Using Diversity to Reduce the Impact of Exotic Pests: How it Should Be Applied

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QUIZ TIME!

What do the following trees have in common?


Katsuratree *Cercidiphyllum japonicum*


Hardy rubber tree
Eucommia ulmoides


Ginkgo
Ginkgo biloba


Osage-orange
Maclura pomifera

What do these species have in common?

They are monotypic (the only members of their genus)

And they have few pest problems

Genera with many species

Genera	Species[1]	Pests[2]
Acer	128	208
Betula	62	158
Fraxinus	43	147
Prunus	430	326
Populus	48	168
Quercus	593	269
Sorbus	125	311
Ulmus	42	205

[1]Krussmann. 1977. *Manual of Cultivated Broad-Leaved Trees & Shrubs*. Timber Press

[2]Johnson and Lyon. 1988. *Insects that feed on Trees and Shrubs.* Cornell University Press
Sinclair and Lyon. 2005. *Diseases of Trees and Shrubs.* Cornell University Press

Balsam poplar
Populus balsamifera

Schubert chokecherry *Prunus virginana* 'Schubert'

Genera with limited number of species.

Genera	Species	Pests
Clasdratis	2	2
Gymnocladus	2	2
Liriodendron	2	15
Liquidambar	3	12
Maackia	2	1
Phellodendron	4	4
Ptelea	6	1
Nyssa	3	15
Tilia	22	31

Redmond linden
***Tilia americana* 'Redmond'**

Monotypic genera

Genera	Species	Pests
Cercidiphyllum	1	1
Eucommia	1	1
Ginkgo	1	0
Maclura	1	2

Hardy rubber tree
Eucommia ulmoides

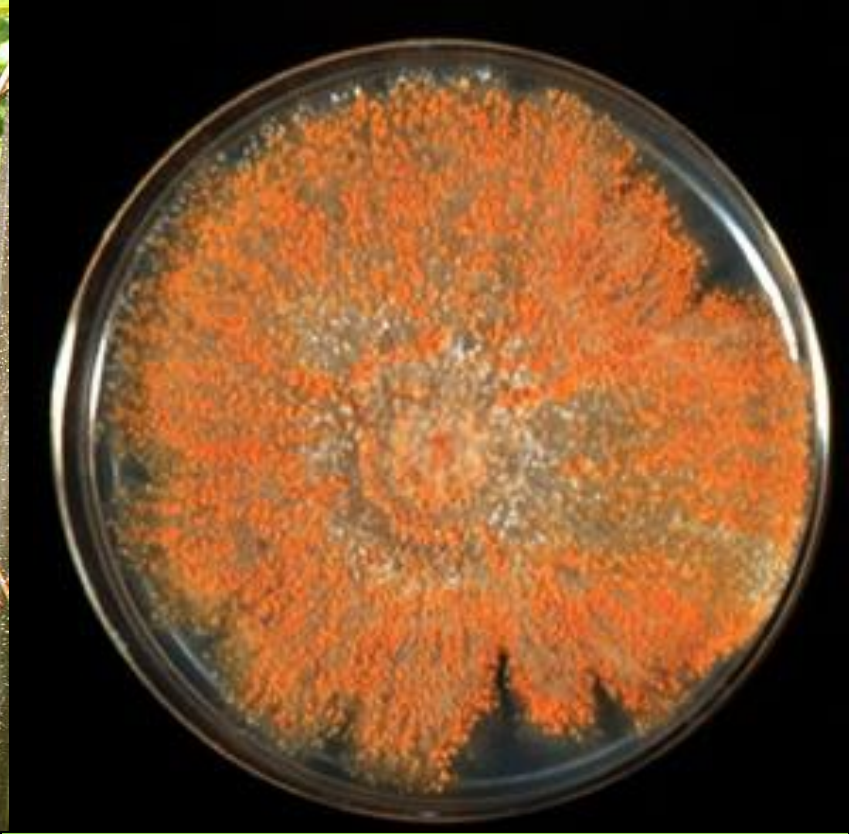
As a general rule

The more species in a genus

the more pests

American chestnut

Okay what do these problems have in common?

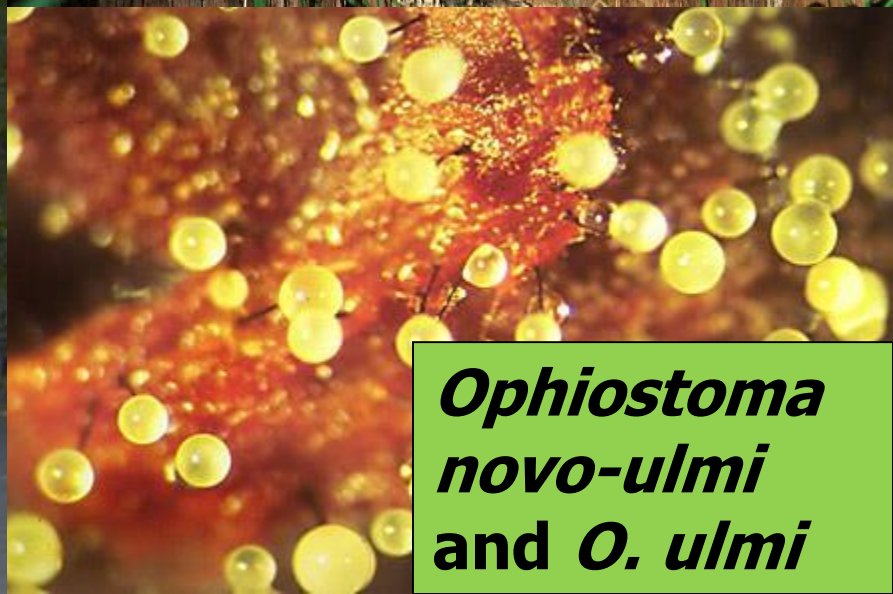


Chestnut blight
Cryphonectria parasitica


Chestnut forests


Chestnut blight introduced 1905

Dutch elm disease



Ophiostoma novo-ulmi **and** ***O. ulmi***


MEN
WORKING


STOP

Emerald ash borer

What do these all have in common?

The pest becomes a deadly threat when introduced to a new continent.

The pest attacks a genus, not a species.

Each genus has species on all three temperate continents.

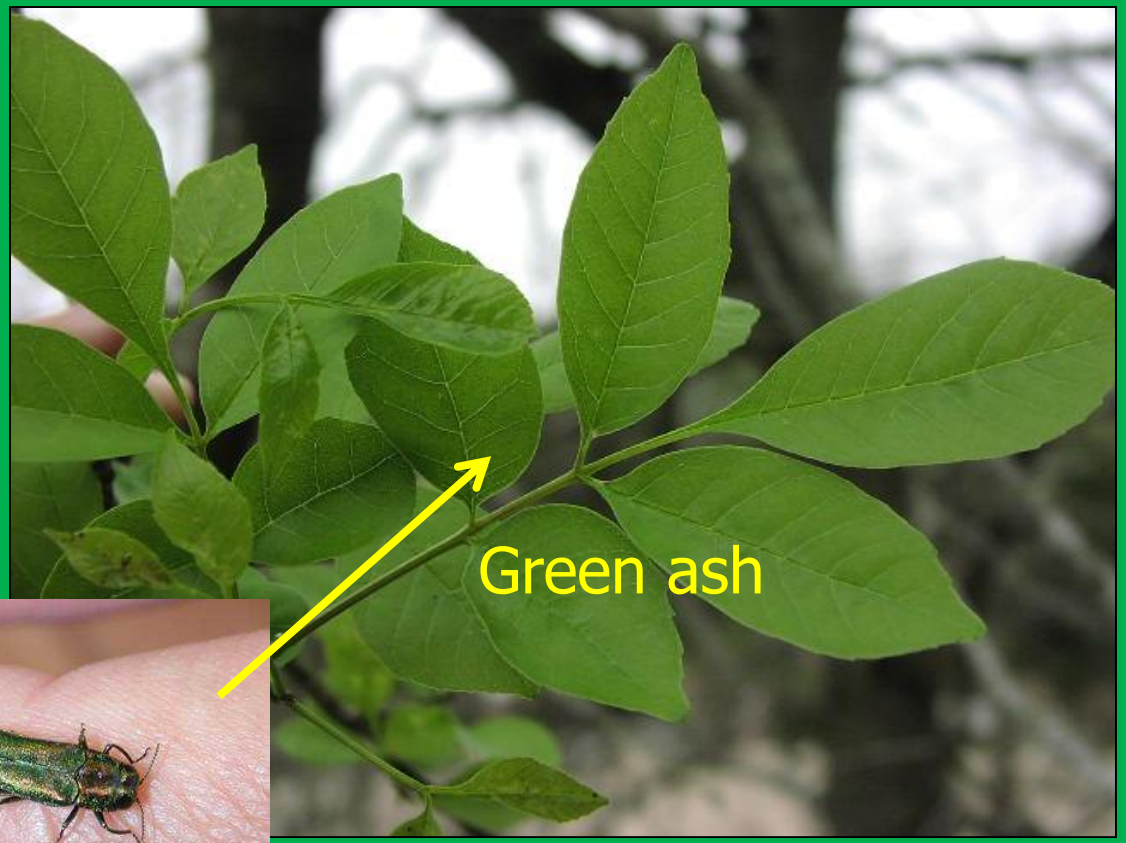
Santamour (1990) proposed no more than 10% in a species, 20% in a genus and 30% in a family

