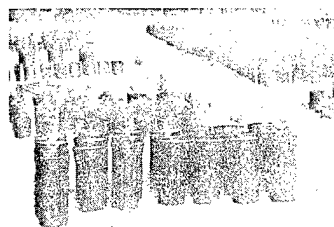
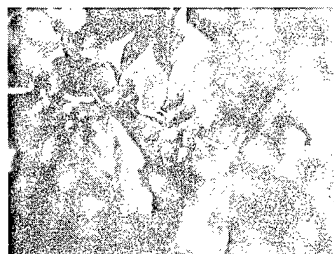


US Army Corps
of Engineers



ECOSYSTEM MANAGEMENT AND RESTORATION RESEARCH PROGRAM

TECHNICAL REPORT EL-97-16

YAUPON (*Ilex vomitoria*)

Section 7.5.10, U.S. ARMY CORPS OF ENGINEERS WILDLIFE RESOURCES MANAGEMENT MANUAL

by

Chester O. Martin

DEPARTMENT OF THE ARMY

Waterways Experiment Station, Corps of Engineers
3909 Halls Ferry Road, Vicksburg, Mississippi 39180-6199

and

Sarah P. Mott

Conservation Communications
Vicksburg, Mississippi 39180



August 1997

Final Report

Approved For Public Release; Distribution Is Unlimited

DTIC QUALITY INSPECTED 2

19971015 079

Prepared for DEPARTMENT OF THE ARMY
U.S. Army Corps of Engineers
Washington, DC 20314-1000

Under EIRP Work Unit 32420

The contents of this report are not to be used for advertising, publication, or promotional purposes. Citation of trade names does not constitute an official endorsement or approval of the use of such commercial products.

The findings of this report are not to be construed as an official Department of the Army position, unless so designated by other authorized documents.



PRINTED ON RECYCLED PAPER

PREFACE

This work was sponsored by the Headquarters, U.S. Army Corps of Engineers (HQUSACE), as part of the Ecosystem Management and Restoration Research Program (EMRRP), Work Unit 32420, entitled Development of U.S. Army Corps of Engineers Wildlife Resources Management Manual. Mr. Dave Mathis, CERD-C, was the EIRP Coordinator at the Directorate of Research and Development, HQUSACE. The Program Monitors for the study were Ms. Cheryl Smith, Mr. F. B. Juhle, and Mr. Forrester Einarsen, HQUSACE. The report serves as a section of the U.S. Army Corps of Engineers Wildlife Resources Management Manual.

This report was prepared by Mr. Chester O. Martin, Stewardship Branch (SB), Environmental Laboratory (EL), U.S. Army Engineer Waterways Experiment Station (WES), and Ms. Sarah Pearson Mott, Conservation Communications, Vicksburg, MS. Review and comments were provided by Dr. Wilma A. Mitchell and Mr. John Tingle, SB.

The report was prepared under the general supervision of Dr. Michael E. Passmore, Chief, SB; Dr. Robert M. Engler, former Chief, Natural Resources Division, EL; and Dr. John Harrison, Director, EL. Dr. Russell F. Theriot, WES, was Program Manager, EMRRP.

At the time of publication of this report, Dr. Robert W. Whalin was Director of WES.

This report should be cited as follows:

Martin, Chester O., and Mott, Sarah P. 1997. "Yaupon (*Ilex vomitoria*): Section 7.5.10, U.S. Army Corps of Engineers Wildlife Resources Management Manual," Technical Report EL-97-16, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

NOTE TO READER

This report is designated as Section 7.5.10 in Chapter 7 -- PLANT MATERIALS, Part 7.5 -- WOODY SPECIES, of the U.S. ARMY CORPS OF ENGINEERS WILDLIFE RESOURCES MANAGEMENT MANUAL. Each section of the manual is published as a separate Technical Report but is designed for use as a unit of the manual. For best retrieval, this report should be filed according to section number within Chapter 7.

YAUPON (*Ilex vomitoria*)

Section 7.5.10, U.S. ARMY CORPS OF ENGINEERS WILDLIFE RESOURCES MANAGEMENT MANUAL

DESCRIPTION	4	ESTABLISHMENT	11
DISTRIBUTION	6	Site Selection	12
HABITAT REQUIREMENTS	6	Site Preparation	12
Shade	7	Propagules	13
Soils	7	Planting Methods	13
Moisture	7	MAINTENANCE	14
WILDLIFE VALUE	8	FOREST MANAGEMENT	14
Bird Use	8	CAUTIONS AND LIMITATIONS	15
Deer Use	8	LITERATURE CITED	16
Nutritional Value	10	APPENDIX A: SCIENTIFIC NAMES OF PLANT SPECIES	A1

Yaupon (*Ilex vomitoria*) is an evergreen shrub or small tree that is common in the moist pine and hardwood forests of the south Atlantic-Gulf Coastal Plain and the savanna scrublands of east-central Texas. *Ilex*, the largest genus of the family Aquifoliaceae, contains 14 species native to the United States (Harrar and Harrar 1962). Of the 6 holly species found in the southern United States, including American holly (*I. opaca*), dahoon (*I. cassine*), and possumhaw (*I. decidua*), yaupon is the most valuable to wildlife (Halls and Ripley 1961). Its thicket-forming characteristics make it excellent cover for many birds, and its fruits and foliage provide a year-round food source for white-tailed deer (Halls 1977).

