

Conifers for the Southeast[®]

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INTRODUCTION

Back in the mid-1990s American Nurseryman magazine ran a series of articles utilizing conifer experts from around the country, but only one of those experts was from the southeastern United States. In the Coastal Plain region, conifers are often thought of as pine trees for forestry or junipers for landscaping, that is it. Due to a lack of information on conifer adaptability for the Lower South, in 1996 I started collecting germplasm for an evaluation project at The University of Georgia campus located in Tifton, Georgia. The Tifton Campus is located 103 km (64 miles) north of the Florida border in south-central Georgia. The station is located in USDA Hardiness Zone 8a and Tifton averages about 100 days per year at or above 32 °C (90 °F).

The initial plantings were installed in January 1997. Individual plants were planted every 3.8 m (12.5 ft) within rows with 6 m (20 ft) between rows. Composted pecan shells were applied as mulch and drip irrigation was installed with an emitter at each plant. Fertilizer is applied at the rate of 50 lbs N per acre in the spring and 25 lbs N per acre in August using 16-4-8 soluble granular fertilizer with micronutrients. The pH of the site at time of planting was 5.5. Weeds were controlled with preemergent applications of simazine and oryzalin in February and September. Glyphosate was applied as needed as a post-emergent herbicide.

FACTORS TO CONSIDER

During the study period the lowest temperature in the winter has been -10 °C (14 °F). Tifton is located in an area where the temperatures never spend 24 h below freezing. Even though temperatures may plummet into the upper teens every winter, temperatures the following day are usually in the low to upper 30s. By adding protection from drying winds, certain conifers from more tropical areas can be grown in the Coastal Plain region of the southeast because temperatures never linger below the freezing mark for days on end.

Photoinhibition can also cause damage or winter browning of foliage under conditions of high light intensity and low temperatures. The response only occurs in leaves exposed to the sun as those on the north side of the plant often remain green. In plants such as *Chamaecyparis*, *Cryptomeria*, *Platyclusus*, *Taiwania*, and *Thuja*, foliar browning is due to the production of a pigment known as rhodoxanthin. This pigment is produced to prevent damage to the chloroplasts when light levels are high and temperatures are low or when photosynthesis cannot run efficiently enough to dissipate excessive light energy. In Japan it was discovered that natural polyploids of *Cryptomeria* remained green in the winter due to increased levels of antioxidant enzymes. In 2008 Dr. Ryan Contreras and I initiated a program to develop polyploid Japanese cedars to see if we could create non-browning "evergreen evergreens." After several attempts we successfully produced over 100 polyploid seedlings. These plants are being grown out and will be planted to the field in 2011 for further evaluation.

High temperatures also create problems for conifers in the south. The three main problems are the duration of high temperatures, high nighttime temperatures, and elevated soil temperatures. In south Georgia, we average 90–100 days per year with temperatures at or above 90 °F and summer lasts from early May until mid-October. Depending on their origin, most conifers have an optimum photosynthetic temperature range of 20 to 29 °C (60 to 85 °F). Add in high nighttime temperatures which increase plant respiration and many conifers begin to run a negative carbohydrate balance as they burn up all the sugars made by photosynthesis during the day. Since carbohydrates are needed for plant growth, little to no growth occurs. The Year 2010 was one of the hottest summers on record in Georgia, particularly for nighttime temperatures. It has been fairly common over the past 20 years for temperatures to still be in the upper 80s at 22:00, but this was the first summer where temperatures were in the 90s that late into the evening. Many conifers grow at elevations much higher than those found in the southeast. Due to the adiabatic lapse rate which dictates that temperatures usually decrease about 3 °F for every 305 m (1,000 ft) increase in elevation, many conifers grow in habitats with much cooler night temperatures.

High soil temperatures increase respiratory demands of the root system as well. Throughout much of the southeast, clay soils dominate the landscape. Wet, heavy soils can be a conifers worst enemy since high temperatures and low oxygen availability lead to increased respiratory demands. If sufficient oxygen is not available, this can lead to the death of roots and eventually a decline of the entire plant. Many conifers die during periods of heavy rainfall late in summer since the air pockets in the soil are saturated with water and oxygen is not sufficiently available to meet the demands of the roots. Heavy soils should be amended or raised beds can be utilized. Low oxygen availability is less of a concern on the sandy soils of the Coastal Plain region where there is sufficient drainage. Supplemental irrigation is essential for plant establishment and often helps with survival during the growing season during periods of drought. Plants such as a Japanese cedar grow best in coarse, mountain soils in areas that receive upwards of 2,540 mm (100 in.) of rain per year. Much of the southeast gets less than 1,270 mm (50 in.) much rainfall in a normal year.

Soil type (sandy vs. clay), soil pH, and alkalinity of irrigation water all influence nutritional aspects of conifer growth. In south Georgia on our sandy loam soils it is necessary to fertilize most conifers to optimize growth and keep foliage color looking good throughout the winter. On clay soils in the northern part of the state, many collectors only fertilize their collections at planting. The difference — clay soils have sufficient cation exchange capacity to hang onto soil nutrients whereas they tend to leach from sandy soils. Nitrogen seems to be the biggest limiting factor for good growth. Many conifers from Vietnam and southern China grow on acidic limestone karst soils, indicating the need for calcium. Gypsum can be used to increase soil calcium levels without increasing soil pH, otherwise dolomitic limestone can be used. In the highly acidic, leached sands of the Coastal Plain, magnesium deficiency often occurs on conifers such as *Keteleeria evelyniana* and *Nageia nagi*. Epsom salts (magnesium sulphate) can be used to correct deficiencies of magnesium. Iron deficiency can also occur on alkaline sites or when alkaline irrigation water from limestone aquifers is used for a number of years, particularly with drip irrigation systems.

