New Concepts in Improving Ornamental Plant Adaptability with Stress-Tolerant Rootstocks

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INTRODUCTION

Fifteen years of ornamental plant adaptability trials at The NCSU Arboretum with widely diverse species from around the world has shown the single most important environmental/climatic limitation to be root survival under wet, hot summer conditions. As temperatures rise, respiration rates increase, which create a requirement for more oxygen to permit root survival. Sudden flooding of poorly drained soils during maximum temperature periods can create temporary, but quickly fatal, anaerobic conditions for roots at the time of peak oxygen demand. This situation is unique to the southeastern U.S. Conversely, soils in southwest and western states are dry (and subsequently well aerated) during periods of high temperatures, while central and northeast areas are cooler when rains occur.

In addition, modern container production with carefully formulated media of coarse texture and rapid drainage allows simple, successful production of plants with fragile root systems which often cannot be subsequently grown easily in landscape soils of the production region. Prominent examples include many Ericaceous plants and such native and exotic taxa as *Franklinia alatamaha*, *Gordonia lasianthus*, *Ilex* ×*meserveae* ("blue hollies"), and *Taxus* ×*intermedia*.

Grafting is used to produce plants which combine aerial portions of superior ornamental or productive capacity with adapted and tolerant root systems suitable for the area of production. The majority of such grafting is used in fruit crop production, where an economic product permits the extra costs of such specialty propagation. Very little research has been conducted on potential rootstocks specifically for ornamental plants in the southeastern U.S. due to: (1) lack of commercial grafting operations in the region, (2) lack of such specific skills among most academic researchers, and (3) the time and expense to conduct such long-term trials on "minor" crops.

Commercial grafting firms in the Pacific Northwest and the Northeast are not aware of the potential problem and often use rootstocks which work well in those areas, but are failures when planted in the southeastern U.S. A prime example is the use of *Abies balsamea* or *A. fraseri* seedling rootstock for all fir grafting—due to their low cost and availability as a major Christmas tree species. These are the two weakest rootstock systems for firs, and such grafted plants never survive the first month of wet summer conditions in the southeastern US. In early years after its introduction, *Cornus* 'Eddie's White Wonder' was grafted in the Pacific northwest on *C. nuttallii* which cannot be grown in the southeast, leading early researchers to believe the scion cultivar could not be grown in the east. Many other such examples exist.

CONCEPTUAL GRAFT COMBINATION SUGGESTIONS

The following listing contains **theoretical, proposed** rootstock : scion graft combinations for research and production trials. The listing has been formulated from observations of plant behavior at the NCSU Arboretum, other gardens around the world, and from native habitats of many of the species. The plants listed first (before the hyphen) are taxa which have been observed to have more tolerance to hot, wet southeastern U.S. soils than average species of the genera and therefore have potential for rootstock use. The plants listed following the hyphen are those which have ornamental value, but have been observed to have survival problems in poorly drained soils and therefore would be the scion or cultivar that becomes the shoot system of the grafted plant.

In a few cases, bigeneric combinations (where species from different genera are grafted together) have been proposed where tolerant species do not exist within the problem genera. Bigeneric grafts are generally less successful than interspecific grafts, but enough successful combinations have been achieved in the past to warrant trial. An asterisk (*) is used after the proposed combination where promising trial grafting work has been conducted at NCSU or observed elsewhere.

POTENTIAL LOW-OXYGEN- AND HIGH-SOIL-TEMPERATURE-TOLERANT ROOTSTOCK: GRAFT COMBINATIONS

Abies firma—for other *Abies* taxa*.

Acer japonicum or ***A. palmatum***—for *A.. circinatum* and *A. macrophyllum.*

Acer rubrum—for *A. pentaphylla**.

Acer saccharum—for *A. griseum**.

Arbutus unedo—for *A. arizonica, A.menziesii*, and *A. texana.*

Baccharis halimifolia—for *B. pilularis*.

Betula nigra—for other *Betula* taxa*.

Calycanthus floridus—for *C. occidentalis.*

Ceanothus ×pallidus or ***C. americanus***—for west coast *Ceanothus* taxa.

