Oak (*Quercus* spp.) Sprouts Growth Rates on a Central Oklahoma Shallow Savannah Range Site

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The Cross Timbers area in Central Oklahoma is characterized by noncommercial timber oak (*Quercus* spp.) trees occurring in moderate to dense stands on shallow soils underlain by sandstone. Where these soils are intermingled with shale-derived soils with a heavy textured subsoil, the area often appears as a savannah with the trees occurring in dense mottes.

The oak mottes, predominately *Q. stellata* (QUST) and *Q. marilandica* (QUMA), are often composed of dense, even-aged trees because of the tendency for these trees to grow from root sprouts of top-killed trees rather than from seedlings. After a period of several years the stand becomes more open because of low regeneration from seedlings and a relatively high mortality of existing trees.

Many ranchers in this area, in an effort to produce more herbaceous forage, use bulldozers or chaining to remove the oak and other woody plants. In a relatively short period of time,

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Table 1. Age class (years) distribution, height (m) and diameter (cm) of *Quercus marilandica* (QUMA), *Q. prinoides* (QUPR) and *Q. stellata* (QUST) sprouts.

	Age class					
	3	4	5	6	7	All ages
No. Sprouts						
QUMA	0	5	7	9	3	24
QUPR	4	4	6	4	3	21
QUST	0	4	6	15	7	32
All species	4	13	19	28	13	77
Height $\bar{x}$± sd)						
QUMA		1.5±0.3	2.3±0.9	2.4±1.9	2.4±1.7	2.2± 0.6
QUPR	1.0±0.3	1.1±0.1	1.8±0.0	1.4±0.6	1.8±0.6	1.5±0.1
QUST		1.9±0.5	2.4±0.7	2.9±0.7	3.4±0.7	2.8±0.8
Diameter ($\bar{x}$±sd)						
QUMA		3.1±0.8	5.3±2.3	5.8±2.1	4.2±3.0	5.0±1.8
QUPR	2.3±1.5	2.3±0.3	3.3±1.0	2.8±1.0	2.8±0.5	2.7±1.0
QUST		3.4±1.1	4.4±1.7	5.9± 1.5	5.5±1.1	5.2±1.6

regrowth from root sprouts creates a stand of sprouts more dense than before the area was cleared. Oaks are very competitive with native warm-season perennial grasses because of shading and production of most of their twig and leaf growth in April and early May or about 30-45 days before perennial grasses begin their rapid growth. Since the range improvement practice of mechanical control of oaks is beneficial for only a limited number of years, this study was conducted to obtain some basic information on the growth rate of oak sprouts during the first few years after clearing.

Methods

The study area is located at Lat. 36°5'N, Long. 97°11'W in Payne County, Oklahoma. The vegetation was dominated by oak sprouts on an eroded, Darnell-Stephenville Complex soil type. The area was cleared of trees by bulldozing in 1964 and grazed yearlong by cattle between 1964 and 1970.

In February, 1971, we laid out five belt transects, 1 m × 60 m from a common point along five different compass bearings in the center of a uniform stand. Compass bearings were used in the dense brush to reduce bias by wandering. Along each transect at 3-m intervals the nearest tree of either QUST, QUMA, or *Q. prionoides* (QUPR) was cut down at ground level if an appropriate tree occurred within a 1-m radius of each point.

After the trees were cut down, each tree's diameter, height and age were determined. The diameter was determined 1 dm above ground level using a diameter tape. The length of the downed tree was used at its height. The age was determined by counting the number of annual rings in each cross section. Age determination was easier to make immediately after cutting, because distinguishing annual rings became progressively more difficult as the cross sections dried.

Results and Discussion

Most of the sprouts were 5 or 6 years old (Table 1). The average ring counts were 4.9, 5.4, and 5.8 for QUPR, QUMA, and QUST, respectively. Very few sprouts were less than 4 and none were older than 7 years. The 7-year old sprouts apparently sprouted the year of bulldozing. About 80% of the potential sprouts were present within 2 or 3 years after tops were removed.

Judging from the age class distribution, QUST sprouts' response to top removal was more immediate than that of QUMA sprouts. About 70% of the QUST sprouts sprouted in the first or second year, whereas only about 50% of the QUMA sprouts sprouted during this period. Errors in ring counts may account for some of the difference, but the counting procedures were consistent and no difference in the difficulty of distinguishing rings was apparent between species.

Within each age class the order of sprout height from tallest to shortest was consistently QUST, QUMA, and QUPR. Concurrently, QUST had the greatest range in height and QUPR the lowest. About 50% of the QUST sprouts were over 3 m tall, whereas fewer than 20% of the QUMA sprouts were over 3 m tall. QUST and QUPR sprouts were more uniform in height within an age class than were QUMA sprouts. The coefficients of variation for age class heights ranged from 14 to 31% for QUST, 0 to 41% for QUPR, and 21 to 73% for QUMA.

The diameter of sprouts was not as consistent as height within species or within age classes. The coefficients of variation for age class diameters 1 dm above ground level ranged from 21 to 37% for QUST, 18 to 64% for QUPR, and 25 to 72% for QUMA. Furthermore, the variation in diameter was greater for the older QUMA, but less for the older QUST and QUPR sprouts.

We chose to measure diameter 1 dm above ground level rather than at breast height (DBH) because we wanted to relate sprout age and diameter to the potential of retreating sprouts with a rotary shredder. Generally, the maximum diameter of oak sprout that can be cut by a skilled operator using a heavy-duty, rotary shredder is 7-8 cm (Personal observations). If a high percentage of the sprouts are of this diameter, the shredder will need to travel at a low rate of speed. Even moving slowly the operator will spend a significant amount of time replacing shear pins. Oak sprout shredding will apparently need to be done within 5 years after top removal or sooner if favorable growing conditions cause faster diameter growth of sprouts.

In general, QUST sprouts were more numerous, taller, older and more uniform in height and diameter by age class than were QUMA or QUPR sprouts. The stand was very dense with almost no forage in the understory. Retreatment by shredding may need to be done very 4-5 years if low sprout growth is to be maintained for forage production and relatively low treatment costs.