Santamour, F.S.1990. Proc. 7th Conf. Metro. Tree Improvement Alliance, Morton Arboretum pp 57-65

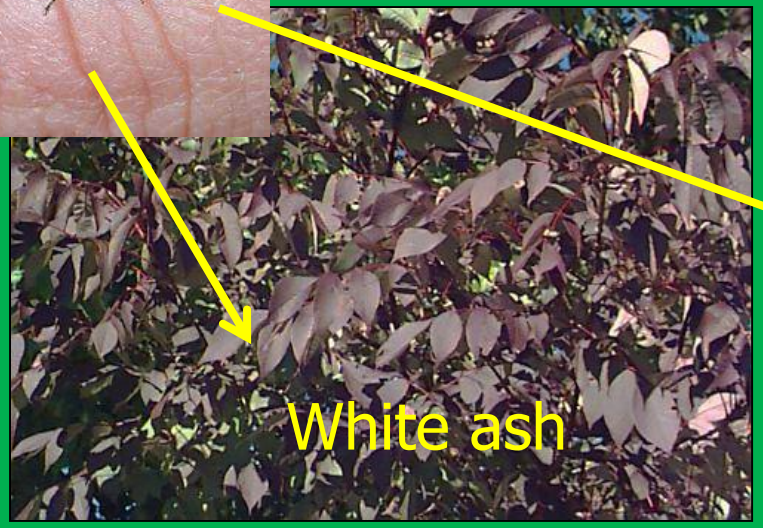
It is not enough

No more than 5 percent of the urban forest from any one genus

Blue ash



Green ash



White ash

Black ash

Order	Family	Genera
Fabales	Caesalpiniaceae	Cercis, Gleditsia, Gymnocladus
	Fabaceae	Maackia, Robinia
Fagales	Betulaceae	Alnus, Betula, Carpinus
	Fagaceae	Fagus, Quercus
Lamiales	Bignionaceae	Catalpa
	Oleaceae	Fraxinus, Syringa
Malpighiales	Salicaceae	Populus, Salix
Malvales	Malvaceae	Tilia
Proteales	Platanaceae	Platanus
Rosales	Cannabaceae	Celtis
	Rosaceae	Crataegus, Malus, Prunus, Pyrus, Sorbus
	Ulmaceae	Ulmus
Sapindales	Rutaceae	Phellodendron
	Sapindaceae	Acer Aesculus

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	Bignonaceae	Catalpa
		Fraxinus, Syringa
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Malvales	Malvaceae	
Proteales	Platanaceae	Tilia
		Platanus
Rosales	Cannabaceae	Celtis
		Crataegus, Malus, Prunus,
		Pyrus, Sorbus
		Ulmus
Sapindales	Rutaceae	Phellodendron
	Sapindaceae	Acer
		Aesculus

Bronze birch borer

Oak wilt

Emerald ash borer

Dutch elm disease

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	Malvaceae	Tilia
	Platanaceae	Platanus
	Cannabace	
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	Ulmaceae	Ulmus
Sapindales	Rutaceae	Phellodendron
	Sapindaceae	Acer, Aesculus

Ash and privet borer
Ash/lilac borer

Fireblight

Order	Family	Genera
Fabales	Caesalpiniaceae	Cercis, Gleditsia, Gymnocladus
	Fabaceae	Maackia, Robinia
	Betulaceae	Alnus, Betula, Carpinus
	Fagaceae	Fagus, Quercus
	Bignionaceae	Catalpa
	Oleaceae	Fraxinus, Syringa
	Salicaceae	Populus, Salix
Malpighiales		
Malvales		Tilia
Proteales	Platanaceae	Platanus
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	Ulmaceae	Ulmus
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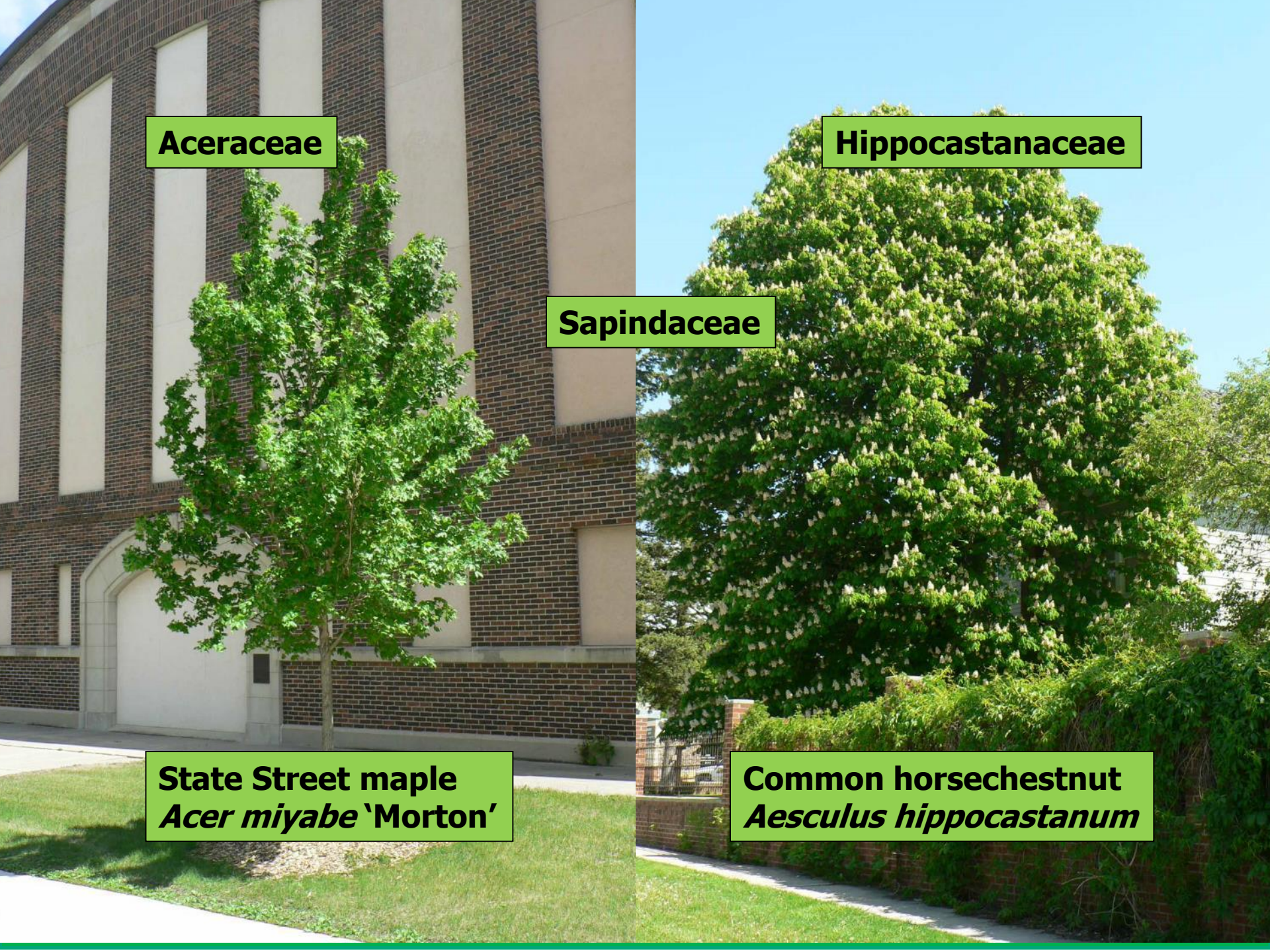
	Sapindaceae	Acer, Aesculus

