

DISEASE-RESISTANT ELM CULTIVARS

Their role in the conservation of the White-letter Hairstreak

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**Butterfly
Conservation**

Saving butterflies, moths and their habitats

Disease-resistant elm cultivars, *Butterfly Conservation* trials report August 2019

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1. Abstract

The Hampshire & Isle of Wight Branch of *Butterfly Conservation* (BC) initiated trials of elm cultivars and species resistant to Dutch Elm Disease (DED) in 2000, in fulfilment of Objective 5 for the White-letter Hairstreak (WLH) in BC's *South Central Regional Action Plan*: to evaluate their potential as host plants for the butterfly, then on the IUCN Red List as 'in imminent danger of extinction'. In 2015, the White-letter Hairstreak was found breeding on the DED-resistant cultivars LUTECE and 'Sapporo Autumn Gold'. The discovery of the WLH on LUTECE is particularly significant as the tree has a very different periodicity from the reputedly favourite native host, wych elm, suggesting the insect is possessed of a considerable adaptability which could see it breeding on all the high-resistance cultivars featured in this report.

2. Introduction

The trials are located at four sites in southern Hampshire which feature very diverse ground conditions, from arid rendzinas atop an outlier of the South Downs to waterlogged clays below 1m A S L along the shores of Portsmouth Harbour. This report describes 11 cultivars with a scientifically proven '5 out of 5' resistance to DED, and the anomalous species, the European White Elm *U. laevis* which, whilst devoid of any innate resistance, is rarely infected owing to a triterpene in its bark rendering it unpalatable to the vector beetles.

The high DED-resistance of the cultivars featured in this report has been determined in Europe by the Institut Nationale pour la Recherche Agronomique (INRA) in France, the Istituto per la Protezione delle Piante (IPP) in Italy, the Universidad Politecnica Madrid (UPM), and the Eisele GmbH nursery in Germany. Testing in all instances was by inoculation with unnaturally high doses (10^6 spores / ml) of the DED pathogen *O. novo-ulmi* subsp. *americana*.

The trials therefore initially concentrated on the growth and appearance of the trees, together with their tolerance of environmental stresses such as exposure, drought, and waterlogging.

3. List of highly DED-resistant trees included in the trials

CULTIVAR	ORIGIN
'Ademuz'	Universidad Politecnica Madrid, Spain
'Columella'	Dorschkamp, Wageningen, Netherlands
'Morfeo'	IPP, Florence, Italy
'Nanguen' = LUTÈCE *	Dorschkamp, Wageningen, Netherlands
'New Horizon'	WARF, Wisconsin, US
'Plinio'	IPP, Florence, Italy
'Rebona'	WARF, Wisconsin, US
'San Zanobi'	IPP, Florence, Italy
'Sapporo Autumn Gold'	WARF, Wisconsin, US
'Wanoux' = VADA	Dorschkamp, Wageningen, Netherlands
'Wingham'	IPP, Florence, Italy

SPECIES (exceptionally high field resistance)

Ulmus laevis

Various locations in Europe

* Names in upper case are the 'selling' names used in commerce. Cultivar names are written in lower case within single inverted commas. Other elms trialled are listed at the end of the report.



Figure 1. LUTECE elm, Newport, IoW, hosting the WLH in 2015

Photo: Caroline Dudley

4. Performance

Most of the elms described here are hybrid cultivars, with Asiatic ancestors such as the Himalayan Elm *U. wallichiana* and Siberian Elm *U. pumila*, from whom they have inherited their anti-fungal genes. However, environmental conditions in the Far East are, with few exceptions, very different from those found in southern England. A critical aspect of the trials has therefore been the assessment of the trees' adaptation to a temperate maritime climate.

Several cultivars also differed in appearance from the European species, with fastigate structure and / or uncharacteristic foliage. Ergo: some would not, for all their virtues, look at home in the wider countryside, and better retained as ornamentals for urban streets and parks.

