these efforts will fill a valuable niche in the landscape industry, which is continuously searching for groundcover plants that produce good color in shady environments. Our program strives to produce new and better coleus selections for the commercial arena as well as producing information for the academic field. Our goal for the coleus-breeding program is to generate new selections that will meet today's demands in ornamental excellence.

The China Connection — People, Plants, and Plans of a Horticultural Giant©

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INTRODUCTION

China's incredible growth and development in the past decade has been the subject of many television specials and print media articles. The facts and figures are astounding: Seventy-five percent of the world's cranes, 40% of the world's concrete, and 16,000 new joint ventures last year alone. China is about to become the big consumer of world oil and steel and graduates 160,000 new engineers each year. These graduates enter an economy boasting a growth rate in the double-digit range. In the midst of all this change, the central government has embraced the regreening of China's industrial base with unimaginable vigor. The "golden triangle" of eastern China is marked by the huge population that lies in and between Nanjing, Shanghai, and Ningbo — an area considered a major economic engine of Eastern China. This region has endured disturbance for thousands of years, but only in the last two decades has it seen a surge in population, the result of an amazing rural to urban migration, a migration driven by the promise of an industrialized China. The area is comparable in many respects to the southeastern U.S. [U.S.D.A. Hardiness Zone 7–9 with 1016–1524 mm (40–60 inches) rainfall per year, with substantial summer rains and drier winters].

The landscape of the watershed and floodplains of the Yangtze is a sight to behold. Attractive concrete apartments are commingled with government buildings, shops, factories, and fruit, vegetable, fish, and animal farms. One thing is apparent: China's land use planners have not shortchanged trees as a part of the picture.

China celebrates the idea that cities featuring refined parks, tree-lined streets, and plenty of vegetation are better than those that don't. Urban landscapers focus their energy on highways, roads, parks, river walks, plazas, canals, and waterways. In fact, China mandates that citizens of large cities be within a thousand meters of a grandiose park. This is horticulture at its biggest. Main thoroughfares in city and urban environs often sport wonderful tiers of vegetation. These tree and shrub plantings take in the gamut of ultimate plant sizes, from small shrub/tree plantings to broad, long landscapes of trees destined to be patriarchs that will provide shade and comfort for citizens in these huge cities. With three million new cars on the roads in China each year, urban planners are in a hurry to make the changes needed for their industrious and very crowded citizens. A center medium of trees and shrubs, then two to four lanes for vehicular traffic, a line of vegetation, bicycle

path, another line of vegetation, and wide sidewalks for pedestrians is the approach for many of the avenues in city centers.

The new super highway that runs from Shanghai to Nanjing and further west is proof positive of the commitment to urban forestry. This main toll highway links the downtowns of major cities and manufacturing areas and is 242 km (150 mi) long, with four lanes going west and four lanes going east. The center medium is a highway blur of very uniform Chinese juniper, *Juniperus chinensis*. The species was selected because it responds to pruning, is durable and dense enough to "reduce oncoming vehicular headlight distraction." If that isn't enough, both sides of the highway are thickly planted to a wide collection of trees, and not just an occasional specimen. Roadside forests are three and four tiers deep, almost always planted at very high density. Trees and large shrubs are generally field dug in tightly packed nurseries with a small root ball and then pruned hard. Trunks and main branches are commonly wrapped with jute rope to prevent the trunk from "drying," and trees are kept moist during the first season of growth. The species list for street trees and shrubs in southeast China is extensive, with over 200 species grown to fit the needs of specific landscape requirements. Several may be a surprise to many U.S.A. horticulturists. For instance, the camphor tree (*Cinnamomum* sp.) is a staple almost everywhere simply because it's accepted as a very durable evergreen, medium-sized tree that tolerates high-traffic landscapes. Sycamores of various species are popular and often pollarded. *Persea* (syn. *Machilus*), *Michelia,* and *Phoebe* make their presence known. A weeping *Sophora japonica* is quite popular. Our very own U.S.A. native, the great southern magnolia, *Magnolia grandiflora*, is common. *Liriodendron chinense*, *Liriodendron tulipifera,* and the hybrid are widely utilized. Deodar cedar, *Cedrus deodara*, is often spotted in grand colonies making blue exclamation points. The dawn redwood, *Metasequoia glyptostroboides*, bald cypress, *Taxodium distichum*, and, to some extent, the pond cypress, *Taxodium distichum* var. *imbricarium* (syn. *T. ascendens*), are common. One of the front-runners in terms of sheer numbers and growing in popularity is the bald cypress, *Taxodium distichum*, a native of southern U.S.A. While the dawn redwood and Chinese water cypress, *Glyptostrobus pensilis*, are still planted extensively, the bald cypress is everywhere and makes a huge statement in the landscape of the Yangtze delta.