Verticillium wilt


Aceraceae
Sapindaceae
Hippocastanaceae
State Street maple
Acer miyabe 'Morton'
Common horsechestnut
Aesculus hippocastanum

No more than 5 percent of the urban forest from any one genus

And be cautious with species-rich genera

No more than 5 percent of the urban forest from any one genus

And this is even more important for genera found on all three temperate continents


Asia
North America
Europe
South America
Africa
India

First fossil records occurred from Northern Ontario to Yunnan

Hinsinger et al. 2013. PLoS ONE 8(11)

Eocence 56-34 million years ago

***Fraxinus* population now separated:**
-20 in North American
-20 in East Asia
- 3 in Europe and West Asia
Wallander and Albert 2000. Amer. J. Bot 87:1827-1841

Miocene 23-5 million years ago

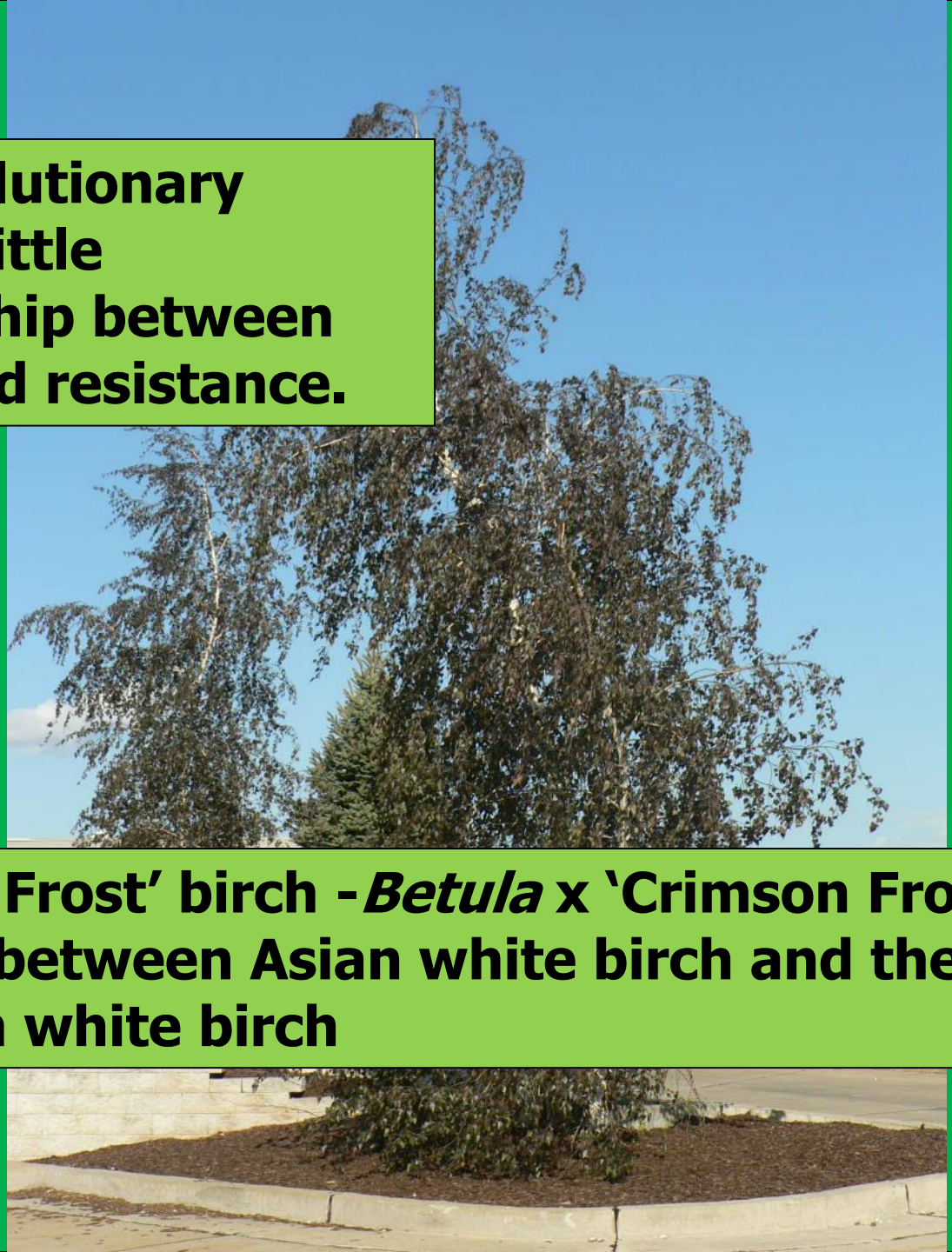
Okay so why is this important to know if we are moving genera across the planet?

If evolutionary history; increased stress reduces resistance to the pest.

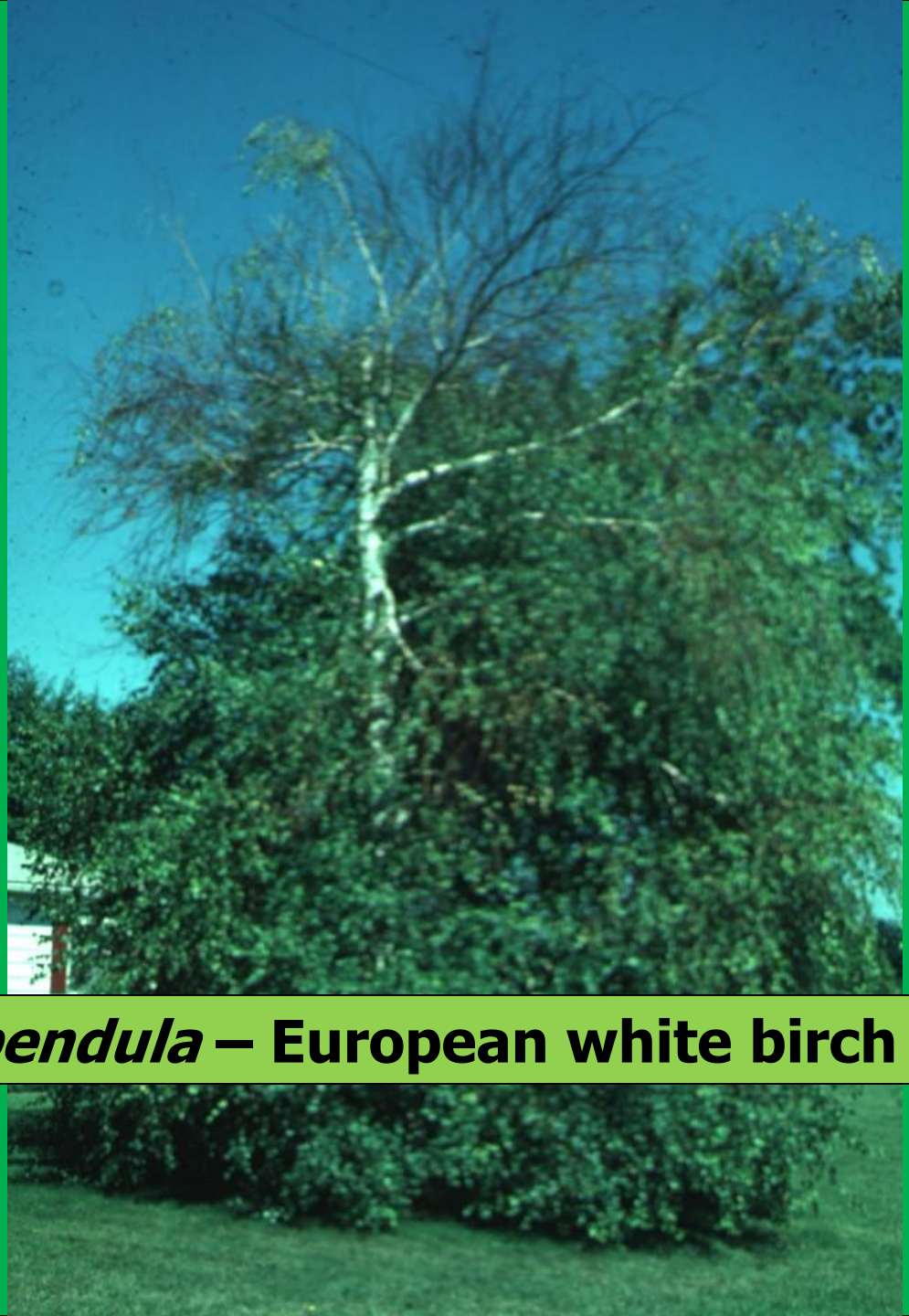
Nielsen et al. 2010. Environ. Entomol. 40: 648-653

***Betula papyrifera* 'Renci'– Renaissance Reflection birch**

If no evolutionary history: little relationship between stress and resistance.



