U. S. Department of Agriculture
Forest Service Research Paper SO-90

Flowering and Fruiting

Of Southern Browse Species

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Forest Service
U. S. Department of Agriculture

1973

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Flowering and fruiting dates are reported for 14 browse species growing in the open and beneath trees in an east Texas pine-hardwood forest. Dates for individual species generally were not influenced by tree cover. Usually flowers bloomed earliest when March temperatures were highest. In the open, plants generally produced fruit more consistently and abundantly and at an earlier age than beneath the trees. American beautyberry and yaupon yielded the most fruit. Honeysuckle and yaupon fruits persisted longest through the winter.

Additional keywords: Phenology, fruit yields, *Pinus elliottii, P. taeda.*

Because plant fruits are a vital food source for wild birds and mammals, wildlife managers need to know when various plants bear fruits and how much they yield. This paper describes the flowering and fruiting characteristics of 14 common species of woody vines, shrubs, and small trees in southern forests. The information is based on observations made at the Stephen F. Austin Experimental Forest near Nacogdoches, Texas, from 1963 through 1972. Certain phases of the study were reported previously (Halls and Alcaniz, 1968 and 1972).

SITE TREATMENTS

A sawtimber-size stand of shortleaf *(Pinus echinata* Mill.) and loblolly *(P. taeda* L.) pines was thinned to a tree basal area of 70 sq. ft. per acre. Understory vegetation was cut or killed with chemicals before planting of 1-year-old seedlings. Nine plants of each of the 14 species were spaced equally within each of four contiguous ¼-acre blocks. Shrubs and vines were planted 5 feet apart; small trees, 10 feet apart.

The same planting schedule and arrangement were implemented in a nearby abandoned field. Here the land was disked before planting, and weeds were controlled by disking until the study plants were definitely established and thereafter by mowing.

Twenty-four plants of each species (three from each block in the two planting sites) were selected for flowering and fruiting observations. A few of these plants died during the study. The age when plants first bore mature fruits was noted. Thereafter, the seasonal development of flowers and fruits was recorded from beginning date of growth until final fruit fall the following winter. Samples of mature fruits were collected, dried at 70°C., and weighed to compute an average ovendry weight per fruit. This figure was multiplied by number of fruits per plant to obtain the total annual yield. Number of mature fruits per gram, moisture content, and ratio of pulp to seed were calculated when a sufficient sample was available from 1967 through 1972.

Temperatures were continuously recorded by hygrothermographs at both study locations, and daily rainfall was measured by a standard rain gage nearby.

WEATHER RECORDS

Rainfall.—Annual rainfall ranged from a low of 32 inches in 1967 to a high of 66 inches in 1968 (table 1). For 7 years out of 9 it was below the longtime average of 46 inches. Droughts of several weeks duration occurred

[1] On the staff of the Wildlife Habitat and Silviculture Laboratory, which is maintained at Nacogdoches, Texas, by the Southern Forest Experiment Station in cooperation with the School of Forestry, Stephen F. Austin State University.

in the summers of 1964 and 1965. Total rainfall in 1966 was very close to the yearly average. The 1967 rainfall was 14 inches below average, and soils were especially dry from June through November. In contrast, rainfall was much above average in 1968 and through May 1969. This wet period was in turn followed by a prolonged dry period that extended through June 1972. Heavy rains occurred in July, and rainfall was above average for the remainder of the year.

Table 1.—*Seasonal rainfall (inches) at Stephen F. Austin Experimental Forest*

Year	Winter	Spring	Summer	Fall	Total
1964	9.4	13.2	7.2	8.9	38.7
1965	10.9	11.9	7.2	11.7	41.7
1966	11.7	15.1	12.6	6.8	46.2
1967	6.6	11.2	6.3	8.0	32.1
1968	13.0	26.7	14.0	12.4	66.1
1969	15.1	13.6	5.2	8.8	42.7
1970	9.6	8.4	6.9	9.0	33.9
1971	4.8	9.1	7.0	16.0	36.9
1972	8.0	8.5	12.9	15.5	44.9

Temperature.—From 1964 through 1972 the average maximum monthly temperature was 78.7°F. in the open and 76.9°F. beneath the trees. Occasionally, however, the maximum temperature was higher under the trees. The widest differences occurred in the falls of 1966 and 1968 and in the summer and fall of 1969, when temperatures in the open were 4° to 8°F. above those in the shade. The highest maximum temperature, 95.0°F., was reported in August.

