North Central Forest Experiment Station 3.01

CENTRAL HARDWOOD NOTES

Principles Of Natural Regeneration

To maximize chances of successful regeneration, carefully consider the following regeneration principles.

- Harvesting alone does not guarantee that the desired species will be established.
- The conditions required for the initial establishment and early growth of the desired species largely determine what regeneration method you should use and any supplemental treatments needed to enhance regeneration success.
- The species must be suited to the site.
- You should evaluate the regeneration potential of the desired species.

Regeneration Potential

The *regeneration* potential of a species or species group is the capacity of its various sources *of reproduction* to capture growing space when it becomes available. New growing spaces occur when canopy openings are created as a result of natural events or management practices such as harvest cuts. At any given time the regeneration potential of **a** stand depends on the presence of one or more sources of reproduction. These sources include:

- **Seed,** either from the current seed crop or seed stored in the forest floor.
- **Advance reproduction,** which is reproduction already in place in the form of seedlings, seedling-sprouts, root sprouts (suckers), and occasionally stump sprouts; stems are <2 inches d.b.h.
- **Stump sprouts** and **root sprouts,** not in place but potentially originating from the stumps or roots of standing overstory trees following disturbance (stems $\geq$2 inches d.b.h.). While most central hardwoods will produce stump sprouts, few species produce root sprouts.

Advance Reproduction is Important

Advance reproduction is the primary source of reproduction for most tree species in the central hardwood forest (table 1). For example, successful regeneration of oaks, hickories, and maples requires advance reproduction. For these species, seedling-sprouts are the primary reproduction growth form; they arise from the recurrent dieback of shoots of reproduction that originate as seedlings.

Table 1 .-*Sources of reproduction and shade tolerance of some species in central hardwood forests*

Species	Relative importance of reproduction source in relation to species regeneration potential'					Shade tolerance
	Seed from current seed crop	Seed stored in forest floor	Advance reproduction"	Stump sprouts'	Root sprouts (suckers) from cut trees	
Hardwoods						
American basswood			1	1	2	tolerant
American beech			1	3	2	very tolerant
American elm			1	3	2	intermediate
Bigtooth aspen	2		3	3	1	very intolerant
Black cherry		1	2	2		intolerant
Blackgum			1	2		intolerant
Black walnut	1		1	2		intolerant
Black willow	1			2	2	very intolerant
Butternut			1	2		intolerant
Eastern cottonwood	1			1	3	very intolerant
Eastern hophornbeam			1	2		very intolerant
Flowering dogwood			1	2		very intolerant
Green ash		1	1	2		intermediate
Hackberry			1	3		intermediate
Hickories			1	3		intolerant
Oaks			1	2		intermediate
Quaking aspen	2		3	3	1	very intolerant
Red maple			1	2		tolerant
Sassafras			1	2	1	intolerant
Silver maple			1	2		tolerant
Slippery elm			1	3	2	intermediate
Sugar maple			1	2		very intolerant
Sweetgum	1			1	1	intolerant
Sycamore	1		2	2		intolerant
White ash		1	1	2		intermediate
Yellow-poplar		1	2	2		intolerant
Conifers						
Eastern hemlock			1			very intolerant
Eastern redcedar	1		1			intolerant
Eastern white pine	1		1			intermediate
Pitch pine	1		1	2		intolerant
Shortleaf pine	1		1	3		intolerant
Virginia pine	1		1			intolerant

[a] 1 = primary source; 2 = potentially significant but not primary source; 3 = minor source. Relative importance of reproduction source is for sawtimber-size stands.

[b] Includes seedlings, seedling-sprouts, and in a few species root sprouts (i.e., species occurring in root sprouts column).

[c] Sprouts originating from stumps of trees ≥ 2 inches d.b.h.

Do Many Stems of Advance Reproduction Guarantee Regeneration Success?