'Crimson Frost' birch -*Betula* x 'Crimson Frost'
A hybrid between Asian white birch and the European white birch



***Betula pendula* – European white birch**

Same true with ash.

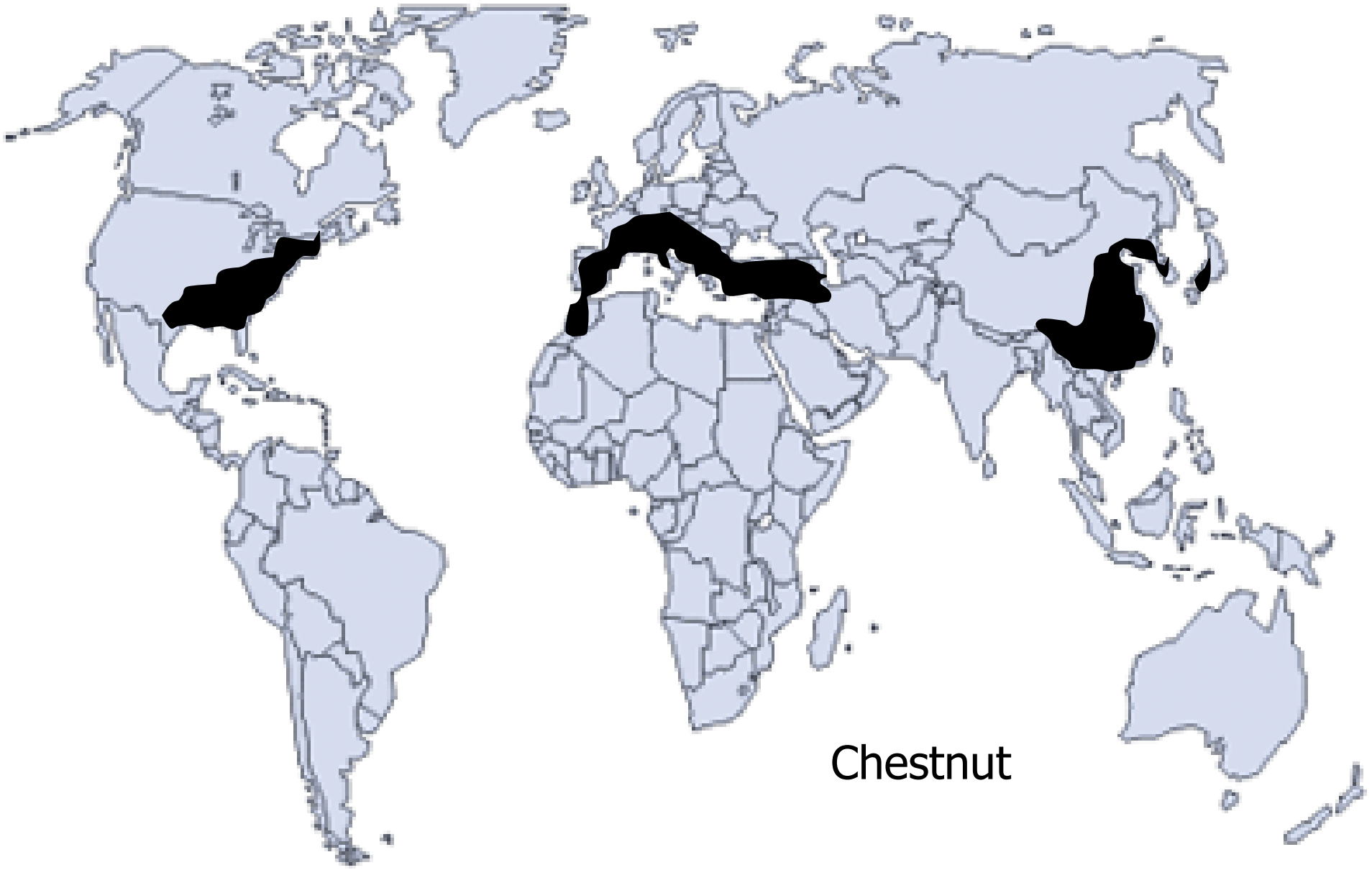
Rebek et al. 2008. Environ. Entomol. 37: 242-246

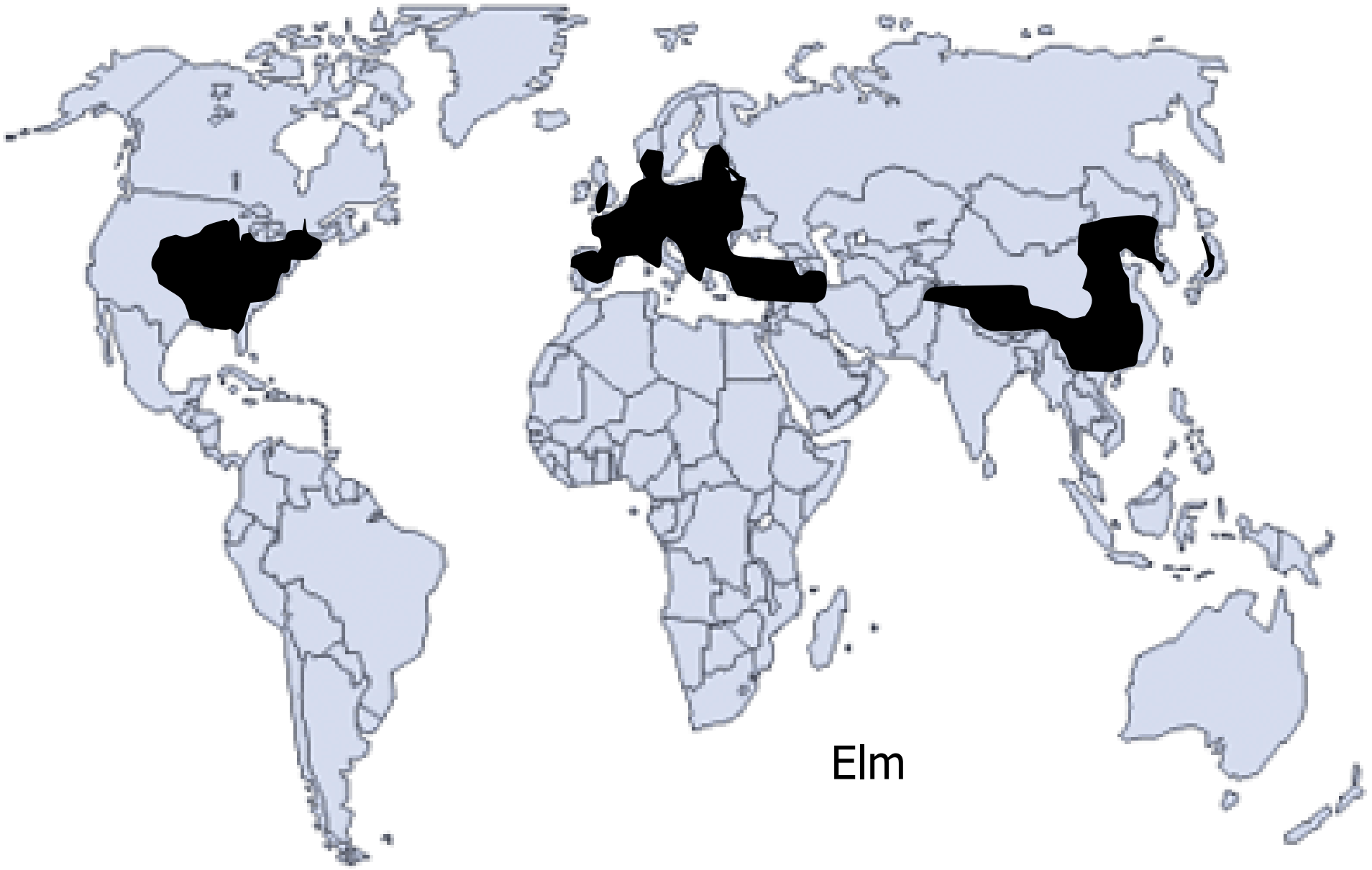
'Northern Blaze' white ash
***Fraxinus americana* 'Jefnor'**

