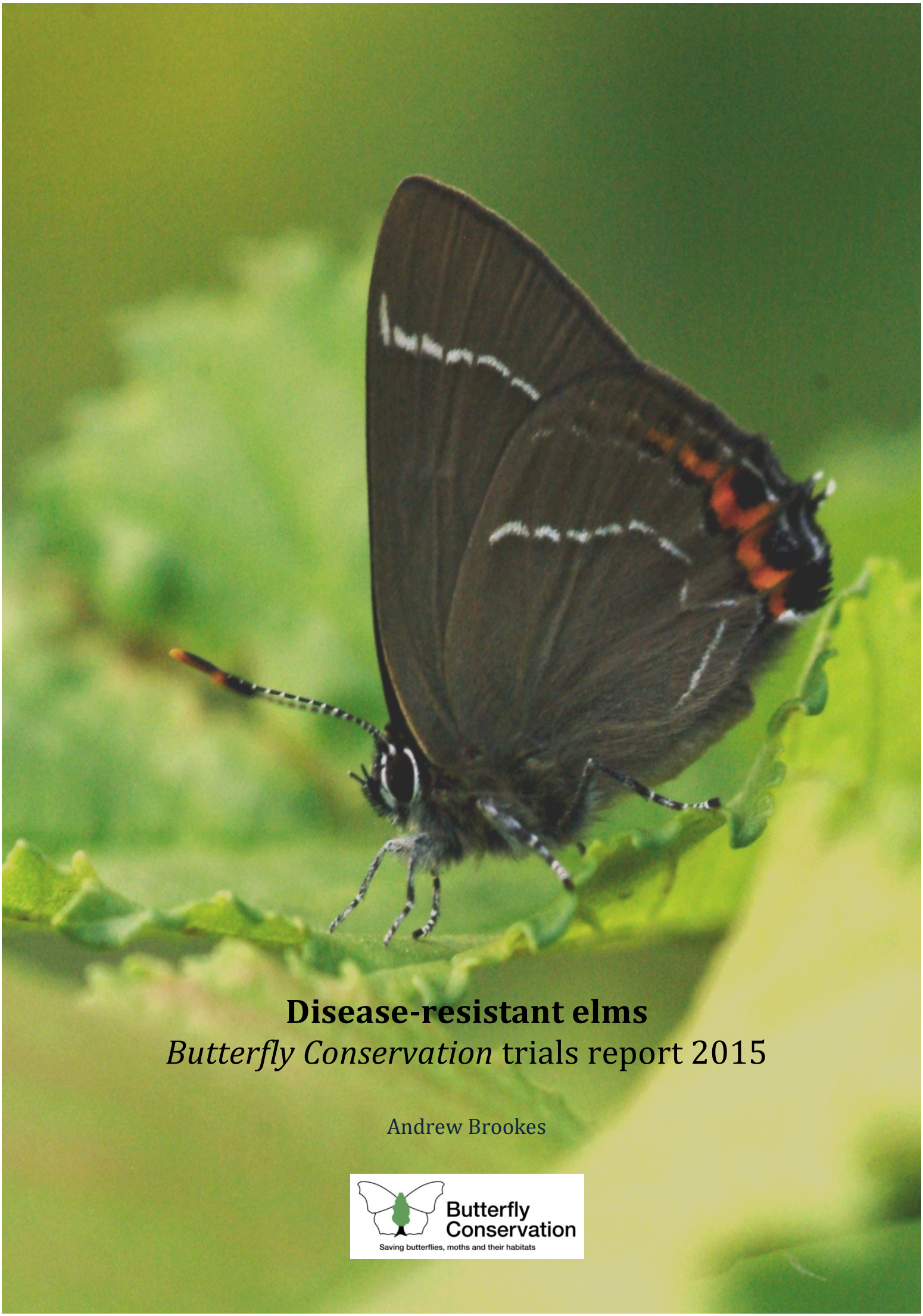


Disease-resistant elms

Butterfly Conservation trials report 2015

Andrew Brookes

Butterfly Conservation
Saving butterflies, moths and their habitats

Disease-resistant elm cultivars

Butterfly Conservation trials report, 5th revision, 2015

Contents:

