

Identifying Live Oak Features

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Live oak (*Quercus virginiana*) is a tree found in the lower Coastal Plains of the United States. Identifying live oak is more than recognizing nearly evergreen leaves and Spanish moss drapes. Live oak, especially when small or juvenile, can be mistaken for several other trees. This publication will present live oak attributes and characters which can help with both the identification and appreciation of this majestic tree.

Leaf

Live oak leaves grow alternately along the twigs. Leaves are simple, unlobed, thick, stiff, and leathery. Leaves are elliptical to elongated-elliptical in shape with a more-or-less wedge-shaped base. Live oak is considered evergreen because leaves remain green and persist on the tree until after the new leaves of the following Spring expand. Leaves are 1.5 to 4.5 inches long and ½ to 2 inches wide. Leaf shape and size are highly variable, especially in special habitats and physiographic locations. Leaf shape varies so widely, live oak has been misidentified or formed into small regional varieties in the past. The leaf edge is smooth to slightly wavy, with rarely a few scattered teeth, especially on juvenile shoots. The leaf edge is slightly curled under, not tightly rolled. The leaf tip is rounded without a bristle tip.

Live oak leaves are shiny dark green in color on top and gray-green below. The underside is covered with many tricomes (plant hairs). Live oak tricomes are star-shaped (stellate). The main vein on the underside is yellowish in color. Side leaf veins can be visualized by the slight depressions they form on the leaf's upper surface. The side veins unite just before the outer leaf edge. The leaf petiole is stiff and short (~1/4 inch long).

Leaf Confusion

There are seven evergreen or persistent leaved oaks. These oaks are: Chapman oak (*Q. chapmanii*), Darlington oak (*Q. hemisphaerica*), bluejack oak (*Q. incana*), laurel oak (*Q. x laurifolia*), Texas live oak (*Q. fusiformis*), dwarf live oak (*Q. minima*), sand live oak (*Q. virginiana* var. *geminata*), and live oak (*Q. virginiana*). Live, sand live, dwarf live, Texas live, and bluejack all have stellate tricomes on leaf undersides and have a leaf edge which is thickened and rolls downward but is not tightly curled around. Live oak, dwarf live, Texas live, and sand live oak have a rounded leaf tip without a bristle tip. Because of the closely related nature of the live oak species, varieties, and hybrids, identification can be difficult.

Flowers

Live oak flowers are wind pollinated. Live oak is monecious (both sexes on the same tree), but each flower is either male or female. Flowers are functional in Spring from February to March for about



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two weeks. The male flowers are a light yellow-colored dangling catkin 2-3 inches long. Male flowers develop in last year's leaf axil. Several female flowers are found on one inch long, pale green spikes growing from the current year's leaf axils. Female flowers have a bright red stigma.

Different varieties or forms of live oak maintain their genetic uniqueness by flowering at slightly different times. For example, typical live oak flowers several weeks before the sand live oak variety in the same area. Live oak becomes sexually mature relatively quickly. Stump and root sprouts are sexually mature and flower the next year after expansion. Seedlings are sexually mature and flower about five years after germination. Full flower production does not occur for 7-12 years. Trees older than 100 years old tend to not generate proportionally as many female flowers as middle-aged trees with full crowns, although some flowering does continue to the end of life.

Seeds

Live oaks generate an oblong, barrel-shaped acorn 3/4 to 1 inch long with a short point at the end. Acorns are held at the end of a long stem (1-4 inch long peduncle). Acorns grow in clusters of up to five per clump with 2-3 per clump typical. The acorn cap is bowl-like, top-shaped, and covers 1/3 to 1/2 of the acorn. The acorn cap has thin reddish-brown, hairy scales. As in the rest of the white oak group, live oak acorns mature and are ready to germinate at the end of the current growing season. The acorn matures by October to a dark blackish-brown color. Acorns usually fall by January 1. Acorns contain an embryo surrounded by two fleshy cotyledons enclosed by the hard outer shell. (See Figure 1) The inner surface of the acorn shell is smooth. Acorns are not viable for long, and quickly die and decay.