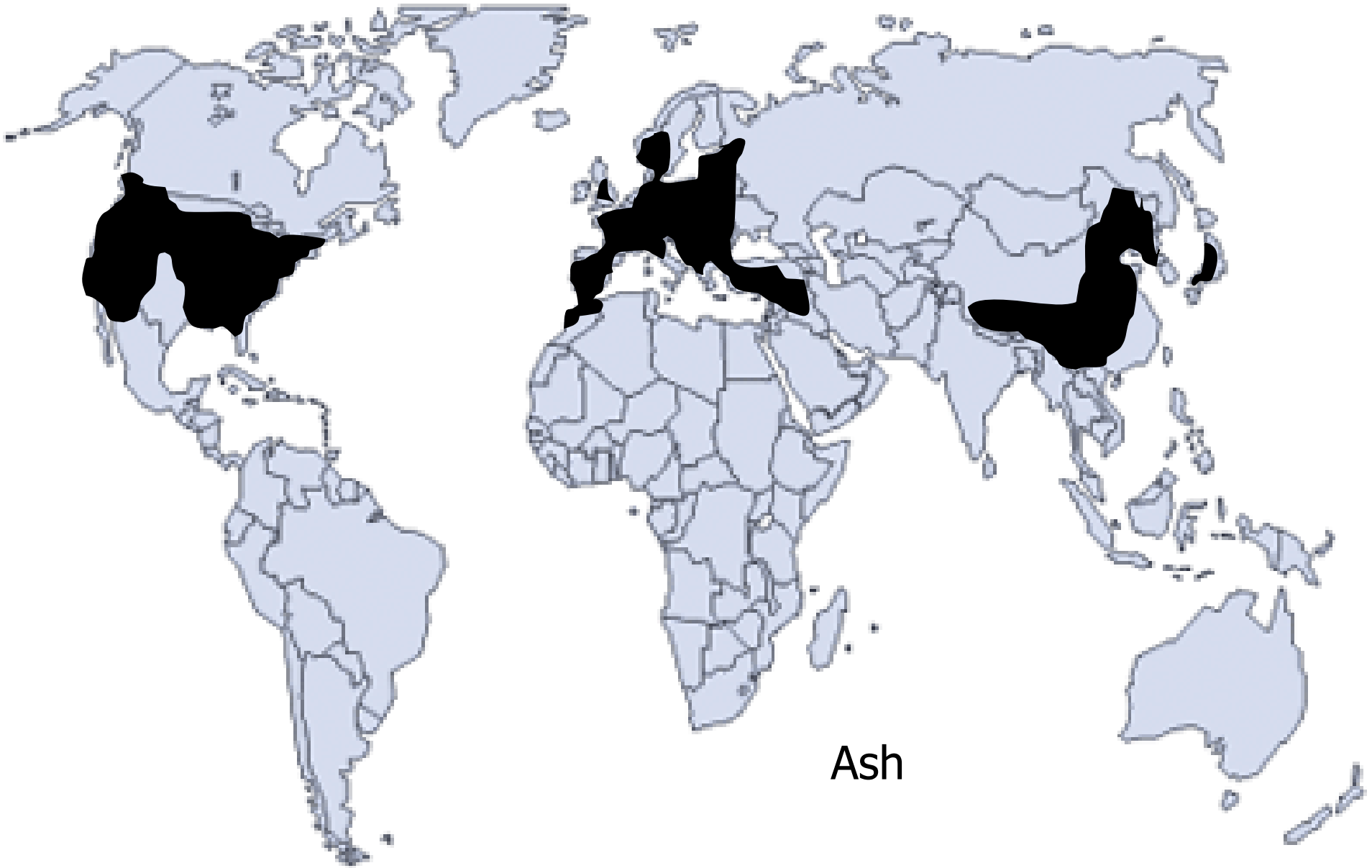
‘Mancana’ Manchurian ash
***Fraxinus mandshurica* ‘Mancana’**

Manchurian ash phloem contains hydroxycoumarins, an allelochemical not found in Green or White ash.