The average daily minimum temperature was 52.8°F. in the open and 53.4°F. beneath trees. The lowest mean minimum temperature, 35.6°F., occurred in February.

In comparison to longtime Weather Bureau records at nearby Nacogdoches, the following months were several degrees colder than normal: January in 1964, 1966, 1970; February from 1964 through 1968; March in 1965 and 1969; and July and August in 1968. Temperatures were considerably warmer than average in January and February of 1969, 1971, and 1972; March 1967 and 1972; April 1965 and 1967; June 1971; July 1969; August 1964, 1969, and 1970; and September 1971.

The date of the last spring freeze varied from March 9 in 1967 to April 7 in 1971, and the first freeze in fall ranged from October 19 in 1967 to November 15 in 1972. The length of the frost-free season was from 205 days in 1970 to 234 days in 1968.

SEASONAL DEVELOPMENT OF FLOWERS

Flowering dates for most species were not consistently influenced by tree cover. However, American beautyberry flowered a few days earlier in the open; and flowering dogwood, sassafras, and common greenbrier flowered a few days earlier beneath trees (fig. 1).

Flowering of almost all species was earliest in 1967 and 1972, when March temperatures were highest. Generally flowers bloomed late when March was cool; but this relationship was inconsistent, particularly for species blooming in May and June. January and February temperatures had no obvious effect on flower initiation, nor did amount of precipitation. In a wet spring some species would flower early and others late. Such diverse responses to the same environmental factors have been noted elsewhere (Blaisdell, 1958).

The interval between first flower emergence and peak of bloom was shortest for rusty blackhaw, common greenbrier, and saw greenbrier (3 to 5 days) and longest for flowering dogwood plants in the open (14 to 16 days). Other species had average intervals of 6 to 10 days.

In a typical year species bloomed in the following order: (1) flowering dogwood and sassafras, (2) rusty blackhaw, red mulberry, and smallflower pawpaw, (3) yaupon and common greenbrier, (4) saw greenbrier, dwarf live oak, Japanese honeysuckle, and Alabama supplejack, (5) sweetbay magnolia and muscadine grape, and (6) American beautyberry.

Flowering dogwood and sassafras formed buds in early winter and reached their peak of bloom in late March or early April. Since frosts often killed sassafras flowers, only the late blooms developed into mature fruits. Although dogwood flowers were often discolored by a freeze, the fruits were rarely damaged. When fruits set, they generally grew to maturity.

For rusty blackhaw, red mulberry, and smallflower pawpaw,[2] blooming usually peaked during the first or second week in April. Red mulberry blossoms were occasionally nipped by late freezes, and only a small proportion of all three species' flowers developed into mature fruits.

Yaupon and common greenbrier flowered late enough (mid-April) so that they were never damaged by a freeze. Yaupon produced abundant flowers; but common greenbrier, only a few.

Flowering peaked in late April for saw greenbrier, dwarf live oak, Japanese honeysuckle, and Alabama supplejack. Greenbrier flowers were sparse. Live oak continued to form new flowers several weeks after the peak of bloom; many of the flowers aborted and were replaced by others. Honeysuckle also formed a few flowers throughout the summer and fall if rainfall was above average; these late blooms seldom developed into mature fruits, however. Supplejack flowers were present only briefly in the spring, and most of them developed into mature fruit.

Sweetbay magnolia and muscadine grape flowered in mid-May. The magnolia's sparse flowers developed into one or two full-size cones and a few immature fruits. Grape flowers were also sparse; and many of the developing fruits aborted, especially in hot, dry weather.

Flowering of American beautyberry did not peak until June. Although flowers continued to form through summer and autumn when moisture was plentiful, late blooms seldom developed into mature fruits.