The acorn is small but sweet tasting, and used by a host of wildlife species. Many animals eat and distribute live oak acorns (mammals, opossums, and birds). The small size of the acorns allow for major caching of seeds by relatively small animals. Early native American cultures in the live oak range used live oak acorns for food (rinsing the tannins out with water) and for a cooking oil (boil crushed acorns and skim oil off of the top). Live oak acorns contain approximately 5% protein and 6% fat. Acorn production is usually good every year with little periodicity (no masting cycle). There are approximately 20-25 acorns per ounce. Acorns will germinate immediately on moist, warm, mineral soil. Acorns not germinated by mid-Spring can be considered dead due to pests (especially from *Curculio* spp. weevils). To minimize seed set, an ethephon containing product applied at 30 ounces per 10 gallons of water rate has been shown to be effective. At this rate little foliage damage is visible. Live oaks should be treated to prevent seed set in Spring when female flowers are at full bloom.

Collect & Sow

Live oak acorns can be collected after October from the tree. Acorns on the ground have a much lower germination percentage due to pests (like weevils) and from drying. See Figure 2. Remove any acorn caps remaining attached and float test the acorns in a bucket of water – discarding floating acorns, caps and debris. Also, remove any acorns with small holes, shell cracks, or fungal growth. The larger the acorns, the greater success in germination and early growth. Do not use hot water baths or microwave heating to kill weevils within acorns as germination is severely impacted. See Figure 3. Immediately sow acorns in good, well-drained but moist, mineral soil. Storage is not recommended as fungal pests and drying quickly destroy germination potential. Short storage periods under cool, moist (high relative humidity not wet) conditions can be used for several weeks. Do not allow acorn moisture contents to drop below 35%.

Live oak acorns have no cold requirement before germination and should be quickly planted in fall. Sow acorns eight inches apart and cover with 1/3 inch of mineral soil and 1 inch of a low density, organic mulch on top. Protect the germination area from animal thieves and beware of fungal rots beginning with over-watering. Germination should begin within days and be completed in four weeks. The

new radicle (root) will quickly expand into the soil and grow fat on the nutritive materials coming from the cotyledons. The acorn is now extremely prone to both under-watering and over-watering damage. Partial shade can be beneficial because it allows for germination but helps prevent the emerging radicals from drying out. Transplant strong growing seedling live oaks with large root systems (possess a number of large diameter roots) to field growing areas. Grow live oaks 2-8 years to meet objectives of the planting site.

Planting

For best planting results, the Gilman (University of Florida) live oak planting system is recommended. Plant a root pruned, field grown, ball and burlapped tree which has been hardened off and dug at least 10 weeks before transplanting. Late Summer, Fall or early Winter digging is successful as long as the tree is root pruned. Non-root pruned trees have poorer survival than root pruned trees. Do not use fall transplanting with live oaks. Spring transplanting assures good root colonization.

Excavate a large planting hole and cultivate the rest of the site beforehand if possible. Do not fertilize the first year. Do not use any backfill amendments or treatments. Irrigate the tree frequently (twice a week) for the first year adding 1.5 gallons per inch of trunk diameter. Concentrate irrigation water over the root ball. Additional water can be added to the planting site if good drainage is assured. Control competing weeds for at least the first three years. Maintain a cleared soil surface area around the base of a newly planted tree.

Bark & Twigs

Live oak bark has a range of bark colors modified by exposure and surface growths. Bark can be dark-brown, greyish-brown, to dark reddish-brown, generally described as a medium brown. The bark has shallow furrows with flat scaly ridges between. The bark is rough, divided into rough squares, and medium in thickness when mature and thin when juvenile. Bark on branches reclining on the soil or close to ground can be discolored by abrasion or by soil splash from rain.

Twigs are stiff but slender and hairy. The pith is solid and continuous. Winter buds are blunt on the end and about 1/16 inch long. Buds have chestnut brown scales with white hairs at the margins. Leaf scars are half round with the main bundle scar clearly present. Twigs have minute stipule scars. Sprouts from stumps and the tops of large roots, and young twigs provide forage for a number of animals.

