



Disease-resistant elm cultivars
Butterfly Conservation trials report, 3rd revision
2013

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1. Abstract

The Hampshire & Isle of Wight Branch of *Butterfly Conservation* (BC) initiated trials of elm cultivars 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. The trials are believed to be the most comprehensive of their kind in the world. This report, originally published in 2010, has been substantially revised in the light of the 'Princeton' fiasco. 'Princeton', an American Elm cultivar, was widely sold and promoted in the UK without having been tested for resistance to DED in Europe. The recent loss of many 'Princeton' to DED, notably at Highgrove House, has prompted the exclusion of other American cultivars until such time as their resistance can be proven.

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 8 of the 9 cultivars with a scientifically proven '5 out of 5' resistance to DED and 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:

- Appearance (form / structure, leaf size and shape)
- Phenology
- Rate of growth

and susceptibility to:

- Exposure (wind scorch, branch breakage)
- Drought
- Waterlogging (anoxic soils)

3. List of trees

CULTIVAR	ORIGIN
'Columella'	Dorschkamp, Wageningen, Netherlands
'Morfeo'	IPP, Florence, Italy
'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

Other cultivars and exotic species were planted, but are not described here on account of their resistance to DED in Europe being either sub-standard or, as with most of the American cvs, simply unknown. It is hoped that tests to be conducted by Noordplant, Netherlands, and IRSTEA, France, in 2014 will determine the resistance of the American cultivars, notably the promising 'Patriot'.

CULTIVAR	ORIGIN
'Arno'	IPP, Florence, Italy
'Dodoens'	Dorschkamp, Wageningen, Netherlands
'Fiorente'	IPP, Florence, Italy
'Lewis & Clark' = PRAIRIE EXPED.	North Dakota State University, USA
'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

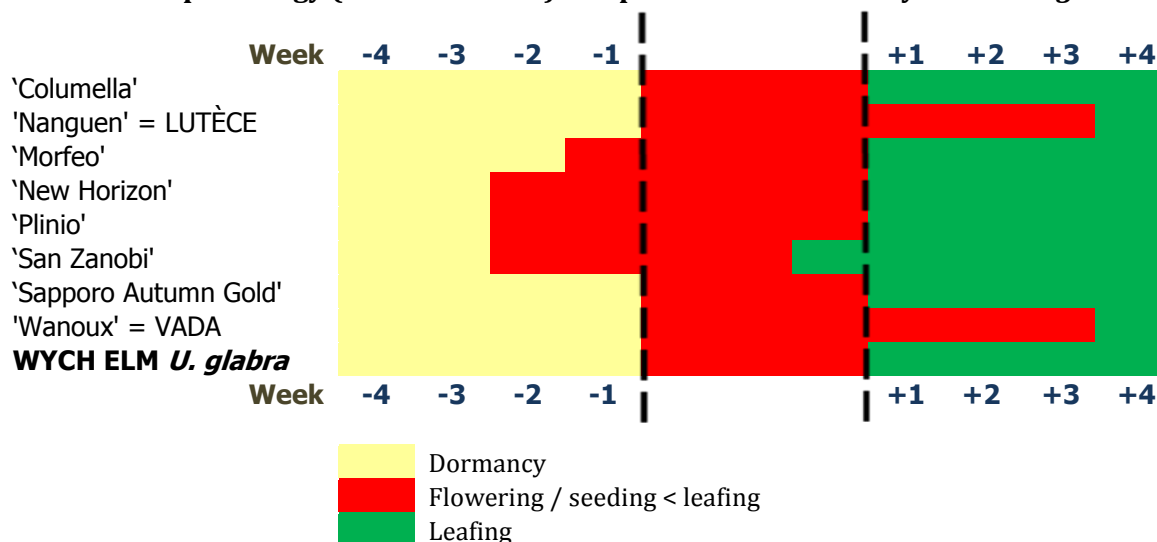
EXOTIC SPECIES	ORIGIN
<i>Ulmus davidiana</i>	Liaoning Province, China
<i>Ulmus davidiana</i> var. <i>japonica</i>	Sapporo, Japan
<i>Ulmus laciniata</i>	Sapporo, Japan
<i>Ulmus laevis</i>	Val d'Allier, France
<i>Ulmus macrocarpa</i>	Beijing Botanic Garden, China

*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. Comparative phenology

Another factor of significance is the synchrony of the trees' phenology with the life-cycle of the WLH. The larva emerges from its ovum in mid March in Hampshire, and immediately feeds on the elm flowers, progressing to the seeds, ultimately the leaves. Thus it is of critical importance that the cultivars are in flower at the same time as the native hostplants, such as the Wych Elm *Ulmus glabra*. Below is a simplified plot of the phenology of the cultivars relative to that of the Wych Elm.

