway and Finland and at elevations up to 1500m in the central Alps⁵. *T. platyphyllos* has a smaller range, reaching slightly farther south but only reaching southern Sweden at its northern extent and having a much more patchy occurrence in northern central Europe. Neither species is present in the far west of Europe, with the western extent in North-West Spain and Wales⁶. In Europe, two other species of lime occur naturally: the silver lime (*Tilia tomentosa* Moench.) and the Caucasian lime (*Tilia dasystyla* Stev.) with two noticeable subspecies *caucasica* and *dasystyla*. *T. tomentosa* especially occurs in the Balkans and Hungary, while *T. dasystyla* is peculiar to the regions around the Black Sea^{5, 7, 8}.

Habitat and Ecology

Both *T. cordata* and *T. platyphyllos* are trees of lowlands and the lower slopes of hills rather than higher elevations, and have been present in European woods for more than 10000 years⁹. In Britain, limes are generally associated with oak and beech woodlands, and their presence is often taken as an indicator or ancient woodland (i.e. since before 1600 CE)⁴. In Central Europe



Large-leaved lime (*Tilia platyphyllos*) on karst plateau near Lokev village (Sežana, Slovenia). (Copyright Stefano Zerauscek, www.flickr.com: AP)

Threats and Diseases

T. cordata and *T. platyphyllos* are generally quite disease resistant. Bleeding stem cankers caused by *Phytophthora cactorum* and *Phytophthora citricola* have been recorded on limes. *T. cordata* is sensitive to *Phytophthora plurivora*^{19, 20}. Aphids can be a problem, but to a much lesser extent with *T. cordata* and *T. platyphyllos* than with common lime: in severe infestations the honeydew dripping onto lower leaves allows sooty moulds to grow, blocking light from reaching the leaf surface. In common with several woody plants, limes are susceptible to be attacked by the gypsy moth (*Lymantria dispar*) and by the nun moth (*Lymantria monacha*)²¹⁻²⁴. In particular, *T. cordata* is highly



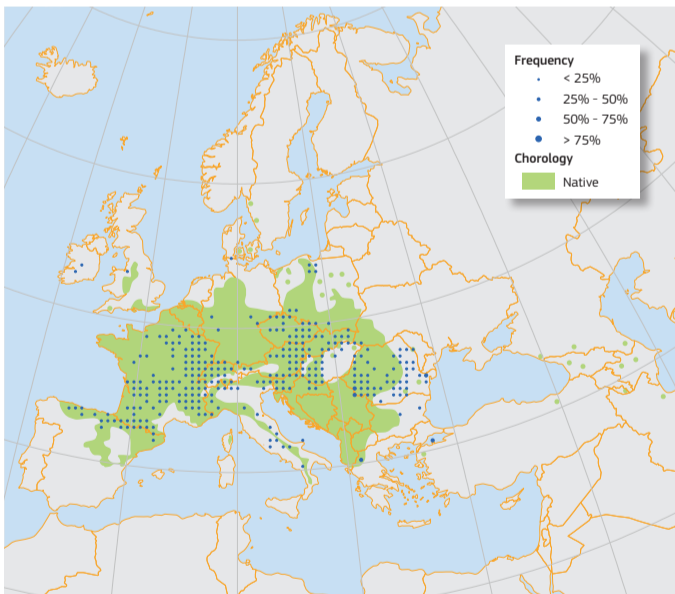
Pendulous fruits of small-leaved lime (*Tilia cordata*). (Copyright AnRo002, commons.wikimedia.org: CC0)



Red galls on lime leaves caused by the mite *Eriophyes tiliae*.
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Leaves of European lime are very similar, with toothed margin, cordate base and pointed tips.
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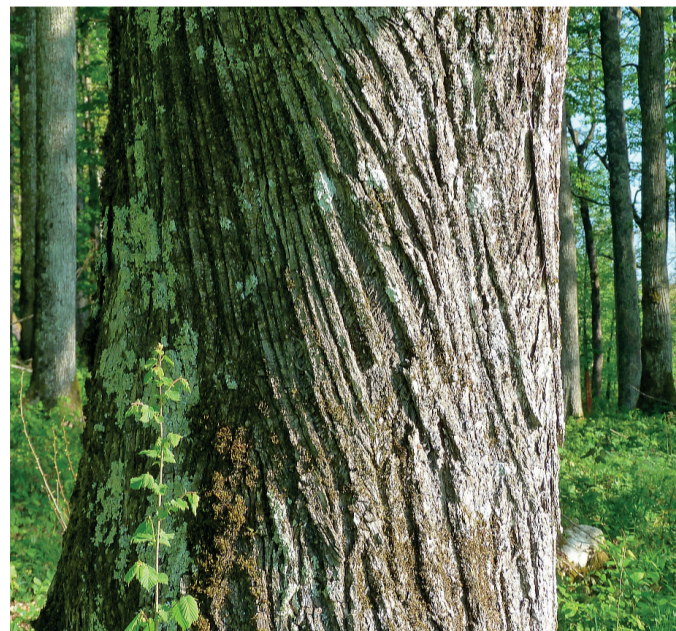


Map 1-B: Plot distribution and simplified chorology map for *Tilia platyphyllos*. Frequency of *Tilia platyphyllos* occurrences within the field observations as reported by the National Forest Inventories. The chorology of the native spatial range for *T. platyphyllos* is derived after EUFORGEN²⁸.