Yaupon has no commercial timber value, but its bright red fruits and dark green foliage (often used for Christmas decorations) give it ornamental value as a landscaping plant (Vines 1960). Dried yaupon leaves, which have a high caffeine content, were traditionally brewed by Native Americans in a bitter, medicinal tea called "black drink" or "cassine" (Vines 1960, Bailey and Bailey 1976). The long history of this tea (Spanish explorers recorded its use by east Texas natives in the early 1500's) originated several local names for yaupon, including emetic holly, south-sea tea, Carolina tea, Appalachian tea, Indian black drink, chocolato del Indio, and Yopan del Indio. Other common names for yaupon are evergreen holly, evergreen cassena, yapon, yopan, cassena, cassine, cassio-berry bush, and Christmas berry (Vines 1960).

This report was prepared as a guide to assist biologists and natural resources personnel with the selection, cultivation, and management of plant materials for wildlife and habitat development programs. Major topics covered are description, distribution, habitat requirements, wildlife value, establishment, and cautions and limitations. Wildlife management programs on U.S. Army Corps of Engineers lands should emphasize the use of native plant materials to improve habitat diversity and support a variety of game and nongame wildlife species.

DESCRIPTION

Yaupon is an evergreen, thicket-forming shrub with many stiff, divergent stems arising from the base (Vines 1960, Radford et al. 1968, Halls 1977). It may grow to the size of a small tree, 24 to 30 ft (7.5 to 9 m) tall, with a low, dense, rounded crown and a trunk diameter of 12 to 14 in. (30 to 36 cm) (Vines 1960, Grelen and Duvall 1966). Growth is slow to medium (Coastal Zone Resources Division 1978), and the shrub produces white, heavy, hard, strong, and close-grained wood weighing about 46 lb per ft³ (737 kg per m³) (Vines 1960).

Yaupon bark is 1/16 to 1/8 in. (1.5 to 3.2 mm) thick and brownish to mottled gray or almost black (Vines 1960). Except for lenticels, the bark is tight and smooth on branches and twigs, but it eventually breaks into thin, small scales on older trunks. The round, stout twigs are sparsely pubescent and often short and crooked. Winter buds are blunt and minute, with brown scales.

The simple, alternate leaves are thick and leathery, dark green and glossy above, and paler below (Vines 1960, Halls 1977) (Fig. 1). They are oblong to oval or elliptic in shape, 0.4 to 1.8 in. (1 to 4.5 cm) long, and 0.31 to 0.58 in. (0.8 to 2 cm) wide; size may vary considerably, even on a single branch (Vines 1960, Grelen and Duvall 1966, Radford et al. 1968). Margins are revolute and shallowly toothed, lending a wavy appearance to leaf edges (Grelen and Duvall 1966, Radford et al. 1968). Petioles are short (to 0.25 in. or 6.3 mm), broad, and grooved (Vines 1960, Foote and Jones 1989). Leaves usually persist for 2 years, falling as new growth begins in the third season (Grelen and Duvall 1966).

Both female and male flowers are small, averaging 0.25 in. (6.3 mm) in diameter, with 4 to 5 white petals and green sepals (Vines 1960, Grelen and Duvall 1966). Staminate flowers are borne in fascicles in the leaf axils and have 4 to 5 yellow stamens and a rudimentary pistil. Pistillate flowers, with 4 to 5 rudimentary stamen filaments and a fertile pistil, are also found in the leaf axils or at nodes just below the leaves. They are borne as solitary flowers or in sessile cymes of 2 to 3 flowers (Grelen and Duvall 1966, Radford et al. 1968, Bailey and Bailey 1976). There is disagreement in the literature as to whether the plants are monoecious or dioecious (Vines 1960, Grelen and Duvall 1966, Halls 1977, Coastal Zone Resources Division 1978). Flowers bloom March



Figure 1. Close-up yaupon (*Ilex vomitoria*), showing leaves and fruit (top) and branches heavily laden with drupes in late fall (bottom)

through May on branches of the previous growing season (Grelen and Duvall 1966, Radford et al. 1968, Halls 1977).

Yaupon fruit is a shiny, round, bright red (rarely yellow) drupe, 0.16 to 0.22 in. (4 to 6 mm) in diameter with 4 pale amber, irregularly grooved nutlets 0.12 to 0.16 in. (3 to 4 mm) long (Radford et al. 1968, Halls 1977). The abundant fruits are produced in October and November and may persist on the stems all winter (Halls 1977, Coastal Zone Resources Division 1978) (Fig. 1). Yellow-fruited yaupons have occasionally been listed as species varieties. However, since they generally do not reproduce such fruits reliably, these yaupons are regarded as unstable forms (Vines 1960). Cultivars of yaupon are discussed in the Establishment section of this report.

DISTRIBUTION

Yaupon is native to the coastal plain of the southeastern and south-central United States. The species ranges from southeast Virginia to central Florida and westward to eastern Texas and Oklahoma (Vines 1960, Bailey and Bailey 1976, Coastal Zone Resources Division 1978, Payne and Copes 1988). In the Southeast, yaupon is most abundant in coastal plain forests of Louisiana, Texas, and Arkansas (Halls 1977) and reaches its largest size in bottomlands of east Texas (Vines 1960). When planted and maintained for ornamental use, yaupon may be established somewhat farther north and west than its natural occurrence.

HABITAT REQUIREMENTS

In the southeastern coastal plain, where yaupon most frequently occurs (Vines 1960), average temperatures vary from 60° F (15.5° C) in January to 85° F (29° C) in July in central Florida to about 40° to 75° F (4.4° to 24° C) for the same months in Virginia (U.S. Department of the Interior 1970). Average annual rainfall ranges from 57 in. (144 cm) in Louisiana to 35 in. (89 cm) in east-central Texas, and the length of the growing season varies from about 300 days in Florida and Texas to about 200 days in southeastern Virginia.

