

An aerial photograph showing a dense, vibrant green forest canopy. The trees are packed closely together, creating a textured, almost uniform green surface. The lighting is bright, highlighting the individual leaves and branches from above.

Oak Regeneration

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Minnesota Extension Service



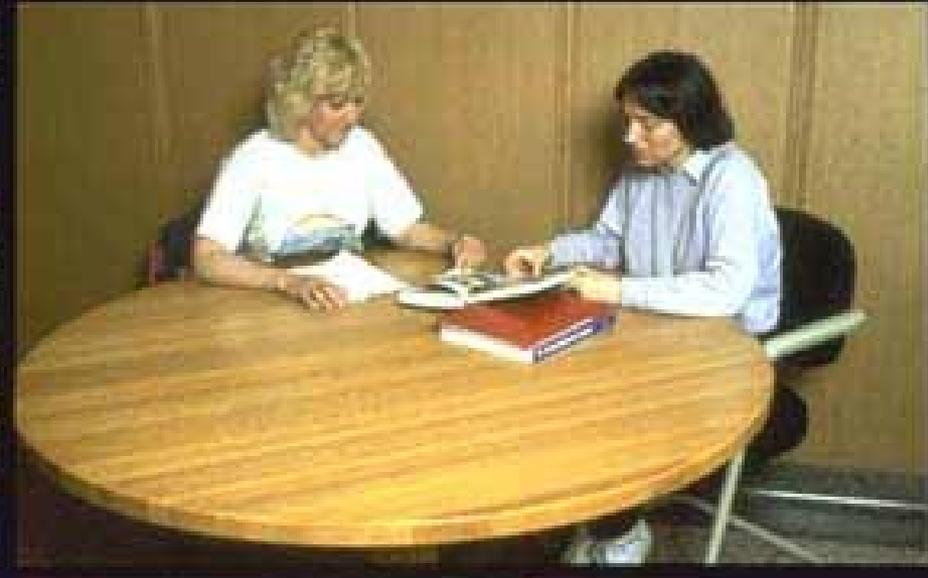
Woodlands blanket our landscape with an abundant mixture of tree species. Among them are the oaks. These majestic trees are a valuable resource, but oaks are slowly disappearing from our woodlands.



When oaks are harvested or die of natural causes, they're often replaced by other tree species. And now more oaks are being cut than are being grown.



Despite their reputation for strength and long life, oaks are surprisingly difficult to regenerate. This program describes how to manage hardwood stands to perpetuate the oaks.



Why should we be concerned about the oaks? Oaks can be used for wood products ranging from railroad ties and fuelwood to wall panels, flooring, cabinets, and furniture.



Oaks produce acorns, a nourishing food for white-tailed deer, turkeys, squirrels, nuthatches, woodpeckers, and a host of other birds and mammals.



And sustaining a mixture of tree species helps guard against future losses from insects and diseases that attack a single species. Oaks contribute to this diversity.



There are several oak species in this area. Oaks in the red oak group have pointed lobes on their leaves. They include northern red, black, and northern pin oak. Their acorns drop to the ground in fall but they don't germinate until spring.



Common members of the white oak group, with rounded lobes, are bur, white, swamp white, and chinkapin oak. Acorns from these species germinate in the fall soon after dropping to the ground.



Oaks grow best on deep soils that are located on middle and lower slopes that face north or east. Northern red and white oaks are especially suited to these relatively cool, moist, and fertile sites. But oaks are difficult to regenerate on good sites because of intense competition from many tree, shrub, and plant species.



Oaks grow poorly where soil depth is shallow, especially on narrow ridgetops and steep, upper slopes that face south or west. Although oaks don't grow well on such sites, they survive better than other species do, and there's less competition for the oak regeneration. Black and northern pin oaks tolerate these dry sites. Bur oak is the most drought tolerant.



