

Eastern Tennessee / Western North Carolina Outdoor Ornamental Nursery Scenario

This scenario is one of a suite of scenarios intended to represent outdoor ornamental nursery scenarios in the United States. It should be noted that nurseries are diverse and represent a range of topographic, cultivation, and plant types. Scenarios, when possible have been developed to represent conservative nursery practices that will yield “high-end” runoff, but not unrealistic of actual nurseries in the area. Similarly, selection of curve numbers are based on best available data from TR-55 until further calibration can be performed using regional runoff data, which at the time of scenario development is generally unavailable for nurseries. Figure 1 provides an overview of available curve numbers from TR-55 in order to provide context to the relative magnitude of the curve number used in this scenario. The closest curve number that could be associated with outdoor nurseries is for “farmsteads”, due to similar cover conditions. Curve numbers are generally among the highest available, exceeded primarily by soils in poor condition.

This scenario is parameterized to generally represent outdoor ornamental nursery production in eastern Tennessee/western North Carolina. The scenario nominally represents outdoor ornamental nurseries in Warren County, TN since it is the county with the most number of acres in production in the region. In 2002, the state of Tennessee ranked 4th in the U.S. for total number of ornamental nursery acres in the outdoors (i.e., not under glass), with nearly 40,500 acres in the open (USDA 2002a). In 2002, North Carolina ranked 9th in the U.S. for outdoor nursery acreage. In Tennessee, over 50% (21,884 acres) of the total acreage is located in Warren County which has been referred to as “the nursery capital of the world”. Warren County ranks number 1 in the U.S. with approximately 21,900 acres of outdoor nurseries in the county according to the 2002 USDA census of agriculture (USDA 2002a). The total value of agricultural products sold in Warren Co. in 2002 was approximately 94 million dollars, of which approximately 87% of the revenue was generated from the sale of nursery and greenhouse crops. Warren County produces a large volume of nursery stock and ranks number 1 in the U.S. for nursery stock production (USDA, 2002b). MLRAs 122, 125, 128, and 130 dominate eastern Tennessee and western North Carolina; however the majority of Warren County is located in MLRA 122.

Plants cultivated by outdoor nurseries are diverse. For this scenario, crop parameters have been selected when possible to be representative of typical outdoor nursery practices in eastern Tennessee and western North Carolina. In general, this scenario represents outdoor deciduous nursery stock, including production shade trees, flowering ornamental trees and shrubs. Traditional nursery production in the area is in the field and the majority of nurseries are wholesale (Halcomb, 2002; Craig Adkins, personal communication). Although container planting is used in the region, many species are commonly grown in propagation ground beds. As a general rule local experts recommend that nurseries produce about 70% of tried and true plants such as sugar maple, dogwoods, pin oak, ‘Andora’ juniper, etc. A lesser extent of plants include plants such as clethra, fothergilla, deciduous holly, hostas, red maple, crab apple, hydrangea, etc

(Halcomb, 2002). In western North Carolina the trend is similar; plants are grown for landscape size material, and include several hundred species/cultivars of shade trees, flowering ornamental trees and shrubs, conifers, and broadleaved evergreens. Up to 40% of nursery fields can be roadways, field borders, fence rows, wooded areas, and areas too steep for growing. Fields are generally divided into blocks divided by roadways (Halcomb, 2002). Irrigation is often used. Methods are primarily overhead irrigation with travelling gun. Irrigation is applied to newly planted fields, and to fields that are approaching permanent wilting point at a rate of one inch of water per acre per 24 hours per week. Trees leaf out in mid-March and senesce in late October (Craig Adkins, personal communication).

Metfile W13882 is the closest meteorological station to Warren County, TN and is within approximately 60 miles to the southeast of the county centroid. Its data were collected in Chattanooga, TN located in the eastern part of the state. The station is located approximately 211 meters above mean sea level (AMSL) which is comparable to McMinnville TN (central Warren County), which is approximately 290 meters AMSL. Chattanooga receives an average rainfall of 55 inches (NOAA, 2006).

