



Propagation Protocol for growing

BAREROOT OAKS

Quercus L.

| Gregory A Hoss

Missouri is home to 19 species of oak (*Quercus* L. [Fagaceae]). This genera is the most important in terms of wildlife value, forest products, and forest cover in the state. At the George O White State Forest Nursery, located in south central Missouri, we grow 13 of the 19 species—about 1.5 million 1+0 oak seedlings annually.

We obtain our acorns primarily from local purchase right here at our nursery. Our nursery has been operating since the 1930s and each fall we set up a buying station. Generations of local folks have brought us acorns and other seeds collected within about a 80 km (50 mi) radius of the nursery. Each summer we announce the species we desire, our price, and the total amount of seeds we will purchase. We have found that price has little to do with what people bring us. If seeds are available, people will collect and bring them to us. If the crop is poor, no price will get us our seeds. In most years, we are able to obtain all of the white (*Quercus alba* L.), northern red (*Q. rubra* L.), black (*Q. velutina* Lam.), and pin (*Q. palustris* Muenchh.) oak acorns we need. Acorns are brought to us in buckets, bags, and just loose in car trunks

KEY WORDS
nursery, Fagaceae, acorns, fertilization

NOMENCLATURE
USDA NRCS (2004)

SEED PROCUREMENT

Acorns are perishable seeds. For the most part, we try to collect and plant them as soon as they fall from the tree. We have had some success storing “red” oaks for up to 1 y, but for the most part we plant all we collect or purchase each year. This does put us at the mercy of poor seed years, which happens fairly regularly with at least some species.

Bur oak acorn (Q. macrocarpa Michx.)
Photo by Gregory A Hoss

or pickup truck beds. We weigh the seeds and pay the collector.

We also obtain seeds from 2 other sources: seed contractors and agency buying stations. For some species, such as cherrybark (*Q. pagoda* Raf.), Nuttall (*Q. texana* Buckl.), and willow (*Q. phellos* L.) oak, we buy all of our seeds from contractors—individuals and seed companies that collect and sell seeds for a living. At about 4 or 5 locations around the state, with the assistance of our local forestry offices, we set up buying stations. As is the case at the nursery, ordinary folks bring us seeds—we weigh the quantity and pay them for their service. At our buying stations in north and west Missouri we can usually buy all of the chinkapin (*Q. muehlenbergii* Engelm.), bur (*Q. macrocarpa* Michx.), and swamp white (*Q. bicolor* Willd.) oak acorns needed. We use contractors and local purchases to fill out our needs on other oak species. Usually, our seed goal for an individual species is met with the combined purchases at our nursery, from field stations, and private contractors. Rarely do we get all of our acorns from a single source.

Quality is the biggest difference in the seeds we purchase from local folks as compared to that from seed contractors. Nearly all acorns procured from vendors are ready to plant. Acorns we purchase locally generally need further cleaning to remove caps, sticks, grass clippings, leaves, garbage, and nonviable seeds. We use a Jesse aspirator (Gene M Jessee Inc, Chico, California), which uses suction, vibration, and gravity, to separate viable from nonviable seeds. For us, it does a great job in preparing oaks (and many other species) for planting.

ACORN HANDLING PRIOR TO PLANTING

Red Oak Group

Of the red oak group, we grow northern red, black, Nuttall, cherrybark, willow, pin, and Shumard (*Q. shumardii* Buckl.

var. *shumardii*) oaks. We use the aspirator to clean all of these species. Clean acorns are put in open-topped plastic tubs and placed in our coolers (1 °C [34 °F]) until we are ready to plant. Formerly, we floated our red oaks in water, but we found that during cut tests of “floaters,” especially during a dry fall, many of them were viable seeds. We want acorns that have little or no insect damage and when clipped in half have white or cream-colored cotyledons. Further, in some informal test plantings of floaters and sinkers, both types yielded similar germination percentage. Now, the aspirator removes the poor-quality seeds, allowing us to avoid the floater–sinker problem.

White Oak Group

In the white oak group we grow white, bur, chinkapin, swamp white, swamp chestnut (*Q. michauxii* Nutt.), and overcup (*Q. lyrata* Walt.) oaks. We aspirate white, swamp white, swamp chestnut, and chinkapin oaks. In addition, we float white oak acorns as a standard practice. Unlike the other oak species, after aspiration we do see many floating white oak acorns. Cut tests reveal most of these floaters are nonviable, often lacking cotyledons because of acorn weevil feeding, or the cotyledons are colored brown or gray. Occasionally, if the seed lots of swamp white, swamp chestnut, or chinkapin oak look to be of poor quality after aspiration, we will float them. Clean acorns are stored the same as those in the red oak group, except for bur and overcup oaks (see below).

PLANTING

We sow most of our acorns just as soon as we finish processing them, so planting is nearly a daily operation during fall. We are especially vigilant with *Q. alba*, attempting to get it in the ground within a day or two of cleaning and never allowing it to sit over a weekend. As soon as we have enough acorns to plant a bed or two we sow them. Most other species

in the white oak group store better so we are in less of a hurry than we are with *Q. alba*. Species in the red oak group seem to store fine for a few weeks of storage as long as we keep them wet and cold. Because we fall sow about 15 500 kg (34 000 lb) of acorns, we cannot let any seeds sit around very long or we won't get them all planted!

For most of our acorns, we use a homemade seeder that sows 5 rows at a time. Our raised beds are 1.2 m (4 ft wide). We sow *Q. alba* acorns fairly shallow, about 2.5 to 5.0 cm (1 to 2 in) deep. On most of the other oaks we sow 7.5 to 13 cm (3 to 5 in) deep to help avoid predation problems caused by deer and birds. We cannot use our seeder for the very small acorns of cherrybark and willow oaks, so we raise the bed, cut rows with the seeder, and then sow by hand.