Roots

Live oak root systems are wide-spreading and shallow, requiring good drainage and plenty of oxygen. When calculating root system extent and size for young trees, unlike in other species, there is no strong relationship between root spread and crown spread. The root plate (zone of rapid taper or structural root area) can be calculated by using the diameter measure of the stem at 4.5 feet above the soil measured in inches multiplied by 0.9 to yield the diameter of the root plate in feet (centered on the trunk). For example, a 20 inch diameter tree would have a root plate diameter in an unconstrained area of 18 feet (9 feet radius out from the trunk). It is essential in live oak to conserve the root plate area and prevent paving, trenching, compaction and other forms of root or soil damage from occurring.

Live oaks generate rhizome-like roots running just below the ground coming from the stem base or where roots have been initiated from ground contact. These rhizomes (stem-like roots or root-like stems) generate the new sprouts coming from around live oaks. These rhizomes are good sources for reproduction cuttings. Live oak root systems are large and well interconnected both within and between trees. Many times separate stems will share an interconnected root system because they arose from the same stump and have the same genetic content (clonal system). Live oak roots can be naturally or artificially infected with ectomycorrhizae fungi. Ectomycorrhizae fungi infection increases fine root mass in mature live oaks on stressed sites.

Wood

Live oak wood is extremely dense and hard, making it strong and durable in use. Live oak heartwood averages 54 pounds of dry weight per cubic foot and almost 90 pounds of wet / green weight per cubic foot. Live oak is diffuse porous and the annual increments are difficult to count. Sapwood is whitish in color and heartwood is greyish-brown. There are a few broad rays and many narrow rays present. The wood has no noticeable odor or taste.

Wood density values denote a hot burning and high energy content for fuel wood or charcoal. In the past, the strength and durability of live oak wood prevented most hand powered breakdown with saws, and so, planks were seldom generated. The hubs of wheels and machine cogs were hewed and carved from live oak. The most celebrated use of live oak wood was using the natural shape of branches and stems in building the ribs and knees of wooden ship frames. The frame work would be of live oak, the shell of longleaf pine, and the masts of longleaf or white pine. Live oak bark saw limited use in the past for generating tannins for leather.

Weighty Concerns

Early lumber producers found the wood difficult to work, and hard on their labor and equipment. The wood is heavy and the tree is deceptive is how much different sized parts weight. The weight of standing live oak tree parts has two components, the weight of the wood material and the weight of the moisture in the wood. The moisture content of living live oak xylem and associated tissues can vary greatly. In live oak an estimate of green wood moisture content in a living tree is 70-80% moisture content on an oven-dry basis.

Table 1 estimates how many cubic feet of woody materials are in a given branch, stem or root segment based upon its average diameter (outside the bark) and the length of the segment considered. Bark weight, cavities, soil, included foreign materials, and atypical growths are not included in the volume estimate and the subsequent weight calculation. Segment weight can be estimated from multiplying the cubic feet volume determined in Table 1 by the average green wood density of live oak in pounds per cubic feet (~90 lbs/ft³). The formula is: $[90 \text{ (lbs/ft}^3) \times \text{volume of live oak segment (ft}^3)] = \text{Estimated Weight of Live Oak Segment (lbs.)}$. For example, a branch with an average diameter of 10 inches weights 54 pounds for each foot of length, or 324 pounds for a 6 feet long segment.

Conclusions

Live oak is an interesting tree species with unique attributes crafted from the soils and climate of the Southern coastal plain of the United States. Live oak has been both threatened and saved by its biological and ecological characteristics. Understanding live oak can better prepare people to work, live, build, and play around them -- both sharing the sun.

(For further information on live oaks please see the other publications in this series which cover – scientific naming, growth features, and management, major pests, genetic variability and varieties, and a bibliography of important live oak information.)