Nearly two-dozen different soils in Warren County have been identified as fair to very good for nursery production (Halcomb, 2002). Nurseries require soils that are well drained internally and on the surface. Deep soils free of large rocks are also important as many outdoor nurseries grow nursery stock that is dug, balled, and burlapped for sale. Exact locations and geographic extent of nurseries in the region are not available; therefore soils were selected based on soil recommendations listed in Halcomb (2002), the geographic extent of the listed soils in the area, the drainage group, slope, and erodibility. In developing this scenario, preference was given to selecting a benchmark soil that is in hydrologic group “C” or “D”, and is capable of supporting outdoor nurseries (EPA, 2004). The Captina series was selected for this scenario since it is of large extent in the region (USDA, 2006a) and is the most common benchmark soil in Warren County that is also in hydrologic group C. Captina soils are capable of supporting nursery production and are listed as “fair” soils for the modeled use (Halcomb, 2002). Captina represents the 90th percentile of vulnerability in drainage for soils in Warren County (the most extensive benchmark soil in drainage group C and the third most extensive soil overall in Hydrologic group C). It is in the 90th percentile for erodibility (0.43) and is within the typical slope range for outdoor nurseries in the area (Halcomb, 2002; Craig Adkins, personal communication) (Table 5).

Captina is a Hydrologic Group C soil, which represents approximately 2% of the soils in Warren County. Captina soils have a USLE K factor of 0.43, which is common to eight other soils in Warren County. Based on representative values from USDA (2006) approximately 67% of Warren County soils have a pH lower than 5.5, the representative pH of Captina soils. However, soil pH is not currently a PRZM input parameter and is not expected to often affect chemical fate in the acidic range. Captina soils have an A horizon from 0 to 9 inches (0-23 cm) deep, and a B horizon from 9 to over 60 inches (23-152 cm) deep (USDA, 2006b).

Table 1. PRZM 3.12 Climate and Time Parameters for Eastern TN / Western NC – Ornamental Nurseries.		
Parameter	Value	Source/Comments
Starting Date	Jan. 1, 1961	Meteorological File Chattanooga, TN (W13882)
Ending Date	Dec. 31, 1990	Meteorological File Chattanooga, TN (W13882)
Pan Evaporation Factor (PFAC)	0.75	PRZM Manual Figure 5.1. Value represents most of eastern Tennessee.
Snowmelt Factor (SFAC)	0.16	PRZM Manual Table 5-1. Max of the min range of values for mixed coniferous/deciduous open areas.
Minimum Depth of Evaporation (ANETD)	17.5 cm	PRZM Manual Figure 5.2 (EPA, 1998) Set to guidance default for free draining soils.

Table 2. PRZM 3.12 Erosion and Landscape Parameters for Eastern TN / Western NC – Ornamental Nurseries.		
Parameter	Value	Source/Comments
Method to Calculate Erosion (ERFLAG)	4 (MUSS)	PRZM Manual (EPA, 1998)
USLE K Factor (USLEK)	0.43	USDA NRCS Soil Data Mart (http://soildatamart.nrcs.usda.gov/) Value listed for the soil series Captina.
USLE LS Factor (USLELS)	0.3	LS equation (Haan and Barfield, 1978) LS value for 2% slope and 400' slope length
USLE P Factor (USLEP)	0.6	Rows are contoured whenever possible (Halcomb, 2002). Set to 0.6 for 1-2 % slope and contouring as per PRZM Scenario Guidance (EPA, 2004).
Field Area (AFIELD)	172 ha	Area of Shipman Reservoir watershed (EPA, 1999)
NRCS Hyetograph (IREG)	3	PRZM Manual Figure 5.12 (EPA, 1998)
Slope (SLP)	2%	USDA NRCS Soil Data Mart (http://soildatamart.nrcs.usda.gov/) Mid-point for the soil series Captina. PRZM Scenario Guidance (EPA, 2004).
Hydraulic Length (HL)	600 m	Shipman Reservoir (EPA, 1999)
Irrigation Flag (IRFLAG)	2	Craig Adkins, Area Specialized Agent, North Carolina Cooperative Extension Service. Irrigation is applied to newly planted fields, and to fields that are approaching permanent wilting point.