1. Abstract

The Hampshire & Isle of Wight Branch of *Butterfly Conservation* (BC) initiated trials of elm cultivars and species highly resistant to Dutch Elm Disease (DED) in 2000. The trials are 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, now a DEFRA UK Biodiversity Action Plan 'Priority' species (no. 945) on account of its increasing scarcity as a consequence of DED pandemic. This report, originally published in 2010, has been substantially revised in the light of the 'Princeton' fiasco. 'Princeton', an American Elm cultivar, was widely pro-moted in the UK without having been tested for resistance to DED in Europe. The loss of many 'Princeton' to the disease, notably at Highgrove House, has prompted the relegation of other American cultivars until such time as their resistance has been proven here.

This fifth revision also acknowledges the discovery of the White-letter Hairstreak on LUTECE elm planted in 2003 on the Isle of Wight, the first known instance of the butterfly breeding on a modern, highly DED-resistant cultivar. This discovery is hugely significant in demonstrating the insect's adaptability, able to survive on a tree that has a very different periodicy to its preferred native host, the Wych Elm *Ulmus glabra*.

2. Introduction

The elm trials are located at four sites in southern Hampshire. The sites feature very diverse ground conditions, from arid rendzinas atop an outlier of the South Downs to waterlogged London Clays less than 1 m A S L along the shores of Portsmouth Harbour. This report describes cultivars with a scientifically proven '5 out of 5' resistance to DED available in Europe. The resistance of the trees to DED has been determined by the *Institut Nationale pour la Recherche Agronomique* (INRA) in France, and the *Istituto per la Protezione delle Piante* (IPP) in Italy; testing in both instances was by inoculation with unnaturally high doses (inoculum strength 10^6 spores / ml) of the pathogen *Ophiostoma novo-ulmi*.

The BC trials in Hampshire have therefore focussed on the growth and appearance of the trees, together with their tolerance of environmental stresses such exposure, drought, and waterlogging.

3. List of trees

CULTIVAR	ORIGIN
'Ademuz'	University Politecnica Madrid, Spain
'Columella'	Dorschkamp, Wageningen, Netherlands
'Nanguen' = LUTECE *	Dorschkamp, Wageningen, Netherlands
'New Horizon'	WARF, Wisconsin, USA
'Plinio'	IPP, Florence, Italy
'San Zanobi'	IPP, Florence, Italy
'Sapporo Autumn Gold'	WARF, Wisconsin, USA
'Wanoux' = VADA	Dorschkamp, Wageningen, Netherlands

Below is a list of other cultivars and exotic species planted. These are not described here on account of their resistance to DED or other diseases in Europe subsequently being found to be either sub-standard or, as with most of the American cultivars, simply unknown.

CULTIVAR	ORIGIN
'Arno'	IPP, Florence, Italy
'Dodoens'	Dorschkamp, Wageningen, Netherlands
'Fiorente'	IPP, Florence, Italy
'Lewis & Clark' = PRAIRIE EXPED.	North Dakota State University, USA
'Morfeo'	IPP, Florence, Italy
'Morton' = ACCOLADE	Morton Arboretum, Illinois, USA
'Morton Glossy' = TRIUMPH	Morton Arboretum, Illinois, USA
'Patriot'	USDA National Arboretum, USA
'Princeton'	Princeton Nursery, Princeton, Mass. USA
'Prospector'	USDA National Arboretum, USA
'Valley Forge'	USDA National Arboretum, USA

EXOTIC SPECIES	ORIGIN
Ulmus davidiana	Liaoning Province, China
Ulmus davidiana var. *japonica*	Sapporo, Japan
Ulmus laciniata	Sapporo, Japan
Ulmus laevis	Val d'Allier, France
Ulmus macrocarpa	Beijing Botanic Garden, China
Ulmus microcarpa	Chayu region, Tibet

*NB Names in capitals are the selling names used in commerce, as opposed to the registered cultivar names which are always written within single inverted commas. Unlike cultivar names, selling names may vary from country to country.