TAXODIUM

The fact that the bald cypress has found a good home in southeast China shouldn't be surprising (Creech, 2003). After all, the bald, pond, and Montezuma cypress (*T. distichum*, *T. distichum* var. *imbricarium*, and *T. mucronatum*), respectively, have few problems in the U.S.A. A studied comparison reveals that the climate, topography, and soil of southern China fit bald cypress requirements across a wide region. Taxodiums are tough, long-lived deciduous conifers particularly well adapted to wetland habitats, yet they perform admirably in drier spots if given a little attention during the establishment years. The bottom line is that it's a durable landscape tree in the U.S.A. and in China. There are other factors driving increased use in China. After many years, the species makes a fine, high quality lumber, and patience is considered a high virtue in China. It performs well in compacted, low-oxygen or swamp conditions. Salt-tolerant types of *Taxodium* make fine candidates for high alkalinity soils—and salty wetland reclamation projects. They can stand up in a hurricane. In the right spot, their potential longevity and size is astounding.

DNA analyses classify *T. distichum*, which ranges widely across the Southern U.S.A., as the species, with *T. distichum* var. *imbricarium* and *T. mucronatum*, native to Mexico and southern Texas, as varieties. It has come to the author's attention that changes in the nomenclature of the genus *Taxodium* have been proposed [see Aronold and Denney (in press, 2006) and Lickey and Walker (2002)] and if accepted will include the following name changes:

Replace *T. distichum* with *T. distichum var. distichum*

Replace *T. ascendens* with *T. distichum var. imbricarium*

Replace *T. mucronatum* with *T. distichum var. mexicana*

These changes have not been included in the text because they have not been accepted as of the date of publication. *Taxodium mucronatum* has fast growth, alkalinity tolerance, no knees, holds its foliage longer, flushes earlier in spring, is often open, wide, and unbalanced, generally not as hardy, and not usually as uniform, columnar or clean as *T. distichum*. While native to the southern U.S.A. and Mexico, there have been few efforts in the U.S.A. to improve *Taxodium* via controlled crosses and selection of superior types. In China, however, breeders have a 40-year history working with selecting improved progeny of controlled crosses — and multiplying them by cutting propagation. In China, where *T. distichum* is widely used as shelterbelt and urban trees, hybrids combine the best characteristics of each species, and fast-growing clones have been developed. The clone T302 (a *T. distichum* × *T. mucronatum* hybrid, introduced into U.S.A. as *Taxodium* 'Nanjing Beauty'), T401 (*T. distichum* var. *imbricarium* × *T. mucronatum*), and T202 (*T. distichum* var. *imbricarium* × *T. mucronatum*) are suitable for alkaline and salt-rich coastal floodplains with 8.0-8.5 pH. Controlled crosses between *T. distichum* and *T. mucronatum* have been verified as true interspecific hybrids by Karyotype analysis (Zhao et al., 1992). Attributes of T302 included faster growth than *T. distichum*, good columnar form, longer foliage retention, almost double the alkalinity tolerance of *T. distichum*, no knees, and easy rooting when juvenile. Clone T302 was introduced into the U.S.A. in January 2002 and, with the permission of the Nanjing Botanical Garden, given the name *Taxodium* 'Nanjing Beauty' in 2003**.** This cultivar was selected in 1988 from a batch of seedlings that were the result of a cross made by Dr. Chen Yong Hui in 1980 between *T. distichum* and *T. mucronatum*. Propagation is via cuttings taken in May and June from plants grown 1 year and then pollarded at about 1 ft height. Pollarding creates numerous upright vigorous shoots, the best kind of cuttings for early June propagation. I have seen three nurseries in China specializing in this particular clone, each propagating hundreds of thousands of T302. Rooting percentages observed were excellent. The scientists are convinced that the key to good rooting is the quality of cutting wood and mist control. While hormones are used, this is not seen as very important.