Table 3. PRZM 3.12 Crop Parameters for Eastern TN / Western NC – Ornamental Nurseries.		
Parameter	Value	Source/Comments
Initial Crop (INICRP)	1	Default value
Initial Surface Condition (ISCOND)	2	2 = cover crop. Halcomb (2002) and Craig Adkins, Area Specialized Agent, North Carolina Cooperative Extension Service.
Number of Different Crops (NDC)	1	Set to number of crops in simulation. Default value.
Number of Cropping Periods (NCPDS)	30	Set to weather data in meteorological file: Chattanooga, TN (W13882).
Maximum rainfall interception storage of crop (CINTCP)	0.1	Table 5-4 PRZM manual, light density crops (EPA, 1998).

Table 3. PRZM 3.12 Crop Parameters for Eastern TN / Western NC – Ornamental Nurseries.		
Parameter	Value	Source/Comments
Maximum Active Root Depth (AMXDR)	76 cm	Craig Adkins, Area Specialized Agent, North Carolina Cooperative Extension Service.
Maximum Canopy Coverage (COVMAX)	15%	Up to 40% of nursery field can be covered in roads, wooded areas, field borders, and areas to steep to grow, leaving 60% available for production (Halcomb 2002). Assumes light density planting such that one-quarter (15%) of remaining area is canopy.
Maximum Canopy Height (HTMAX)	183 cm (6ft)	Height varies widely as many different cultivars are grown. Transplants may be up to 6ft tall (Halcomb 2002)
Soil Surface Condition After Harvest (ICNAH)	2	2 = cover crop. Halcomb (2002) and Craig Adkins, Area Specialized Agent, North Carolina Cooperative Extension Service.
Date of Crop Emergence (EMD, EMM, IYREM)	16/03/61	Craig Adkins, Area Specialized Agent, North Carolina Cooperative Extension Service. Values are set to keep E/T and canopy coverage terms working correctly for this deciduous scenario. Set to typical leaf bloom dates (March 15). Adjusted to the nearest corresponding RUSLE date (RUSLE Project; Nb0OCOCM).
Date of Crop Maturity (MAD, MAM, IYRMAT)	15/04/61	Values are set to keep E/T and canopy coverage terms working correctly for this deciduous scenario. Set to 1 month post leaf bloom.
Date of Crop Harvest (HAD, HAM, IYRHAR)	22/10/61	Craig Adkins, Area Specialized Agent, North Carolina Cooperative Extension Service. Values are set to keep E/T and canopy coverage terms working correctly for this deciduous scenario. Set to typical leaf-off dates.
Maximum Dry Weight (WFMAX)	0.0	Not used in scenario
SCS Curve Number (CN)	82, 82, 82	TR-55, Table 2-2c (USDA 1986). Value for farmsteads, buildings, lanes, driveways, and surrounding lots. Up to 40% of nursery fields can be covered in roads, wooded areas, field borders, and areas to steep to grow, leaving 60% available for production (Halcomb 2002).
Manning's N Value (MNGN)	0.014	RUSLE Project; Nb0OCOCM for Asheville, NC orchards with cover in alleyways (USDA, 2000). These data were used to approximate values for nurseries in eastern TN / western North Carolina as no data for ornamental nurseries were included in the project.
USLE C Factor (USLEC)	0.058 - 0.273	RUSLE Project; Nb0OCOCM for Asheville, NC orchards with cover in alleyways (USDA, 2000). These data were used to approximate values for nurseries in eastern TN / western North Carolina as no data for ornamental nurseries were included in the project. Note: RUSLE dates and C factors from the RUSLE project have been reordered and tied to emergence dates.