FRUITING

Age at first fruiting.—Whether planted in the open or under trees, American beautyberry first produced fruit at age 2 years. All other species except red mulberry produced mature fruit at an earlier age in open than beneath trees (table 2). In the open, sweetbay magnolia and common greenbrier bore fruit at age 6; and most other species, at 3 or 4 years. Beneath trees, the beginning fruit-bearing age ranged from 5 to 9 years. Sweetbay magnolia, dwarf live oak, saw greenbrier, rusty blackhaw, and muscadine grape plants beneath trees did not bear fruit during the study.

[2] In this study the flowering and fruiting dates were earlier for smallflower pawpaw and red mulberry, and the fruiting dates were later for Alabama supplejack and rusty blackhaw than the dates presented in taxonomic texts (Vines, 1960; Correll and Johnston, 1970).

Table 2.—*Age at which species first bore mature fruit*

Species	Open	Beneath trees
	-- *Years* --	
Smallflower pawpaw	4	7
Alabama supplejack	3	8
American beautyberry	2	2
Flowering dogwood	4	9
Yaupon	4	7
Japanese honeysuckle	3	5
Sweetbay magnolia	6	(1)
Red mulberry	4	2
Dwarf live oak	4	(1)
Sassafras	4	8
Saw greenbrier	4	(1)
Common greenbrier	6	9
Rusty blackhaw	5	(1)
Muscadine grape	4	(1)

[1] Plants beneath trees did not bear fruit by 1972.

The proportion of fruit-bearers was much higher for plants growing in the open than for those beneath trees (table 3). Usually this proportion increased as the plants grew older; however, this trend was not consistent for several species. On the average, American beautyberry and Japanese honeysuckle had the highest proportion of plants bearing fruit.

Season of fruiting.—Usually when a plant bloomed early, the fruit matured early; but for several species there was no relationship between dates when flowers appeared and dates when fruit matured. For example, in any given year a species might flower earlier than average but bear mature fruit later than usual.

Generally, the fruits of Alabama supplejack, American beautyberry, and red mulberry matured at least 10 days later on plants beneath trees than on those in the open. No consistent difference between locations was observed for other species.

Red mulberry was the only species that bore mature fruit in the spring (May), and the interval from first appearance to end of drop was only about 6 weeks. Smallflower pawpaw, sweetbay magnolia, sassafras, and muscadine grape produced mature fruit in summer or