One way oaks regenerate is from stump sprouts. Northern red oaks sprout more often than other oak species. Young, small diameter trees sprout best. As trees grow older and larger, they lose their ability to sprout. Sprouts that arise near the ground line produce the most desirable trees.



A sprout that originates high on the stump is more likely to break off or to develop decay at its base.



While sprouts grow quickly because of their large root systems, usually there aren't enough stump sprouts per acre to adequately stock a new stand with oaks.



Acorns are the most abundant source of oak regeneration. In a good year, acorn production may range up to 250 thousand an acre. This sounds like a lot, but red oaks produce good acorn crops only one or two years out of every five.



Even then insects and animals may destroy over half the crop. In a poor seed year nearly all acorns will be consumed by insects and wildlife.



The best acorn-producing trees have large crowns and are at least 14 inches in trunk diameter.



Acorns are commonly dispersed by gravity, squirrels, and blue jays.



Germination and survival are best when acorns are buried in mineral soil under a light covering of leaves. Acorns exposed on top of the leaf litter will dry out and are more likely to be eaten by mammals and birds.

SHADE TOLERANCE

INTOLERANT

- Aspen
- Black walnut
- Paper birch

INTERMEDIATE

- Northern red oak
- White oak

TOLERANT

- Ash
- Basswood
- Elm
- Hickory
- Maple

Seedlings that grow from acorns can't survive more than a few years without adequate sunlight. Northern red oak and white oak are intermediate in shade tolerance. They need less sunlight than aspen, black walnut, and paper birch, but they require more sunlight than ash, basswood, elm, hickory, maple, and most other species.



To regenerate oaks, a timber harvest should be designed to provide the sunlight and growing space that oak seedlings need to survive. A stand may be ready for harvest and regeneration when trees reach economic maturity. That occurs when oaks are about 16 inches in diameter on poor sites, 20 inches on good sites, and 24 inches on the best sites.



A stand can also be regenerated when most trees are of poor quality or undesirable species, when a stand is greatly understocked, or when many trees are dying from a natural cause.

Regeneration Steps

1. Measure oak regeneration
2. Control competition
3. Apply regeneration and harvest system
4. Monitor seedlings & control competition

To encourage natural oak regeneration, you should work with a forester and follow these steps: First, measure potential sources of oak regeneration. Second, control competition from undesirable trees, shrubs, and herbaceous plants. Third, apply a regeneration and harvest system that encourages oak. And fourth, monitor oak seedling development and control competition after the harvest. Let's take a close look at each step.



Before you harvest timber, a forester should count oak seedlings and potential stump sprouts in sample plots and assess the size of the acorn crop. If your woodland has already been harvested, it's still important to evaluate regeneration. Then you'll know whether or not the species mix and number of trees will meet your woodland management objectives.

Seedling Height (Feet)

Seedlings Per Acre

Under 1	15,435
1 - 2	3,087
2 - 4	1,029
Over 4	514

The number of oak seedlings needed to stock the next stand depends on seedling size and the percentage of oaks desired in the species mix. As a rule, if all the oak seedlings were less than 1 foot tall, you'd need 15,435 per acre. If all were more than 4 feet tall, you would need just 514 per acre. Large seedlings are more likely to survive and outgrow competing vegetation than small seedlings.



There are most likely to be oak seedlings in the understory on dry sites because oaks are drought hardy and survive there better than most other species. Very dry sites will not support fast growing, high quality oaks, but they can provide wildlife habitat and some wood products.



Oaks are more difficult to regenerate on fertile sites that are moist, but well-drained. Many tree, shrub, and herbaceous species grow well on these sites and provide too much competition for oak seedlings to survive. When such stands are harvested, some oaks will reproduce from stump sprouts, but there will be few oak seedlings.



The second step in regenerating oaks is to control competition faced by oak seedlings. The most severe competition is often created by a dense understory of shade tolerant shrubs or trees such as sugar maple, ironwood, and prickly ash.