Yaupon is found in several habitat types, including mixed pine-hardwood stands, sand dunes, savannas, and bottomland hardwood forests (Halls 1977, Coastal Zone Resources Division 1978, Cook 1984, Newsom 1984). It is a common understory species, along with wax myrtle,¹ inkberry, large gallberry, saw palmetto, blueberries, and poison oak in longleaf-slash pine forests of the coastal plain. Common overstory species associated with longleaf and slash pine are water oak, laurel oak, post oak, and blackjack oak; loblolly pine and blackgum are associates on slightly wetter sites. In

¹ Scientific names of plant species are given in Appendix A.

loblolly pine-hardwood forests (with sweet bay, red bay, blackgum, red maple, post oak, or southern red oak), yaupon is a predominant understory plant with greenbriers, large gallberry, blackberries, swamp cyrilla, and dahoon (Newsom 1984).

Yaupon is commonly found in the southern mixed hardwood forests of Florida associated with southern magnolia, white oak, loblolly pine, water oak, swamp chestnut oak, maple, sweet bay, tulip tree, American beech, dogwood, wild olive, witch hazel, redbud, American holly, horse sugar, sparkleberry, wax myrtle, or ironwood (U.S. Department of Agriculture (USDA), undated). In Louisiana, Pearson (1975) found that yaupon occurred most frequently on loblolly-shortleaf pine sites but was also present in longleaf-slash pine, oak-pine, oak-hickory, and oak-gum-cypress habitats. Yaupon is occasionally found in the sand hills of South Carolina (Radford et al. 1968).

Yaupon is a dominant shrub of live oak savannas in the Texas coastal prairie (Springer 1977) and of mesic, "big thicket" stands of beech, magnolia and loblolly pine in southern east Texas (Marks and Harcombe 1975). In east Texas, it occurs on approximately 2.5 million acres (1 million ha) of pine forest (Duncan and Scifres 1983) and is common in the post oak savanna region (Cook 1984).

Shade

Yaupon tolerates shade well but grows best in the open. In east Texas pine stands, yaupon produced up to 150 lb per acre (168 kg per ha) of browse (green weight) when it grew beneath pine canopies (Halls 1977). However, plants of the same age growing in the open produced 5 to 57 times that amount. Fruit production of plants on open sites in east Texas was 19 times greater than that of plants growing in shaded areas.

Soils

Yaupon grows best in moist, well-drained soils with permeable subsoils (Halls 1977, Payne and Copes 1988) and a pH of 4.8 to 7.6 (Coastal Zone Resources Division 1978). It is usually found on dune sand, sandy and loam soils, and, less frequently, on clay soils (Coastal Zone Resources Division 1978; USDA, undated). Most soils in the coastal plain, with the exception of those in river deltas, are rather low in fertility (Buckman and Brady 1969). Yaupon is reported to tolerate extreme soil conditions, including low fertility, high salt content, and high pH (≥ 7.5) (Coastal Zone Resources Division 1978).

Moisture

Year-round moist, but well-drained, soil conditions favor yaupon. Dry weather during the growing season will inhibit twig growth, but the plants respond rapidly with new growth when soil moisture becomes more favorable (Halls 1977). With adequate rain, yaupon will continue growing until mid-October in the Southeast.

WILDLIFE VALUE

Yaupon is considered to have medium food value and high cover value for wildlife (Coastal Zone Resources Division 1978). Of the holly species found in the southern coastal plain, yaupon is considered to have the most browse value (Halls and Ripley 1961). Yaupon thickets provide excellent nesting and year-round cover for many birds (Davison 1967) (Table 1). The fruit is sought by white-tailed deer, squirrels, raccoons, and many bird species (Lay 1961), and the foliage is browsed by large and small herbivores (Payne and Copes 1988). Summer blooms are reported as an important pollen source for bees (Cerulean et al. 1986). Foliage is available year-round for browse and cover. Fruits are available beginning in mid-autumn and last throughout the winter if not eaten.

Bird Use

A number of birds use yaupon for nesting and roosting cover, including red-winged blackbirds, boat-tailed grackles, cardinals, towhees, painted buntings, and mockingbirds. In coastal areas, yaupon thickets provide shelter for a variety of wading birds such as herons, egrets, and ibises (Coastal Zone Resources Division 1978).

Yaupon is a staple food of wild turkeys in the flatwoods of Georgia and north Florida, and both wild turkeys and northern bobwhites seek its fruit in the fall and winter (Lay 1961, Ripley et al. 1962). The fruit is also considered a choice food of mockingbirds and cedar waxwings (Davison 1967). Twenty-eight bird species have been reported to eat the fruits of *Ilex* species (including yaupon) in the Southeast. Common among these are mourning doves, blue jays, scrub jays, sparrows, juncos, woodpeckers, northern cardinals, rufous-sided towhees, northern mockingbirds, gray catbirds, brown thrashers, eastern bluebirds, thrushes, cedar waxwings, and American robins (Dillon 1981).

Deer Use

Yaupon is a year-round food source for white-tailed deer and provides green forage that contains sufficient protein for deer maintenance in late winter (Halls 1977). Highest utilization generally occurs in the fall and winter when deer eat the fruits and browse the leaves and twigs (Lay 1961, Grelen and Duvall 1966, Newsom 1984). Yaupon is used with intermediate frequency by deer across much of its range (Newsom 1984) but is a main source of deer food in the post oak savanna region of Texas (Cook 1984). On some ranges in central Texas, it is the only common evergreen deer food and can support 1 deer per 4 acres (1.6 ha) or less (Lay 1961).