Eyles et al. 2007. J. Chem. Ecol. 33: 1430-1448


Chestnut


Elm


Ash


浑南西路
HUNNANXI ROAD
首创·国际城
FIRST CITY
沃尔玛
WAL-MART
富民街


Dandong China
North Korean border

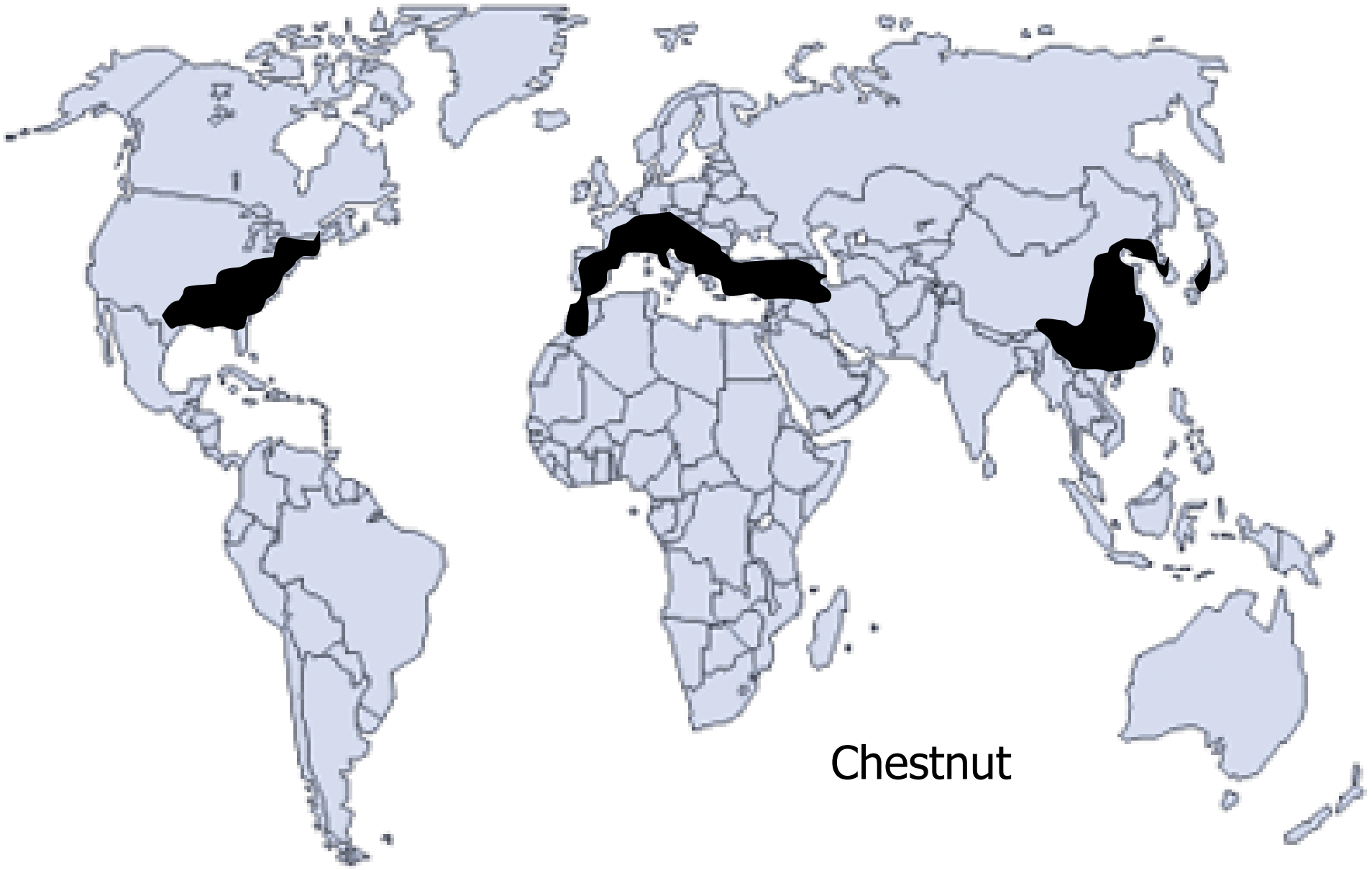
Fraxinus rhynchophylla

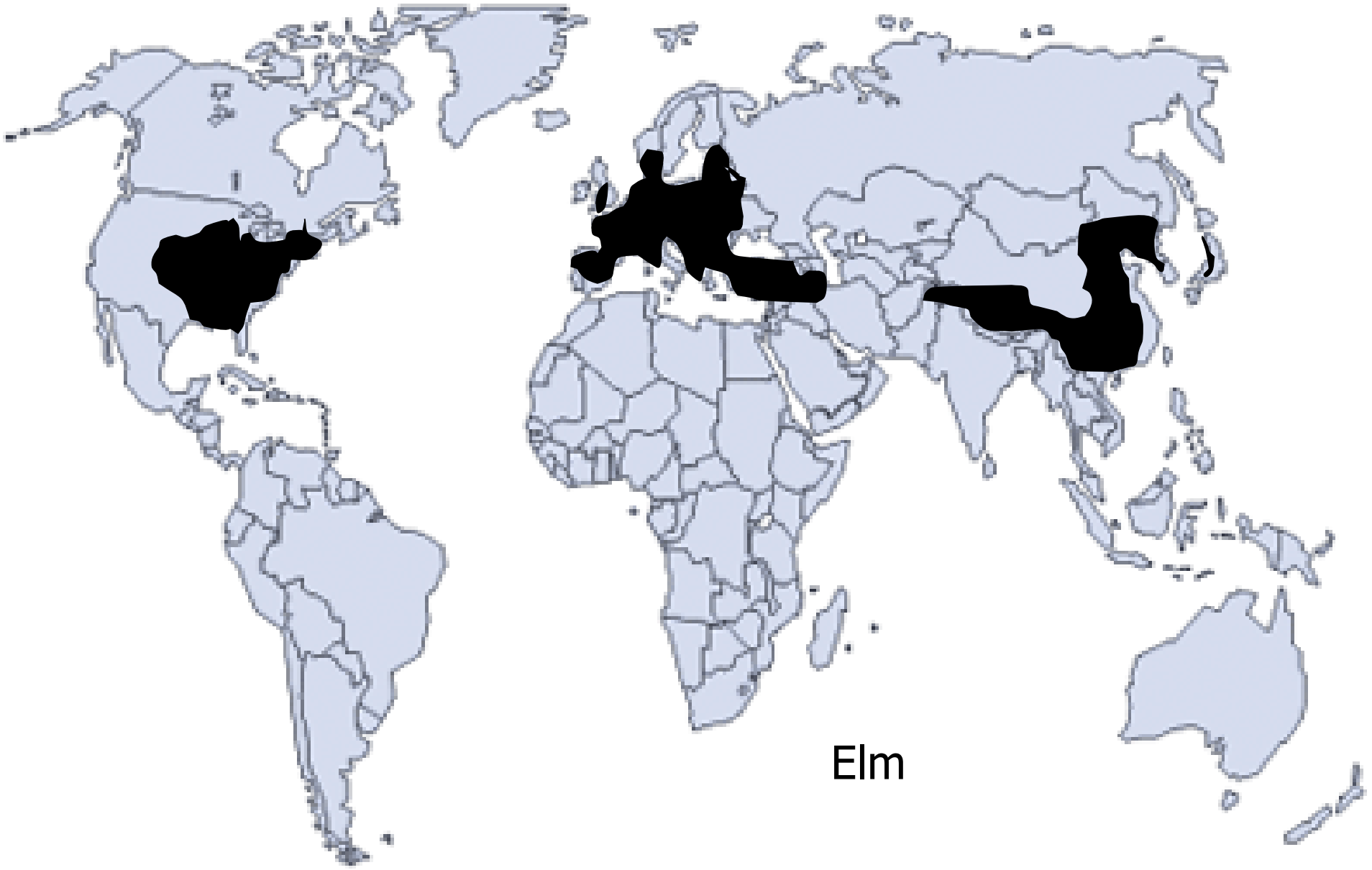
Abies, Acer, Alnus, Betula, Carpinus, Catalpa, Cornus, Gleditsia, Juglans, Juniperus, Kalopanax, Larix, Maackia, Malus, Magnolia, Phellodendron, Picea, Pinus, Populus, Prunus, Pterocarpa, Quercus, Tilia, Ulmus

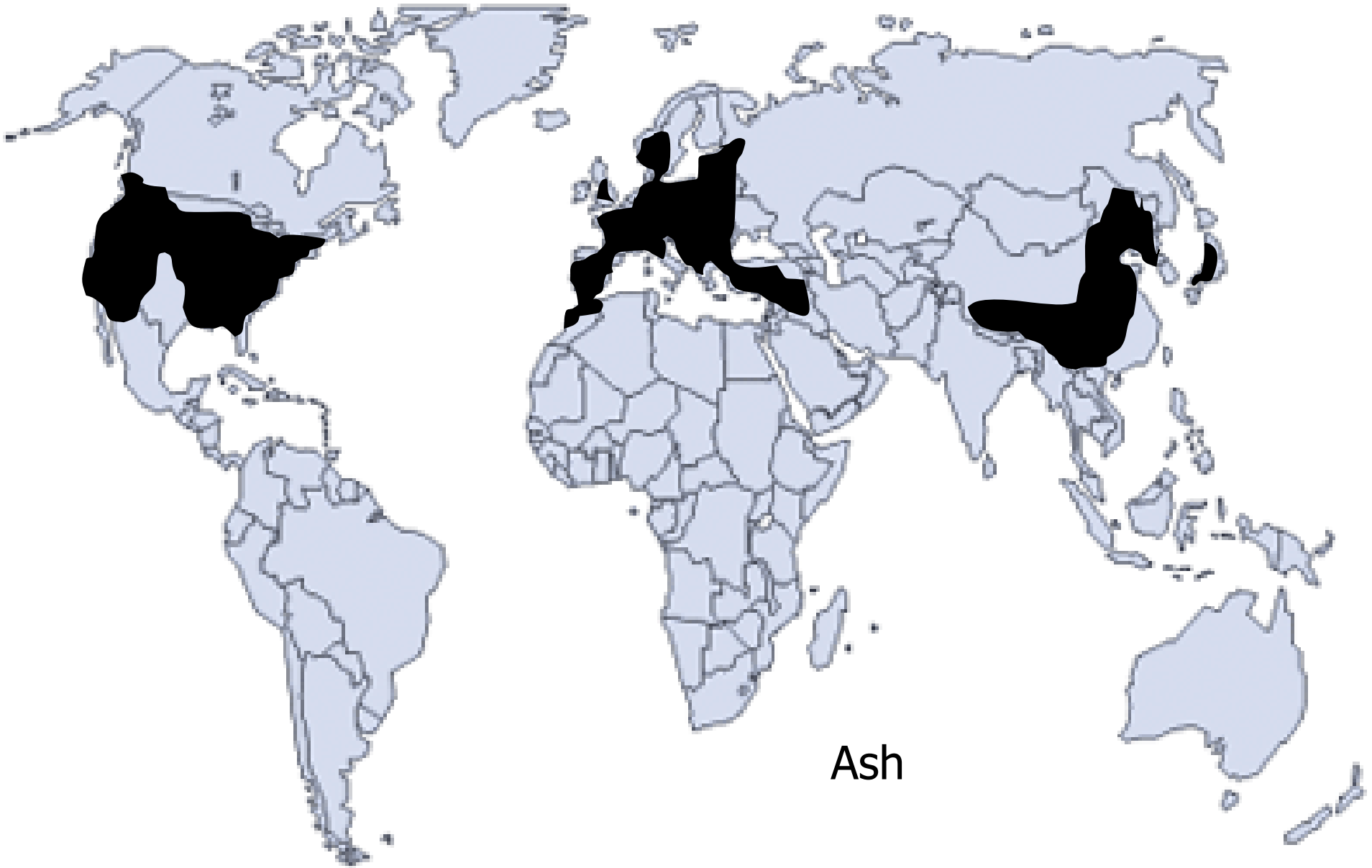

Here is what is coming!