Table 4. PRZM 3.12 Captina Silt Loam Soil Parameters for Warren County, Tennessee – Ornamental Nurseries		
Parameter	Value	Source/Comments
Total Soil Depth (CORED)	152 cm	NRCS Soil Data Mart (SDM) (http://soildatamart.nrcs.usda.gov)
Number of Horizons (NHORIZ)	4	NRCS Soil Data Mart (SDM) (http://soildatamart.nrcs.usda.gov). Top horizon spans scenario horizons 1 and 2 in order to conform to PRZM input requirements. SDM horizons 3 & 4 combined into 1 horizon for simplicity. PRZM Scenario Guidance (EPA, 2004).

Horizon Thickness (THKNS)	10 cm (HORIZN = 1) 13 cm (HORIZN = 2) 38 cm (HORIZN = 3) 91 cm (HORIZN = 4)	NRCS Soil Data Mart (SDM) (http://soildatamart.nrcs.usda.gov). Top horizon spans scenario horizons 1 and 2 in order to conform to PRZM input requirements. PRZM Scenario Guidance (EPA, 2004).
Bulk Density (BD)	1.35 g/cm ³ (HORIZN = 1) 1.35 g/cm ³ (HORIZN = 2) 1.45 g/cm ³ (HORIZN = 3) 1.53 g/cm ³ (HORIZN = 4)	NRCS Soil Data Mart (SDM) (http://soildatamart.nrcs.usda.gov). Midpoint of the reported range. PRZM Scenario Guidance (EPA, 2004).
Initial Water Content (THETO)	0.25 cm ³ /cm ³ (HORIZN =1) 0.25 cm ³ /cm ³ (HORIZN =2) 0.29 cm ³ /cm ³ (HORIZN =3) 0.24 cm ³ /cm ³ (HORIZN =4)	NRCS Soil Data Mart (SDM); values are mean 1/3-bar water contents of Captina soils. Horizon 4 is mean of SDM horizons 3 & 4 weighted by horizon thickness. (EPA, 2004).
Compartment Thickness (DPN)	0.1 cm (HORIZN = 1) 1.0 cm (HORIZN = 2) 2.0 cm (HORIZN = 3) 1.0 cm (HORIZN = 4)	NRCS Soil Data Mart (SDM) (http://soildatamart.nrcs.usda.gov). PRZM Scenario Guidance (EPA, 2004).
Field Capacity (THEFC)	0.25 cm ³ /cm ³ (HORIZN =1) 0.25 cm ³ /cm ³ (HORIZN =2) 0.29 cm ³ /cm ³ (HORIZN =3) 0.24 cm ³ /cm ³ (HORIZN =4)	NRCS Soil Data Mart (SDM); values are mean 1/3-bar water contents of Captina soils. Horizon 4 is mean of SDM horizons 3 & 4 weighted by horizon thickness. PRZM Scenario Guidance (EPA, 2004).
Wilting Point (THEWP)	0.10 cm ³ /cm ³ (HORIZN =1) 0.10 cm ³ /cm ³ (HORIZN =2) 0.14 cm ³ /cm ³ (HORIZN =3) 0.14 cm ³ /cm ³ (HORIZN =4)	NRCS Soil Data Mart (SDM); values are mean 15-bar water contents of Captina soils. Horizon 4 is mean of SDM horizons 3 & 4 weighted by horizon thickness. PRZM Scenario Guidance (EPA, 2004).
Organic Carbon Content (OC)	1.2% (HORIZN = 1) 1.2% (HORIZN = 2) 0.15% (HORIZN = 3) 0.15% (HORIZN = 4)	NRCS SDM; values for horizons 1 to 3 = mean %OM / 1.724. PRZM Scenario Guidance (EPA, 2004).

