SECTION 3

FIELD PRODUCTION

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Section 1 and Section 13 may contain related titles.

Field Growing Florist Branches

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Nature of Work: Alternative crops and methods of production have a long history in the NC mountains. “Broken" boxwood, *Buxus sempervirens*, and wildcrafted laurel, *Kalmia latifolia*, stems as well as galax, *Galax aphylla*, foliage have been exported by the ton to florist markets. "The demand for specialty cut flowers - essentially all flowers but roses, camations and chrysanthemums - continues to increase and with it, there will be a parallel increase in production." (Armitage, 1993)

It was the objective of this research to evaluate potential cut stem crops for field production by Western North Carolina nurserymen. The crops chosen were *Callicarpa japonica* 'Leucocarpa' for fruiting stems, *Salix chaenomyloides* for male catkins or pussy willows and *Forsythia X intermedia* for their flowers.

Container grown one-gallon seedlings of *Callicarpa japonica* 'Leucocarpa' were selected for uniformity and planted in clay loam soil at the Mountain Horticultural Crops Research Station (MHCRS), Fletcher, NC on April 4, 1991. Nutritional status of the soil had been adjusted according to soil test recommendations. Three plants were fertilized at each of three rates. These treatments were randomized within each of three replicates. Treatments were broadcast ammonium nitrate, 34-0-0, 0.25, 0.50 or 1.00 oz. per plant applied one month after planting in 1991 and in April 1992. Stems with abundant fnuit were harvested in late October 1991 and October 1992, graded to length (1.0, 1.5, 2.0 and 2.5 ft.) and totalled. All non-harvestable stems were cut to a height of approximately one foot.

In 1992, a similar experiment was established with Japanese Giant Pussywillow, *Salix chaenomyloides*. All treatments were the same but data collection was adjusted to account for the nature of the plant. Stems were harvested in late January when silvery-white catkins were just becoming apparent then all non-harvested stems were cut back as with *Callicarpa*. Harvested stem lengths were graded to under one ft, over one but under two, over two but under three and over four feet.

A cultivar evaluation for *Forsythia X intermedia* was initiated in 1993. No compact or dwarf cultivars were selected because longer stems are more valuable in the florist trade DeWolf and Hebb, 1971). Because cultivar nomenclature appear to be confused in the trade, cuttings were obtained from original accessions at the Amold Arboretum of Harvard University in late summer 1993, rooted at the Mountain Horticultural Crops Research

Station, Fletcher, NC and container grown before establishing the field planting in fall 1994. Forsythia cultivars were planted ten feet apart within a rows. There were three replicates with cultivars randomized within replicates. In April of each year, plants were fertilized with ammonium nitrate. The first year, 0.5 oz. N was applied per plant. The second year, 1.0 oz. N was applied per plant. Weeds were controlled manually and with a directed spray of 1% glyphosate solution. Forsythia stems were harvested when 50% of florets were open, late February in 1996 and mid March in 1997.

Results and Discussion: Data in Table 1 indicates that during both years increasing the rate of ammonium nitrate application decreased the number of stems usable for florist cuts in *Callicarpa* japonica 'Leucocarpa'. Both years foliage did not drop prior to frost. Frost fumed foliage crispy but did not promote abscission. Frost also resulted in many brown fruit. As a result, this research was abandoned in 1992 because of the frost susceptibility problem. Armitage's 1993 book states that callicarpa stems should be cut when the basal fruit clusters are fully colored and the terminal fruits are still green. If we had known this, perhaps the frost browning could have been avoided by earlier harvesting.

Table 1. Total Number of Callicarpa japonica 'Leucocarpa' stems per plant as influenced by rate of ammonium nitrate application in 1991 and 1992.

Oz. N/plant	1991[ns]	1992[ns]
0.25	71.6	185.3
0.50	69.0	158.7
1.00	65.3	116.8

[ns] No significant difference

Data in Table 2. indicate that there was no significant increase in the total number of harvestable *Salix chaenomyloides stems*, i.e., those with consistent and prominent catkins, when rates of ammonium nitrate application were increased. There was also no increase in the number of longer, more valuable stems when rate of ammonium nitrate application was increased (data not shown). The primary factor affecting stem length and quantity of stems produced per bush in these unirrigated plots was rainfall. 1992 was a year with normal, i.e., at least one inch per week, rainfall while 1993 was a dry, hot summer, (the hottest July ever recorded in Asheville, NC).

Table 2. Total Number of *Salix chaenomyloides* stems per plant as influenced by rate of ammonium nitrate application in 1992 and 1993.