The SFA Mast Arboretum in Nacogdoches, Texas, acquired two clones, T140 and T27, in March 2005, which are considered more evergreen and salt tolerant than T302; T140 grows faster than T27, which produces a wider profile and they show strong *T. mucronatum* characteristics with improvement in form and vigor. The Chinese believe they have selected another clone, T1, that will be superior to both T140 and T27, but more genotype and environment studies are needed. The foundation of the most recent selections is derived from crosses made by Professor Chen and Liu in 1992 at the Nanjing Botanical Garden. Pollen from *T. mucronatum* was applied to T302, and fifteen selections were made in 1995. The main characteristics

for selection were: (1) fast growth rate, (2) dark green color during the growing season and a red-orange leaf color in the autumn, and (3) evergreen leaves. In 2006 or 2007, the results from T140 and T27 will be reported and registered with the Chinese Forestry Department. It will be at least 5 years before T140 and T27 enter commerce. In June, 2005 there were less than 100 each of these two clones. Clones T118, 120, and 149 have already been registered with the Chinese Forestry Department at the provincial level, while T302 has been registered at the national level.

Taxodium improvement work at the Nanjing Botanical Garden is currently directed by Professor Yin Yunlong. The SFA Mast Arboretum has assisted the project by providing seed from various provenances in the southern U.S.A. (*T. distichum* and *T. distichum* var. *imbricarium*), Mexico (*T. mucronatum*), and New Mexico (cold-hardy *T. mucronatum*, Las Cruces, New Mexico). The Chinese *Taxodium* improvement project has been intense for many years, and this southern U.S.A. native plant is being planted in huge numbers (millions) in southeastern China. In addition, it has recently been verified that Professor Ye Peizhong, Nanjing, created ×*Taxodiomeria* in 1963, a cross of *T. mucronatum* with *Cryptomeria japonica* var. *sinensis*. The cross has been repeated and verified by DNA analysis but has yet to be imported into the U.S.A. At the Nanjing Botanical Garden, fields of seedling hybrid Liriodendrons are under selection, and several cultivars are propagated via grafting and marketed in the region. Sun and cold tolerant michelias are also a focus of the tree improvement-breeding program.

Where will all these millions of trees be planted? One possible home is a remarkable project along the coast, a coastal dike system for the Shanghai and Ningbo coastlines over 700 miles long. The dike is China's strategy to deal with the devastating blows of typhoons and storm surges, every bit as intense as the recent hurricanes that have afflicted U.S.Gulf Coast. Long stretches of the dike complex are managed via locks that reduce the inflow of salty tidal waters and are managed to change salt flats to soils more suitable for trees and human use. In August 2005, the People's Republic of China committed two billion dollars for a coastal dike "windbreak forest" project, a man-made forest several hundred meters wide and hundreds of miles long on the mainland side of the dike with substantial plantings planned in and part of constructed wetlands and "parks." The estimate of 75 billion trees needed for planting in the next two decades was provided to me by several sources, but I have been unable to verify this astounding number. The mix of salt-tolerant trees and plants planned for the project is quite extensive and the acreage planted appears healthy. The government's commitment to a windbreak forest has resulted in a heated nursery buildup in the region with nursery and landscape companies developing strategies to capture a portion of this new and unique market.

SWEET OSMANTHUS (*OSMANTHUS FRAGRANS*)

I was invited by Professor Xiang Qibai of the Nanjing Forestry University to participate in the First International Symposium on Sweet Osmanthus, 4-7 Oct. 2004, in Shanghai, China, and to present the paper "Status and Use of *Osmanthus fragrans* in Southern U.S. Landscapes." The conference was attended by 108 participants from 11 countries. I was accompanied by Bill Brown, General Manager of Magnolia Nursery, Waller, Texas. China has applied to the International Horticulture Society to be the official International Registry for the genus, and while that application is pending, there's good reason to think it's justified.

The ancient sweet *Osmanthus* of China is one of the ten traditional flowers of China. It is heavily planted in landscapes, parks, and roadsides. The Chinese revere the plant for its durability, character, fragrance, and landscape utility in high-traffic landscapes. Old trees are respected, signed and interpreted, and given holy attendance. Protective fences mark their importance. Tourists flock to admire their size and glory. The most ancient plant known in China rests comfortably in the grounds of the Shengshui Temple, Nanzheng County, Shannxi Province, and is over 2100 years old. It is 12.2 m (40 ft) in height, and this magic tree was planted by the Xiaohe himself, the Minister of the Han Dynasty. One of the most impressive trees is the stately specimen in the landscape of Linggu Temple, Nanjing city, Jiangsu province. This dense-foliaged giant is over 6.4 m (21 ft) in height and sports a crown diameter of 7.3 (24 ft). It rests alone in the valley, and when it is in bloom on an early October morning, the entire valley is filled with its magic fragrance. During October when the species is at its best, over ten Chinese cities honor the plant with a wide range of special holidays. In a carnival-like atmosphere, Chinese citizens flock to sweet *Osmanthus* gardens to enjoy festivals celebrating the sweet *Osmanthus* as a national treasure of China.

