



Managing Oak Regeneration in Red Pine Plantations

MICHIGAN STATE
UNIVERSITY
EXTENSION

By: Michael B. Walters

Red pine plantations cover nearly one million acres of Michigan. Most plantations were established in the 1930's and 1950's and thinning or final harvesting is occurring. Among the myriad of management options (e.g. replanting pines, extending red pine rotations, old growth), converting red pine to economically desirable and ecologically valuable hardwood species, such as oaks may be desirable in some areas. Of the hardwoods, oaks are of especially great interest because they have high economic and ecological value and because regenerating them is currently difficult, especially on good sites. However, patterns of oak regeneration in pine plantations vary greatly such that active management may be necessary to promote high regeneration densities in many cases. Here, we use preliminary results from a long term project to develop interim recommendations for promoting conditions favorable for oaks regeneration in mature red pine plantations.

Factors affecting patterns of hardwood regeneration in red pine stands

Field observations and preliminary data suggest that there are three main factors affecting oak regeneration densities in red pine plantations that are also practical targets for management 1) seed availability of oaks versus their competitors), 2) light availability/thinning intensity, and 3) forest floor barriers to seedling establishment for oaks versus their competitors. At present we have preliminary information on the first two factors.

Seed availability. Reflecting seed fall patterns, young seedling densities in red pine stands show that that seed availability decreases strongly with increasing distance from hardwood borders (Figure 1). Furthermore, seedling densities for wind dispersed competitors of oaks such as red maple are at very high densities near plantation borders, but drop off faster than oaks and animal dispersed seeds with distance. As a result, in the interior of red pine plantations total seedling densities are very low, but composition is dominated by cherry, oak, beech and other species moved around by animals.

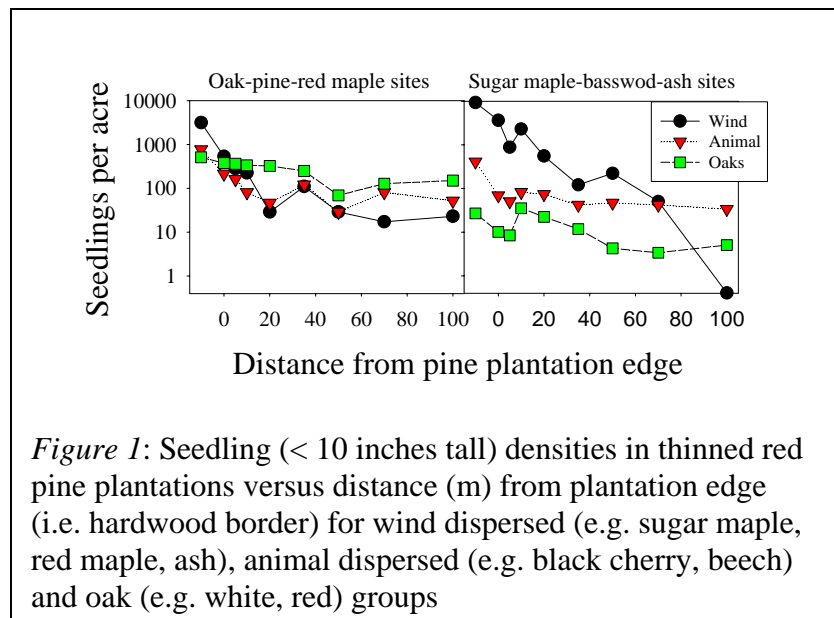


Figure 1: Seedling (< 10 inches tall) densities in thinned red pine plantations versus distance (m) from plantation edge (i.e. hardwood border) for wind dispersed (e.g. sugar maple, red maple, ash), animal dispersed (e.g. black cherry, beech) and oak (e.g. white, red) groups

The pattern in Figure 1 is due to the short average dispersal distances for most tree species found in pine plantation understories. Specifically for oaks we found that first-year seedling densities in a year following a heavy acorn crop dropped to fewer than 500 per acre at distances greater than 30 meters from parent trees (Figure 2).

Light availability/thinning intensity

Densely stocked red pine plantations often have understories near empty of vegetation due, in part, to very low understory light levels strongly limiting seedling growth and survival for most tree species. In these conditions, shade intolerant to mid-tolerant oak species germinate and survive for 2-3 years but then die. In addition to directly impacting survival, low light causes lower height growth rates which can make oaks accessible to deer browse (20 cm-1.5 m in height) for a longer period of time. Our data show that oak sapling height growth rates are decreased by ½ in densely stocked stands (200 ft² per acre, 0.2 m/year) compared to open-growing conditions (0.4 m/year). Thus an open-grown oak would take 3-4 years to growth through the zone of deer brose risk whereas one growing beneath densely stocked red pine would take 6-7 years.

Management Recommendations

Favoring oak seedlings:

- Most mature red pine plantations have small admixtures of mature hardwood species. In these cases, when stands are thinned, oaks should be retained, and unwanted, prolific seeding competitors, such as red maple, should be removed. Similarly, competitors can be removed preferentially over oaks if hardwood stands adjacent to red pine plantations are partially cut.
- Adequate seedling numbers for natural regeneration may occur within 30 meters of adult oaks.
- Because they are seed limited and often regeneration poor, interiors of pine plantations with hardwood borders, (e.g. > approximately 30 m from borders), or pine plantations without hardwood borders, may provide a rare opportunity to establish oaks by seeding with minimal competition from other species. In particular productive northern hardwood sites where oak quality for wood products is high but regeneration is especially limited by intense competition may be prioritized for this treatment

Thinning red pine to promote oak establishment and canopy recruitment. A thinning schedule designed to promote oak establishment and recruitment will depend on current conditions and local seed availability.

- In stands where adult oak seed sources are not abundant and oak establishment is to be accomplished with seeding, low understory light levels should be maintained by thinning to high residual basal area (Benzie 1977, Figure 7) to discourage establishment of competitors. Near the

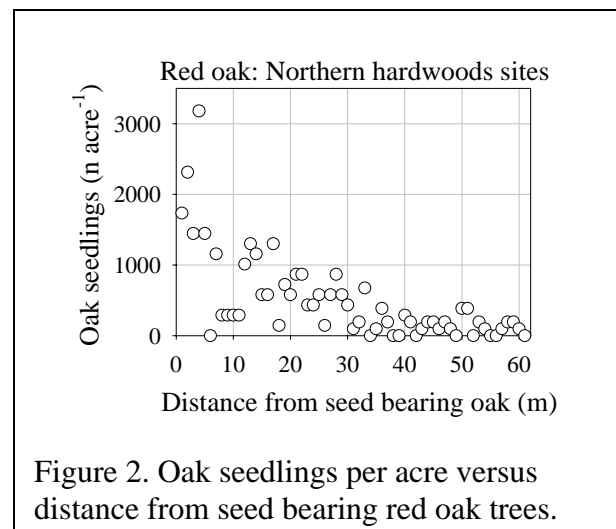


Figure 2. Oak seedlings per acre versus distance from seed bearing red oak trees.

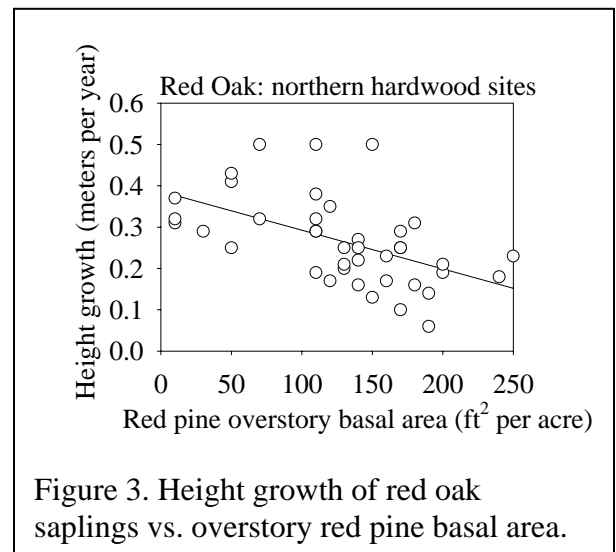


Figure 3. Height growth of red oak saplings vs. overstory red pine basal area.

end of the red pine rotation, stands could then be thinned to lower residual basal area just prior to seeding. In combination this may enhance survival and growth of establishing oaks and minimize density of competitors. For final harvest of red pine (removing all or most of remaining stems), if damage to established oak saplings is likely, stands could be harvested in winter and oak saplings lopped to promote vigorous, straight-stemmed stump sprouts the following year.

- In situations where abundant oak regeneration is present and/or abundant red oak seed sources are present intermediate thinning could be to lower residual basal area than above. If possible, heavy thinning should be timed with heavy acorn crops. These occur approximately every four years for red oak and three years for white oak but their periodicity is not highly predictable (Sork et al. 1993). Similar to the approach above, if oaks are being managed for wood products, then stem damage on oak regeneration from multiple harvest entries can be remedied by lopping oaks regeneration to promote stump sprouting.

References

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- Sork, V.L., Bramble, J., Sexton, O. 1993. Ecology of mast-fruiting in 3 species of North American deciduous oaks. *Ecology* 74: 528-541.