Yaupon is relished by cattle and may be intensely browsed when green grass is scarce (Lay 1961, Grelen and Duvall 1966). Thill (1982) found substantial dietary overlap for yaupon and other plant species between deer and cattle on longleaf pine-bluestem (*Andropogon* spp.) range in

Table 1
Wildlife Reported to Use Yaupon

<u>Songbirds</u>	<u>Food</u>	<u>Cover</u>
Red-winged blackbird (<i>Agelaius phoeniceus</i>)		X ¹
Eastern bluebird (<i>Sialia sialis</i>)	X	
Northern cardinal (<i>Cardinalis cardinalis</i>)	X	X
Gray catbird (<i>Dumetella carolinensis</i>)	X	X ²
Blue jay (<i>Cyanocitta cristata</i>)	X	
Scrub jay (<i>Aphelocoma coerulescens</i>)	X	
Northern mockingbird (<i>Mimus polyglottos</i>)	* ³	X
American robin (<i>Turdus migratorius</i>)	X	
White-throated sparrow (<i>Zonotrichia albicollis</i>)	X	X
Chipping sparrow (<i>Spizella passerina</i>)	X	
Song sparrow (<i>Melospiza melodia</i>)	X	X
Brown thrasher (<i>Toxostoma rufum</i>)	X	X
Gray-cheeked thrush (<i>Catharus minimus</i>)	X	
Swainson's thrush (<i>C. ustulatus</i>)	X	
Hermit thrush (<i>C. guttatus</i>)	X	
Wood thrush (<i>Hylocichla mustelina</i>)	X	
Rufous-sided towhee (<i>Pipilo erythrophthalmus</i>)	X	X
Cedar waxwing (<i>Bombycilla cedrorum</i>)	*	
Red-bellied woodpecker (<i>Melanerpes carolinus</i>)		X
Red-headed woodpecker (<i>M. erythrocephalus</i>)	X	
Boat-tailed grackle (<i>Quiscalus major</i>)		X
Painted bunting (<i>Passerina ciris</i>)		X
Dark-eyed junco (<i>Junco hyemalis</i>)	X	X
<u>Game Birds</u>		
Wild turkey (<i>Meleagris gallopavo</i>)	** ⁴	X
Mourning dove (<i>Zenaida macroura</i>)	X	
Northern bobwhite (<i>Colinus virginianus</i>)	X	X
<u>Mammals</u>		
White-tailed deer (<i>Odocoileus virginianus</i>)	X	
Squirrels (<i>Sciurus</i> spp.)	X	
Raccoon (<i>Procyon lotor</i>)	X	

Sources: Lay (1961), Davison (1967), Coastal Zone Resources (1978), Dillon (1981).

¹ X = use documented.

² X = observation by C.O. Martin.

³ * = fruit is choice food.

⁴ ** = fruit is staple food.

Louisiana. When heavily browsed, yaupon tends to hedge, forming dense, sometimes grotesque, shapes. The short, stiff branches protect enough leaves inside the crown to keep the plant alive and allow its survival on overstocked range (Halls 1977). Optimum yaupon browse use has been estimated at approximately 40% of annual growth. Continued heavy use may eliminate reproduction and reduce forage yield (Lay 1961). Lay (1965) ranked yaupon in southeast Texas pine stands as "intermediate" in its resistance to clipping, as compared with greenbriers and large gallberry, which best survived heavy clipping.

Nutritional Value

Although the relative nutritional values of a plant will vary according to season, location, and management, the following measurements can be used as a guide in evaluating the contribution of a species to wildlife nutrition. The relative nutritional value of yaupon fruits is low for crude protein (6.8%), phosphorus (0.09%), and calcium (0.16%) but is relatively high for crude fat (7.7%) and fiber (29.9%) (Short and Epps 1976, Halls 1977). Yaupon produces an average of 6200 fruits and 37,800 seeds per lb (2812 fruits and 17,146 seeds per kg), and large seed crops occur on an average of 1- to 2-year intervals (Schopmeyer 1974).

Most yaupon plants with stems ≥ 2 in. (≥ 5 cm) (about 4 years old) will bear fruit each year, although fruit production varies (Halls and Ripley 1961, Schopmeyer 1974). Lay (1961) reported that sample plots produced 10.8 lbs per acre (12.1 kg per ha) one year and only 4.2 lb per acre (4.7 kg per ha) the next. Plants growing in open areas tend to produce greater fruit yields at an earlier age than those growing beneath forest canopies. In east Texas, the average fruit production for 11-year-old plants grown in the open was nearly 5 lb (2.2 kg) per plant (dry weight) (Halls 1977).

Yaupon is considered an important browse species because its leaves and twigs supply relatively high levels of crude protein, phosphorus, and calcium throughout the year (Stransky and Halls 1976). Browse quality is best in the spring, when the flush of new growth increases nutritional values, and decreases as growth slows and stops (Stransky and Halls 1976, Springer 1977). Stransky and Halls (1976) found mean crude protein levels highest in spring (16.69% in leaves and 10.11% in twigs) and lowest in winter (11.99% in leaves and 3.73% in twigs). Phosphorus content of leaves and twigs ranged from 0.18% and 0.15% in April to 0.08% and 0.04% in mid-November. Spring calcium levels were 0.313% for leaves and 0.456% for twigs, while winter levels decreased to 0.225% and 0.394% for leaves and twigs, respectively.