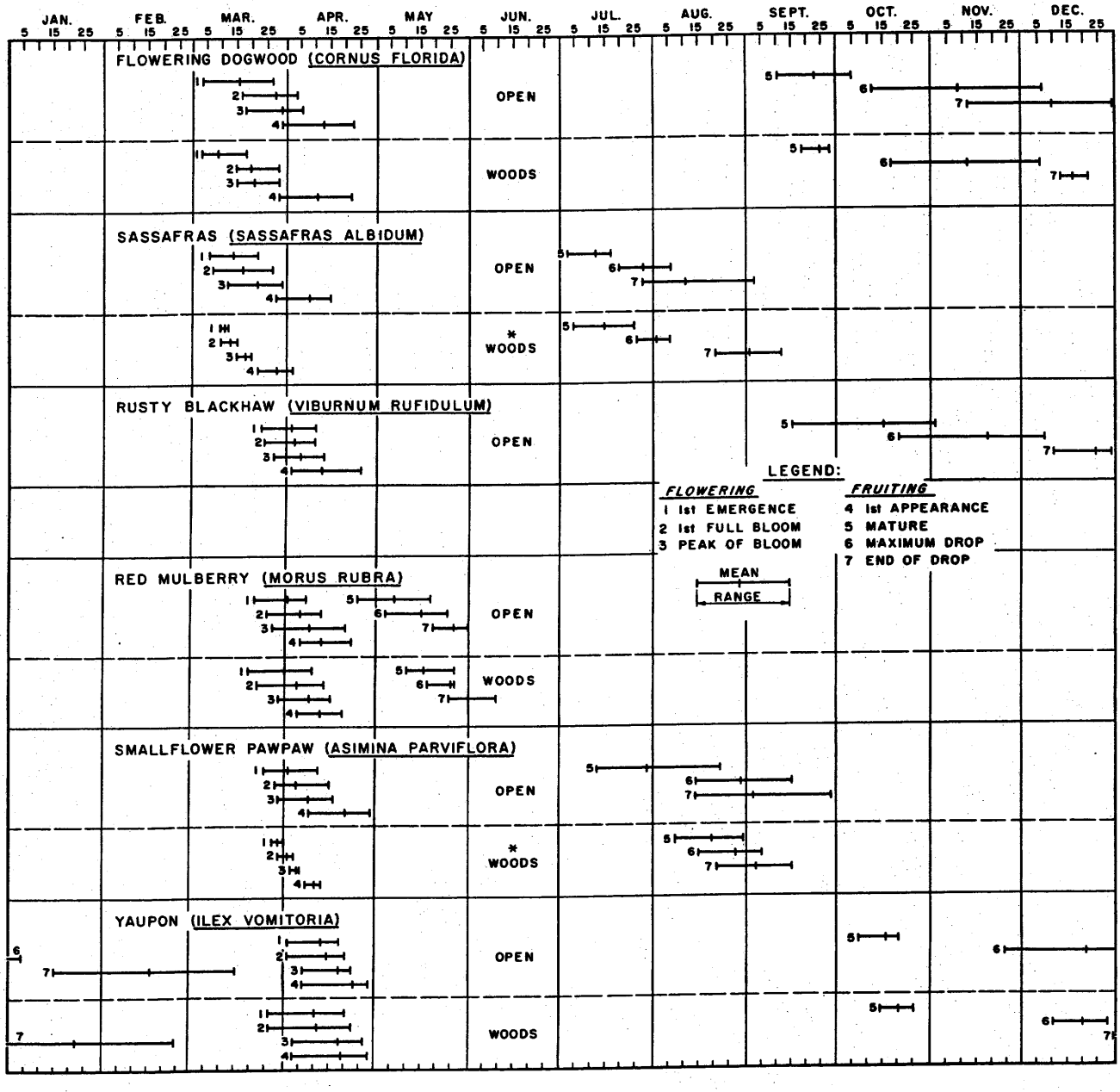
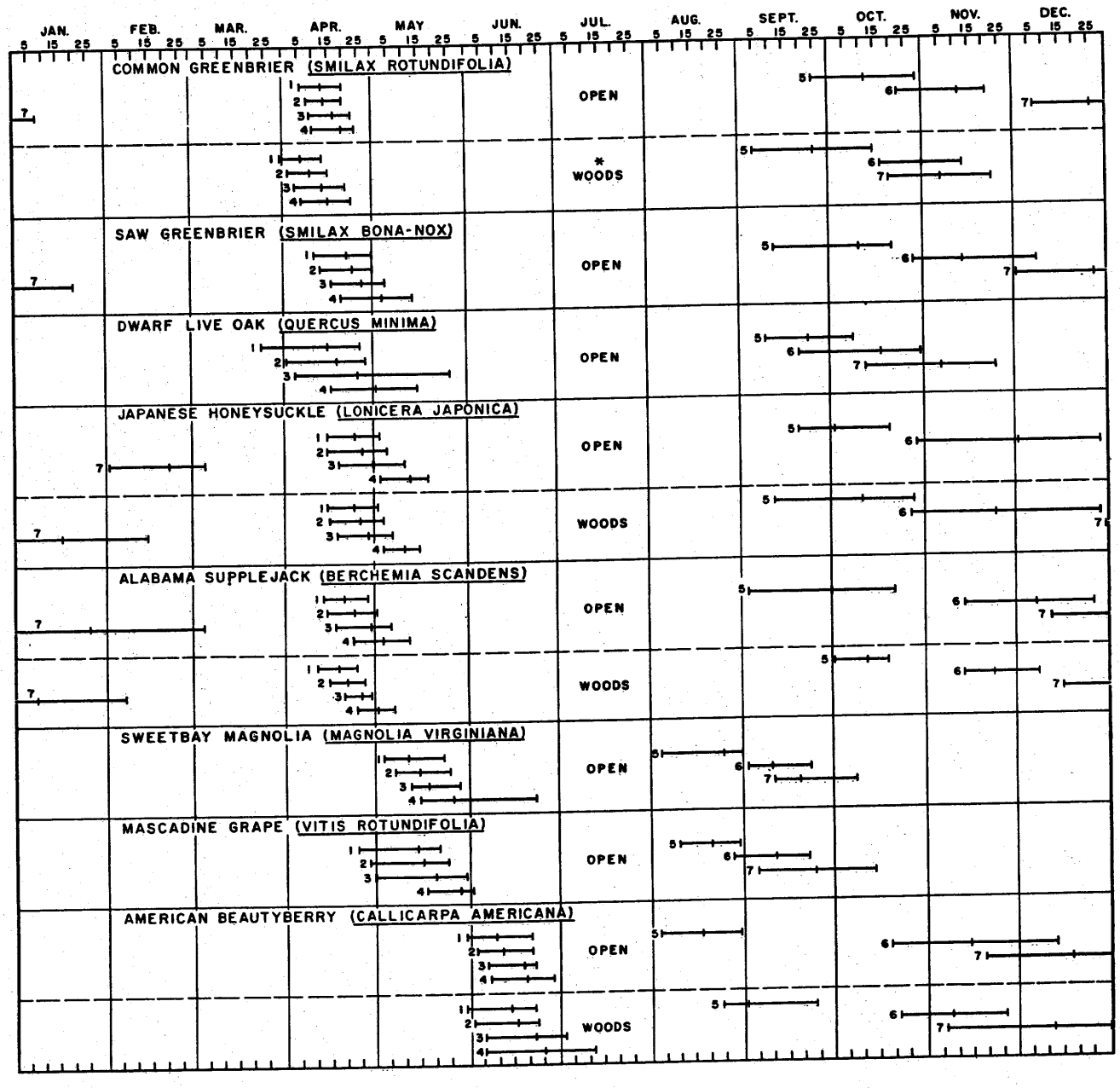


