Pairing of Woody Landscape Plants between Eastern Asian and North American species

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서병기

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ABSTRACT

Eight eastern Asian and North American species pairs of woody landscape plants were suggested by the morphological and molecular divergence. Eastern Asia native *Calycanthus chinensis* pairs with *C. floridus*, *C. fertilis*, *C. mohrii* and *C. occidentalis* which are native to North America. *Campsis grandiflora* pairs with *C. radicans*. *Cornus kousa* pairs with *C. nuttallii*. *Elaegnus macrophylla* pairs with *E. commutata*. *Juglans ailantifolia*, *J. mandshurica*, and *J. cathayensis* pairs with *J. cinerea*. *Liriodendron chinense* pairs with *L. tulipifera*. *Magnolia hypoleuca* pairs with *M. fripetala*, *M. fraseri* var. *fraseri*, and *M. macrophylla* var. *macrophylla*. *Pinus koraiensis* pairs with *P. strobus*. And Acer, Betula, Carpinus, Fraxinus, Malus, Pinus, Quercus, Tilia, Ulmus and Vaccinium genera have also pairing species between eastern Asia and North America.

Key words: *Calycanthus, Campsis, Cornus, Elaegnus, Juglans, Liriodendron, Magnolia, Pinus*

INTRODUCTION

Some floristically similar species of woody landscape plants are often founded in eastern Asia and North America. Their journey into eastern Asia or North America was probably through two pathways. One is across Europe and western Siberia. The other is via the shores of Seaway. The migration of some species between eastern Asia and North America was probably via the North Atlantic land bridges. And for some species, the Bering land bridge hypothesis was favored over the North Atlantic land bridge

hypothesis based on the estimated divergence time and the geological history of the North Temperate region.

Eastern Asian-North American disjuncts in genera have been examinied for allozyme divergence and sequence divergence of the internal transcribed spacers(ITS) of nuclear ribosomal DNA. The pattern of relationships portrayed by the isozyme data sometimes suggests a longer period of separation between the eastern and western Asian forms. So we can get the estimation of divergence of the species pairs between eastern Asia and North America from the isozyme data.

Also the time of divergence as measured from the isozyme data correlates with an independent assessment of the origin of these disjuncts as determined from the fossil record. Fossil evidence and geological data suggest that the intercontinental disjuncts in some species are ancient.

Though different extinction patterns and variation in molecular evolutionary rates may be partly responsible, this heterogeneous pattern of divergence is best explained by different times of disjunction in different taxa, which in turn suggests that the floristic similarity between the two continents was most likely attained by multiple migrations via both Bering and North Atlantic land bridges, or possibly even with involvement of dispersal.

MATERIALS AND METHODS

These data were taken from the North Carolina State University library computer net at NC State University. And the present data were mainly based on the following journals; American Journal of Botany, Plant Systematics and Evolution, Systematic Botany, Annual Missouri Botany Garden and The Chronicles of the NCSU Arboretum.

RESULTS AND DISCUSSION

Eight eastern Asian and North American species pairs of woody landscape plants were suggested by the morphological and molecular divergence and phylogenetic relationship(Table 1). Eastern Asian native *Calycanthus chinensis* is supposed to pair with four Calycanthus species which is native to southern or southeastern USA. *Calycanthus chinensis* formely named *Sinocalycanthus sinensis,* is native to China. The four smilar species to it grow in North America. *Calycanthus floridus,* common sweetshrub is native to southern USA; Virginia to Florida. *Calycanthus fertilis,* pale sweet-shrub and *C. mohrii,* Mohr sweetshrub are native to southeastern USA. *Calycanthus occidentalis,* California sweetshrub grows in western USA; California. Raulston(1993) reported that

there are five Calycanthus species on earth. All of them are native to North America except *Calycanthus chinensis*. Time divergence among them was estimated as 6.6 million years.

Campsis grandiflora, Chinese trumpetcreeper which is native to China and Japan pairs with *Campsis radicans*, Common trumpetcreeper which is native to southeastern USA; Pennsylvania to Missouri, Florida and Texas. Wen and Jansen(1995) reported that the morphological and molecular comparisons were made between *Campsis grandiflora* from eastern Asia and *C. radicans* from eastern North America. The cpDNA divergence between the two vicariad species was 2.44% which is the highest reported among North temperate disjunct taxa and one of the highest reported for infrageneric taxa. Detailed morphological comparisons also suggest a high level of divergence. The journey of *Campsis* species between eastern Asia and North America could be through the Bering land bridge.