Sensitive Parameter Uncertainties

Meteorological File

As characterized above, Metfile W13882 (Chattanooga TN) is the closest metfile to Warren County, which was used to represent this scenario. The metfile is located approximately 60 miles from Warren County and is generally representative of the area. However, the terrain is mountainous and elevations vary widely. Rainfall in eastern TN and western NC may be over or underestimated due to terrain and orographic effects. A sensitivity analysis of meteorological stations in the surrounding region would reduce uncertainty in the PRZM results.

Slope

The scenario USLELS value was calculated with the Haan and Barfield equation (1978) using a 2% slope and an assumed 400-foot slope length, as per PRZM scenario development guidance (EPA, 2004). A slope of 2% was selected because it is midpoint of the range for Captina soils according to USDA (USDA 2006b). This value is also supported by (Halcomb 2002) which indicates nurseries should not be located on steep slopes and by Craig Adkins (Area Specialized Agent, North Carolina Cooperative

Extension Service, personal communication) who indicated that slopes may range from 0-6%. This scenario may underestimate runoff for nurseries located on slopes greater than 2%

USLE C Factor and Manning's N Value

The RUSLE Project does not include data for ornamental nursery crops. Therefore, USLE C Factor and Manning's N values were selected from data on North Carolina orchards with cover in the alleyways, due to the similarities between conditions. Halcomb (2002) suggests that up to 40% of nursery fields can be covered in roads, wooded areas, field borders, and areas too steep to grow, leaving 60% available for production. Roads, travel lanes, waterways, etc. should be covered in fescue (Halcomb, 2002) or other permanent ground cover/crop adhering to Nursery Crop Best Management Practices for field nurseries (Craig Adkins, personal communication). Of the available locations, Asheville North Carolina has the most similar meteorological conditions and cover in alley ways as this scenario.

Soil Data

No geospatial data were available to determine the exact locations and geographic extent of nurseries in the region. The USGS National Land Cover Data set includes a nurseries classification; however it indicates that no nurseries are present in Warren County, even though it is the "nursery capital of the world". This is likely due to the resolution of the data (30 m) and age of the data set (based on 1970's and 80's imagery). As a result, soils were selected based on soil recommendations listed in Halcomb (2002), the geographic extent of the listed soils in the area, the drainage group, slope, and erodibility. The soil selected is a hydrologic group C soil; however there is some evidence that nurseries in the region are located primarily on hydrologic group B soils (Craig Adkins, personal communication). Better geographic herefore runoff and erosion may be potentially overestimated

Crop Parameters

Outdoor ornamental nurseries are highly diverse in the numbers, sizes, and types of plants grown. Ornamental nurseries also vary in the cultivation methods which can range from potted plants (container operations) to field nurseries that may harvest and package plants as bare root or balled and burlapped. This scenario has been parameterized to be representative of the most "typical" nursery plants in the area (see description above).

Curve Number

The curve number is the most sensitive parameter in PRZM scenarios. The curve number for this scenario was based on TR-55 (Table 2-2c). Up to 40% of nursery field

can be covered in roads, wooded areas, field borders, and areas too steep to grow, leaving 60% available for production (Halcomb 2002). Therefore the land use type closest to this scenario was the value for a hydrologic group C soil representative of farmsteads, buildings, lanes, driveways, and surrounding lots. Runoff and erosion may be under or over-estimated for alternative nursery operations and model validation has high value in this regard. Based on preliminary investigation, no runoff data are available for validating runoff from outdoor nursery operations in this geographic area.