Figure 1.—*Flowering and fruiting chronology of plants growing in the open and beneath trees. (* indicates that data are available only for 2 years.)*


JAN.
FEB.
MAR.
APR.
MAY
JUN.
JUL.
AUG.
SEPT.
OCT.
NOV.
DEC.
5 15 25
COMMON GREENBRIER (SMILAX ROTUNDIFOLIA)
OPEN
* WOODS
SAW GREENBRIER (SMILAX BONA-NOX)
OPEN
DWARF LIVE OAK (QUERCUS MINIMA)
OPEN
JAPANESE HONEYSUCKLE (LONICERA JAPONICA)
OPEN
WOODS
ALABAMA SUPPLEJACK (BERCHEMIA SCANDENS)
OPEN
WOODS
SWEETBAY MAGNOLIA (MAGNOLIA VIRGINIANA)
OPEN
MASCADINE GRAPE (VITIS ROTUNDIFOLIA)
OPEN
AMERICAN BEAUTYBERRY (CALLICARPA AMERICANA)
OPEN
WOODS

early fall; but almost all their fruit dropped by October. Fruit persisted through November or December on all other species and through most of the winter on yaupon and honeysuckle. In these two species, the end of drop was later for plants in the open, probably because they produced much more fruit than those in the woods.

Fruit yields.—In any year the yields were apt to be high for one species and low for another. The period of high production also varied considerably between species. Wright (1953) previously noted that there was little correlation among woody species in the occurrence of good seed years.

American beautyberry yielded more fruit than any other species during this study (table 3). In the open, plants grew rapidly the first few years and produced abundant fruit. Yields peaked at 1,722 grams per plant in 1966, when plants were 5 years old. The following year, however, the plants deteriorated; and many stems died back. This general decadence continued through 1969, and fruit yields declined sharply to 107 grams. In 1970 many of the old stems sprouted at the base, and the plants again produced a substantial fruit crop. During the next 2 years, severe dieback of stems diminished fruit yields. In the woods, the young plants developed more slowly; and they produced less fruit. Beginning in 1965 the yields tended to be relatively high and low on alternate years.