5. Availability in the UK

On 1 January 2018 strict import controls were imposed by DEFRA to reduce the risk of the accidental import of alien phytophtherae unknown in the UK, notably Elm Yellows (phloem necrosis). Accordingly, all consignments of elms from outside the UK must now carry phyto-passports declaring their area of origin free of such diseases. This has meant the termination of all imports of the worthy elm cultivars raised by IPP Italy, owing to the prevalence of Elm Yellows across much of the country. However, these same trees are still reviewed in this report as there is no restriction on their propagation in the UK provided they are not used for commercial purposes. Negotiations began in 2019 with several British nurseries to explore the propagation of some of the better cultivars under licence.

6. The butterfly

The White-letter Hairstreak *Satyrrium w-album* is a monophagic species entirely reliant on elm. Larvae have been very occasionally found feeding on oak and bird cherry in continental Europe, but these occurrences are regarded as random. Moreover, it is *sexually mature* elm which is preferred as the larvae hatch in mid-March, a number of weeks before the leaves flush, and immediately feed on the elm flowers before progressing to the seeds. (Figure 2). However, recent research by Bink et al. in the Low Countries discovered that larvae hatching on flowerless trees are able to survive by remaining dormant for up to six weeks, ie. until the leaves flush, provided climatic conditions allow them to rehydrate immediately on hatching. This phenomenon could explain the occasional sightings of the butterfly on immature English elm *U. minor* 'Atinia' suckers.

The White-letter Hairstreak is also endemic to much of the Far East, where it thrives on several of the Asiatic elms used in hybridization or planted in their own right in Europe and the US, such as Japanese and Siberian elm, which have also been colonized by the butterfly in the UK. The butterfly is not found in North America. The WLH has only recently colonized elms at the BC trials plantations owing to extinctions in their neighbourhoods soon after planting. However, it has been found breeding elsewhere on the cultivar 'Nanguen' (selling name: LUTÈCE) planted on the Isle of Wight in 2003, 'New Horizon' at the Vauxhall Pleasure Gardens, London, and 'Sapporo Autumn Gold' in Hertfordshire.

NB. The French natural history unit VarWild has produced a 14-minute film of the lifecycle of the WLH, with close-up photography: <https://www.youtube.com/watch?v=vdDNGF2HDr0>



Figure 2. White-letter Hairstreak larva on elm flower.

Photo: Peter Eeles

7. The future

The discovery by the Escuela de Montes, Universidad Politecnica Madrid (UPM), of putative native field elms *Ulmus minor* with a very high resistance to Dutch elm disease must represent the most significant development in the history of European elm breeding. The trees are currently undergoing assessment at four UPM outstations before release to commerce. However, retrospective DNA analysis has recently found that several, at least, hold genes of *Ulmus pumila*, introduced in the 16th century, which will compromise their intended use as forestry material in Spain.

The restrictions introduced by DEFRA on elm imports from the EU have significantly reduced the range of cultivars imported into the UK. Moreover, the importation of *all* plants may yet be subjected to two years' quarantine, as advocated by Forest Research, in recognition of the threat from alien phytophtherae, 17 of which have been accidentally introduced to the UK in the past 30 years. Ergo, attempts are being made to persuade British nurseries to obtain Plant Breeders' Rights to raise and legitimately sell the trees in the UK. However, as the potential elm market is essentially founded on conservation, the volume of sales is likely to be comparatively small. Making a financial commitment (@4000 Euros down-payment in 2019) may therefore be considered prohibitive, and it is hoped agreements can be reached on a royalty-only basis.

In 2019, the hybrid obtained by Dr David Herling ('Wingham' × *U. minor* 'Tonge Hill') indicated high DED-resistance after inoculation tests conducted in Kent, offering the possibility of a home-bred resistant tree approximating the stature of the native Plot elm. However, it will be the response of the tree in 2020 to the inoculation that will be of critical importance. Tests on seedlings from openly pollinated 'Morfeo' and 'San Zanobi' are also keenly anticipated.