Cercis canadensis or ***C. chinensis***—for *C. griffithii, C. occidentalis.*

Chamaecyparis pisifera or ***C. thyoides***—for *C. lawsoniana* and *C. nootkatensis* cultivars.

***×Chitalpa tashkentensis* (*Catalpa* × *Chilopsis* hybrid)**—for *Chilopsis linearis*.

Cornus florida—for *C. nuttallii* and *C.* 'Eddie's White Wonder'*.

Crataegus aestivalis—for other *Crataegus* taxa.

Cupressus bakeri or ***C. arizonica* [syn. *C. glabra*]**—for *C. sempervirens* 'Swane's Golden'.

Elaeagnus ×ebbingei or ***E. pungens***—for *E. angustifolia.*

Fagus grandifolia—for *F. sylvatica* cultivars; trial on *Nothofagus sp.* ??

Garrya lindheimeri **[syn. *G. ovata* var. *lindheimeri***—for *G. elliptica* 'James Roof'.

Photinia* ×*fraseri—for *Heteromeles arbutifolia* .

***Ilex* 'Nellie Stevens'**—for *I. aquifolium* and *I.* ×*meserveae* ("blue hollies")*.

Itea chinensis—for *I. ilicifolia.*

Kalmia latifolia—for *K. cuneata* and *K. microphylla.*

Magnolia virginiana—for *M. sieboldii* and *M. wilsonii.*

Myrica cerifera—for *M. californica.*

Picea abies, P. omorika, or ***P. orientalis***—for *P. breweriana.*

Pieris japonica—for *P. floribunda.*

Two-Needle Pines: *Pinus glabra* , *P. pinea, P. sylvestris,* or ***P. virginiana***—for *Pinus edulis, P. muricata.*

Three-Needle Pines: *Pinus palustris, P. serotina, P. rigida,* or ***P. taeda***—for *Pinus coulteri, P. jeffreyi, P. ponderosa, P. sabiniana* .

Five-Needle Pines: *Pinus cembra, P. parviflora,* or ***P. strobus***—for *Pinus albicaulis, P. aristata, P.flexilis, P. torrey*

Pseudolarix amabilis—for *Larix* taxa (unlikely bigeneric graft—but the only possibility for *Larix* in the South).

Quercus virginiana—for the numerous west coast and Mediterranean evergreen *Quercus* species.

Rhaphiolepis umbellata—for *Raphiolepis indica* taxa.

Rhododendron chapmani—for small-leaved evergreen *Rhododendron* taxa; a possible trial for *Kalmiopsis leachiana.*

Rhododendron atlanticum—for deciduous *Rhododendron* taxa; specifically *R. occidentale.*

Sorbus alnifolia—for other *Sorbus* taxa.

Spiraea sp.—for *Holodiscus discolor* (unlikely bigeneric graft, rootstock suckering is a potential problem).

Stewartia monadelpha, S. pseudocamellia Koreana Group, or ***S. pseudocamellia***—for *S. malacodendron* and S. *ovata.*

Styrax americanus or ***S. japonicus***—for *S. hemsleyanus, S. obassia, S. officinalis, S. officinalis* var. *redivivus* [syn. *S. californicus*], *S. platanifolia, S. texana*, and *S. youngae.*

Syringa oblata* var. *dilatata—for *S. vulgaris* cultivars.

Taxus chinensis—for *Taxus* ×*media* cultivars.

Thuja orientalis **[syn. *Platycladus orientalis*]**—for *Microbiota decussata* (unlikely bigeneric graft—but the only possibility for the South).

Tsuga canadensis or ***T. sieboldii***—for *T. caroliniana, T. heterophylla,* and *T. mertensiana.*

CONCLUSION

Successful combinations from the above potential grafting/rootstock trials would make possible the favorable landscape cultivation of new ornamental plants currently impractical or impossible to grow in the southeastern U.S. There is an industry conception that grafted plants are a commodity of the past with increasingly unavailable skills needed and greater costs than for cutting production of clonal taxa. This statement is generally true for mass-market crops, but for a number of plants grafting may be the only feasibility for successful use of the taxa in the region. Knowledge of graft combination feasibility would create opportunities for development of regional specialty propagation nurseries to fill the potential consumer market for such connoisseur plants.

RELATED LITERATURE

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