Yaupon had the second highest yield per fruiting plant; but because this species is dioecious—i.e., has separate staminate (male) and pistillate (female) plants—the proportion of total plants bearing fruit was relatively small. The ratio of fruit yields between open- and woods-grown plants was 19:1. After plants in the open began to bear fruit (age 4), their yields tended to be high or low on alternate years. In 1972 the yield per fruiting plant was the highest recorded for any species during the study.

The alternate high and low yields of American beautyberry growing beneath trees and of yaupon in the open were apparently unrelated to weather conditions. Rather, as noted in other studies (Kozlowski, 1971), the variance seemed to be a physiological characteristic of individual plants.

Seven other species produced fruit both in the open and beneath trees, but yields from woods-grown plants were insignificant. In the open, smallflower pawpaw and flowering dogwood plants yielded only small quantities of fruit in their early years; but in 1971 and 1972 their yields were much higher. Apparently the plants were just approaching their optimum potential then. In contrast, the fruit yields for Japanese honeysuckle were highest when the plants were 4 to 6 years old and considerably less thereafter. Yields of Alabama supplejack were substantial and relatively consistent between years. Although sassafras yields were typically small, substantial quantities were produced occasionally. The fruit yields of red mulberry and common greenbrier were always small. Red mulberry plants beneath trees became heavily invested with white peach scale in 1968 and 1969, and by 1971 all plants had died.

Five species produced fruit in the open but not beneath trees. Yields were never very large for sweetbay magnolia and common greenbrier. Rusty blackhaw produced small amounts of fruit through 1971, but a large increase in 1972 indicated that the species was just beginning to reach its potential. Dwarf live oak plants produced moderate amounts of acorns each year, with relatively high yields in 1971; during the last 3 years of the study, each plant bore fruit. In muscadine grape, yields per fruiting plant were fairly consistent between years, but only a small proportion of the plants bore fruit.

Fruit and seed characteristics.—Table 4 lists the species observed and describes their fruits and seeds. Information on the kind, color, and size of fruits and seeds was taken from taxonomic texts; data on the number of fruit per gram, moisture content, and pulp to seed ratios were derived in this study. Berries, drupes, aggregates, cones, and acorns were included.

The fleshy berries, aggregates, and berry-like fruits had high moisture contents; for example, moisture in American beautyberry, red mulberry, and muscadine grape averaged about 80 percent of total weight. Sassafras had the least moisture content (47 percent); and Alabama supplejack, the highest (60 percent) for the drupes. Only seeds were sampled for dwarf live oak and sweetbay magnolia; their mean moisture content was 45 percent or less.

Table 3.—*Fruit yields of browse plants growing in the open and beneath pine trees*

Species	Year	Open		Beneath trees	
		Yield per fruiting plant	Plants bearing fruit	Yield per fruiting plant	Plants bearing fruit
		Grams	*Percent*	*Grams*	*Percent*
Smallflower pawpaw	1967	7	11	0	0
	1968	3	22	0	0
	1969	0	0	0	0
	1970	0	0	0	0
	1971	77	17	33	10
	1972	135	67	22	20
Alabama supplejack	1965	2	25	0	0
	1966	129	33	0	0
	1967	141	33	0	0
	1968	196	33	0	0
	1969	173	33	0	0
	1970	165	33	1	10
	1971	874	42	6	10
	1972	258	42	0	0
American beautyberry	1963	49	91	1	26
	1964	578	91	2	75
	1965	1,554	100	17	25
	1966	1,772	100	65	91
	1967	585	100	29	58
	1968	231	100	133	100
	1969	107	100	51	58
	1970	834	100	240	58
	1971	342	100	18	58
	1972	183	83	26	83
Flowering dogwood	1965	1	25	0	0
	1966	13	58	0	0
	1967	5	58	0	0
	1968	4	17	0	0
	1969	150	58	0	0
	1970	9	50	9	42
	1971	269	100	3	25
	1972	788	100	38	83
Yaupon	1965	1	17	0	0
	1966	93	25	0	0
	1967	36	25	0	0
	1968	339	42	19	8
	1969	150	42	28	8
	1970	336	42	5	42
	1971	270	42	39	42
	1972	2,212	42	88	50
Japanese honeysuckle	1965	4	100	0	0
	1966	138	100	0	0
	1967	127	100	1	17
	1968	222	100	3	42
	1969	43	100	5	92
	1970	68	100	11	92
	1971	23	100	6	92
	1972	26	100	2	92
Sweetbay magnolia	1968	20	42	0	0
	1969	3	42	0	0
	1970	5	27	0	0
	1971	16	64	0	0
	1972	6	33	0	0