4. Performance

Only one of the trees died in the trials, for reasons unknown, but two cultivars exhibited poor stability and required stake support for several years, while several others grew very slowly and / or exhibited poor structure. Most of the elms are hybrid cultivars, with Asiatic ancestors from whom they have inherited their anti-fungal genes. However, environmental conditions in the Far East are, with few exceptions, very different from those experienced in southern England. Typically, winters in the mountains of Asia, where most of the elm species are found, are dry and very cold, whilst summers are short, hot, but wet. A critical aspect of the trials was therefore the assessment of the cultivars' adaptation to a temperate maritime climate. Many of the cultivars also differ in appearance from the European species, often being significantly smaller with uncharacteristic foliage. Ergo: some would not, for all their virtues, look at home in the wider English countryside, and are better retained as ornamentals in the urban environment.

Cultivar	Δ d.b.h. cm	Cultivar	Δ ht. cm
Ademuz	2.06	Ademuz	103
Nanguen = LUTÈCE	1.98	San Zanobi	87
San Zanobi	1.45	Nanguen = LUTÈCE	64
Plinio	1.35	Plinio	60
Columella	1.22	Columella	56
New Horizon	0.85	Sapporo Autumn Gold	53
Wanoux = VADA	0.85	Wanoux = VADA	53
Sapporo Autumn Gold	0.62	New Horizon	13

Average annual increments in d.b.h*. and height at Great Fontley, Fareham
*d.b.h. = diameter at breast height (@1.3m)

5. The butterfly

The White-letter Hairstreak *Satyrium 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 required as the larvae hatch in mid-March, a number of weeks before the leaves flush, and immediately feed on the elm flowers, progressing to the seeds. (Fig. 1).

Much enouragement can be found in the fact that the White-letter Hairstreak is also endemic to much of the Far East, including Siberia and Japan, where it thrives on several of the elms used in hybridization in Europe and the USA; the insect is not found in North America however. Although the WLH has yet to colonize the trees in the trials' plantations, it has been found on the DED-resistant cultivar 'Nanguen' (selling name: LUTECE).

Fig. 1 White-letter Hairstreak larva on elm flower. **Photo: Peter Eeles**

Fig. 2 LUTECE elm, Newport, IoW, hosting the WLH in 2015 **Photo: Caroline Dudley**

6. The future

The propagation by the Forestry Department of the University Politecnica Madrid of native Field Elms *Ulmus minor* with a very high resistance to Dutch elm disease must represent the most significant development in the 87-year history of European elm breeding. The trees are awaiting patenting by the Spanish government, whereupon they will become commercially available. Able to sucker readily from roots, they should make excellent hedgerow trees.

Meanwhile, the release without patent of the Italian clone FL493, the second most DED-resistant cultivar ever raised by the Institute of Plant Protection, Florence, presents the opportunity to freely propagating and marketing an excellent elm within the United Kingdom. The tree has a complex ancestry, including the English Huntingdon Elm, whose foliage it closely resembles; it should be commercially available in the UK by 2018.

The recent discovery of the Elm Yellows phytoplasma across France remains a cause for concern, as many hybrid cultivars with exotic species such as *U. wallichiana* in their ancestries have been found to be particularly susceptible, as are some forms of Field Elm. As a precaution against its introduction to the UK, and against mutations of Dutch elm disease, the planting of a range of cultivars in any one scheme is recommended.

The importation of all trees from Europe may well become more strictly controlled, even subjected to quarantine, in recognition of the threat from alien phytophtherae, 17 of which have been accidentally introduced to the UK in the past 30 years. Ergo, the propagation of home-grown elms is to be actively encouraged.