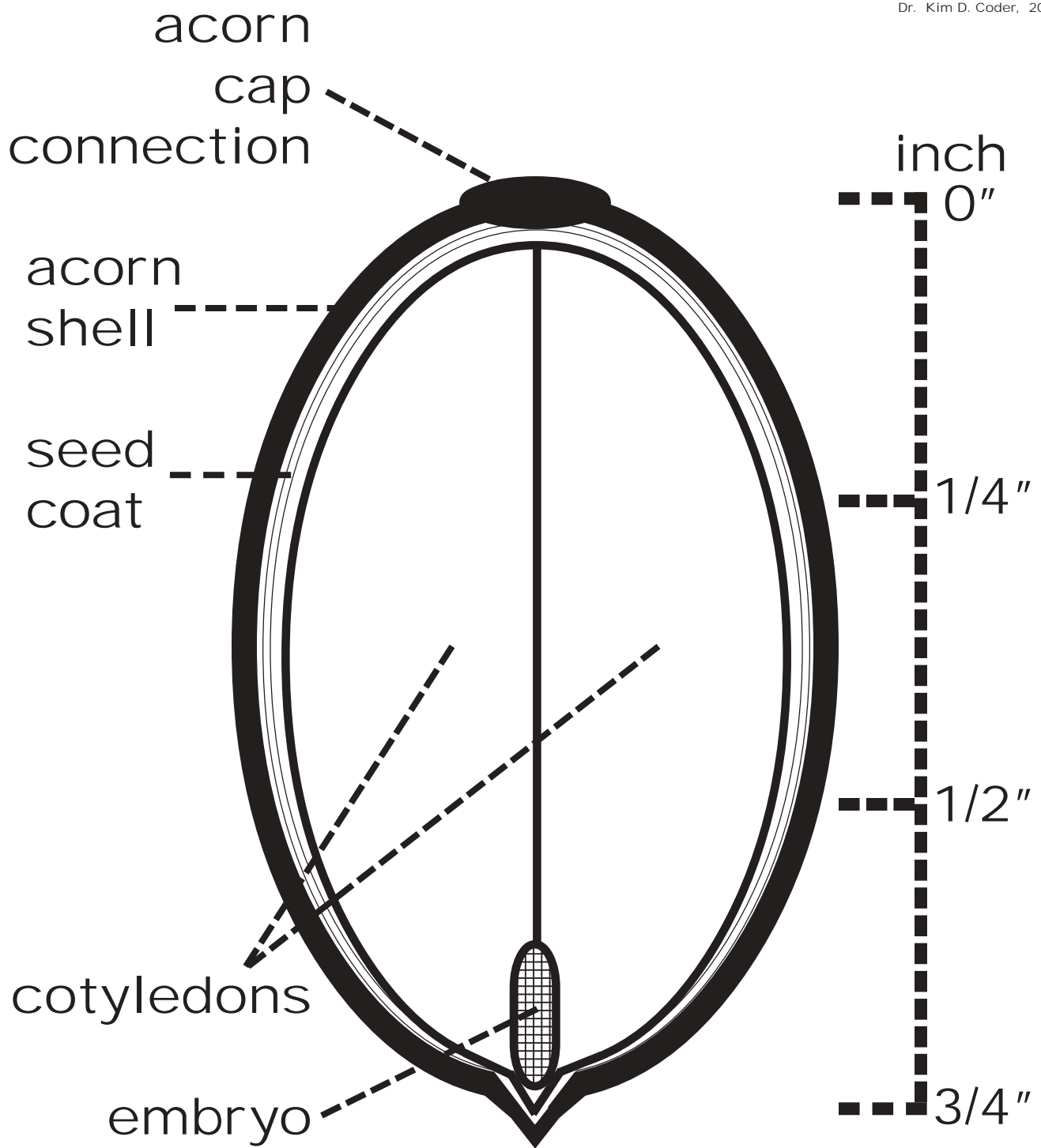


Figure 1: Idealized live oak acorn cut longitudinally. Size selected as average for SE Georgia in fall of 2003.

$$\text{germination percent} = \{0.94 - [0.031 \times (\text{acorn weight loss percent})]\} \times 100$$