Hurricanes can wreak havoc on a conifer collection. Many pines snap off at the top or may blow over in shallow soils. In 2004, four hurricanes with winds of in ex-

cess of 64 kph (40 mph) came through south Georgia in a matter of months. Many conifers in the collection were not damaged, but all the ones that blew over were in the genus *Cupressus*! In many cases it appears that top growth outgrows the supporting root system.

There are a number of pests that attack conifers in the southeast. In my experience the main pests have been foliar diseases (*Cercosporidium*, phomopsis tip blight), cankers (bot canker and *Seridium*), pine tip moths on two- and three-needled pines, root rot in container and field-grown plants, and spider mites. Woolly adelgids are now problems in the upper south on firs and hemlocks.

CONIFERS FOR CONSIDERATION

Abies firma or Momi fir from southern Japan is the only true fir that can grow across the entire southeastern region. Momi fir has good resistance to phytophthora root rot and is being used as an understock to evaluate other species in the south. In Zones 6 and 7a, *A. homolepis* and *A. nordmanniana* perform well. For conifer enthusiasts along the gulf coast, *Afrocarpus falcatus* has finely textured foliage and makes a large shrub or small tree. New growth is damaged below 18 °F but there has been no stem dieback in Tifton. The Parana pine, or *Araucaria angustifolia*, has been a pleasant surprise in Georgia — performing well in Tifton and next to the conservatory at the Atlanta Botanical Garden. Hybrids between this species and the monkey puzzle tree, *A. araucana*, are being evaluated for resistance to root rot. *Araucaria bidwillii* has also grown well with minimal winter damage to shoot tips in Tifton.

In the Piedmont and mountain regions of the south (Zones 6b and 7), incense cedar (*Calocedrus decurrens*) performs very well, but old trees are rarely seen in the Coastal Plain. Two Asian species, *C. formosana* from Taiwan and *C. macrolepis* from southeastern China have performed exceptionally well in Zone 8a. The Taiwanese incense cedar has dark green foliage which is very attractive. Unfortunately, both species have been fairly difficult to root from cuttings.

Numerous Deodar cedars have been introduced in the past decade. Many growers like *Cedrus deodara* 'Bush's Electra' because it is heavily branched and looks good in a large container. The cultivar 'Gold Cone' has performed well in the Deep South and has nice yellowish foliage during much of the year. Many plants from Taiwan perform well in south Georgia, including *Chamaecyparis obtusa* var. *formosana*. A plant in my trials reached a height of 6.7 m (22 ft) in 10 years. Selections are needed that do not turn brown in the winter time. All dwarf *C. japonica* selections that I have tried over the last 13 years are dead, rarely living more than 7 years. 'Gyokuryu' and 'Rein's Dense Jade' are two intermediate forms that have performed well. I am currently working with a selection from north Georgia that has good form and remains green through the winter.

The genus *Cupressus* is in taxonomic turmoil at the moment. Until a final determination can be made, I will just call them all *Cupressus*. Leyland cypress can be destroyed by several pathogens, including *Cercosporidium* which requires spray treatments every 2 weeks from June to Thanksgiving to prevent the problem. I have an unnamed clone that has shown excellent disease resistance that may be useful for the Christmas tree industry. The selection 'Gold Rider' is the best yellow-foliaged form but it is the poster child for phomopsis tip blight in south Georgia. *Cupressus funebris* is an attractive upright conifer with pendulous foliage that de-

serves more use while the Arizona cypress selection *C. arizonica* var. *glabra* 'Chaparral' receives positive comments from all who see it. Numerous junipers thrive throughout the southeast. *Juniperus formosana* is an upright grower with weeping branches that does well in Zones 7–8a.

Keteleeria's are fir relatives from southern China and northern Vietnam. *Keteleeria davidiana* is rare in the southeast but well worth the effort if you want a tree that looks like a fir and thrives in the lower south. Another nice species is *K. evelyniana* which has performed well in south Georgia and north Florida. Spruces are not good plants for the Lower South. The only spruce to survive in my trials has been *Picea chihuahuana* from Mexico. At Cox Arboretum in Canton, Georgia (USDA 7a), *P. morrisonicola*, *P. omorika*, and *P. orientalis* have all grown well. *Pinus pseudostrabus* from Mexico is an excellent five-needled pine that has grown well in south Georgia. I have also been pleasantly surprised by the growth of certain *P. armandii* and *P. wallichiana* selections.

Taiwania cryptomerioides, while not a plant with great commercial potential, makes a fantastic specimen conifer for large gardens and public spaces. On the commercial side, *Thuja* 'Green Giant' performs exceptionally well throughout the south and holds up well in the heat of south Georgia with none of the disease problems destroying the Leyland cypresses. Interest in conifers for southern landscapes is increasing. Research is being conducted at University of Georgia Tifton Campus and the Center for Applied Nursery Research in Dearing, Georgia, to bring new introductions to market in the near future.