Fig. 3 Elm yellows Photo: Eric Collin

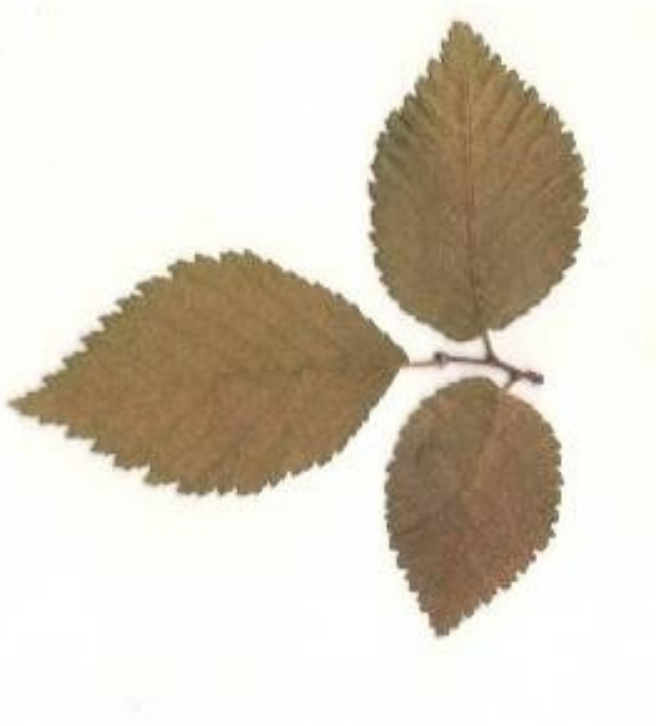
7. The trees described

The following pages offer illustrated description of the cultivars and the species *Ulmus laevis*. A performance checklist is offered on each page:

+++ = Good, ++ = Fair, + = Poor.

‘Ademuz’

Ulmus minor cultivar from Ademuz district of Valencia
Origin: University Politecnica Madrid, released 2015



DESCRIPTION

'Ademuz' is mostly monopodial, and comparatively fast-growing at >100 cm per annum, the fastest of the seven *U. minor* clones under assessment at Puerta de Hierro, Madrid. The branches are 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 54 × 34 mm, the margins doubly serrate. Foliar density relative to 'Sapporo Autumn Gold' is described as 'medium'. ‘Ademuz’ and its siblings readily sucker from roots to form clumps.

‘Ademuz’ is scheduled to be released to commerce in winter 2015.

PERFORMANCE

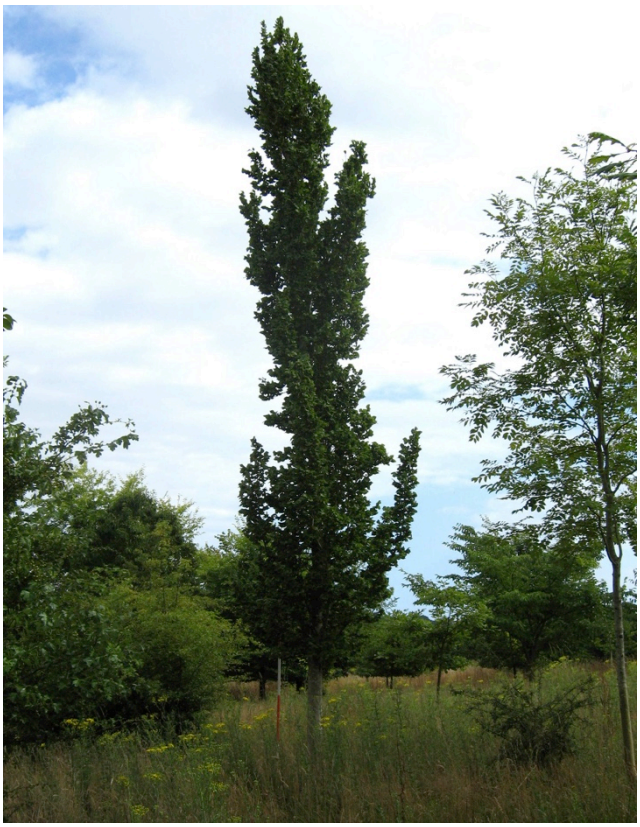
+++ Stability (resistance to wind rock)
+++ Resistance to exposure (leaf scorch, branch breakage)
+++ Resemblance to native elm
+ Suitability for street planting
+++ Rate of growth (ht. max.: 0.56 m p. a. / d.b.h.: 1.22 cm p. a.)
+++ Tolerance of waterlogging (>3 months’ inundation over winter)
+++ Tolerance of drought

Wikipedia: http://en.wikipedia.org/wiki/Ulmus_%27Ademuz%27
ResistantElms: http://www.resistantelms.co.uk/ulmus-minor-ademuz/

‘Columella’

Hybrid cultivar: ‘Plantyn’ selfed

Origin: Dorschkamp, Netherlands; released 1989.