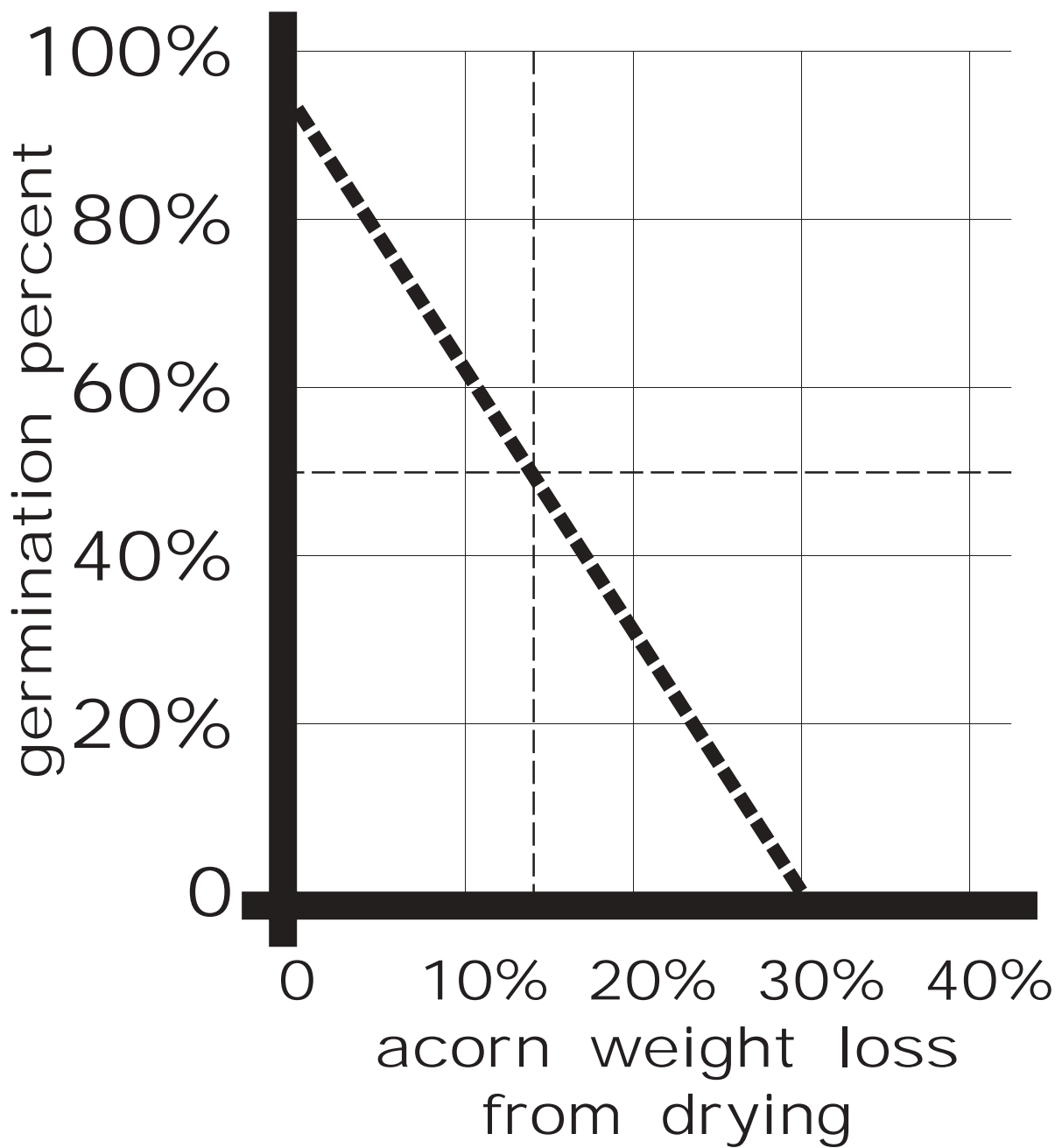


Figure 2: Estimated live oak acorn germination percentage as acorn dries. Note 50% reduction in germination percentage as acorn weight drops 14% from green, on-tree weight.