Meanwhile in Germany, at the Eisele nursery, Darmstadt, licenced propagators of 'New Horizon' and 'Rebona', further testing of the company's own hybrid, provisionally named 'Eisele H1' which includes the American elm *Ulmus rubra*, a cousin of the wych elm, is due in 2020. The Eisele company has already applied for patent. The recent discovery of the Elm Yellows phytoplasma *Candidatus phytoplasma ulmi* across France up to the Channel coast remains a cause for concern, as many hybrid cultivars with Asiatic species such as *U. wallichiana* in their ancestries have been found to be especially susceptible, the disease historically unknown beyond Europe and North America. At least one European elm authority considers it likely the disease already exists in the UK, its presence masked by the resemblance of its overt symptoms to those of DED. As a precaution against Elm Yellows and mutations of DED, the planting of a range of cultivars in any one location is always to be strongly recommended.



Figure 3. White-letter Hairstreak ovipositing on LUTECE elm.

Photo: Peter Hunt

8. The trees described

The following pages offer illustrated descriptions of the 11 most disease-resistant cultivars on both sides of the Atlantic, together with the European White Elm *Ulmus laevis*. A performance checklist is offered on each page:

+++ = Good, ++ = Average, + = Poor

'Ademuz'

Ulmus minor cultivar from Spain

**DESCRIPTION**

'Ademuz' is one of a number of highly DED-resistant Field Elm *Ulmus minor* clones under assessment by the Escuela de Montes, Universidad Politecnica Madrid, as potential forestry trees. The branches are largely devoid of corky tissue, the leaves, on 5 mm petioles, are ovate, typically oblique at the base and acuminate at the apex, the average length and width 5.5 × 3.5 cm, the margins doubly serrate. The tree, cloned from an unidentified specimen near the eponymous town north-west of Valencia, develops a balanced, open structure, and was considered the most attractive of the 'Madrid 7', scoring 4.5 out of 5. Foliar density relative to 'Sapporo Autumn Gold' is described as 'medium'. 'Ademuz' readily suckers from roots to form clumps.

PERFORMANCE

- +++ Stability (resistance to wind rock)
- +++ Resistance to exposure (leaf scorch, branch breakage)
- +++ Resemblance to native elm
- ++ Suitability for street planting
- +++ Rate of growth
- ++ Tolerance of waterlogging
- +++ Tolerance of drought

Wikipedia: http://en.wikipedia.org/wiki/Ulmus_%27Ademuz%27

ResistantElms: <http://www.resistantelms.co.uk/ulmus-minor-ademuz/>

'Columella'

Hybrid Dutch cultivar: 'Plantyn' self- or openly-pollinated



DESCRIPTION

'Columella' has a most distinctive fastigiate, monopodial structure, although the crown eventually broadens with age. The peculiarly twisted leaves are in asymmetric clusters on short branchlets, often encircling them and remaining thus well into winter, a trait inherited from its Exeter Elm ancestor. 'Columella' readily defoliates in drought, a trait inherited from its Himalayan elm ancestor, and is also salt-intolerant. Moreover, trees in the Netherlands > 25 years old are now collapsing because of graft incompatibility with their wych elm rootstocks. However, all trees raised post-2012 are understood to have been propagated on their own roots.

PERFORMANCE

- +++ Stability (resistance to wind rock)
- +++ Resistance to exposure (leaf scorch, branch breakage)
 - + Resemblance to native elm
- +++ Suitability for street planting
- +++ Rate of growth
 - ? Tolerance of waterlogging
 - ++ Tolerance of drought

Wikipedia: http://en.wikipedia.org/wiki/Ulmus_%27Columella%27

ResistantElms: <http://www.resistantelms.co.uk/elms/ulmus-columella/>

'Morfeo'

Hybrid Italian cultivar: Heybroek '405' (*U. × hollandica* × *U. minor*) × *U. chenmoui*



DESCRIPTION

'Morfeo' is a robust, fast-growing tree able to freestand at a very early age. The stem commences forking at between 1.5 and 2.0 m from the ground, the branches on juvenile trees with irregular patches of corky bark. The reddish branchlets bear mid-green elliptic leaves, < 120 mm (avg. 88 mm) long × < 80 mm (avg. 56 mm) broad with 10 mm petioles. The leaves closely resemble those of the Field Elm, with typically asymmetric base and acuminate apex; they turn crimson in late October, before falling in early November. In the UK the tree begins flowering in its fourth year, the perfect, apetalous wind-pollinated flowers appearing in mid-March. Reputed to sucker from roots, it has yet to do so in the BC trials.