DESCRIPTION

A tall, fastigiate tree with very upright branches, but develops a broader crown in later years. The rough and curiously twisted leaves, < 7 cm long, are the result of a recessive gene inherited from its Exeter Elm ancestor, and are arranged in asymmetric clusters on short branchlets. The first Dutch cultivar highly resistant to the new strain of DED, it was released in 1989. Owing to the Himalayan Elm in its ancestry, ‘Columella’ is quickly stressed by drought, and will readily shed its leaves as early as August.

PERFORMANCE

+++ Stability (resistance to wind rock)
+++ Resistance to exposure (leaf scorch, branch breakage)
+ Resemblance to native elm
+++ Suitability for street planting
++ Rate of growth (ht. max.: 0.56 m p. a. / d.b.h.: 1.22 cm p. a.)
+++ Tolerance of waterlogging (>3 months’ inundation over winter)
+ Tolerance of drought

Wikipedia: http://en.wikipedia.org/wiki/Ulmus_%27Columella%27
ResistantElms: http://www.resistantelms.co.uk/elms/ulmus-columella/

‘Nanguen’ = LUTÈCE

Hybrid cultivar: (‘Plantyn’ × *(U. minor* × *U. minor))* × (‘Bea Schwarz’ × ‘Bea Schwarz’ self.)
Origin: Dorschkamp, Netherlands; released 2002 by INRA, France (patent holders).

DESCRIPTION

The stem of LUTÈCE typically forks at a height of 1 - 2 m, < 5 steeply ascending branches develop to form an open crown. LUTÈCE is distinguished by the shape and colour of its leaves; < 11 cm long × 10 cm wide, almost identical to those of the Field Elm *U. minor*, but with a very rough upper surface and coarsely serrated margins. The leaves are very late to flush, rarely before mid May, a trait inherited from its Himalayan Elm *U. wallichiana* ancestor. In adolescence, the tree required prolonged staking before it was able to freestand at about age 6.

A specimen planted 2003 at Newport, IoW, became the first known DED resistant cultivar to host the WLH. In France, LUTÈCE has proven susceptible to the Elm Yellows phytoplasma, a pathogen as yet unknown 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 (ht. max.: 0.64 m p. a. / d.b.h.: 1.98 cm p. a.)
+++	Tolerance of waterlogging (>3 months’ inundation over winter)
+++	Tolerance of drought

Wikipedia: http://en.wikipedia.org/wiki/Ulmus_%27Nanguen%27
ResistantElms: http://www.resistantelms.co.uk/elms/ulmus-lutece/

‘New Horizon’

Hybrid cultivar: *Ulmus davidiana* var. *japonica* × *U. pumila*
Origin: Wisconsin Alumni Research Foundation (WARF); released 1995 .


Photo: Ronnie Nijboer

DESCRIPTION

The tree 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. The tree increases in height only slowly, while its trunk thickens comparatively quickly. Like its Siberian Elm parent, the crown of ‘New Horizon’ can suffer <25 % natural twig dieback over winter, seriously disfiguring the tree. Moreover, ‘NH’ is the most sensitive of all the trees on test to ground conditions, growing poorly on all but fertile and free draining soil, although none perished anywhere.

A specimen possibly supports the WLH at Defence Munitions Gosport, where three were put-up by trunk-shaking in 2015.

PERFORMANCE

+++ Stability (resistance to wind rock)
+ Resistance to exposure (leaf scorch, branch breakage)
+ Resemblance to native elm
+++ Suitability for street planting
+ Rate of growth (ht. max.: 0.13 m p. a., d.b.h.: 0.85 cm p. a.)
+++ Tolerance of waterlogging (>3 months’ inundation over winter)
+++ 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 cultivar: ‘Plantyn’ × *U. pumila*
Origin: Istituto per la Protezione delle Piante, Italy; released 2004

‘Plinio’ on moist, fertile soil

‘Plinio’ on chalk downland

DESCRIPTION

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, whereas on thin, arid chalk soils more substantial roots are stimulated, whilst exposure encourages a sturdier, bushy tree. The leaves are < 6.5 cm long by 3 cm broad and glabrous on both sides, but devoid of autumn colour.

The tree is only available by mail order from Umbraflor, Spello, Italy; min. order value 500 Euros.