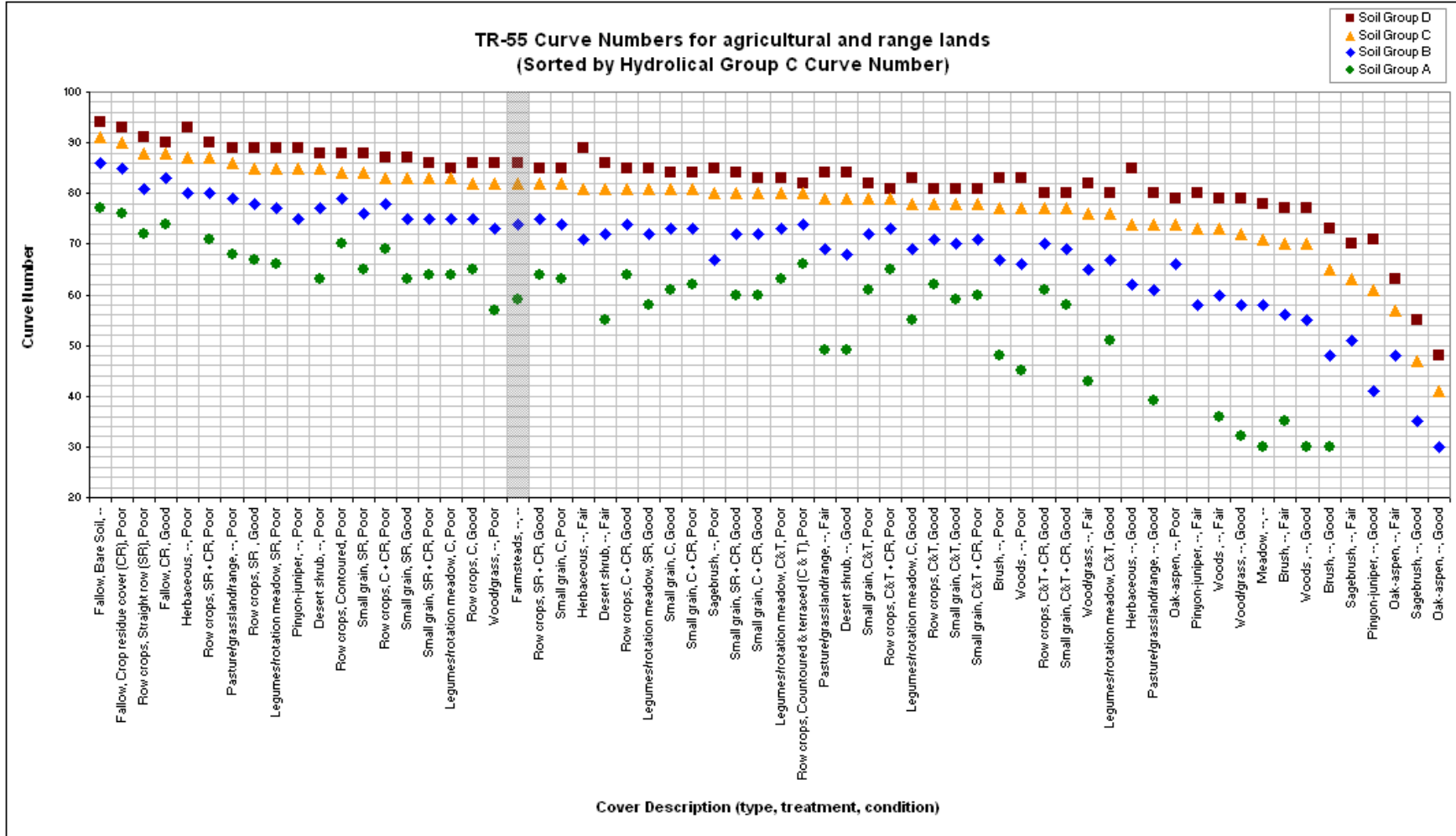


Figure 1. TR-55 (USDA, 1986) Farmstead curve number used for scenario development relative to other available cover types, soil treatments, and conditions.

Table 5. Soils of Warren County, TN Ranked by Area^{a,b}.