PERFORMANCE

- +++ Stability (resistance to wind rock)
- +++ Resistance to exposure (leaf scorch, branch breakage)
- ++ Resemblance to native elm
- ++ Suitability for street planting
- +++ Rate of growth
- ++ Tolerance of waterlogging
- +++ Tolerance of drought

Wikipedia: http://en.wikipedia.org/wiki/Ulmus_%27Morfeo%27

ResistantElms: <http://www.resistantelms.co.uk/morfeo/>

'Nanguen' = LUTÈCE

Hybrid Dutch cultivar: ('Plantyn' × (*U. minor* × *U. minor*)) × ('Bea Schwarz' × 'Bea Schwarz' selfed)

**DESCRIPTION**

The stem of LUTÈCE typically forks at a height of 1 - 2 m, with < 5 branches steeply ascending to form an open crown. The leaves are < 11 cm long × < 10 cm wide, similar in shape to those of the Field Elm *U. minor*, but with a rough upper surface and coarsely serrated margins. The leaves are very late to flush, rarely before mid-May, a trait inherited from the Himalayan Elm *U. wallichiana* ancestor. In adolescence, the tree can require prolonged staking before it is able to freestand at about age 6. A specimen planted 2003 at Newport, IoW, was found to host the WLH in 2015. In France, some young LUTÈCE plants were killed by the Elm Yellows phytoplasma, a pathogen unknown in the UK, the Himalayan elm known to be particularly susceptible to the disease.

PERFORMANCE

- ++ Stability (resistance to wind rock)
- +++ Resistance to exposure (leaf scorch, branch breakage)
- +++ Resemblance to native elm
- ++/+ Suitability for street planting (++ for grafted trees, + on own roots)
- +++ Rate of growth
- ++ Tolerance of waterlogging
- +++ Tolerance of drought

Wikipedia: http://en.wikipedia.org/wiki/Ulmus_%27Nanguen%27

ResistantElms: <http://www.resistantelms.co.uk/elms/ulmus-lutece/>

'New Horizon'

Hybrid American cultivar: *Ulmus davidiana* var. *japonica* × *U. pumila*



DESCRIPTION

The tree initially has a compact, pyramidal form, with comparatively dense foliage comprising glabrous, dark-green, elliptical leaves < 12 cm long by < 7 cm broad, occasionally without the asymmetric bases typical of the genus. Flowering, and consequently fruiting, is meagre, a trait inherited from its Japanese elm 'mother'. The tree increases in height only slowly, while its trunk thickens comparatively quickly. The crown of 'New Horizon' can occasionally suffer < 25 % natural twig dieback over winter, seriously disfiguring the tree. Moreover, it grows poorly on all but free-draining soil although none perished anywhere. Available only as >4 m standards, it was found colonized by the White-letter Hairstreak in Vauxhall Pleasure Gardens, London, in 2017.

PERFORMANCE

- +++ Stability (resistance to wind rock)
- ++ Resistance to exposure (leaf scorch, branch breakage)
 - + Resemblance to native elm
- +++ Suitability for street planting
 - + Rate of growth
 - ++ Tolerance of waterlogging
 - +++ Tolerance of drought

Wikipedia: http://en.wikipedia.org/wiki/Ulmus_%27New_Horizon%27

ResistantElms: <http://www.resistantelms.co.uk/elms/the-best-of-the-rest/>

'Plinio'