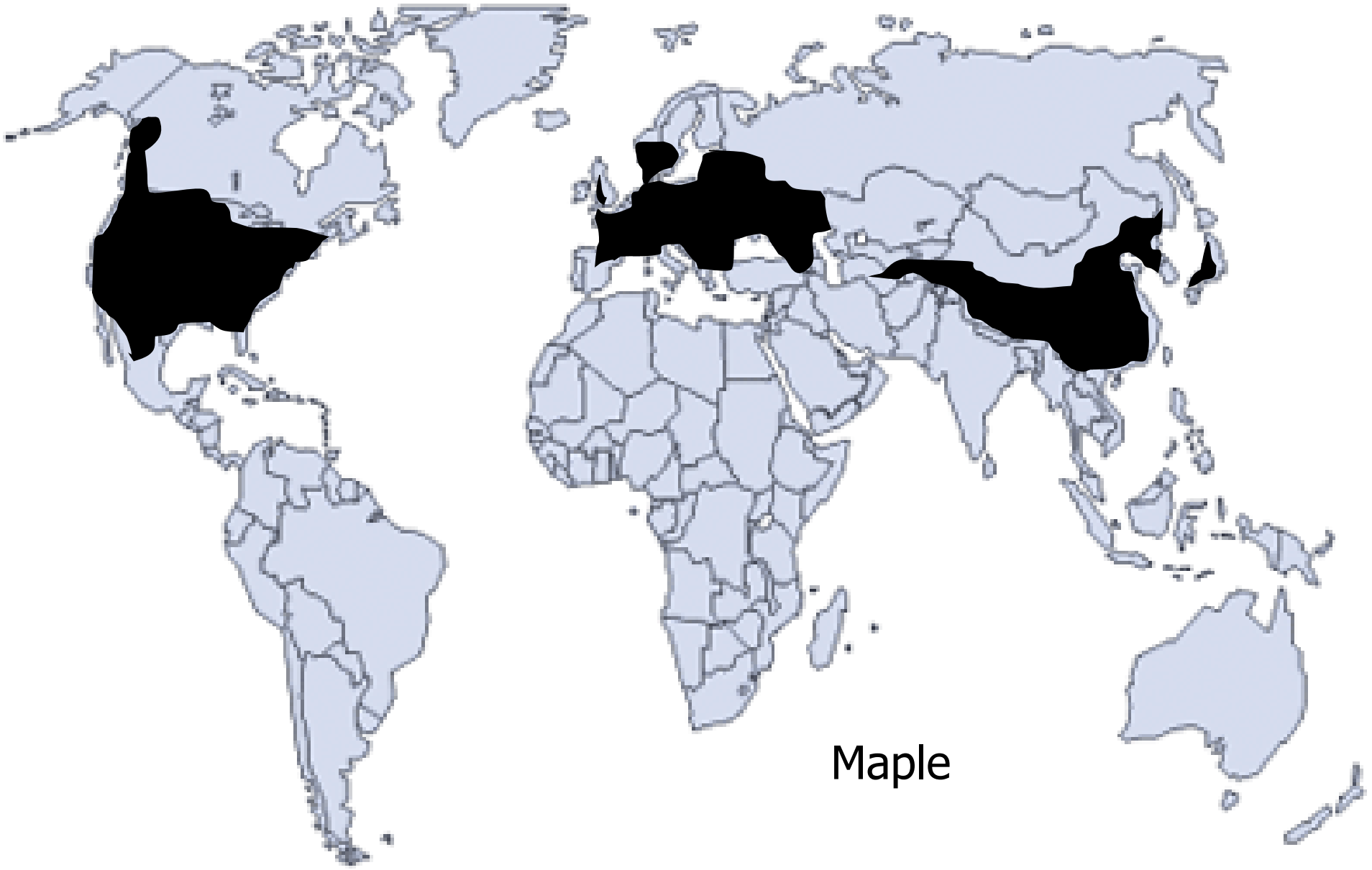
Maple
Acer

***Acer* x *freemanii* 'Jeffsred'– Autumn Blaze maple**


Chestnut

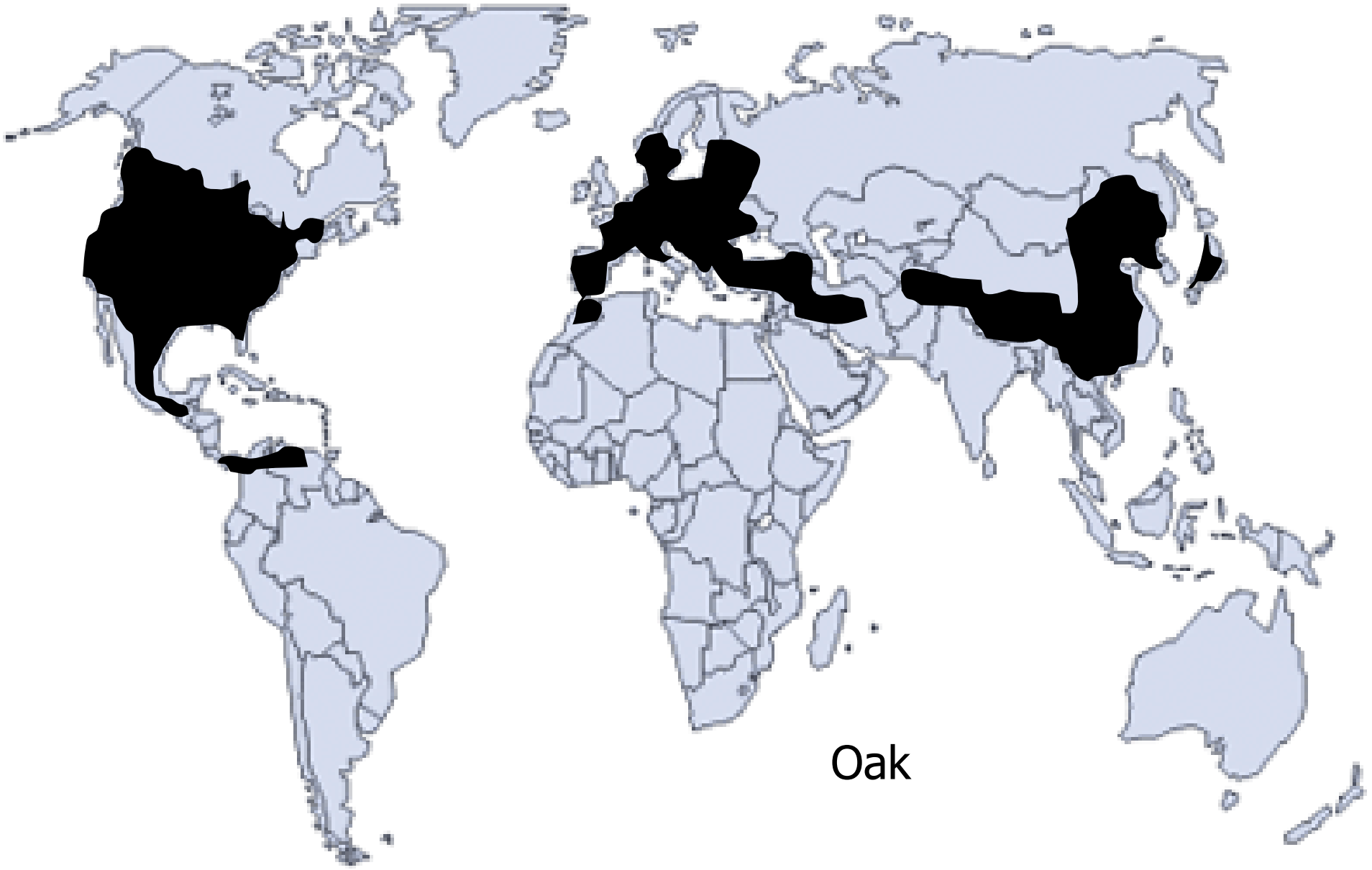

Elm


Ash


Maple

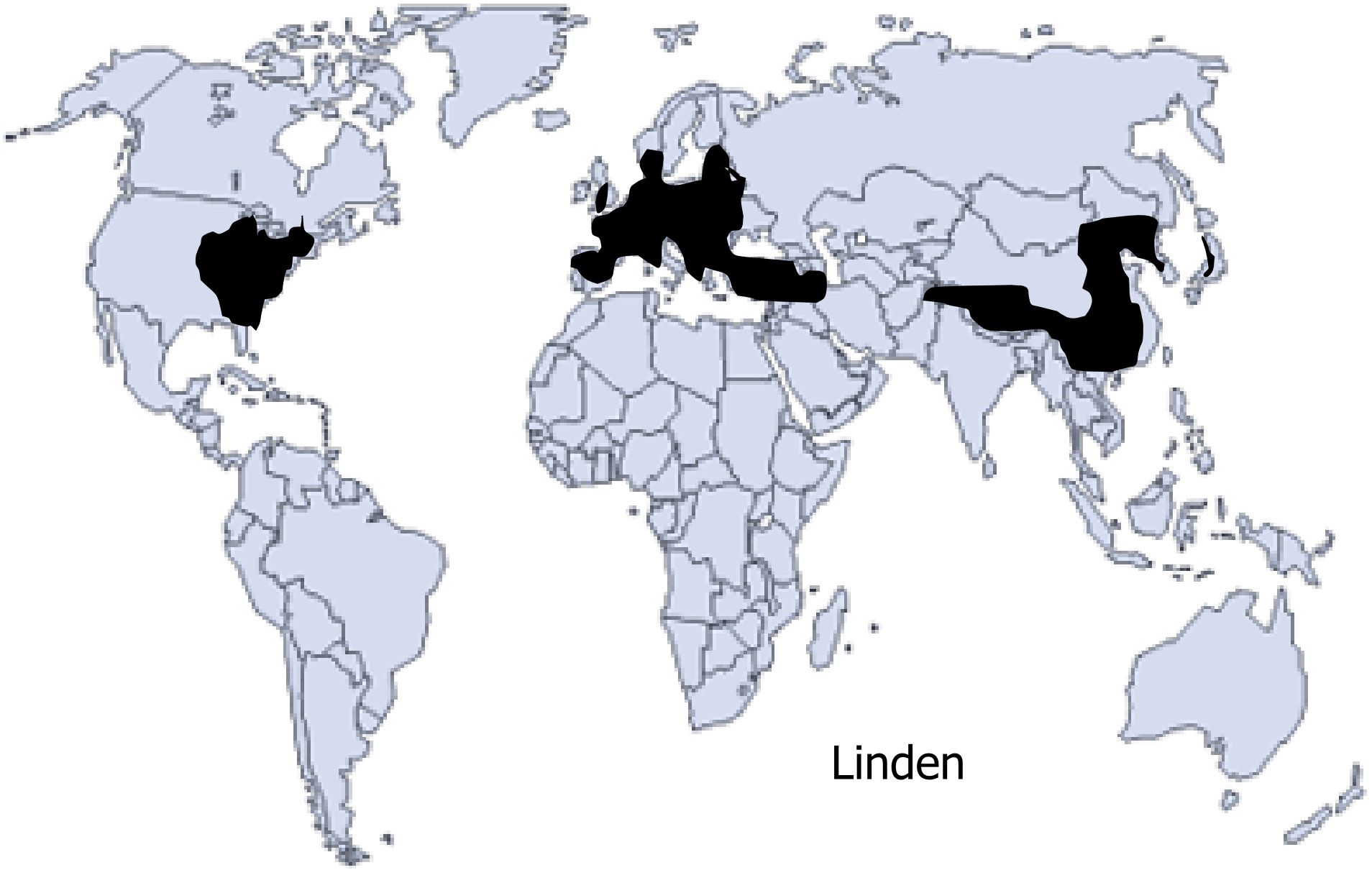
Oak
Quercus

***Quercus rubra* – Northern red oak**


Oak

Linden
Tilia

***Tilia tomentosa* – Silver linden**


Linden

Kentucky coffeetree
Gymnocladus dioica


Coffeetree


Chinese coffeetree (Soap tree)
Gymnocladus chinensis


We need to explore the planet more!
(particularly China)

Nothing is native to the urban environment


Maackia

Amur maackia *Maackia amurensis* 'Summertime'


Hoptree


Common hoptree
Ptelea trifoliata

CONTRAINDICATION

Situations which a procedure potentially inadvisable

CONTRAINDICATION

The species environmental requirements must match the site conditions

35 feet in 10 years