$$\text{germination percent} = 94 - [2.0 \times (\text{minutes in } 120^{\circ}\text{F water bath})]$$

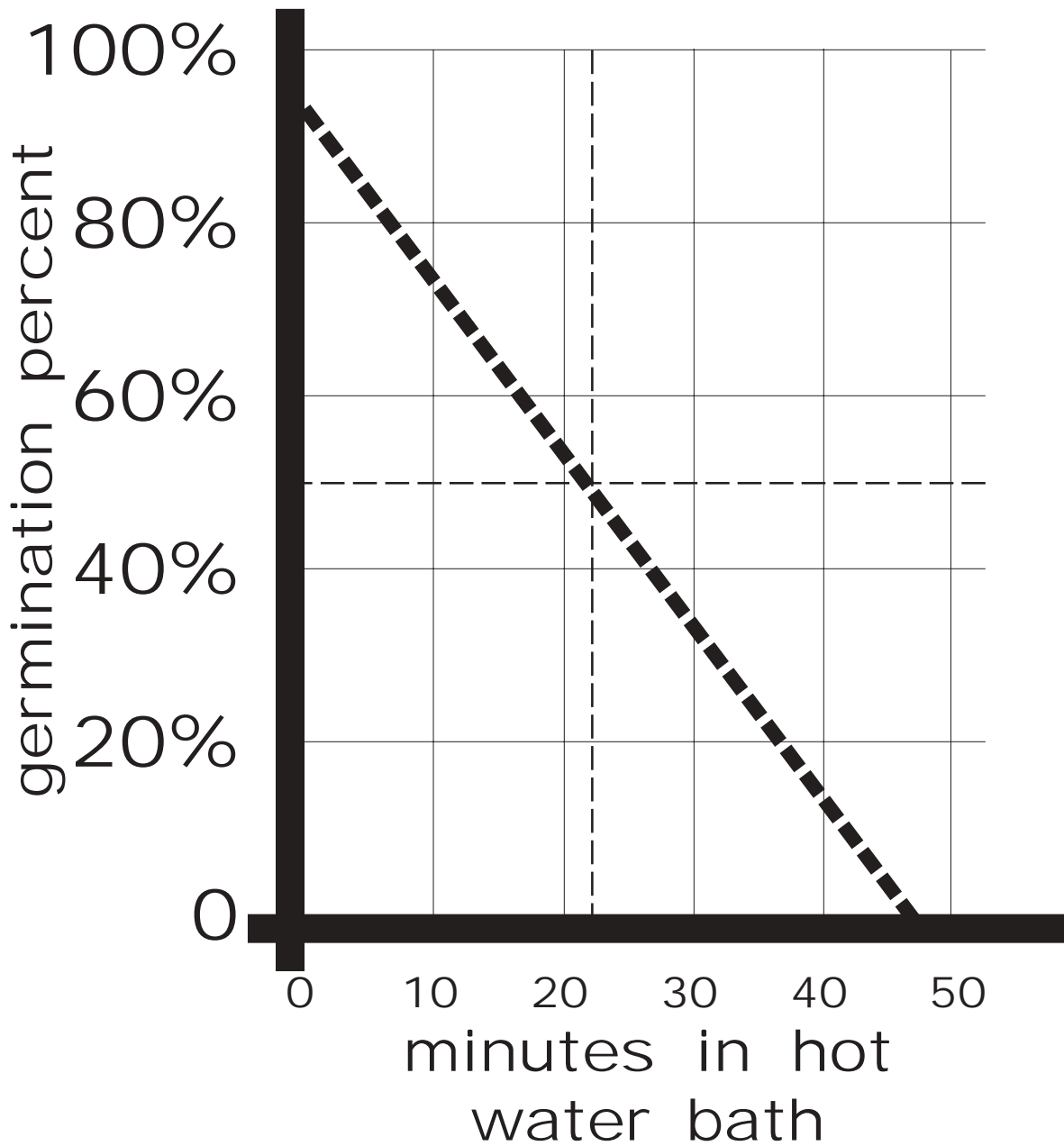


Figure 3: Estimated live oak acorn germination percentage as acorns are heated in a 120°F water bath in order to kill insect pests. Note 50% reduction in germination percentage as acorns are bathed for 22 minutes.