Oz. N/plant	1992[ns]	1993[ns]
0.25	103.6	78.3
0.50	87.3	31.0
1.00	95.3	53.7
2.00	110.3	48.0

[ns] No significant difference

The cultivar 'Spectabilis,' which is commercially important for cut stem production in Holland (Boyle and Smith, 1991), consistently produced flowers in the autumn thereby limiting the number of flowers per stem when harvested in spring. The total number of stems per plant harvested is shown in Table 3.

Table 3. Total number of harvestable stems per plant of *Forsythia X intermedia* cultivars in 1996 and 1997

	Total Stems Per Plant*	
Cultivar	1996	1997
Arnold Brilliant	2.7 e	3.7 e
Beatrix Farrand	11.7 d	30.7 cd
Karl Sax	11.3 d	49.0 c
Lynwood	79.7 a	103.0 a
Spectabilis	29.7 c	48.3 bc
Spring Glory	47.0 b	68.7 b
Farrand Hybrid	11.0 d	17.3 de

*Rp05 Duncan's New Multiple Range Test.

Significance to the Industry: 1. Production of *Callicarpa japonica* 'Leucocarpa' and *Salix chaenomyloides* stems is not increased by increasing rate of nitrogen application. 2. Moist soils are essential for production of *Salix chaenomyloides* stems. 3. *Forsythia* 'Lynwood' aka 'Lynwood Gold' produced by far the largest number of harvestable stems. *Forsythia* 'Spring Glory was a distant second but bloomed about a week earlier in a paler yellow color so may be worth consideration. *Forsythia* 'Spectabilis' spring quality was reduced by fall flowering. Production by other cultivars was so poor under NC mountain conditions that they should be avoided.

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Are 'Barton' and 'Cloud Nine' the Same Cultivar'?

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Nature of work: Flowering dogwood (*Corpus florida* L.) is a highly prized ornamental tree native to the eastern North American deciduous forest. Cultivars are usually selected from seedlings or sports occurring on cultivars or native trees that exhibit unusual or interesting horticultural characteristics. At present, there are more than 100 recognized cultivars in production(8). Most cultivar are distinguished solely on appearance of the foliage and bract characteristics, such as size and color, and occasionally berry and twig color. With so few characteristics to classify and segregate cultivars, it is often difficult to identify similar appearing dogwoods. For example, nurserymen have experienced problems in discerning differences between 'Barton' and 'Cloud Nine', two extremely popular white- bracted cultivars (Don Shadow, personal comm.). Byers nursery developed 'Barton' from a seedling found at Stark's nursery in Missouri, whereas Chase nursery propagated and released 'Cloud Nine' from a plant located in Alabama. Both dogwoods were introduced independently about 30 years ago.

'Barton' and 'Cloud Nine' are virtually indistinguishable using the horticultural characteristics mentioned above. Therefore to unequivocally identify the two cultivars, we evaluated alternative phenotypic characteristics and analyzed their DNA . 'Barton' and 'Cloud Nine' were included with eight other cultivars in a trial at the University of Tennessee Plateau Experiment Station, Crossville, TN. In this study, ten cultivars were placed in a randomized complete block design with five replications (three trees per replication) and evaluated for the following phenotypic or horticultural characteristics: dogwood canker resistance, spot anthracnose resistance, susceptibility to frost damage, bloom number, bract length and phenology (7).

DNA profiling techniques have been able to detect genetic differences between dogwood cultivars and to identify putative hybrids between dogwood cultivars (6). The same and additional DNA fingerprinting strategies were also employed to detect genetic differences between 'Barton' and 'Cloud Nine'. Total genomic DNA was extracted from young expanding leaves of three trees of each cultivar using a commercially available DNA isolation kit. DNA amplification fingerprints (DAF) or profiles were generated using twelve arbitrary oligonucleotide primers, each consisting of eight base pairs (4). Additional fingerprints were generated using a powerful nucleic acid scanning technique capable of distinguishing closely related organisms (5). This fingerprinting approach is based on the production of arbitrary signatures from amplification profiles (ASAP) (3), a dual-step amplification procedure that generates "fingerprints" DAF profiles using mini- hairpin primers (2). Products were electrophoretically separated on either 4.5 or 10% polyacrylamide gels (4) and visualized with a silver stain (1). Amplification profiles were produced at least twice for each conventional and mini-hairpin primer.

Results and Discussion: Results from the field evaluation of the ten cultivars at the Plateau Experiment Station indicate that 'Barton' and 'Cloud Nine' are equally susceptible to dogwood spot anthracnose and frost damage and more susceptible than all other cultivars tested. Furthermore, both 'Barton' and 'Cloud Nine' produced statistically similar number of blooms per tree, had similar sized bracts, and had similar rates of flower development. These cultivars could not be distinguished by any parameter measured in this experiment (7).