Ferns, nettles, and other herbaceous plants also create dense shade and some species produce toxins that kill oak seedlings. If there's too much competition for the oaks, it must be controlled.



Ferns, shrubs, and trees less than 10 feet tall can be killed by a herbicide applied to the foliage in late summer or fall.



You can prevent herbicide damage to small oaks by cutting the oaks before applying the herbicide. The cut stems will then resprout.



Large shrubs and saplings can be controlled by herbicides applied as a basal spray.



Shrubs and small trees can also be killed by careful bulldozing before, during, or after logging. The goal is to uproot trees, without severely displacing the soil.

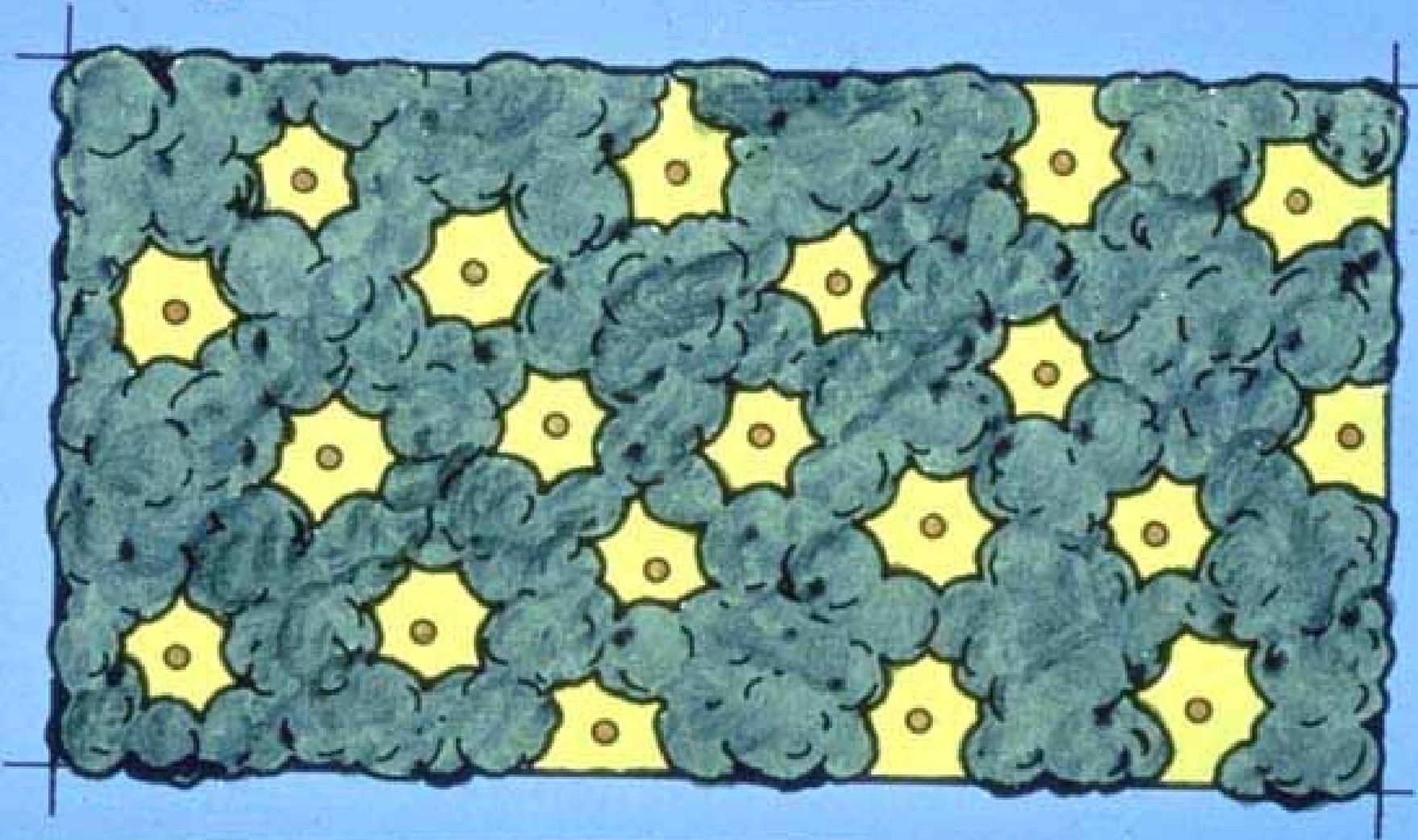


Large trees can be killed by felling and applying herbicide to the cut stump or by girdling with an axe or chainsaw and applying herbicide to the girdle.



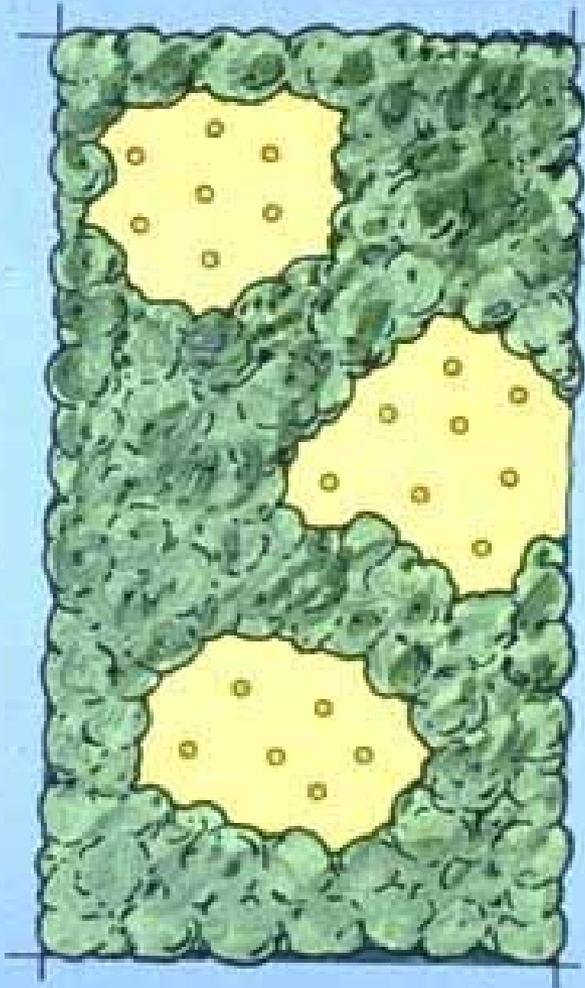
Step three in oak regeneration is to harvest existing timber in a manner that creates environmental conditions favorable to oaks.