Table 3.—*Fruit yields of browse plants growing in the open and beneath pine trees* (Continued)

Species	Year	Open		Beneath trees	
		Yield per fruiting plant	Plants bearing fruit	Yield per fruiting plant	Plants bearing fruit
		Grams	*Percent*	*Grams*	*Percent*
Red mulberry	1965	0	0	2	8
	1966	0	0	2	8
	1967	7	50	0	0
	1968	22	58	3	17
	1969	17	58	1	8
	1970	10	50	3	25
	1971	6	42	0	[1]0
	1972	10	50	0	0
Dwarf live oak	1967	5	75	0	0
	1968	50	75	0	0
	1969	67	88	0	0
	1970	60	100	0	0
	1971	201	100	0	0
	1972	45	100	0	0
Sassafras	1967	5	8	0	0
	1968	19	17	0	0
	1969	154	33	0	0
	1970	3	25	0	0
	1971	48	25	91	10
	1972	129	33	129	10
Saw greenbrier	1965	1	8	0	0
	1966	11	25	0	0
	1967	11	17	0	0
	1968	13	25	0	0
	1969	4	25	0	0
	1970	2	50	0	0
	1971	8	42	0	0
	1972	2	17	0	0
Common greenbrier	1967	1	33	0	0
	1968	2	67	0	0
	1969	7	100	0	0
	1970	10	100	1	8
	1971	1	67	0	0
	1972	6	58	2	17
Rusty blackhaw	1967	2	8	0	0
	1968	0	0	0	0
	1969	6	8	0	0
	1970	2	8	0	0
	1971	4	8	0	0
	1972	84	58	0	0
Muscadine grape	1967	56	17	0	0
	1968	107	18	0	0
	1969	388	18	0	0
	1970	239	27	0	0
	1971	300	36	0	0
	1972	149	36	0	0

[1]All plants beneath trees had died by 1971.