Amplification of genomic DNA of both cultivars with standard octomer primers failed to detect any polymorphic DNA; the profiles generated were monomorphic for over 300 character loci. A recent study of 12 cultivars and 6 putative hybrids between cultivars of flowering dogwood using DAF, revealed aufficient polymorphic DNA to allow statistically identification of most cultivars (Caetano-Anolles and Trigiano, unpublished data). However, only one polymorphic character locus out of 192 was detected between 'Barton' and 'Cloud Nine'. ASAP, which can detect up to 14 fold higher levels of polymorphic DNA than DAF (5), failed to reveal a single polymorphism in over 200 loci generated by four mini-hairpin primers amplifying two DAF profiles. All of the molecular and horticultural data indicate that 'Barton' and 'Cloud Nine' are very similar, if not identical.

Significance to the Industry: 'Barton' and 'Cloud Nine', two popular white-bracted cultivars, are indistinguishable using the phenotypic and molecular characteristics evaluated in this study. Although these DNA profiling technologies were unable to unequivocally separate the two cultivars, they are useful for positively identifying closely related cultivars, discerning relationships between cultivars and detecting and confirming hybrids between two cultivars. Perhaps more importantly, the techniques and procedures may be useful in patent and copyright protection.

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Red Maple Selections for the Southeastern United States

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Nature of Work: Trials have been underway at three locations in Georgia to evaluate growth and adaptability of red maple (Acer rubrum L.) selections in the Southeastern United States. The locations, Blairsville, Athens, and Tifton, are in USDA Hardiness zones 6b, 7b, and 8a, respectively. Red maple is a commonly used landscape tree throughout the Eastern United States. There are many new or underused selections of red maple with landscape potential for urban and residential sites in Georgia and surrounding states. Many cultivars in these evaluations have shown excellent growth rates and superior fall color, two of the most important criteria in tree selection.

Seedling red maples are often planted with expectations of rapid growth, attractive canopy form, and excellent red fall color. However, studies have shown great variability among seedling red maples collected from 49 locations across their native range, extending throughout the Eastern United States and Canada (7). This seedling variability has been the major source of selection among for new cultivars of red maple (5). The popularity of red maple cultivars rests in their uniformity with regard to a particular form, unique foliage, or fall color. However, considerable variation remains among cultivars in their regional adaptability. Of about 55 recognized red maple cultivars, few have been selected from seedlings originating in the southern portion of their native range. Determination of suitable red maple cultivars for the Southeast can increase the selection of shade and ornamental trees for landscape use.

Cultivars in these trials represent a broad cross section of the classified red maples, including a comparison of red maple cultivars known from previous studies to perform well in the Southeastern United States (2, 6, 8, 9), with new or pending releases from the National Arboretum in Washington D.C., and selections from the Freeman maple group. Freeman maples, generally grouped with red maple cultivars (4), are recognized botanically as *Acer x freemanii* E. Murray, indicating their hybrid origin from interspecific crosses and backcrosses between *Acer rubrum* L., and *Acer saccharinum* L. (1). Seedling selections from south Georgia/north Florida were also included in the Tifton trials.

Cultivar installation began in January 1992, with trees ranging from 4 to 5 feet in height on their own roots supplied by the U.S. National Arboretum and several nursery sources. Initial size differences among cultivars were not significant. Trees were planted on 10 x 12.5 foot spacing and were fertilized with 50 lbs. N/acre using 16-4-8 plus micro nutrients at planting and in subsequent years in March prior to bud break. Drip irrigation was supplied to each tree. Height and stem diameter measurements were taken at planting and annually following the 1992 through 1995 growing seasons. Growth increases were determined by the difference in current and the previous season's measurements. Thirty-one selections were evaluated in all (Table 1).

Results and Discussion: Trials of the type presented here will prove valuable as new introductions from selected seedlings and the National Arboretum are released to industry. These results give an indication of expectations of growth following establishment under field conditions or in the landscape throughout Georgia and other regions of the Southeast with similar climates.

Generally, the trees common to Blairsville and Tifton demonstrated greater growth in Blairsville than Tifton, the exception being `Alapaha', a seedling selection from south Georgia. Trees common to Athens and Tifton demonstrated greater growth in Tifton than Athens. Greatest height growth across all cultivars and locations was for NA-61016, an `October Glory' x `Autumn Flame' cross; `Alapaha'; and two seedling selections from north Florida which were evaluated at the Tifton location (Table 1).