Single Tree Selection

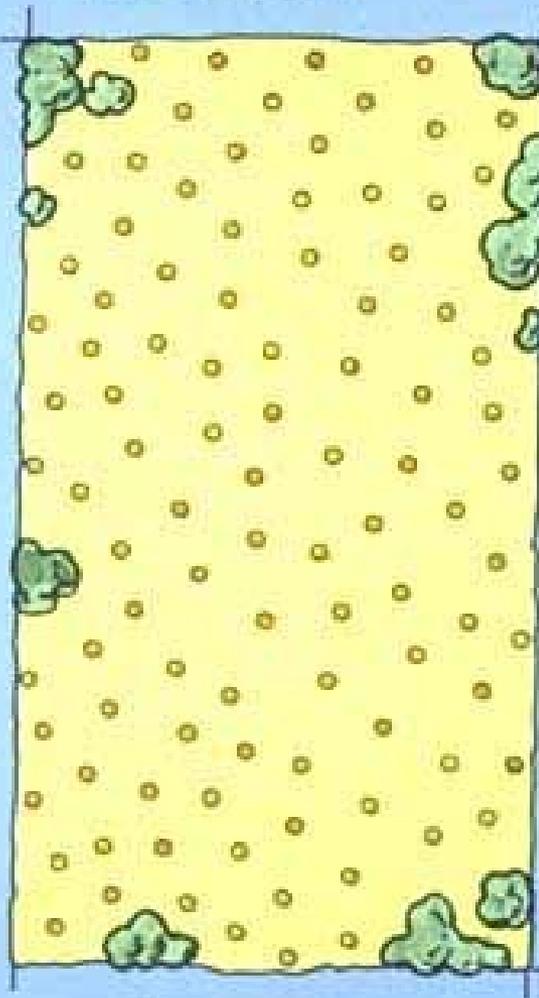


Harvesting individual, mature trees that are scattered throughout a woodlot will regenerate shade tolerant species. But oak seedlings and stump sprouts will not receive adequate sunlight to survive.

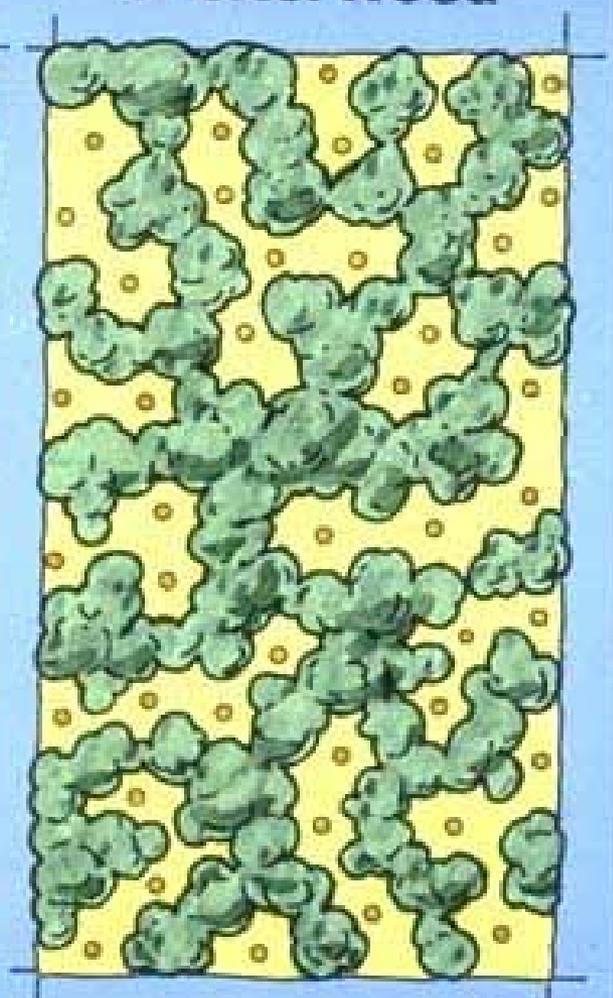
Group Selection



Clearcut



Shelterwood



To give oak seedlings full sunlight, group selection and clearcutting are recommended. Shelterwood is a two-step process that prepares a stand for group selection or clearcutting. These systems differ in the size and arrangement of canopy openings. They will regenerate a mixture of tree species, including oaks



Group selection means cutting all trees in an area from 1/2 to 2 acres in size. These small harvest areas will not sustain a large number of oaks, but some landowners prefer group selection for aesthetic or wildlife purposes.



Clearcutting is similar to group selection, except that clearcuts are larger than 2 acres. If deer browsing is a problem, clearcuts should be at least 4 acres. If your primary objective is to grow timber, there's no reason to limit maximum stand size.



Group selection and clearcutting are recommended when there are plenty of oak seedlings in the understory, or when there is a good acorn crop, or when oaks will be re-planted.



Before or during the harvest, be sure to control undesirable trees and shrubs.



A forester may recommend a shelterwood harvest when there are not enough oak seedlings or potential stump sprouts to adequately stock a new stand. This harvest encourages oak regeneration and prepares a stand for later clearcutting or group selection.