For most species we try for a density of 54 to 65 acorns per m² (5 to 6 acorns/ft²). For *Q. alba* and species with small acorns, such as chinkapin, willow, cherrybark, and pin oaks, we sow at 81 to 97 acorns/m² (7.5 to 9 acorns/ft²) to compensate for poorer germination with the white oak and for bird predation on the small acorns.

An exception to fall sowing is bur and overcup oak. At our nursery, deer dig up seedbeds and eat acorns, especially those fall-sown. To avoid this, we spring-sow these 2 species. After cleaning, we put acorns into mesh bags, soak them 24 h in water and then place the mesh bags inside plastic bags that are sealed and stored in the cooler at 1 °C (34 °F). Acorns are stored this way from collection time in mid-October through sowing time in early April. While we do see quite a bit of primary root growth, it doesn't seem to affect germination or growth in the seedbed. During the past 5 y we have run 2 trials to compare fall- versus spring-sown bur oak. Acorns sowed in fall had considerably more deer predation and in both trials, spring-sown seedlings were larger than those fall-sown. This may be a result of our typical dry falls and resulting desiccation in the fall-sown seedbeds. Spring sowing



Figure 1. Freshly sown overcup oak acorns before being covered with soil.



Photos by Gregory A Hoss

Figure 2. The bed former is used to cover acorns after planting.

helps us avoid desiccation and deer. In spring, the spring-sown seeds usually germinate just a week later than those fall sown. Two disadvantages are the cold storage space needed to keep 10 205 kg (22 500 lb) of acorns all winter and having to open the plastic bags to get the acorns out in the spring—they can be very moldy and, well, yucky. To meet our goal of bed density of 54 to 65 acorns per m² (5 to 6 acorns/ft²), we use a conversion between

dry weight (immediately before soaking) and wet weight (immediately after cold storage) to accurately estimate the number of acorns to sow. To sow them, we cut rows with the acorn seeder and then drop the acorns onto the bed with a manure spreader (Figure 1). We then pull our bed former again to drag up any acorns from the wheel paths back into the bed and to cover the acorns with soil (Figure 2). Immediately after sowing, all of our

acorns are mulched with about 2.5 cm (1 in) of seasoned hardwood sawdust.

FERTILIZATION AND OTHER PRACTICES

The spring before planting acorns, we amend the soil with 785 kg/ha (700 lb/ac) 1N:3P₂O₅:5K₂O, grow a soybean cover crop, and fumigate in fall. We use

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Figure 3. A healthy stand of 1+0 northern red, bur, and Shumard oak seedlings.

RoundUp Ready® soybeans so we can control weeds throughout the growing season by using glyphosate herbicide without harming the cover crop. During the first week of August we disc under (we do not plow) the cover crop and disc the ground several more times over the next 6 wk to obtain a smooth, level soil surface. During the last week of September we contract to have the soil fumigated with 390 kg/ac (350 lb/ac) methyl bromide.

All of our oaks are grown as 1+0 seedlings. We do not carry any oak over as a 2+0—they just get too big to handle during the second year. Most of our oaks get about 224 kg/ha (200 lb/ac) total nitrogen during the growing season, generally divided among 7 to 8 applications of ammonium sulfate (21N:0P₂O₅:0K₂O:24S) beginning in late May and ending by the last week of July. For northern red and Shumard oak, we use the same schedule and fertilizer but only apply about 112 kg/ha total nitrogen (100 lb/ac) to keep them from growing too large.

In all of our white oak group, we often have serious problems with powdery mildew during late summer. As a

standard practice, we apply preventative fungicides from early June into September on a 7 to 9 d schedule. In addition, leafhoppers attack the new shoot growth on all of our oak seedlings. Using the same schedule as that for fungicides, we apply a systemic insecticide.

Our summers are humid with daytime temperatures often in the 30s °C (90s °F). In the months of June, July, and August we generally average 300 mm (12 in) of rain. Therefore, we irrigate just about every day to keep the fields moist and the seedlings cooler. We want our oaks to put on 3 to 4 flushes of growth during the growing season and a stressed seedling will shut down and no longer produce new height growth. Therefore, with frequent irrigation, complete weed control, no root pruning or undercutting, and insect and disease control we grow excellent 1+0 seedlings (Figure 3).

We begin harvesting (lifting) seedlings in mid-November and attempt to have all of our trees lifted by the first week of April. We found that oak seedlings store well in cold storage 1 °C (34 °F) when placed on open racks and kept moist. The major problem with harvesting seedlings

early in our lifting season is the presence of dead leaves. Many oak species retain their dead leaves until well into winter. If seedlings have leaves, we will not lift and store them (we will lift for shipment and immediate planting). Dead leaves on seedlings will mold, eventually leading to shoot rot that degrades seedling quality.

We begin our main shipping season in early February and continue into early May. All of our oak seedlings are graded by size and root collar diameter (caliper) and bundled in groups of 25 for shipment. For nearly all species the minimum height is 30 cm (12 in) and the minimum caliper is about 6 mm (1/4 in). For white oak, *Q. alba*, the slowest and most difficult oak for us to grow, our minimum height is 20 cm (8 in) and minimum caliper is 5 mm.

REFERENCE

- USDA NRCS. 2004. The PLANTS database, version 3.5. URL: <http://plants.usda.gov> (accessed 5 Oct 2004). Baton Rouge (LA): National Plant Data Center.

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