PERFORMANCE

++ Stability (resistance to wind rock)
+++ Resistance to exposure (leaf scorch, branch breakage)
++ Resemblance to native elm
\+ Suitability for street planting
++ Rate of growth (ht. max.: 0.60 m p. a., d.b.h.: 1.35 cm p. a.)
++ 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/

‘San Zanobi’

Hybrid cultivar: ‘Plantyn’ × *U. pumila*
Origin: Istituto per la Protezione delle Piante, Italy; released 2003.

DESCRIPTION

'San Zanobi' is a moderately fastigiate, tree, the branches gradually becoming pendulous with age. The glabrous, bright green leaves are < 15 cm long × < 6 cm broad. Like its compatriot 'Plinio', the tree lacks striking autumn colours. Widely planted as a street tree in Italy, notably in and around the Villa Medici in Rome.

The tree is only available by mail order from Umbraflor, Spello, Italy; min. order value 500 Euros.

PERFORMANCE

++	Stability (resistance to wind rock)
+++	Resistance to exposure (leaf scorch, branch breakage)
++	Resemblance to native elm
+++	Suitability for street planting
+++	Rate of growth (ht. max.: 0.87 m p. a., d.b.h.: 1.45 cm p. a.)
+	Tolerance of waterlogging (>3 months’ inundation over winter)
+++	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 cultivar: *Ulmus davidiana* var. *japonica* × *U. pumila*
Origin: Wisconsin Alumni Research Foundation (WARF); released 1975 .

DESCRIPTION

‘Sapporo Autumn Gold’ forms a densely foliated vase-shaped crown, the structure similar to that of the Field Elm *U. minor*. The leaves are narrowly-elliptical, < 9 cm long by < 4.5 cm wide; as the name implies, the leaves turn pale yellow in autumn. Flowering usually begins when the tree is aged six years. Although 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, and has become the yard-stick by which others are judged. The tree is known to sustain the White-letter Hairstreak in captivity.

NB Some specimens planted by Christchurch B C circa 1985 have succumbed to Dryad’s Saddle fungus.

PERFORMANCE

++	Stability (resistance to wind rock)
+++	Resistance to exposure (leaf scorch, branch breakage)
+++	Resemblance to native elm
++	Suitability for street planting
++	Rate of growth (ht. max.: 0.53 m p. a., d.b.h.: 0.62 cm p. a.)
+	Tolerance of waterlogging (>3 months’ inundation over winter)
+++	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 cultivar: ‘Plantyn’ × ‘Plantyn’ selfed

Origin: Dorschkamp, Netherlands; released 2003, by INRA, France (patent holders).

DESCRIPTION

VADA is a more compact tree than its sibling LUTÈCE. The glossy, dark-green leaves, < 11 cm long by 8 cm wide, are coarsely toothed and have conspicuous, impressed venation. Slower-growing than LUTÈCE, the *Butterfly Conservation* trial trees were planted as whips in 2007. A specimen was planted in the grounds of the Hotel Matignon, Paris by departing Prime Minister Lionel Jospin before the tree was named and released to commerce.

PERFORMANCE

+++ Stability (resistance to wind rock)
+++ Resistance to exposure (leaf scorch, branch breakage)
++ Resemblance to native elm
+++ Suitability for street planting
++ Rate of growth (ht. max.: 0.53 m p. a., d.b.h.: 0.85 cm p. a.)
++ Tolerance of waterlogging (>3 months’ inundation over winter)
+++ Tolerance of drought

Wikipedia: http://en.wikipedia.org/wiki/Ulmus_%27Wanoux%27
ResistantElms: http://www.resistantelms.co.uk/elms/ulmus-vada/

8. Recommended trees

Countryside

Sheltered sites with moist, well drained soils:

- Ademuz
- Nanguen = LUTÈCE
- Sapporo Autumn Gold
- *Ulmus laevis*

Exposed download with arid, chalk soils:

- Ademuz
- Plinio
- Nanguen = LUTÈCE

Waterlogged sites with heavy clay soils:

- Ademuz
- Nanguen = LUTÈCE
- *Ulmus laevis*

Town

Parks:

- Nanguen = LUTÈCE
- San Zanobi
- Sapporo Autumn Gold
- Wanoux = VADA
- *Ulmus laevis*