Hot water baths or microwave heating are NOT recommended for live oak acorns in order to kill pests before planting.

Table 1: An approximate number of cubic feet in a segment of live oak branch, stem or root with a given average diameter or circumference (in inches) and a given length (in feet).

NOTE: Most values are rounded to whole numbers.

diameter (inches)	circumference (inches)	length (feet)														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
2	6.3	0.02	0.04	0.07	0.09	0.11	0.13	0.15	0.17	0.2	0.2	0.2	0.3	0.3	0.3	0.3
3	9.4	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40	0.4	0.5	0.5	0.6	0.6	0.7	0.7
4	13	0.1	0.2	0.3	0.35	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.1	1.2	1.3
5	16	0.1	0.3	0.4	0.6	0.7	0.8	1.0	1.1	1.2	1.4	1.5	1.6	1.8	1.9	2.1
6	19	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0
7	22	0.3	0.5	0.8	1.1	1.3	1.6	1.9	2.1	2.4	2.7	2.9	3.2	3.5	3.7	4.0
8	25	0.4	0.7	1.1	1.4	1.8	2.1	2.4	2.8	3.1	3.5	3.8	4.2	4.5	5.0	5
9	28	0.4	0.9	1.3	1.8	2.2	2.7	3.1	3.5	4.0	4.4	5	5	6	6	7
10	31	0.6	1.1	1.6	2.2	2.7	3.3	3.8	4.4	5.0	6	6	7	7	8	8
12	38	0.8	1.6	2	3	3.9	5	6	6	7	8	9	9	10	11	12
14	44	1.1	2	3	4	5	6	8	9	10	11	12	13	14	15	16
16	50	1.4	3	4	6	7	8	10	11	13	14	15	17	18	20	21
18	57	1.8	4	5	7	9	11	12	14	16	18	20	21	23	25	27
20	63	2.2	4	7	9	11	13	15	18	20	22	24	26	28	31	33
22	69	2.6	5	8	11	13	16	19	21	24	26	29	32	34	37	40
24	75	3.1	6	9	13	16	19	22	25	28	31	35	38	41	44	47
26	82	3.7	7	11	15	18	22	26	30	33	37	41	44	48	52	55
28	88	4.3	9	13	17	21	26	30	34	39	43	47	51	56	60	64
30	94	4.9	10	15	20	25	30	34	39	44	49	54	59	64	69	74
32	101	6	11	17	22	28	34	39	45	50	56	62	67	73	78	84
34	107	6	13	19	25	32	38	44	51	57	63	69	76	82	88	95
36	113	7	14	21	28	35	42	50	57	64	71	78	85	92	99	106
38	119	8	16	24	32	39	47	55	63	71	79	87	95	102	110	118
40	126	9	18	26	35	44	52	61	70	79	87	96	105	114	122	131
42	132	10	19	29	39	48	58	67	77	87	96	106	116	125	135	144
44	138	11	21	32	42	53	63	74	85	95	106	116	127	137	148	159
46	145	12	23	35	46	58	69	81	92	104	116	127	139	150	162	173
48	151	13	25	38	50	63	75	88	101	113	126	138	151	164	176	189
50	157	14	27	41	55	68	82	96	109	123	136	150	164	177	191	205
55	173	17	33	50	66	83	99	116	132	149	165	182	198	215	231	248
60	189	20	39	59	79	98	118	138	157	177	197	216	236	255	275	295
65	204	23	46	69	92	115	138	161	184	208	231	254	277	300	323	346
70	220	27	54	80	107	134	160	187	214	241	267	294	321	348	374	401
75	236	31	61	92	123	155	184	215	246	276	307	338	368	399	430	460

Estimated live oak branch, stem, or root segment weight in pounds determined by:
 [90 (lbs / ft³) X volume of live oak segment as determined above (ft³)].