The least growth across all cultivars and locations occurred with NA-56024 and NA-57772 in Tifton, `Alapaha' in Blairsville, and NA-55410 in Athens (Table 1). Selections NA-56024 and NA-57772 are from northern Minnesota and NA-55410 is from northern Wisconsin, all in USDA hardiness zone 3. The poor performance of `Alapaha' in Blairsville is related to a lack of winter hardiness (3). In Tifton, `Alapaha' normally defoliates around the first of December, and is often flowering by the first week of February. By not hardening off in the fall and leafing out early in the spring, the tree is susceptible to cold damage in USDA zone 6b. This demonstrates the importance of using germplasm appropriate for a given geographical area and the need to select red maple cultivars for USDA zones 6-8. Studies in Alabama (6) and Tennessee (9) found Freeman maple selections `Autumn Blaze', `Scarsen', and `Morgan', generally increased the most in height in red maple trials with multiple cultivars. This precocity for height growth is typical of silver maple (1, 4). `Autumn Blaze', at Athens and Tifton; and Freeman selections `Armstrong', `Morgan', and `Scarsen' included in the Athens trials; while not showing the same growth rates as reported in Alabama (2, 6, 8) and Tennessee (9) appear to be well adapted to growing conditions in the Georgia Piedmont. Growth differences for these evaluations compared to other studies may be attributed to environmental conditions such as rainfall, variable temperatures or reasons such as irrigation practices and own-root trees versus budded trees being compared from study to study. Furthermore, different data collection procedures in different states make it difficult to make cross-study comparisons, such stem diameter increase measurements being taken at different heights by different research teams.

Significance to Industry: The studies presented here indicate which red maple cultivars appear to be superior for regions in the Southeastern United States with similar climates, based on height and diameter growth. As the trees mature, future reports on fall color, branching habits, and scaffold strength will continue to give Georgia growers valuable information. The data presented from these trials could help growers select faster growing cultivars for production. However, while faster growing trees can be an important consideration for nursery growers, not all fast growing trees are adapted throughout the southeast (3). Furthermore, while the southern selections `Alapaha', OH-1, and OH-2 demonstrate excellent growth, southern selections with consistent red fall color are still needed in USDA zone 8. Please use sound horticultural judgement when interpreting the data presented in this and other related studies.

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Table 1. Average annual height increase for Acer rubrum selections for trials in Blairsville, Athens, and Tifton, Georgia 1992 - 1995.

Selection[z]	(cm)	(inches)
NA-57775		
Blairsville (1)	59.7	23.5
Athens (3)	71.0	28.0
Tifton (3)	71.7	28.2
NA-56021 (Cumberland)		
Blairsville (1)	87.3	34.4
Athens (2)	50.7	20.0
Tifton (3)	70.3	27.7
NA-60068 (October Glory x Autumn Flame)		
Blairsville (2)	88.7	34.9
Tifton (3)	63.3	24.9
NA-59905 (Somerset)		
Blairsville (2)	72.3	28.5
Tifton (3)	64.3	25.3
NA-59906 (Sun Valley)		
Blairsville (1)	97.3	38.3
Tifton (3)	69.7	27.4
NA-56024		
Blairsville (2)	73.5	28.9
Tifton (3)	32.0	12.6
NA-57772		
Blairsville (1)	48.7	19.2
Tifton (2)	39.3	15.5
Alapaha		
Blairsville (1)	39.3	15.5
Tifton (3)	105.0	41.3
Autumn Blaze		
Athens (3)	68.3	26.9
Tifton (1)	76.7	30.2
Autumn Flame		
Athens (3)	53.3	21.0
Tifton (1)	90.0	35.4
Red Sunset		
Athens (3)	64.3	25.3
Tifton (3)	79.3	31.2

October Glory		
Athens (3)	79.7	31.4
Tifton (1)	84.7	33.3
Edna Davis		
Athens (1)	67.3	26.5
Tifton (1)	73.3	28.9
NA-55410		
Athens (3)	46.0	18.1
Tifton (3)	77.7	30.6
NA-61016 (October Glory x Autumn Flame)		
Athens (3)	71.7	28.2
Tifton (3)	108.3	42.6
Armstrong (Athens - 3)	67.3	26.5
Hampton (Athens - 3)	80.7	31.8
Indian Summer (Morgan, Embers) (Athens - 3)	92.0	36.2
Karpick (Athens - 3)	70.7	27.8
Middleburg 1 (Athens - 2)	84.0	33.1
Middleburg 2 (Athens - 3)	84.7	33.3
Northwood (Athens - 2)	56.3	22.2
Redskin (Athens - 3)	68.0	26.8
Scarlet Sentinel (Scarsen) (Athens - 3)	71.3	28.1
Tim (Athens - 3)	66.0	26.0
NA-59907 (Brandywine) (Tifton - 3)	69.0	27.2
OH-1 (Tifton - 1)	104.3	41.1
OH-2 (Tifton - 1)	101.7	40.0
OH-3(Tifton-1)	66.7	26.3
OH-4(Tifton-1)	96.0	37.8
OH-6(Tifton-1)	73.0	28.7

[z] Selection accession number, and/or cultivar name if available, trial location, and number of trees in mean.