Yaupon has higher crude protein and phosphoric acid values when grown on burned rather than unburned sites (Lay 1961, Stransky and Halls 1976, Springer 1977). Lay (1961) reported that protein varied from 15% in the spring to 11% in the winter on burned ranges, compared with 9% and 7% on unburned ranges. Phosphoric acid content was 0.43% in the spring and 0.19% in the winter on burned areas, and 0.25% (spring) and 0.16% (winter) on unburned areas.

Both browse quality and production are improved when yaupon grows on open rather than shaded sites. Yaupon growing in the open can produce from 750 to 8550 lb (841 to 9583 kg) of browse per acre (ha) in green weight, while the same-aged plants grown beneath pine stands will produce only up to 150 lb per acre (168 kg per ha) (Halls 1977).

ESTABLISHMENT

Yaupon is easily grown and is sometimes used in ornamental landscape plantings because of its bright red drupes and evergreen leaves. Its tight, compact foliage, tolerance for shearing, and ability to grow well in sun or shade make the shrub a good choice for hedges, screenings, and foundation plantings (Vines 1960, Foote and Jones 1989). Large groups or rows of yaupon can be planted in field corners, at the edges of fields and forests, and on reclaimed dredged material to provide food and cover for wildlife (Coastal Zone Resources Division 1978). In some areas yaupon grows abundantly along roadsides and serves as an excellent barrier planting (Fig. 2). It is one of the most reliable plant materials for seaside locations (Wigginton 1963).

Cultivars recommended as particularly suitable for landscape use include Folsum's Weeping and Pendula, both of which have weeping forms, and Nana and Schellings Dwarf, which have dwarf, compact forms (Foote and Jones 1989). Other available cultivars include Aurea, Dewerth, Grey's Littleleaf, Huber's Compact, Jewel, Otis Miley, Pride of Houston, Pyramidalis, Stokes Dwarf, Tricolor, Wiggins Yellow, and Yawkeyii (Bailey and Bailey 1976). Cultivars are generally available from commercial nurseries and should be selected with careful consideration of the proposed geographic location, site requirements, and use.

Pendula is recommended as a good patio or courtyard specimen. Schellings Dwarf or Stokes Dwarf are considered excellent compact landscape shrubs, but do not produce fruit since they are male plants (Bir 1992). Stokes Dwarf is recommended for the New Orleans area with predominantly alkaline soils and poor drainage conditions. Nana, a dwarf yaupon, is recommended for general use in the southern coastal plain and southern piedmont regions. Native to these regions, it is pest-free and can be used in any soil or exposure, even along the seacoast. Although its use is restricted in the upper southern states, dwarf yaupon can probably be planted as far north as Nashville, Tenn., or Lexington, Ky. However, plants may fail to set fruit beyond that northern limit (Wigginton 1963).

Site Selection

Yaupon is normally established in moist, well-drained soils. However, with minimum maintenance it can be used in xeriscape plantings since it will tolerate habitat conditions of low moisture and soil fertility (Edwards Underground Water District, undated). The species can survive



Figure 2. Yaupon thicket along a roadside in south-central Texas

on sites subjected to winds, limited salt spray and, in some instances, moderate amounts of salt in the soil (Wigginton 1963). Yaupon grows well in shade and sun, but best growth and maximum fruit production occur in open areas (Halls 1977).

Site Preparation

Soil analyses should be performed on potential planting sites to determine specific needs for fertilizer and soil amendments, which should be added as indicated. Phosphorus should be mixed with the top 6 to 8 in. (15 to 20 cm) of soil before plants are set. Nitrogen should be sparingly applied to the surface a few weeks after planting (Bir 1992).

Adding organic matter can improve drainage in heavy soils by increasing air spaces; in sandy soils, this improves the capacity to hold water and fertilizer. Southern yellow pine bark is a recommended organic amendment for the Southeast (Foote and Jones 1989, Bir 1992). The bark should be spread to a depth of 4 in. (10 cm) over an area at least twice the size the plant will cover and mixed thoroughly with the top 6 to 8 in. (15 to 20 cm) of soil (Bir 1992). However, there is some evidence that native soil is best for plant establishment (Foote and Jones 1989).

Propagules

Yaupon may be propagated by seeds and seedlings but is usually propagated by stem or root cuttings (Coastal Zone Resources Division 1978). To ensure fruit production, cuttings should be taken from known female plants from mid-July through August (North Carolina Wild Flower Preservation Society 1977). Male plants must be included in the planting if there are none in the vicinity of the proposed planting site (Coastal Zone Resources Division 1978, Bir 1992). Stem cuttings should be placed in a flat at least 6 in. (15 cm) deep filled with a mixture of 1 part peat and 3 parts sand (Vines 1960). The leaves should rest on the surface with the slanted bases extending about 3 in. (7.5 cm) below the soil surface.

Root cuttings about 3/8 in. (9.5 mm) in diameter can be taken in the fall and planted with only the tips exposed (Vines 1960). Cuttings kept in a cold frame or greenhouse with temperatures of 65° to 75° F (18° to 24° C) should root by spring. However, rooting response will be improved if cuttings are treated with naphthaleneacetic acid or any good chemical root stimulant (Doran 1937, Vines 1960).