This cut should leave a park like stand with a canopy cover of 60 to 70 percent, but no major gaps. It should permit enough sunlight to reach the forest floor to sustain oak seedlings.



During this first cut, leave healthy trees with high quality stems and well-formed crowns. Leave tree species that you want to provide seed for the next generation. Harvest after a good acorn crop, if possible.



Remove undesirable species, and trees with poorly formed stems, small crowns, or substantial damage. This is also the time to control understory trees and shrubs that may compete with oak seedlings.



Work carefully to avoid damaging residual trees which will be harvested later.



Remove the overstory by clearcutting or group selection when a forester determines that there are enough oak seedlings and potential stump sprouts to restock the stand.



Before you begin group selection, clearcutting, or shelterwood, remember the time of year when harvesting occurs can affect oak regeneration. When relying on oak seedlings and stump sprouts to regenerate a stand, you should harvest when the ground is frozen to minimize damage to tree roots.



If harvesting must occur in other seasons, restrict log skidding to narrow corridors. This will minimize uprooting of desirable trees and exposure of mineral soil where seeds from undesirable species may germinate.



When relying on a good acorn crop to re-establish oaks, harvest after the acorns drop, but before the ground freezes. Try to cover the acorns with soil. You can do this by normal log skidding, by intentionally dragging whole trees over the ground, by shallow bulldozing with a toothed blade that runs on the surface, or by disking with equipment designed to scarify patches of soil.



The fourth step in regenerating oak stands is to control competition and monitor oak development after harvesting. Oaks will grow through a dense layer of herbaceous vegetation if they were established before the stand was harvested or if they become established during the first year after harvest. But if trees and shrubs compete with oaks, they should be controlled.

Regeneration Steps

1. Measure oak regeneration
2. Control competition
3. Apply regeneration and harvest system
4. Monitor seedlings & control competition

Now let's review the four steps needed to regenerate oaks. First, measure potential sources of oak regeneration. These may include seedlings, stump sprouts, or acorns. Second, control competition from undesirable trees, shrubs, and herbaceous plants. Third, apply a regeneration and harvest system that encourages oak regeneration. These include group selection, clearcutting, or shelterwood. And fourth, control competition and monitor oak development after the harvest.



While natural regeneration is more economical, planting oak seedlings or acorns may be necessary to reforest open fields. Planting may also be necessary to supplement natural regeneration after clearcutting, group selection, or shelterwood, where there are not enough acorn-bearing trees.

Timber

- Northern red oak
or
- Oak
- Walnut
- Ash

Wildlife or Aesthetics

- White oak
- Black oak
- Bur oak

Fields

- Oak
- Pine

When growing oaks for timber production on good sites, plant northern red oak. You also can plant a mixture of desirable hardwoods, such as oak, walnut, and ash, that are adapted to the site. To improve the wildlife or aesthetic value of poor, dry sites, plant white, black, or bur oak. Fields can be planted with a mixture of pine and oak. Pines will shade the ground, providing early weed control, and they'll grow to marketable size sooner than the oaks.



Seedlings are the most common planting stock. They should have a fibrous root system and a stem at least $\frac{3}{8}$ inch in diameter measured 1 inch above the root collar. Choose seedlings from a seed source known to thrive in your area.