Cornus kousa, Kousa Dogwood which is native to Korea, Japan and China pairs with *Cornus nuttallii*, Pacific dogwood which is native to western North America. Murrell (1993) reported that *Cornus kousa* and *C. nutallii* do not possess protective bracts *C.*

Table 1. List of eastern Asian and North American species pairs of woody landscape plants suggested by morphological and molecular divergency

	Species pairs	Native habitat
EA*	*Calycanthus chinensis*	China
ENA	*C. floridus*	southern USA
ENA	*C. fertilis*	southeastern USA
ENA	*C. mohrii*	southeastern USA
ENA	*C. occidentalis*	California
EA	*Campsis grandiflora*	China, Japan
ENA	*C. radicans*	southeastern USA
EA	*Cornus kousa*	Korea, Japan, China
ENA	*C. nuttallii*	western North America
EA	*Elaegnus macrophylla*	Korea, Japan
ENA	*E. commutata*	North America
EA	*Juglans ailantifolia*	Japan; Sachalin
EA	*J. mandshurica*	Korea, China
EA	*J. cathayensis*	central and western China
ENA	*J. cinerea*	New Brunswick to Georgia, Arkansas
EA	*Liriodendron chinense*	central China; western Hupeh, Kiangsi
ENA	*L. tulipifera*	Massachusetts to Wisconsin, Florida
EA	*Magnolia hypoleuca*	Japan
ENA	*M. fripetala*	North America
ENA	*M. fraseri var. fraseri*	North America
ENA	*M. macrophylla var. macrophylla*	North America
EA	*Pinus koraiensis*	Korea, Amur region, Manchuria, Japan
ENA	*P. strobus*	eastern North America

*EA: eastern Asia
ENA: eastern North America

Table 2. List of eastern Asian and North American species possibility pairs suggested by T. S. Ying (1983).

	Species pairs	Native habitat
EA*	*Acer buergerianum*	Japan, eastern China
ENA	*A. rubrum*	eastern North America, Oklahoma and Texas
EA	*A. mono*	Korea, China, Manchuria
ENA	*A. saccharum*	Georgia, Mississippi, Texas
EA	*Betula platyphylla*	Korea, Manchuria, Japan
ENA	*B. populifolia*	eastern North America
EA	*Carpinus turczaninowii*	Korea, North China
ENA	*C. caroliniana*	eastern North America
EA	*Fraxinus mandshurica*	northeastern China, Japan
ENA	*F. americana*	nova Scotia to Minnesota, Florida, Texas
EA	*Malus baccata*	northeastern Asia to north China
ENA	*M. angustifolia*	Tifton, Georgia, Athens
EA	*Pinus densifolia*	Korea, Japan, China
EA	*P. thunbergiana*	Korea, Coast of Japan
ENA	*P. resinosa*	eastern North America
EA	*Quercus acutissima*	Korea, Japan, China
ENA	*Q. alba*	North America
EA	*Q. aliena*	Korea, Japan
ENA	*Q. coccinea*	Maine to Florida, west to Minnesota
EA	*Q. dentata*	Korea, Japan, Manchuria, northern China
ENA	*Q. laurifolia*	southern USA
EA	*Q. mongolica*	Korea, Siberia, China, Japan, Mongolia
ENA	*Q. rubra*	North America
EA	*Q. variabilis*	Korea, Nothern China, Japan
ENA	*Q. velutina*	eastern USA
EA	*Tilia amurensis*	Korea, Manchuria
ENA	*T. americana*	central and eastern North America
EA	*T. chinensis*	China
ENA	*T. heterophylla*	eastern USA
EA	*Ulmus pumila*	Korea, Siberia, northern China, Manchuria
ENA	*U. rubra*	central and southern USA
EA	*U. parvifolia*	Korea, China, Japan
ENA	*U. americana*	eastern North America
EA	*Vaccinium japonicum*	Korea, Japan
ENA	*V. erythrocarpum*	south eastern USA

*EA: eastern Asia.
ENA: eastern North America.

kousa have 3~5 cm long bracts and *C. nutallii* have 4~6 cm long bracts.

Elaegnus macrophylla which is native to Korea and Japan pairs with *Elaegnus commutata,* silverberry which is native to North America.