Seeds may be extracted from yaupon drupes by macerating the fruits with water. Seeds of *Ilex* spp. demonstrate a deep dormancy caused by a hard endocarp around the seed coat and by conditions within the embryo (Young and Young 1986). Under natural conditions, germination is commonly delayed for 16 months and may require 3 years (Young and Young 1992). Yaupon seeds normally require 2 years to germinate, and seeds collected at the same time may germinate at different rates (Vines 1960). Cleaned seeds may be stratified at warm temperatures of 68° to 86° F (20° to 30° C) for 60 days, followed by 60 days of prechilling at 41° F (5° C). Prechilling can replace overwinter storage for seeds planted in the spring (Young and Young 1992). Dried seeds can be stored before planting in nursery beds the second fall to germinate the following spring (Coastal Zone Resources Division 1978). Seeds should be sown about 1/4 in. (6 mm) deep in flats with equal parts of peat, soil, or sand and kept moist by mulching or sprinkling (Vines 1960).

Wild plants are not easily transplanted, so containerized or balled stock 1.5 to 2 ft (0.46 to 0.6 m) tall is recommended for establishing yaupon plantings (Coastal Zone Resources Division 1978). Seedlings should be planted as soon as possible after they are obtained, either in the fall or spring. The best planting times in the Southeast are late fall and early winter since plants are dormant and some root growth may occur during the winter (Foote and Jones 1989).

Planting Methods

Yaupon seedlings should be spaced 6 to 7 ft (1.8 to 2.2 m) apart when planted in groups and 5 to 6 ft (1.5 to 1.8 m) apart when planted in rows (Coastal Zone Resources Division 1978). In areas exposed to whipping winds and salt spray, yaupon seedlings should be planted into standing grass cover for protection (Coastal Zone Resources Division 1978).

Generally, planting holes should be approximately twice as wide as the root mass and about 12 in. (25.4 cm) deeper (Foote and Jones 1989). Any root covering should be removed and the roots spread before planting seedlings to the depth at which they had been growing. Holes should be backfilled to the soil line, the soil firmed and thoroughly watered, and an organic mulch applied. Backfill soil can be modified with organic amendments. Annual fertilization will improve growth until plants are well established (Coastal Zone Resources Division 1978), but fertilizer should not be added until just before new growth begins to appear in the spring (Foote and Jones 1989).

MAINTENANCE

Weed control during the seedling stage can significantly increase plant growth and survival. Weed competition can be reduced by hand and/or mechanical cultivation, herbicide application, mowing, and/or mulching (Henderson 1987). Mulching is also recommended to help reduce soil moisture loss.

Once established, yaupon requires little maintenance beyond the usual control of insects and disease and the application of any fertilizer indicated by soil testing. In the absence of regular rainfall, plants will benefit from a thorough watering twice a month during the growing season (Edwards Underground Water District, undated).

FOREST MANAGEMENT

Several forest management practices can impact yaupon. Mechanical site preparation treatments, such as chopping and soil scraping (KG blading), can severely reduce yaupon occurrence and retard fruit production in remaining plants (Stransky and Halls 1976, Stransky and Richardson 1977). Summer burns or a series of hot winter fires will kill yaupon, whereas infrequent, moderately intense winter burns can improve nutrient quality and stimulate new growth (Halls 1977). Minimum fruit yields should be expected the year after burning (Halls 1977, Stransky and Richardson 1977).

In a forested habitat, the quantity and quality of yaupon can be enhanced with a combination of timber harvest, retention of forest openings, and occasional prescribed burning. New foliage produced by these practices will be within the reach of deer for approximately 3 to 5 years (Halls 1980). Forest management practices should be planned, scheduled, and implemented on a rotating, landscape-wide basis to create the habitat diversity that will ensure the production of a wide variety of quality browse species.

CAUTIONS AND LIMITATIONS

Yaupon is subject to pitted scale (*Asterolecarium puteanum*), which makes conical pits on twigs, and tea scale (*Fiorinia theae*), which forms cottony patches on the undersides of leaves (Vines 1960). At the onset of new growth, diseased plants can be sprayed with a chemical, such as Parathion, to destroy scale eggs.

Although not an impediment to tree growth or forest management, yaupon is often considered a problem species on rangelands of east-central Texas where it competes with forage grasses for moisture (Halls 1977). In the post oak savanna region, yaupon is not only resistant to chemical treatments, which normally kill 75% of the post oak and blackjack oak brush of the region, but it can also greatly increase in density when released following oak control (Duncan and Scifres 1983). Duncan and Scifres (1983) found that spring applications of tebuthiuron pellets (20% active ingredient) at 10.9 lb per acre (2 kg per ha) effectively controlled yaupon, reducing the live canopy of the shrub by 80%.

Yaupon may also be considered an undesirable species on longleaf pine-bluestem or wiregrass range managed for threatened and endangered species in the Southeast. Where possible, these areas should be managed by prescribed growing season fires to maintain the native groundcover and prevent the encroachment of woody shrubs. Extreme caution should be used when applying herbicides to sites that support sensitive species.