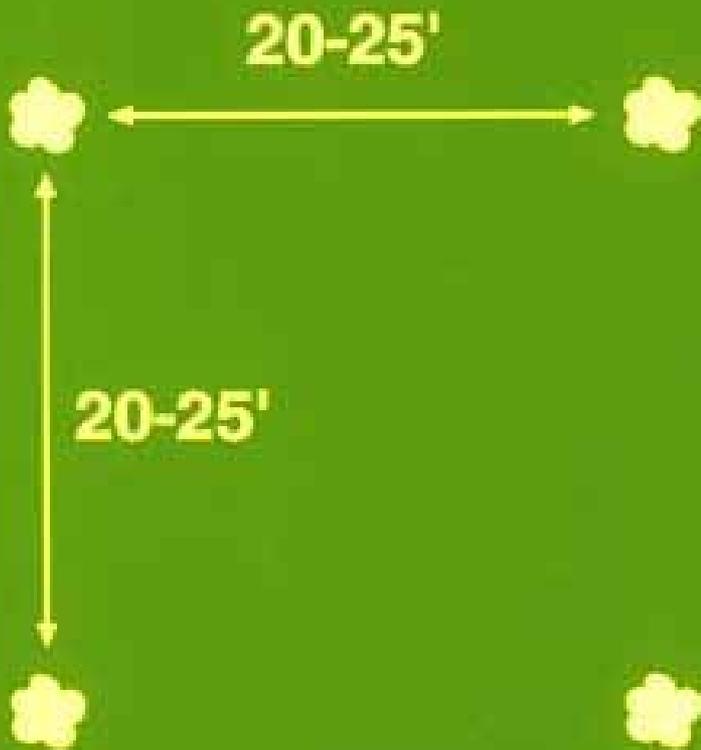


Before planting, clip the tops and roots of oak seedlings, leaving both about 8 inches long. Clipped seedlings develop a more fibrous root system, are easier to handle, and may grow faster than unclipped seedlings.

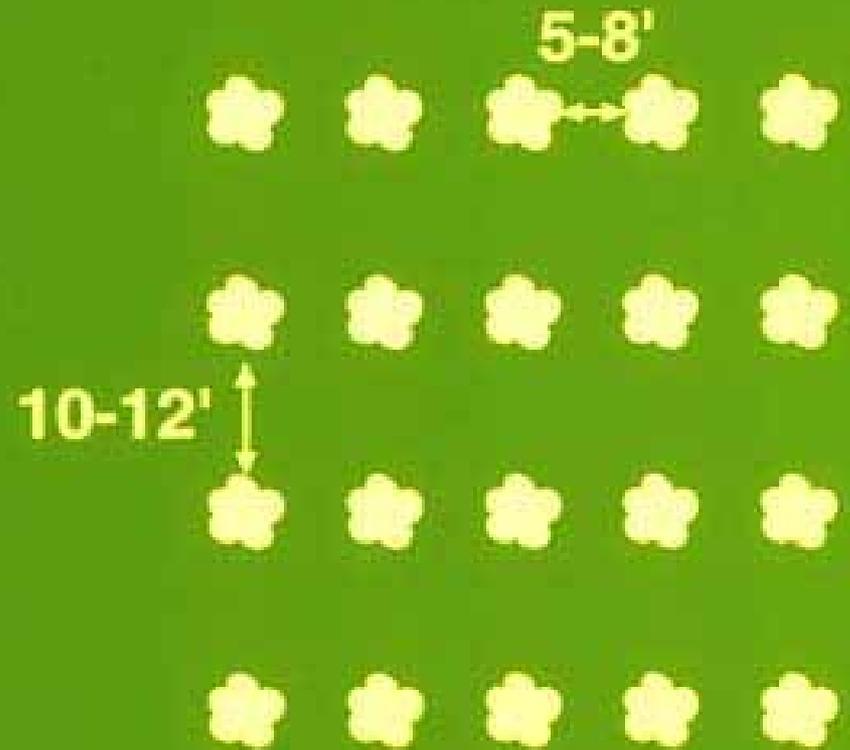


Plant seedlings in moist soil early in the spring soon after the frost leaves the ground. Seedlings with large root systems should be planted in holes. Use a shovel or auger. Plant them deep enough to bury the root collar. Pack the soil firmly to eliminate air pockets.

Woodland



Field



In a woodland, tree seedlings can be planted 20 to 25 feet apart because there'll be other reproduction in the area that will create the density necessary for developing quality trees. In open fields, plant trees 5 to 8 feet apart within rows and leave 10 to 12 feet between rows.