Hybrid Italian cultivar: 'Plantyn' × *U. pumila*



DESCRIPTION

'Plinio' is a Jekyll and Hyde character, forming an ungainly, unsteady tree with sparse, splaying branches and an often inadequate root system where grown on fertile soils (photo, left), whereas on thin, arid rendzinas (chalk soils, photo right) more substantial roots are stimulated, whilst exposure encourages a sturdier, denser, top-growth. 'Plinio' has proven one of the most successful cultivars trialled at the site on Ports Down (a South Downs outlier, drift geology Brickearth). The leaves are < 6.5 cm long × < 3.0 cm broad, glabrous on both sides, but devoid of autumn colour. The tree is one of the most DED-resistant ever raised in the Italian elm breeding programme, but no longer available from Italy owing to prevalence of elm yellows there. Rarely planted in the UK.

PERFORMANCE

- +++/+ Stability (resistance to wind rock) (+++ on chalk / + on fertile soil)
- +++ Resistance to exposure (leaf scorch, branch breakage)
- ++ Resemblance to native elm
 - + Suitability for street planting
- ++ Rate of growth
- ++ Tolerance of waterlogging (>3 months' inundation over winter)
- +++ Tolerance of drought

Wikipedia: http://en.wikipedia.org/wiki/Ulmus_%27Plinio%27

ResistantElms: <http://www.resistantelms.co.uk/plinio/>

'Rebona'

Hybrid American cultivar: *Ulmus davidiana* var. *japonica* × *U. pumila*



DESCRIPTION

'Rebona' is considered an improvement on its sibling 'New Horizon', with a slightly more fastigate pyramidal shape, and a better leader. The tree was only included in the BC trials in 2016 and remains too immature for assessment, however others planted elsewhere in the UK have mostly grown well. The clear-green leaves are similar to 'New Horizon', while flowering, and consequent fruiting is meagre, a trait inherited from its Japanese elm 'mother'. The tree increases in height only slowly, while its trunk thickens comparatively quickly. Available only as > 5 m rootballed standards. As its siblings 'New Horizon' and 'Sapporo Autumn Gold' both host the White-letter Hairstreak, it must be a reasonable assumption that 'Rebona' will do also.

PERFORMANCE

- +++ Stability (resistance to wind rock)
- ++ Resistance to exposure (leaf scorch, branch breakage)
 - + Resemblance to native elm
- +++ Suitability for street planting
 - ? Rate of growth
- ++ Tolerance of waterlogging
- +++ Tolerance of drought

Wikipedia: http://en.wikipedia.org/wiki/Ulmus_%27Rebona%27

ResistantElms: <http://www.resistantelms.co.uk/best-of-the-rest/>

'San Zanobi'

Hybrid Italian cultivar: 'Plantyn' × *U. pumila*



DESCRIPTION

'San Zanobi' is a fast-growing, moderately fastigate tree, the branches gradually arching to become pendulous with age. Lack of stability resulting from asymmetric root development was initially a concern, but has been overcome by better propagation practice. The glabrous, bright green leaves are < 15 cm long × < 6 cm broad. However like its compatriot 'Plinio', the foliage lacks striking autumn colours. 'San Zanobi' begins flowering in its sixth year in the UK. Widely planted as a street tree in Italy, notably in the Villa Medici, Rome. 'San Zanobi' is no longer imported from Italy owing to prevalence of elm yellows there. Rarely planted in the UK, 100 were established on the Pan estate, Newport, IoW, by Natural Enterprise circa 2010.

PERFORMANCE

- +++ Stability (resistance to wind rock)
- +++ Resistance to exposure (leaf scorch, branch breakage)
- ++ Resemblance to native elm
- +++ Suitability for street planting
- +++ Rate of growth
- ++ Tolerance of waterlogging
- +++ Tolerance of drought

Wikipedia: http://en.wikipedia.org/wiki/Ulmus_%27San_Zanobi%27

ResistantElms: <http://www.resistantelms.co.uk/elms/the-best-of-the-rest/>

'Sapporo Autumn Gold'