LITERATURE CITED

- Bailey, L. H., and E. Z. Bailey. 1976. *Hortus Third: A Concise Dictionary of Plants Cultivated in the United States and Canada*. McMillan, New York. 1312 pp.
- Bir, R. E. 1992. *Growing and Propagating Showy Native Woody Plants*. Univ. North Carolina Press, Chapel Hill. 192 pp.
- Buckman, H. O., and N. C. Brady. 1969. *The Nature and Properties of Soils*. McMillan, New York. 653 pp.
- Cerulean, S., C. Botha, and D. Legare. 1986. Planting a refuge for wildlife: How to create a backyard habitat for Florida's birds and beasts. Florida Game and Fresh Water Fish Comm. Nongame Wildl. Program, Tallahassee. 33 pp.
- Coastal Zone Resources Division. 1978. Handbook for terrestrial wildlife habitat development on dredged material. Tech. Rep. D-78-37. U.S. Army Eng. Waterways Exp. Sta., Vicksburg, Miss. 353 pp.
- Cook, R. L. 1984. Texas. Pages 457-474 In L. K. Halls, ed. *White-tailed Deer: Ecology and Management*. Stackpole Books, Harrisburg, Pa. 870 pp.
- Davison, V. E. 1967. *Attracting Birds: From the Prairies to the Atlantic*. Thomas Y. Crowell Co., New York. 251 pp.
- Dillon, O. W. 1981. Invite birds to your home: Conservation plantings for the Southeast. USDA Soil Conserv. Serv., Program Aid 1093. 16 pp.
- Doran, W. L. 1937. Propagation of woody plants by cuttings. Mass. Agric. Exp. Sta. Bull. 491.
- Duncan, K. W., and C. J. Scifres. 1983. Yaupon and associated vegetation response to seasonal tebuthiuron applications. *J. Range Manage.* 36:568-571.
- Edwards Underground Water District. Undated. *Xeriscape: Water conservation through creative landscaping*. San Antonio, Tex. 6 pp.
- Foote, L. E., and S. B. Jones. 1989. *Native Shrubs and Woody Vines of the Southeast: Landscaping Uses and Identification*. Timber Press, Portland, Oreg. 199 pp.
- Grelen, H. E., and V. L. Duvall. 1966. Common plants of longleaf pine-bluestem range. USDA For. Serv. Res. Pap. SO-23. 96 pp.
- Halls, L. K. 1977. Yaupon/*Ilex vomitoria* Ait. Pages 52-54 In L. K. Halls, ed. *Southern fruit-producing woody plants used by wildlife*. USDA For. Serv. Gen. Tech. Rep. SO-16. 235 pp.
- Halls, L. K. 1980. Characteristics of deer browse plants growing in east Texas forests. Pages 21-22 In Third Annu. Meet. Southeast Deer Study Group. Nacogdoches, Tex. 27 pp. (Abstr.)
- Halls, L. K., and T. H. Ripley, eds. 1961. *Deer browse plants of southern forests*. USDA For. Serv., South. For. Exp. Sta., New Orleans, La., and Southeast. For. Exp. Sta., Asheville, N.C. 78 pp.
- Harrar, E. S., and J. G. Harrar. 1962. *Guide to Southern Trees*. Dover Publ., New York. 709 pp.

- Henderson, C. L. 1987. Landscaping for Wildlife. Minn. Dep. Nat. Resour., St. Paul. 145 pp.
- Lay, D. W. 1961. Yaupon. Pages 28-29 In L. K. Halls and T. H. Ripley, eds. Deer browse plants of southern forests. USDA For. Serv., South. For. Exp. Sta., New Orleans, La., and Southeast. For. Exp. Sta., Asheville, N.C. 78 pp.
- _____. 1965. Effects of periodic clipping on yield of some common browse species. J. Range Manage. 18:181-184.
- Marks, P. L., and P. A. Harcombe. 1975. Community diversity of coastal plain forests in southern east Texas. Ecol. 56:1004-1008.
- Newsom, J. D. 1984. Coastal plain. Pages 367-380 In L. K. Halls, ed. White-tailed Deer: Ecology and Management. Stackpole Books, Harrisburg, Pa. 870 pp.
- North Carolina Wild Flower Preservation Society. 1977. North Carolina native plant propagation handbook. Chapel Hill, N.C. 79 pp.
- Payne, N. F., and F. Copes. 1988. Wildlife and fisheries habitat improvement handbook. USDA For. Serv. Wildl. and Fish. Adm. Rep. Unpaged.
- Pearson, H. A. 1975. Multiple-use inventories in Louisiana forests. Proc. Southeast. Assoc. Fish and Wildl. Agencies 29:682-686.
- Radford, A. E., H. E. Ahles, and C. R. Bell. 1968. Manual of the Vascular Flora of the Carolinas. Univ. North Carolina Press, Chapel Hill. 1183 pp.
- Ripley, T. H., L. P. Wilhite, R. L. Downing, and R. F. Harlow. 1962. Game food plants in slash-longleaf flatwoods. Proc. Southeast. Assoc. Fish and Wildl. Agencies 16:35-44.
- Schopmeyer, C. S. 1974. Seeds of the woody plants in the United States. USDA Agric. Handb. No. 450. 883 pp.
- Short, H. L., and E. A. Epps, Jr. 1976. Nutrient quality and digestibility of seeds and fruits from southern forests. J. Wildl. Manage. 40:283-289.
- Springer, M. D. 1977. The effects of prescribed burning on browse, forbs and mast in a Texas live oak savannah. Proc. Southeast. Assoc. Fish and Wildl. Agencies 31:188-198.
- Stransky, J. J., and L. K. Halls. 1976. Browse quality affected by pine site preparation in east Texas. Proc. Southeast. Assoc. Fish and Wildl. Agencies 30:507-512.
- _____, and D. Richardson. 1977. Fruiting of browse plants affected by pine site preparation in east Texas. Proc. Southeast. Assoc. Fish and Wildl. Agencies 31:5-7.
- Thill, R. E. 1982. Deer and cattle diets on longleaf pine-bluestem range. Proc. Southeast. Assoc. Fish and Wildl. Agencies 36:410-419.
- U.S. Department of Agriculture. Undated. Soils and vegetation of the Apalachicola Forest. Forest Service, Southern Region.
- U.S. Department of the Interior. 1970. The national atlas of the United States of America. Geological Survey, Washington, D.C. 417 pp.