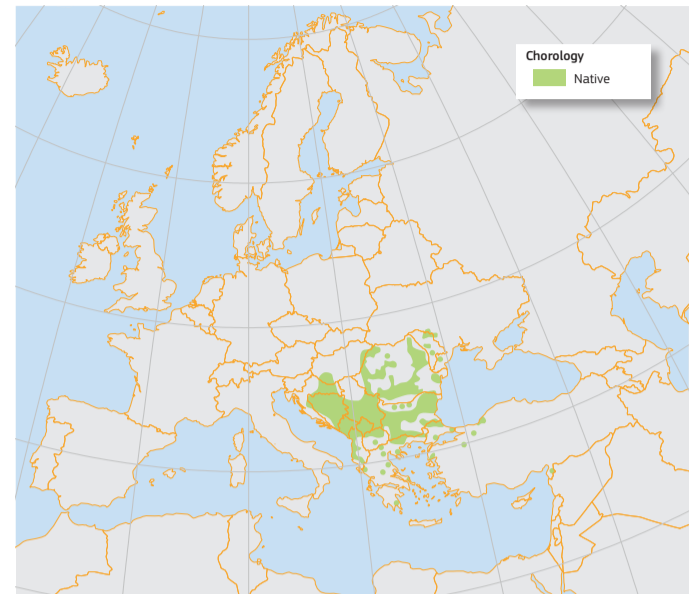
vulnerable to the gypsy moth and *T. platyphyllos* is susceptible to the nun moth. Invertebrates to which limes play host include *Stigmella tiliae*, a leaf-miner; the lime hawk-moth, *Mimas tiliae*; and *Eriophyes tiliae*, the lime nail gall¹⁶. Natural regeneration of limes rarely persists long, as it is very palatable to small browsing mammals, such as bank voles⁴. Mature trees may have their bark stripped by browsing cattle²⁵.



Trunk of small-leaved lime (*Tilia cordata*), which generally reaches lower heights than large-leaved lime (*Tilia platyphyllos*).
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Bark of small-leaved lime (*Tilia cordata*) forming longitudinal fissures at the base of the trunk.
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Map 1-C: Plot distribution and simplified chorology map for *Tilia tomentosa*. Frequency of *Tilia tomentosa* occurrences within the field observations as reported by the National Forest Inventories. The chorology of the native spatial range for *T. tomentosa* is derived after Meusel and Jäger²⁹.

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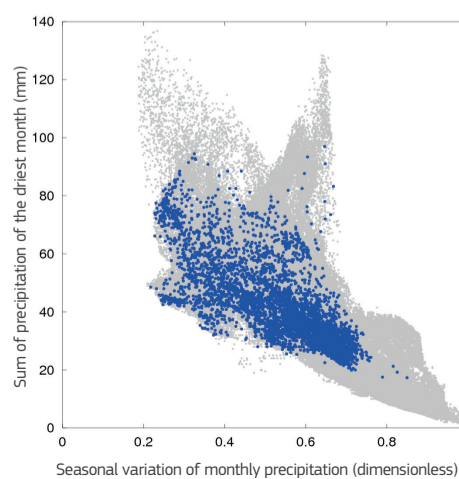
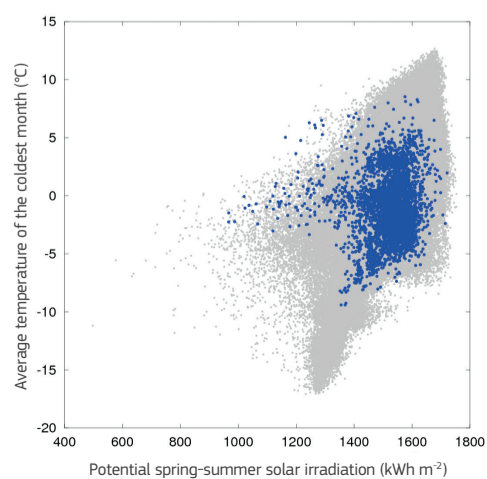
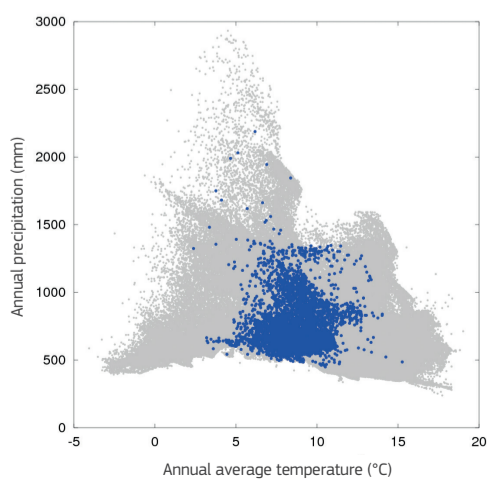
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Hairs in the vein axils on the leaf lower face of small-leaved lime (*Tilia cordata*).
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Field data in Europe (including absences) ● Observed presences in Europe ●

Autoecology diagrams based on harmonised field observations from forest plots for the whole genus *Tilia*.



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