Hybrid American cultivar: *Ulmus davidiana* var. *japonica* × *U. pumila*



DESCRIPTION

'Sapporo Autumn Gold' forms a rounded, open crown similar to that of the Field Elm *U. minor*. The leaves are narrowly-elliptical, < 9 cm × < 4.5 cm wide, turning pale yellow in autumn. Flowering begins when the tree is aged six years. The oldest cultivar on trial, it remains one of the most resistant to DED, exhibiting just 2.8% defoliation and 1.2% dieback after inoculation in Italian trials, and has become the yardstick by which new cultivars are judged. The tree is known to host the White-letter Hairstreak. However, limbs of mature specimens at Christchurch were killed by Dryad's Saddle fungus, while others have suffered branch breakage at exposed sites. 'Sapporo Autumn Gold' remains the cheapest cultivar available, as small bare-root whips from France.

PERFORMANCE

- ++ Stability (resistance to wind rock)
- + Resistance to exposure (leaf scorch, branch breakage)
- +++ Resemblance to native elm
- ++ Suitability for street planting
- ++ Rate of growth
- + Tolerance of waterlogging
- +++ Tolerance of drought

Wikipedia: http://en.wikipedia.org/wiki/Ulmus_%27Sapporo_Autumn_Gold%27

ResistantElms: <http://www.resistantelms.co.uk/sapporo-autumn-gold/>

'Wanoux' = VADA

Hybrid Dutch cultivar: 'Plantyn' × 'Plantyn' selfed



DESCRIPTION

Reported in press as being faster growing than LUTÈCE (in the French trials, VADA achieved 14 m at 20 years of age), this has been contrary to experience in Hampshire. Primarily intended for street planting, VADA is a fairly fastigate tree showing pronounced apical dominance, but it is not yet clear whether it is truly monopodial or merely upright. The stem tends to weave, but the rootstock seems impressively wind-firm. VADA leafs relatively late, in May, though not quite as late LUTÈCE. Leaves on vigorous shoots are large, glossy, and ultimately very dark. However, towards the end of summer the foliage deteriorates, the leaves on the lower half of a branch falling, bestowing a rather shabby, skeletal, appearance. Available as bare-root saplings from France.

PERFORMANCE

- +++ Stability (resistance to wind rock)
- +++ Resistance to exposure (leaf scorch, branch breakage)
 - + Resemblance to native elm
- +++ Suitability for street planting
 - ++ Rate of growth
 - ++ Tolerance of waterlogging
- +++ Tolerance of drought

Wikipedia: http://en.wikipedia.org/wiki/Ulmus_%27Wanoux%27

ResistantElms: <http://www.resistantelms.co.uk/elms/ulmus-vada/>

'Wingham'

Hybrid cultivar: $((U. wallichiana \times U. minor) \times (U. pumila \times U. minor))$ o.p. $\times (U. \times hollandica$ 'Vegeta' $\times U. minor)$ o.p.



DESCRIPTION

The second-most DED-resistant cultivar ever raised by IPP Florence, the tree was never released to commerce in Italy owing to its amorphous structure. In the BC trials, it has proven a qualified success, only prospering on fertile, alluvial soils. Where grown at the eponymous Wingham site in Kent, and at Boarhunt along the Wallington river in Hants it increased in height by over one metre per annum, but on poor chalk soils and clays it has often struggled to survive. Branching is typically rather irregular and unbalanced, but the foliage strongly resembles that of *U. \times hollandica* 'Vegeta', better known as the Huntingdon Elm. Available as whips and saplings propagated in the UK.