Soil	Total Acres	% Area	Hydrologic Group	Erodibility	Slope	pH	OM	Sand	Siltv	Clay
WAYNESBORO	61090	22.0%	B	0-0.28	0-12	0-5	0-2	0-66	0-37.9	0-20
MOUNTVIEW	26769	9.6%	B	0.43	2-12	5	0.75-2	6.9-11.4	68.1-68.6	20-25
BAXTER	21505	7.7%	B	0.28-0.37	12-50	5-5.5	0.75-2	18.1-42.1	37.9-53.8	19.5-31
DICKSON	20843	7.5%	C	0.43	1-4	5	2	14	71	15
ROCKLAND	19464	7.0%	D	0	0	0	0	0	0	0
STONY	17780	6.4%	B	0.28	5-30	5	2	44.3	40.7	15
CHRISTIAN	16167	5.8%	C	0.37-0.43	1-20	4.6-5.5	0.5-2	14.2-20.5	49-71.8	14-33.5
HUNTINGTON	15270	5.5%	B	0.28-0.32	0-2	6.7	2.5	11.3-22.4	67.7-67.7	21-22.5
CUMBERLAND	9257	3.3%	B	0.32-0.37	0-12	5.6	0.75-2.5	18.1-22.4	50.9-55.1	22.5-31
HARTSELLS	7767	2.8%	B	0.28	4-9	4.6	1.5	44.8	41.2	14
RAMSEY	5659	2.0%	D	0-0.2	0-20	0-5	0-1	0-64.8	0-40	0-16.5
CAPTINA^c	5305	1.9%	C	0.43	1-3	5.5	2	14.2	71.8	14
GUTHRIE	5254	1.9%	D	0.43	0-2	4.6	1.5	13.6	68.9	17.5
ETOWAH	5125	1.8%	B	0.37-0.37	0-30	4.3-5	2-3.5	11.4-26.3	52.7-68.6	20-21
LINDSIDE	4655	1.7%	C	0.32	0-2	6.5	2.5	11.3	67.7	21
LAWRENCE	4250	1.5%	C	0.43	0-2	5.5	2	14	71	15
SEQUATCHIE	3732	1.3%	B	0.32	0-12	5	2-2.5	41.1-43	36.9-39.5	17.5-22
RAMSEY-JEFFERSON	3623	1.3%	D	0.2	20-45	5	1	64.8	18.7	16.5
TALBOTT	3505	1.3%	C	0.32-0.37	5-20	5.6	1.25	17.9-20.5	50.1-54.5	25-32
ALLEN	3293	1.2%	B	0.2-0.28	2-30	5	0.5-1.75	34-43	37-38.5	18.5-29
JEFFERSON	2671	1.0%	B	0.24-0.28	0-20	5-6.7	2-2.5	11.3-67.2	15.3-67.7	15-21
LINKER	2432	0.9%	B	0.37	2-12	5	2	42.1	37.9	20
SANGO	2264	0.8%	C	0.43	0-2	5	2	14.3	72.7	13
WHITWELL	1488	0.5%	C	0.24	0-2	5.3	2	43	39.5	17.5
STASER	1413	0.5%	B	0.32	0-25	5.9-6.5	3	65.6-66.5	14.9-15	18.5-19
MELVIN	1263	<0.5%	D	0.43	0-2	6.7	2	14.1	71.4	14.5
GULLIED	860	<0.5%		0	0-0	0	0	0	0	0
MINVALE	720	<0.5%	B	0.37	2-12	5	2	22.4	55.1	22.5
SWAIM	570	<0.5%	D	0.32	3-10	5.5	1.25	17	57	26
COBBLY	442	<0.5%	B	0.28	0-5	5	2	66.8	19.2	14
BRUNO	431	<0.5%	A	0.15	1-3	6.8	1.25	77.7	16.3	6
BODINE	268	<0.5%	B	0.37	20-45	4.6	1.5	30.4	55.6	14

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Contacts

Craig R. Adkins

Area Specialized Agent
North Carolina Cooperative Extension Service
120 Hospital Avenue, NE Suite 1
Lenoir, NC
Phone: 828-757-1290
Email: Craig_Adkins@ncsu.edu

Marcus A. Halcomb

Extension Area Specialist Nursery Production
University of Tennessee
201 Locust Street, Suite 10
McMinneville, TN
Phone: 931-473-8484
Email: mhalcomb@tennessee.edu