Control weeds and brush around planted seedlings for three years. Herbicides are practical and economical. Cultivation may be possible in field plantings.



Tree shelters are expensive, but they protect seedlings from animal damage and promote fast seedling growth. On harsh planting sites or where browsing may be severe, use 50 to 100 tree shelters per acre. They'll assure the survival of a minimum number of oak seedlings.



Acorns are less expensive to obtain and plant than seedlings, but survival is poor. Rodents eat many acorns and competition from trees, shrubs, or other plants may overwhelm the new seedlings. Contact a forester for information about collection, storage, and handling requirements for acorns.



After controlling understory competition, plant acorns in openings at least 1/2 acre in size. Plant acorns 1 to 2 inches deep. Plant at least 6 or 8 acorns for every tree you want. Plant white oak acorns in the fall, as soon as possible after collecting them. Plant red oak acorns in the fall or the following spring.



Let's now review the oak regeneration strategies that are suitable for different woodland conditions.

If:

Seedlings > 1' and
stump sprouts adequate

Then:

- Clearcut
- Group selection

If:

Seedlings < 1' adequate

Then:

- Shelterwood
- Clearcut
- Group selection

When you woodland is stocked with oak seedlings less than 1 foot tall, shelterwood is preferred. It will allow the seedlings to grow to a competitive size before overstory removal. Clearcutting and group selection may be used if the need for an immediate financial return outweighs the need for more oak regeneration.

If:

- Seedlings and stump sprouts not adequate
- Good acorn crop
- Oaks well-distributed

Then:

- Shelterwood
- Clearcut
- Group selection

If the number of oak seedlings and potential stump sprouts is not adequate, but there is a good acorn crop and the seed-producing oaks are well-distributed throughout the harvest area, the shelterwood system is preferred. If you need an immediate harvest to generate income, then clearcutting or group selection may provide adequate reproduction.

If:

- Seedlings and stump sprouts not adequate
- Acorn crop small
- Oaks well-distributed

Then:

- Delay harvest until good acorn crop
- Shelterwood and natural regeneration
- Shelterwood and plant
- Clearcut and plant
- Group selection and plant

If the number of oak seedlings and potential stump sprouts is not adequate and the acorn crop is small, but potential seed-producing oaks are well-distributed throughout the stand, then delay harvesting until there's a good acorn crop. You could also apply the shelterwood system and rely on natural regeneration or plant oak seedlings. If you need an immediate financial return you could apply a clearcut or group selection and plant oak seedlings.

If:

- Seedlings and stump sprouts not adequate
- Oaks not well-distributed

Then:

- Shelterwood and plant
- Clearcut and plant
- Group selection and plant

If the number of advance oak seedlings and potential stump sprouts is not adequate and potential seed-producing oaks are not well-distributed throughout the stand, then planting is necessary to re-introduce oak. Apply a shelterwood, clearcut, or group selection system and plant oak seedlings.

If:

- Stand harvested
- Oak regeneration poor

Then:

- Control competition and plant



Once an oak stand has been regenerated, it may need maintenance to control the species mix and to encourage fast tree growth. Following a harvest, some oaks will produce numerous stump sprouts. When the sprouts are about 10 years old or 2 to 3 inches in diameter, they should be thinned to one or two dominant sprouts per stump. Remaining sprouts will grow faster and straighter. Leave dominant sprouts that are connected to the stump at ground level.



When the stand is 10 to 20 years old and trees are at least 25 feet tall, undesirable tree species that compete with more desirable species should be controlled. Trees can be felled, girdled, or injected with a herbicide.



Your woodland should be inspected periodically to look for damage caused by insects, diseases, wind storms, or fire.



Livestock should be fenced out of woodlands. They will damage seedlings and compact the soil.



Oak woodlands are one of our greatest natural treasures for wood, wildlife, and watershed protection. But they demand careful management to perpetuate the species and quality of trees that meet your objectives.



Contact a forester to inspect your land and provide specific advice tailored to your situation.

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