PERFORMANCE

- ++ Stability (resistance to wind rock)
- +++ Resistance to exposure (leaf scorch, branch breakage)
- ++ Resemblance to native elm
 - + Suitability for street planting
- +++ Rate of growth (on fertile, alluvial soils only)
- ++ Tolerance of waterlogging
 - + Tolerance of drought

Wikipedia: NA

ResistantElms: <http://www.resistantelms.co.uk/elms/FL493/>

Ulmus laevis – European White Elm

Species, grown from seed



Wikipedia



Wikipedia

DESCRIPTION

Ulmus laevis is an anomaly, a fast-growing species with little or no genetic resistance to DED, but which nevertheless usually survives to great age by dint of Alnulin, a triterpene synthesized in the bark which deters the vector *Scolytus* sp. Beetles from feeding on, and thus infecting, it. A unique, vast, surface root system enables the tree to survive anoxic ground conditions during prolonged (> 100-day) floods. Conversely, the tree is very susceptible to drought conditions. *U. laevis* has little value as timber or firewood, but makes an important amenity tree and host of the White-letter Hairstreak. The tree is easily identified in spring by its flowers and later, seeds, on 25-30mm - long stalks. In maturity, the roots form distinctive buttresses around the bole.

PERFORMANCE

- +++ Stability (resistance to wind rock)
- ++ Resistance to exposure (leaf scorch, branch breakage)
- +++ Resemblance to native elm
- +++ Suitability for street planting
- +++ Rate of growth
- +++ Tolerance of waterlogging (>3 months' inundation over winter)
- + Tolerance of drought

Wikipedia: https://en.wikipedia.org/wiki/Ulmus_laevis

ResistantElms: <http://www.resistantelms.co.uk/ulmus-laevis/>

9. Recommended trees

Countryside

Sheltered sites with moist, fertile soils:

‘Ademuz’
‘Morfeo’
‘Nanguen’ = LUTÈCE
‘San Zanobi’
‘Wingham’
Ulmus laevis

Exposed downland with arid, chalk soils:

‘Ademuz’
‘Morfeo’
‘Nanguen’ = LUTÈCE
‘Plinio’
‘San Zanobi’

Sites with heavy soils, poorly drained, but not waterlogged:

‘Ademuz’
‘Nanguen’ = LUTÈCE
Ulmus laevis

Waterlogged sites flooded for several months overwinter:

Ulmus laevis

Town

Parks & Gardens:

‘San Zanobi’
‘Sapporo Autumn Gold’

Streets:

‘Columella’
‘New Horizon’ (on free draining soils only)
‘Rebona’ (on free draining soils only)
‘San Zanobi’

10. Bibliography

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11. Disease-resistant elm cultivars & *Ulmus laevis*: Suppliers in or to the UK

There are currently no British nurseries with Plant Breeders' Rights enabling them to propagate patented elm cultivars for sale in the UK; consequently all but one of the cultivars sold here have been imported from Europe. Owing to historically poor demand, the range and numbers available in the UK are usually low, except for standards supplied for street planting by Hillier Nurseries. Ergo, where large-scale planting is envisaged, importing direct from a continental nursery is often the only option. While tree prices are generally on a par with those in the UK, carriage charges can substantially increase the final cost. Moreover, most European nurseries will insist on a minimum order value of €500. All imports are required to have a phyt passport declaring their area of origin free of elm diseases, notably elm yellows.

NB: All direct imports of elm plants must be registered by the purchaser with DEFRA via the Edomero system.

Ulmus minor 'Ademuz'

Peter Shallcross, Wallmead Farm, Tisbury, Wilts
Bare-root whips, 0.5-1.0m
W: N/A
E: peterjshallcross@gmail.co.uk
T: 07974 140848

'Columella'

Hillier Nurseries, Andlers Ash, Liss, Hants
Standards >4m high, rootballed
W: www.hilliertrees.co.uk
E: hosseinarshadi@hillier.co.uk
T: 01794 368733

'Morfeo'

! Can no longer be imported from Italy; may be propagated from trees in the UK.

'Nanguen' = LUTÈCE

Duchy of Cornwall Nursery, Lostwithiel, Cornwall
5-litre potted trees
W: www.duchyofcornwallnursery.co.uk
E: sales@duchyofcornwallnursery.co.uk
T: 01208 872668

Frank P Matthews, Tenbury Wells, Worcs.
1.0m bare-root whips available 2019, larger potted saplings available 2020
W: www.frankpmatthews.com
E: nick@frankpmatthews.com
T: 01584 810214

'New Horizon'

Hilliers Nurseries, Andlers Ash, Liss, Hants
Standards >4m high, rootballed
W: www.hilliertrees.co.uk
E: hosseinarshadi@hillier.co.uk
T: 01794 368733

11. Disease-Resistant Elm Cultivars & *Ulmus laevis*: Suppliers in or to the UK, cont.:

'Plinio'

! Can no longer be imported from Italy; may be propagated from trees in the UK.