Table 4.—*Fruit and seed characteristics of 14 woody species*

Species	Fruit							Seed	Pulp/seed ratio	
	Kind	Color	Size	Number per gram		Moisture content (percent)				
				Mean	*Range*	*Mean*	*Range*		*Mean*	*Range*
Smallflower pawpaw *(Asimina parviflora)*	Fleshy berry	Black at maturity	5-12 cm. long	0.4	0.3-0.7	64	62-66	Several, 1.5-3 cm. long, bony, turgid, flattened, dark brown	1:1.23	[1] 1:1.23-1.24
Alabama supplejack *(Berchemia scandens)*	Juicy drupe	Bluish-black	About 8 mm. long	22.4	16.1-28.4	60	53-66	A 2-celled stone	1:1.23	1:0.90-1.71
American beautyberry *(Callicarpa americana)*	Berry-like drupe	Reddish-purple	3-6 mm. long wide	71.6	64.9-79.7	80	75-84	4, about 1.5 mm. long	1:0.68	1:0.38-0.98
Flowering dogwood *(Cornus florida)*	Drupe	Bright red to yellow	1-1.5 cm. long	7.0	5.2-7.8	53	52-56	1-2, about 9 mm. long pale brown	1:0.96	1:0.85-1.05
Yaupon *(Ilex vomitoria)*	Drupe	Shiny red	About 6 mm. long	13.7	11.7-15.5	51	46-60	Usually 4 1-seeded stones, up to 4 mm. long	1:0.69	1:0.65-0.76
Japanese honeysuckle *(Lonicera japonica)*	Berry	Black	About 7 mm. in diameter	17.8	12.7-23.0	68	61-72	Several, irregularly ridged	1:0.35	1:0.27-0.45
Sweetbay magnolia *(Magnolia virginiana)*	A cone with drupe-like seeds	Red	4-5 cm. long	12.1	[2] 9.3-15.0	41	[2] 37-45	Each follicle with 1-2 seeds, about 7 mm. long, red	. . .	. . .
Red mulberry *(Morus rubra)*	An aggregate of small drupes	Dark purple	2-3 cm. long	8.7	6.2-11.5	78	72-81	1-2 mm. long	1:0.31	[1] 1:0.26-0.35
Dwarf live oak *(Quercus minima)*	Acorn	Glossy brown	Cup 10-15 mm. broad, 8-16 mm. high	0.8	[2] 0.6-0.9	45	[2] 37-54	15-20 mm. long, 8-12 mm. thick, ¼ to ½ included in cup	. . .	. . .
Sassafras *(Sassafras albidum)*	Drupe, borne on red pedicel	Lustrous blue	About 1 cm. long	6.2	6.0-6.9	47	43-50	Solitary stone, light brown, about 6 mm. long	1:0.73	1:0.60-0.81
Saw greenbrier *(Smilax bona-nox)*	Berry	Glaucous, black	About 6 mm. thick	12.7	8.4-16.5	64	59-69	Usually solitary, 4-5 mm. long, reddish brown with black basal disk	1:1.59	1:1.00-1.91
Common greenbrier *(Smilax rotundifolia)*	Berry	Blue-black	6-8 mm. thick	13.0	10.0-16.1	64	58-69	Usually 2-3, about 4-6 mm. thick	1:1.23	1:0.93-1.76
Rusty blackhaw *(Viburnum rufidulum)*	Drupe	Blue-black	8-15 mm. long	5.2	4.0-7.0	52	44-58	Solitary, flattened	1:0.50	1:0.41-0.56
Muscadine grape *(Vitis rotundifolia)*	Berry	Purple-black	12-25 mm. in diameter	1.4	1.2-1.6	81	78-84	2-3, 7-8 mm. long, 4-5 mm. thick	1:0.28	1:0.18-0.36

[1] Samples taken only 2 years.
[2] Includes only the seed portion of fruit.

The proportion of pulp to seed was highest for muscadine grape, red mulberry, and Japanese honeysuckle, and lowest for smallflower pawpaw, Alabama supplejack, and greenbriers. These ratios are significant in wildlife management since the nutrient content of seeds differs considerably from that of the pulpy and fleshy portions of fruit. Usually the seeds contain more crude protein than the pulp. The value of a fruit with a large proportion of seeds depends mainly on how well the animal digests the seeds (Wainio and Forbes, 1941).

LITERATURE CITED

Blaisdell, J. P.
1958. Seasonal development and yield of native plants on the upper Snake River plains and their relation to certain climatic factors. USDA Tech. Bull. 1190, 68 p.

Correll, D. S., and Johnston, M. C.
1970. Manual of the vascular plants of Texas. 1881 p. Renner, Tex.: Tex. Res. Found.

Halls, L. K., and Alcaniz, R.
1968. Browse plants yield best in forest openings. J. Wildl. Manage. 32: 185-186.

Halls, L. K., and Alcaniz, R.
1972. Growth patterns of deer-browse plants in southern forests. USDA For. Serv. Res. Pap. SO-75, 14 p. South. For. Exp. Stn., New Orleans, La.

Kozlowski, T. T.
1971. Growth and development of trees. Vol. 2, 514 p. N. Y.: Academic Press.

Vines, R. A.
1960. Trees, shrubs and woody vines of the southwest. 1104 p. Austin: Univ. Tex. Press.

Wainio, W. W., and Forbes, E. B.
1941. The chemical composition of forest fruits and nuts from Pennsylvania. J. Agric. Res. 62: 627-635.

Wright, J. W.
1953. Notes on flowering and fruiting of northeastern trees. USDA For. Serv. Northeast. For. Exp. Stn., Stn. Pap. 60, 38 p.

Halls, L. K.

1973. Flowering and fruiting of southern browse species. South. For. Exp. Stn., New Orleans, La. 10 p. (USDA For. Serv. Res. Pap. SO-90)

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