Elm cultivar phenology (observed 2012) compared with that of Wych Elm *U. glabra*



As can be appreciated from the table, half the trees begin flowering up to two weeks before *U. glabra* but, significantly, are still in flower when the flowers of *glabra* emerge. The Dutch clones LUTÈCE and VADA flower / seed at the same time as *glabra*, but the leaves do not flush until nearly a month later, although the seeds are retained until that time, and after. It is hoped the significance of these phenological discrepancies to the butterfly can be evaluated in the next stage of the trial. It is worth mentioning however, that the butterfly was successfully, if inadvertently, reared on an exclusive diet of *U. laevis* seeds at an IRSTEA research station in France after young larvae were unwittingly gathered with seed which then was partially dried and placed in storage for several months (E. Collin, perscomm.).

5. 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. All the 8 trees 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
Morfeo	2.06	Morfeo	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)

6. The butterfly

The White-letter Hairstreak *Satyrium w-album* is a monophagic species entirely reliant on Elm. Larvae have very occasionally been 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.

Much encouragement can be found in the fact that the White-letter Hairstreak is endemic to much of the Far East, including 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 trials trees, as most have only attained sexual maturity since 2008, larvae of other elm-feeding Lepidoptera, notably the Comma butterfly and Buff-Tip moth, have been observed on the trees.



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

7. The trees described

The following pages offer illustrated descriptions of the cultivars in alphabetical order. A performance checklist is offered at the end of each page:

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

'Columella'

Hybrid cultivar: 'Plantyn' selfed

Origin: Dorschkamp, Netherlands; released 1989.



DESCRIPTION

A tall, fastigate 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' will readily shed its leaves when stressed by drought, often 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
- +++ Flowering, fruiting, synchrony with Wych Elm *U. glabra*.
- +++ Leafing synchrony with Wych Elm *U. glabra*.

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

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

'Morfeo'

Hybrid cultivar: (*U. × hollandica* × *U. minor*) × *U. chenmoui*

Origin: Istituto per la Protezione delle Piante, Italy; released 2010.



DESCRIPTION

'Morfeo' is a robust, fast-growing tree able to freestand at a very early age. The stem forks at between 1.5 m and 2 m from the ground, the branches featuring irregular patches of corky bark. The reddish branchlets bear elliptic leaves, < 12 cm long × 8 cm broad, which closely resemble those of the Field Elm. The tree readily produces suckers from its roots. 'Morfeo' has so far proven the most successful of all the cultivars included in the trials, and is one of the most DED-resistant cultivars ever raised, exhibiting only 4% defoliation and 0% dieback after inoculation.

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.: 1.03 m p. a. / d.b.h.: 2.06 cm p. a.)
- +++ Tolerance of waterlogging (>3 months' inundation over winter)
- +++ Tolerance of drought
- +++ Flowering, fruiting, synchrony with Wych Elm *U. glabra*
- +++ Leafing synchrony with Wych Elm *U. glabra*.

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

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

'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 bright green in colour, 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 staking before it was able to freestand at about age 6.

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
- +++ Flowering, fruiting, synchrony with Wych Elm *U. glabra*.
 - + Leafing synchrony with Wych Elm *U. glabra*.

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, demanding a fertile and free draining soil.

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
 - ++ Flowering, fruiting, synchrony with Wych Elm *U. glabra*
- +++ Leafing synchrony with Wych Elm *U. glabra*

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 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 wind exposure produces 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.

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
- ++ Flowering, fruiting, synchrony with Wych Elm *U. glabra*.
- +++ Leafing synchrony with Wych Elm *U. glabra*.

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.

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
- ++ Flowering, fruiting, synchrony with Wych Elm *U. glabra*.
- ++ Leafing synchrony with Wych Elm *U. glabra*.

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 yardstick by which others are judged. The tree is known to host the White-letter Hairstreak.

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
- +++ Flowering, fruiting, synchrony with Wych Elm *U. glabra*.
- +++ Leafing synchrony with Wych Elm *U. glabra*.

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 planted as whips in 2007 have yet to attain sexual maturity. 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
- +++ Flowering, fruiting, synchrony with Wych Elm *U. glabra*.
 - + Leafing synchrony with Wych Elm *U. glabra*.

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:

Morfeo
Nanguen = LUTÈCE
Sapporo Autumn Gold

Exposed sites with arid, chalk soils:

Morfeo
Plinio
Nanguen = LUTÈCE

Waterlogged sites with heavy clay soils:

Morfeo
Nanguen = LUTÈCE

Town

Parks:

Morfeo
Nanguen = LUTÈCE
San Zanobi
Sapporo Autumn Gold
Wanoux = VADA

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

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

'Columella'

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

'Morfeo'

Frank P Matthews 'Trees for Life', Tenbury Wells, Worcs.
Rooted scion grafted trees in 3- litre pots (2013), Bare-rooted whips (2014)
www.frankpmatthews.com
email: enquiries@fpmatthews.co.uk tel. 01584 810214

'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, Ampfield, 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'

Hillier Nurseries, Ampfield, 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 sister of 'New Horizon' not included in BC trials)

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

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

'San Zanobi'

Umbrador, Spello, Italy

All sizes

www.umbrador.it

email: umbrador@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

Buckingham Nurseries, Buckingham

Bare-rooted whips

www.buckingham-nurseries.co.uk

email: web-enquiries@buckingham-nurseries.co.uk tel. 01280 822133

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

'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