- Vines, R. A. 1960. Trees, Shrubs, and Vines of the Southwest. Univ. Tex. Press, Austin. 1104 pp.
- Wigginton, B. E. 1963. Trees and Shrubs for the Southeast. Univ. Ga. Press, Athens. 280 pp.
- Young, J. A., and C. G. Young. 1986. Collecting, Processing and Germinating Seeds of Wildland Plants. Timber Press, Portland, Oreg. 236 pp.
- _____. 1992. Seeds of Woody Plants in North America. Dioscorides Press, Portland, Oreg. 407 pp.

APPENDIX A: COMMON AND SCIENTIFIC NAMES
OF PLANTS MENTIONED IN TEXT¹

Common Name	Scientific Name
American beech	<i>Fagus grandifolia</i>
Blackberry/dewberry	<i>Rubus</i> spp.
Blackgum	<i>Nyssa sylvatica</i>
Blueberry spp.	<i>Vaccinium</i> spp.
Sparkleberry	<i>V. arboreum</i>
Bluestem	<i>Andropogon</i> spp. <i>Schizachyrium</i> spp.
Flowering dogwood	<i>Cornus florida</i>
Greenbriers	<i>Smilax</i> spp.
Holly spp.	<i>Ilex</i> spp.
American holly	<i>I. opaca</i>
Dahoon	<i>I. cassine</i>
Inkberry	<i>I. glabra</i>
Large gallberry	<i>I. coriacea</i>
Possum haw	<i>I. decidua</i>
Horse sugar	<i>Symplocos tinctoria</i>
Ironwood	<i>Carpinus caroliniana</i>
Magnolia spp.	<i>Magnolia</i> spp.
Southern magnolia	<i>M. grandiflora</i>
Sweet bay	<i>M. virginiana</i>
Oak spp.	<i>Quercus</i> spp.
Blackjack oak	<i>Q. marilandica</i>
Laurel oak	<i>Q. laurifolia</i>
Live oak	<i>Q. virginiana</i>
Post oak	<i>Q. stellata</i>
Southern red oak	<i>Q. falcata</i>
Swamp chestnut oak	<i>Q. michauxii</i>
Water oak	<i>Q. nigra</i>
White oak	<i>Q. alba</i>
Pine spp.	<i>Pinus</i> spp.
Loblolly pine	<i>P. taeda</i>
Longleaf pine	<i>P. palustris</i>
Shortleaf pine	<i>P. echinata</i>
Slash pine	<i>P. elliotii</i>
Poison oak	<i>Rhus toxicodendron</i>

(Continued)

¹ Scientific names follow Radford et al. (1968).

APPENDIX A: (Concluded)

<u>Common Name</u>	<u>Scientific Name</u>
Red bay	<i>Persea borbonia</i>
Red maple	<i>Acer rubrum</i>
Redbud	<i>Cercis canadensis</i>
Saw palmetto	<i>Serenoa repens</i>
Swamp cyrilla (titi)	<i>Cyrilla racemiflora</i>
Tulip tree	<i>Liriodendron tulipifera</i>
Wax myrtle	<i>Myrica cerifera</i>
Wild olive	<i>Osmanthus americana</i>
Wiregrass	<i>Aristida</i> spp.
Witch hazel	<i>Hamamelis virginiana</i>

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE August 1997	3. REPORT TYPE AND DATES COVERED Final report		
4. TITLE AND SUBTITLE Yaupon (<i>Ilex vomitoria</i>): Section 7.5.10, U.S. Army Corps of Engineers Wildlife Resources Management Manual		5. FUNDING NUMBERS EIRP WU 32420		
6. AUTHOR(S) Chester O. Martin, Sarah P. Mott				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army Engineer Waterways Experiment Station 3909 Halls Ferry Road, Vicksburg, MS 39180-6199; Conservation Communications, Vicksburg, MS 39180		8. PERFORMING ORGANIZATION REPORT NUMBER Technical Report EL-97-16		
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army Corps of Engineers Washington, DC 20314-1000		10. SPONSORING/MONITORING AGENCY REPORT NUMBER		
11. SUPPLEMENTARY NOTES Available from National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.				
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution is unlimited.		12b. DISTRIBUTION CODE		
13. ABSTRACT (Maximum 200 words) A plant materials report on yaupon (<i>Ilex vomitoria</i>) is provided as Section 7.5.10 of the U.S. Army Corps of Engineers Wildlife Resources Management Manual. The report was prepared as a guide to assist the Corps District or project biologist with the selection, cultivation, and management of suitable plant materials for wildlife and habitat development programs. Major topics covered are description, distribution, habitat requirements, wildlife value, establishment, and cautions and limitations. Yaupon is a native evergreen shrub or small tree that is common in the moist pine and hardwood forests of the South Atlantic-Gulf Coastal Plain and the savanna scrublands of east-central Texas. The thicket-forming characteristic of yaupon makes it excellent cover for many birds, and the fruits are sought by at least 25 bird species and several mammals. Yaupon is a year-round food source for the white-tailed deer (<i>Odocoileus virginianus</i>), providing green forage in late winter that contains sufficient protein for deer maintenance. Yaupon is easily grown and may be used in ornamental landscape plantings because of its bright red berries and evergreen leaves. The shrub's tight, compact foliage and ability to grow well in either sun or shade make it a good choice for hedges, screenings, and foundation plantings. Several cultivars are available from commercial nurseries. Details are provided on propagule selection, site preparation, planting methods, and maintenance requirements.				
14. SUBJECT TERMS Habitat development Plant materials Wildlife management		Ilex vomitoria Southeast Yaupon		15. NUMBER OF PAGES 21
				16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT	