

FORESTRY FACTS



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Tolerance of Tree Species

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Tolerance is a term that foresters and ecologists use to indicate a tree's capacity to develop and grow in the shade of, and in competition with, other trees. Some tree species, such as sugar maple, hemlock and balsam fir, can do this quite well. Other species, including aspen, jack pine and tamarack, need full sunlight for growth and development.

Although we typically think of tolerance as the ability to grow under shade, and we often use the term shade tolerance, the concept involves more factors than merely light. We should probably think of tolerance as the ability of a tree to compete with other trees for other resources such as water and nutrients. Competition is a function of all site factors, including light. With forest trees, competition does not begin until there is closure, either of crowns or roots or both-, and the ability of a tree to endure and overcome competition after closure is tolerance.

Degree of Tolerance

Tree species that compete well under full shade are called **very tolerant** species; those that require full sunlight and limited competition are called **very intolerant** species. Most tolerant species will also prosper when growing in full sunlight with no competition, but the intolerant species are unable to handle competitive shady conditions. Sometimes we hear that a tree is "shade loving;" however, this is incorrect. Although some trees tolerate shade, none of them "love" this condition.

Between the extremes of very tolerant and very intolerant, we find many tree species that range from **tolerant** to **intermediate** to **intolerant** in their ability to grow, develop and compete under shade. The box on page 2 indicates the tolerance for most of our important Lake States tree species.

Tolerance and Succession

Forest succession (discussed in Forestry Fact No. 78, Forest Succession) is strongly related to tolerance. Succession basically progresses from very intolerant species to the very tolerant species over time. Very intolerant species occupy a site first and these are gradually replaced by intolerant species, followed by intermediate species, tolerant species, and finally the very tolerant species take over the site.

Tolerance May Vary

A factor that confuses our understanding of tolerance is that trees may vary in tolerance as they age, or when they grow in a different region, or if they grow on a good site instead of a poor one. Some species may be fairly tolerant throughout life, others may be more tolerant when young than when older, and some are more tolerant when old than when young. For example, white pine is more tolerant during seedling and small sapling stages than later in life; balsam fir appears to be very tolerant throughout its life; and black spruce seems

fairly intolerant when very young, but gains in tolerance with age.

Differences Between Tolerant and Intolerant Trees

Tree species that are very tolerant or tolerant tend to:

- have deeper (longer) crowns,
- have a tapered crown,
- grow in higher stand densities,
- mature slowly, be long lived.

Whereas, tree species that are intolerant or very intolerant tend to:

- have shallow (shorter) crowns,
- have cylindrical crowns,
- grow in low stand densities,
- mature early,
- die earlier.

Impact on Management

Understanding species tolerance is very important when we make forest management prescriptions. If our goal is to establish or maintain a very intolerant species, we must provide full sunlight conditions, typically by clearcutting the stand at harvest time. If, on the other hand, we want to foster very tolerant species, we usually prescribe a partial or selection harvest. Intermediate species usually benefit from open shade that is obtained by a shelterwood harvest.

If we depart from these basic "rules" we will certainly be "fighting Mother Nature," and the consequences will be to establish species other than what we intended. To learn more about clearcutting, selection and shelterwood, see Lake States Woodlands publication G3424, *Harvesting and Forest Management*.

TOLERANCE OF LAKE STATES TREES

Very Intolerant

aspen	balsam poplar
black willow	cottonwood
jack pine	tamarack

Intolerant

bitternut hickory	black ash
black cherry	black walnut
butternut	paper birch
red pine	white ash

Intermediate

American elm	black oak
bur oak	hackberry
red oak	rock elm
shagbark hickory	sycamore
white oak	white pine
white spruce	yellow birch

Tolerant

basswood	black spruce
boxelder	ironwood
north, white-cedar	red maple
silver maple	slippery elm

Very Tolerant

American beech	balsam fir
hemlock	sugar maple

From: Silvics of North America, Vol. 1 & 2. 1990
USDA Forest Service, Agr. Handbook 654,
1552p.