Streets:

- Columella
- San Zanobi
- Wanoux = VADA
- Rebona (not included in BC trials)
- New Horizon (on fertile, free draining soils only)

9. Bibliography

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Santamour, F. S., & Bentz, S. E. (1995). Updated checklist of elm (Ulmus) cultivars for use in North America. *Journal of Arboriculture*, 21(3): May, 1995

Santini, A. et al. (2008). *Euphytica* 163: 45-56. 2008

Santini, A. et al. (2002) . *HortScience* 37(7): 1139-1141. 2002

10. Disease-Resistant Elm Cultivars: Suppliers in or to the UK

'Ademuz' and other Spanish *U. minor* clones

TBA

'Columella'

Hilliers Nurseries, Andlers Ash, Liss, Hants
Bare-root to rootballed trees, girths 8 – 25 cm.
www.hilliertrees.co.uk
tel. 01794 368733

'Nanguen' = LUTÈCE

Duchy of Cornwall Nursery, Lostwithiel, Cornwall
5-litre pot trees
www.duchyofcornwallnursery.co.uk
email: sales@duchyofcornwallnursery.co.uk tel. 01208 872668

Frank P Matthews 'Trees for Life', Tenbury Wells, Worcs
12-litre pot / 2m high trees
www.frankpmatthews.com
email: enquiries@fpmatthews.co.uk tel. 01584 810214

Hilliers Nurseries, Andlers Ash, Liss, Hants
Standards
www.hilliertrees.co.uk
tel. 01794 368733

Les Pépinières Minier, 49250 Beaufort-en-vallée, France
Bare-rooted whips / small potted (min. order value 500 Euros)
www.pepinieres-minier.fr
email: gbsales@minier-nurseries.fr tel. 00 33 2 41 79 48 43

'New Horizon'

Hilliers Nurseries, Andlers Ash, Liss, Hants
Standards
www.hilliertrees.co.uk
tel. 01794 368733

'Plinio'

Umbraflor, Spello, Italy
All sizes
www.umbraflor.it
email: umbraflor@pec.it, tel. 00 39 742 315007

'Rebona' (a more fastigiate sibling of 'New Horizon' not included in BC trials)

Hilliers Nurseries, Andlers Ash, Liss, Hants
Standards
www.hilliertrees.co.uk tel. 01794 368733

Disease-Resistant Elm Cultivars: Suppliers in or to the UK, cont.

'San Zanobi'

Umbraflor, Spello, Italy
All sizes
www.umbraflor.it
email: umbraflor@pec.it tel. 00 39 742 315007

'Sapporo Autumn Gold'

Ashridge Nurseries, Castle Cary, Somerset
Standards
www.ashridgetrees.co.uk/allprods.php
email: info@ashridgetrees.co.uk tel. 01963 359444

Chew Valley Trees, Chew Magna, Bristol
30-litre potted trees
http://www.chewvalleytrees.co.uk
email: info@chewvalleytrees.co.uk tel. 01275 333752

Golden Hill Plants, Marden, Kent
20-litre potted trees
www.goldenhillplants.com
email: goldenhillplants@hotmail.com tel. 01622 833218

Les Pépinières Minier, 49250 Beaufort-en-vallée, France
Small (<50 cm) potted trees (min. export order value = 500 Euros)
www.pepinieres-minier.fr
email: gbsales@minier-nurseries.fr tel. 00 33 24179484

'Wanoux' = VADA

Duchy of Cornwall Nursery, Lostwithiel, Cornwall
10-litre pot trees
www.duchyofcornwallnursery.co.uk
email: sales@duchyofcornwallnursery.co.uk tel. 01208 872668

Golden Hill Plants, Marden, Kent
40-litre and 2-litre potted trees
www.goldenhillplants.com
email: goldenhillplants@hotmail.com tel. 01622 833218

Hilliers Nurseries, Ampfield, Hants
Standards
www.hilliertrees.co.uk
tel. 01794 368733

Les Pépinières Minier, 49250 Beaufort-en-vallée, France
Small (<50 cm) potted trees (min. export order value = 500 Euros)
www.pepinieres-minier.fr
email: gbsales@minier-nurseries.fr tel. 00 33 24179484