'Rebona'

Hilliers Nurseries, Andlers Ash, Liss, Hants

Standards >4m high, rootballed

W: www.hilliertrees.co.uk

E: hosseinarshadi@hillier.co.uk

T: 01794 368733

'San Zanobi'

! Can no longer be imported from Italy; may be propagated from trees in the UK.

'Sapporo Autumn Gold'

Les Pépinières Minier, 49250 Beaufort-en-vallée, France

Bare-root whips, 1.5m tall (min. order value €500)

W: www.pepinieres-minier.fr

E: gbsales@minier-nurseries.fr

T: 00 33 2 41 79 48 43

'Wanoux' = VADA

Les Pépinières Minier, 49250 Beaufort-en-vallée, France

Saplings grafted onto Sapporo Autumn Gold rootstocks, 1.0-1.5m tall (min. order value €500)

W: www.pepinieres-minier.fr

E: gbsales@minier-nurseries.fr

T: 00 33 2 41 79 48 43

'Wingham'

Frank P Matthews, Tenbury Wells, Worcs.

3-litre whips 2m high, and 12-litre saplings 2.5m high

W: www.frankpmatthews.com

E: nick@frankpmatthews.co.uk

T: 01580 812800

Golden Hill Plants, Marden, Kent

Saplings, bare-root

W: www.goldenhillplants.com

E: enquiries@goldenhillplants.com

T: 01622 833218

Ulmus laevis – European White Elm

Landford Trees, Salisbury, UK

1.5-2.0m bare-root saplings *order before end of August*

W: <https://landfordtrees.co.uk/>

E: ed@landfordtrees.co.uk

T: 01794 390808

12. Other elms included in the trials

Below is a list of other cultivars and species planted. These are not described here on account of their resistance to DED or other diseases in Europe being found to be either substandard or, as with most of the American cultivars, simply unknown. Much encouragement was taken from the discovery of the WLH breeding on Siberian Elm *U. pumila* planted as landscaping for the town expansion schemes at Andover and Basingstoke in the 1960s, while at Great Fontley and the Sir Harold Hillier Gardens, WLH larvae were found on Japanese Elm *U. davidiana* var. *japonica*. Four cultivars were felled in 2019 owing to their poor growth and / or susceptibility to DED: 'FL316', 'Morton Glossy' = TRIUMPH, 'Patriot', *U. americana* 'Princeton'.

CULTIVAR	ORIGIN
'Arno'	IPP, Florence, Italy
'Fiorente'	IPP, Florence, Italy
<i>U. americana</i> 'Lewis & Clark' = PRAIRIE EXPEDITION	North Dakota State University, US
'Morton' = ACCOLADE	Morton Arboretum, Illinois, US
'Morton Stalwart' = COMMENDATION	Morton Arboretum, Illinois, US
<i>U. davidiana</i> var. <i>japonica</i> 'Prospector'	USDA National Arboretum, US
<i>U. americana</i> 'Valley Forge'	USDA National Arboretum, US
SPECIES	ORIGIN
<i>Ulmus davidiana</i>	Liaoning Province, China
<i>Ulmus davidiana</i> var. <i>japonica</i>	Odori Park, Sapporo, Japan
<i>Ulmus gaussonii</i>	Anhui Province, China
<i>Ulmus glabra</i>	Mount Šimonka, Slovakia
<i>Ulmus laciniata</i>	Odori Park, Sapporo, Japan
<i>Ulmus microcarpa</i>	Chayu region, Tibet
<i>Ulmus parvifolia</i>	Osaka Castle moat, Japan
<i>Ulmus pumila</i>	Utah, US

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