Not by themselves. Where advance reproduction is the primary source of reproduction, the number, size, and distribution of stems of advance reproduction collectively determine regeneration potential. Size is important because larger stems have a greater likelihood of capturing growing space than smaller ones when the canopy opens. In some ecosystems, the number, size, and distribution of advance reproduction can be used to quantify regeneration potential (see Note *3.02 Assessing Regeneration Potential).*

Differences Among Species

The relative importance of a given reproduction source varies by species. For example, the primary reproduction source for yellow-poplar is seed stored in the forest floor. In contrast, reproduction of eastern cottonwood originates primarily from wind-dispersed seed from the current seed crop. And for most hardwoods, stump sprouts are a potentially important secondary or supplementary source of reproduction in even-aged stands. However, stump sprouting capacity varies widely by species, tree diameter, and age.

Differences Related to Site Quality

While most central hardwood species will grow on a wide range of sites, each species will regenerate and/or grow best over a more limited site range (see Note *4.01 The Importance of* Site *Quality).* Often, the relative abundance of the different sources of reproduction for a given species varies by site quality. For example, advance oak reproduction is off en absent or deficient under oak stands on good sites but may be abundant on medium and poor sites. Thus, abundant regeneration does not always equate with site conditions that are best for subsequent stand growth. Other factors such as competition and frequency of stump sprouting also are influenced by site quality.

Regeneration Methods

The diverse species and sites in the central hardwood region require a range of silvicultural options to regenerate the economically important species (see Note *2.04 Choosing a Silvicultural System).* Each of the major silvicultural systems can be used to regenerate one or more species common to the region; which one to use depends on management objectives and species' regeneration potentials.

Clearcutting

Clearcutting will produce new stands composed largely of the species existing as advance reproduction, those that reproduce from seed stored in the, litter, plus stump sprouts originating from trees in the parent stand. The greater the number of small diameter trees in the overstory, the greater the contribution of stump sprouts to the new stand. Consequently, stands thinned from below several times before final harvest will usually produce few stump sprouts. In any case, the composition of the new stand is predictable from the advance reproduction and overstory present at the time of final harvest.

Clearcutting also may be appropriate for regenerating certain light-seeded bottomland species such as eastern cottonwood, sycamore, and sweetgum. For these intolerant species, clearcutting provides the full sunlight necessary for the germination of seeds that may be wind-dispersed from adjacent stands.

Shelterwood

The shelterwood method may be an appropriate regeneration system where essential advance reproduction is lacking. It is often possible to increase the amount of advance reproduction through moderate reduction of overstory density with one or more shelterwood preparatory cuts. However, site preparation is sometimes necessary to assure regeneration success (see Note 3.04 Treatments *to Encourage Natural Regeneration).*

Seed Tree

In the central hardwood region, the seed tree method usually is restricted to regenerating pine (see Note 2.05 *Silvicultural Systems for Oak-Hickory and Oak-Pine).* It is not an effective method for regenerating species dependent upon advance reproduction or seed stored in the forest floor-which collectively comprise most of the central hardwood species.

Group Selection

The group selection method is applicable where the management objective is to create or maintain an uneven-age forest. The method has the potential for regenerating both tolerant and intolerant species. However, to maintain the uneven-age character of stands, the diameter of openings should not exceed 1 to 2 times the height of dominant trees.

In some parts of the region, sugar maple, red maple, American beech, and other tolerant species tend to replace less shade-tolerant species. The process occurs most rapidly on good sites. Thus, a frequent problem in managing uneven-age stands containing tolerant species is to maintain a desirable mixture of both tolerant species and less tolerant but more valuable species. The group selection method has the potential to maintain such mixtures.

Single Tree Selection

Where an uneven-age forest is the management objective, the single tree selection method will regenerate shade tolerant species such as sugar maple, red maple, and American beech. These species can grow into and dominate very small canopy openings. In contrast, intolerant or moderately tolerant species are unable to develop in the understory as advance reproduction and/or they are unable to successfully occupy the small canopy openings created by the single tree selection method.

References

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Smith, David M. 1962. The practice of silviculture. New York, NY: John Wiley and Sons. 578 p.

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