There are 157 cultivars of sweet *Osmanthus* in China divided into four main groups: Siji, Albus (or Thunbergii), Luteus, and Auranticus (Zang and Xiang, 2004). Cultivars have been selected for flower size, abundance of flowers, characteristics of the flowers, time of bloom and reblooming tendency, tree form and habit, bark, branch, leaf, pedicel, and fruit. When one realizes that sweet *Osmanthus* has been in cultivation in China for over 2000 years, it's not surprising that so many cultivars and forms have proliferated. Only now, however, has China made a national mission to acquire superior clones, propagate them, improve the genus, and popularize the plant worldwide. For instance, the Hangzhou Ludi Seed Company includes the Hangzhou Sweet Osmanthus Variety Cultivation Base, a single nursery (33 ha) in the mountains just west of Hangzhou, a nursery dedicated solely to the production of sweet *Osmanthus*, with an inventory of 1.5 million plants and 40 cultivars.

There is enormous opportunity to popularize sweet *Osmanthus* in the U.S.A. with cultivar improvements. One recent introduction into the U.S.A., *O. fragrans* 'Fudingzhu', or more popularly known as 'Nanjing Beauty', is exceptionally floriferous and known to flower quickly in the container. *Osmanthus fragrans* f. *aurantiacus* is the orange form found occasionally in the landscapes of the southern U.S.A., and it is a treasure when it reaches peak bloom and fragrance. The SFA University Mast Arboretum has eight cultivars, including two that are reported as red-flowering forms (yet to bloom in the garden). I have seen *O. fragrans* 'Zhusha Dangui' and while I caught it just past peak with petals a bit spent, I can say, yes, it's red enough to make the mark.

SHANGHAI FLOWER PORT

In Oct. 2004, I visited the Shanghai Flower Port Enterprise Development Co. Ltd. (SFPED, No. 2 Shengdong Rd. Donghai State Farm, Nanhui District, Shanghai, China P.R. 201303). This star corporation was funded in Sept. 2002 via a multitude of domestic and international sources and is recognized as one of the leading industrialization companies in Shanghai. With 40 ha of modern climate-controlled greenhouses and plans for expansion, the 250-ha complex includes a 28 ha theme park to evaluate and display new plant materials for domestic and export opportu-

nities. Shanghai Flower Port Enterprise Development Co. Ltd. is located between Shanghai's Pudong International Aviation Port and Pudong's Yangshan International Deep-Water Port. Shanghai Flower Port Enterprise Development Co. Ltd. sets up long-term partnerships with companies from around the world including Holland, Germany, Israel, Japan, and China Taiwan. The mix of enterprises involved include the Sino-Dutch Horticultural Training and Demonstration Center, Shanghai Flower Port Enterprise Development Co. Ltd., Shanghai Jetgreen Agriculture Bio-Tech Co. Ltd., Asia East Fields Co. Ltd., Shanghai Sino-Dutch Horticulture Flower Co. Ltd., Shanghai Sino-Dutch Flower Co. Ltd., and the Shanghai Sino-Dutch Horticulture Nursery Co. Ltd. Eastfields produces millions of geranium and poinsettia rooted cuttings in cooperation with the Fischer Group of Germany, and 95% of its products are exported, primarily to the U.S.A.

CONCLUSION

Horticulturally, China is on the move and the sheer volume of nursery production is staggering. Low-tech nursery practices that are efficient and proven are clashing with new technologies and new plant materials. Joint ventures are everywhere. Researchers at universities and botanical gardens are strategizing, breeding, and selecting improved trees for the urban landscape. The fact that native southern U.S.A. germplasm is connected to that breeding effort promises interesting plants for specific sites and demanding conditions. While the U.S.A. is underrepresented in the horticulture business world of China compared to other countries, the potential for healthy exchange of new plant materials, ideas, and business opportunities appears unlimited.

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