Japan native *Juglans ailantifolia,* Korea and China native *J. mandshurica,* and China and Taiwan native *J. cathayensis* pairs with *J. cinerea,* butternut which is native to New Brunswick to Georgia, west to the Dakotas and Arkansas. Fjellstrom and Parfitt(1995) reported that *Juglans cathayensis* is the least derived species. *Juglans*

cathayensis appears equally or more derived than *J. ailantifolia* and *J. mandshurica*. *J. cinerea* is more derived than *J. cathayensis* in the parsimony analysis. These migration events most likely passed from North America to Asia, since the North Atlantic land connection to Eurasia has been eliminated by the time of the Upper Eocene.

Central China native *Liriodendron chinense* pairs with *L. tulipifera*, tuliptree which is native to Massachusetts to Wisconsin, south to Florida and Mississippi. Baghai(1988) and Parks and Wendel(1990) reported that allozyme data suggested the time divergence of 10-16 million years before present, whereas sequence divergence in the plastid genomes (1.24%) led to an estimate of 11-14 million years before present. Interspecific compatibility and relative morphological stasis must have persisted from at least the late Miocene.

Three Magnolia species which are native to USA might pair with *Magnolia hypoleuca*, white bark Magnolia which is native to Japan. The three Magnolia species are *M. fripetala*, *M. fraseri* var. *fraseri*, and *M. macrophylla* var. *macrophylla*.

The Korean Pine, *Pinus koraiensis* which is native to Korea, Manchuria and Japan pairs with *Pinus strobus*, eastern white pine which is native to eastern North America. Ying(1983) suggested pairing between eastern Asia and North America Fifteen species (Table 2).

Acer burgerianum which grow well in Korea and native to China and Japan could pairs with *A. rubrum* which is native to eastern North America. *Acer mono* which is native to Korea, China and Manchuria pairs with *A. saccharum* which is native to Georgia, Mississippi and Texas. Both of them are used a lot in Korean landscape.

Betula platyphylla which is native to Korea has high possibility to pair with *B. lenta* native to Delaware to Oklahoma.

Carpinus turczaninowii which is native to Korea and northern China pairs with *C. caroliniana*.

Fraxinus mandshurica which is native to northeastern China and Japan pairs with *F. americana* which is native to Nova Scotia to Minnesota, Florida, Texas.

Malus baccata which is native to northeastern Asia to northern China pairs with *M. angustifolia* which is native to Tifton, Georgia, and Athens in USA.

Pinus densiflora and *P. thunbergiana* which are native to Korea, China and Japan could pairs with *P. resinosa* which is native to eastern North America.

Five pairs of Quercus species showed the highest possibility to pair between eastern Asia and North America species; *Quercus acutissima* with *Q. alba*, *Q. aliena* with *Q. coccinea*. *Q. dentata* with *Q. laurifolia*, *Q. mongolica* with *Q. rubra*, and *Q. variabilia* with *Q. velutina*.

Tilia amurensis which is nativ to Korea and Manchuria pairs with *T. america* which is native to central and eastern North America. *Tilia chinensis* which is native to China

pairs with *T. hetrophylla* which is native to eastern USA. *Ulmus pumila* which is native to Korea, Siberia, north China and Manchuria pairs with *U. rubra* which is native to central and southern USA. Ulmus parviflora which is native to Korea, China and Japan pairs with *U. americana* which is native to eastern North America.

Vaccinium japonicum which is native to Korea and Japan pairs with *V. erythrocarpum* which is nativ to southeastern USA.

요 약

동아시아와 북미에 분포하는 조경수목을 형태적 특성 및 분자생물학적 특성에 따른 연구 결과를 토대로 분류한 결과 8종에서 밀접한 관련성을 갖고 있었다. 자주받침꽃, 능소화, 산딸나무, 보리밥나무, 가래나무, 튤립나무, 일본목련, 잣나무는 동아시아와 북미에서 각각 밀접한 유연성을 가진 종들이 있어 이들을 조경수목쌍으로 분류할 수 있었다. 그리고, 형태적 특성이 매우 흡사한 종으로는 중국단풍나무, 고로쇠, 들메나무, 야광나무, 소나무와 곰솔, 상수리나무, 갈참나무, 떡갈나무, 신갈나무, 굴참나무, 피나무, 참느릅나무 등에서 동아시와와 북미 조경수목쌍이 존재하는 것으로 판단되었다.

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