Acer x *freemanii* 'Jeffsred'– Autumn Blaze maple

5 feet in 10 years

CONTRAINDICATION

While nothing is native to the urban forest, do not forget about the “sense of place”

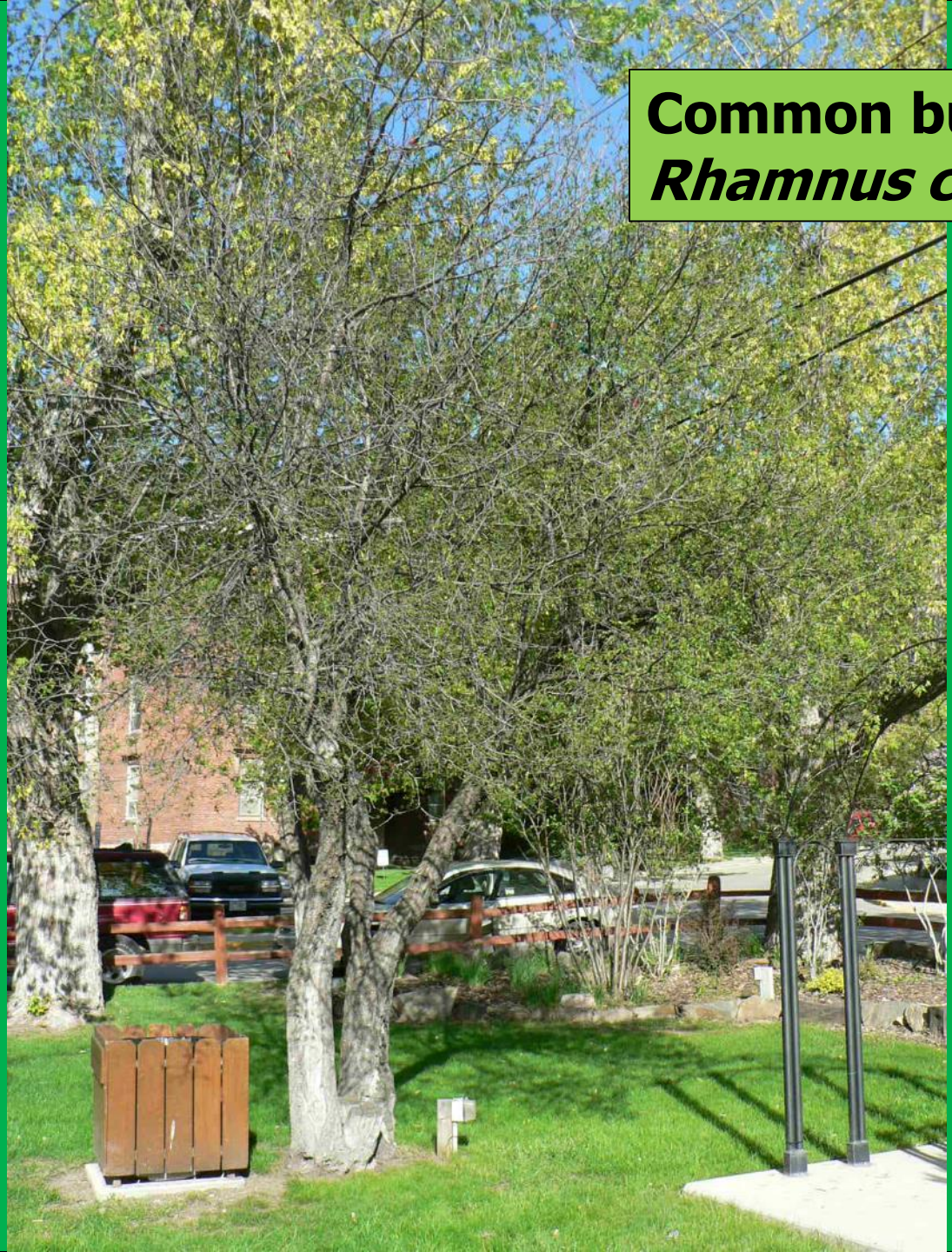

McDonald's

CONTRAINDICATION

Be careful not to create problems by planting invasive species


Phellodendron piriforme – Pearfruit corktree


Corktree



Common buckthorn
Rhamnus cathartica


Maybe best to introduce male (fruitless) clones
Aesculus x 'Homestead' Homestead buckeye


But remember they can “switch”
Ginkgo
Ginkgo biloba

Thank you

Questions?

I can be reached at:
john.ball@sdstate.edu

International Society of Arboriculture

Great Trees on a Great Lake

John Ball

Using Diversity to Reduce the Impact of Exotic Pests: How It Should Be Applied

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