

FOREST STAND IMPROVEMENT

CONSERVATION INFORMATION SHEET - Forestry Series

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Natural Resources Conservation Service

Michigan



An improved stand of hardwoods is well stocked with healthy seedlings, saplings, poles, and sawlog size trees.

What Is Forest Stand Improvement?

Forest stand improvement is the changing of species composition and stocking by cutting and/or killing selected trees and understory vegetation. The species composition and stocking level of trees in a forest may be changed to achieve a variety of purposes. Forest stand improvements may be done to:

- Improve the quality and quantity of wood production.

- Harvest trees and achieve a desired level of tree stocking.
- Initiate natural regeneration of trees in the forest.
- Improve the habitat of forest wildlife.
- Restore and protect plant communities.

Other purposes may be to improve aesthetics; reduce the potential for damage by wildfire, insects, or disease; and to improve recreational uses of the forest.

Improving The Forest For Wood Production

Both large and small acreages of hardwood and coniferous forest in Michigan can benefit through forest stand improvement. Removal of diseased, damaged, deformed, and low value species may improve the overall health and composition of the forest. Such operations are referred to as weeding (*Figure 1*). Thinning (*Figure 2*) is the systematic removal of excess trees in order to provide optimum space for selected crop trees to grow. Weeding and thinning may be done separately or together as pre-commercial operations (usually in younger stands of sapling size, not having reached commercial age) or in older stands incorporated as part of a commercial harvesting operation.

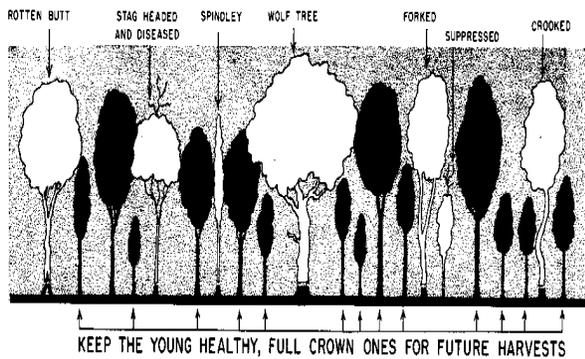


Figure 1 – Weeding Improves Composition and Quality of the Forest.

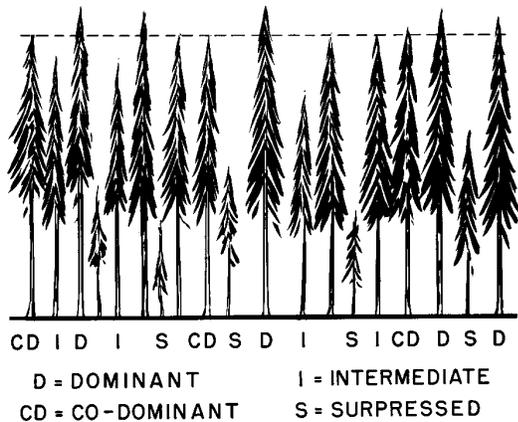


Figure 2 - Thinning Suppressed and Intermediate Trees From the Stand Provides Growing Space for Dominant and Co-Dominant Crop Trees

Guidelines For Thinning Hardwoods

When to Thin

Hardwoods may be thinned for sawtimber as soon as crop trees (well-formed dominant and co-dominant trees in the stand) can be identified. This is usually when trees have reached 3-5 inches diameter at breast height (DBH) 4 feet above the ground.

Hardwoods released by thinning may grow 40-60 percent faster than trees growing in an overstocked, unimproved forest. Favor desirable species such as Yellow Birch, Basswood, Black Walnut, Sugar Maple, Black Cherry, Red and White Oak, Yellow Poplar, and White Ash. Discriminate against Ironwood, Blue Beech, American Beech, and Red Maple. Conduct thinning during dormant seasons on snow covered or frozen ground to minimize damage by insects, diseases (oak wilt and others), and equipment to the residual stand.

Method of Thinning

Select up to 80 future crop trees per acre to be released. Select crop trees on the basis of the following criteria:

- Crown size (dominant or co-dominant trees only), position, and condition.
- Relative tree position and spacing.
- Tree health and vigor (crown should not exceed two-thirds total tree height).
- Bole quality (no forks or dead branches in main stem if over 9 inches DBH).
- Species (based on soil type and local market values).

Thin and maintain overstocked stands of trees that are 5-24+ inches DBH to a density of about 85 square feet basal area per acre. A quick way to determine the average desired spacing may be done by multiplying the measured average diameter in inches (DBH) of the dominant and co-dominant crop trees in the stand by the constant: 1.67. The result

will give the approximate desired spacing in feet between trees. Example: average diameter of trees in stand = 6 inches. Multiply 6 by 1.67 and the result is 10.02 feet, or 10 feet between trees. The recommended growing space is: 10 feet x 10 feet, or 100 sq. ft. per tree. The basal area of trees averaging 6 inches DBH thinned to this spacing is 87.2 sq. ft./acre (*Table 1*). **Note:** Hardwood trees that have grown in excess of 24 inches DBH will generally have met economic maturity. Consider harvesting these if residual stocking is adequate and maximizing income is a primary objective.

General Rules For Thinning Hardwoods

- 1) **Do not thin or weed hardwood stands to less than 80 sq. ft. basal area per acre (doing this could favor undesirable species, promote branching, and cause shock to the residual stand).**
- 2) **Care should be taken to not damage or “bark” boles of residual stand with equipment or during felling.**
- 3) **Girdle or chemically treat large (12 inches diameter +) unmerchantable trees to reduce damage to residual stand.**
- 4) **Favor up to 80 well-formed dominant and co-dominant crop trees per acre.**
- 5) **Do not thin pruned trees.**

TABLE 1 - HARDWOODS				
Number of Crop Trees and Growing Space Recommended for Hardwood Sawtimber Based on Average Diameter of the Stand Measured at DBH				
Ave. DBH (in.)	Basal Area Per Tree (sq. ft.)	No. Crop Trees (per acre)	Distance Between Trees (ft.)	Basal Area Per Acre (sq. ft.)
5	0.14	681	8	95.2
6	0.20	436	10	87.2
7	0.27	302	12	81.5
8	0.35	258	13	90.3
9	0.44	194	15	85.4
10	0.55	151	17	83.1
11	0.67	134	18	89.8
12	0.79	109	20	86.1
13	0.92	90	22	82.8
14	1.07	82	23	87.7
15	1.23	70	25	86.1
16	1.40	60	27	84.0
17	1.58	56	28	88.5
18	1.77	48	30	85.0
19	1.97	43	32	84.7
20	2.18	40	33	87.2
21	2.41	36	35	86.8
22	2.64	32	37	84.5
23	2.89	30	38	86.7
24	3.14	27	40	84.8

Guidelines For Thinning Pines

When to Thin

Generally, pines on average to above average sites (Site Index of 50 or greater) will be ready for commercial thinning by the time they are 25 to 35 years old. Non-commercial thinning (before trees are of commercial age for sale as posts, pulp, cabin logs, pilings, small sawlogs, etc.) may be needed only in heavily-stocked stands that exceed 2,000 trees per acre. Thinning of such stands should be accomplished before they reach 16 feet high or 20 years of age. Conduct thinning during dormant seasons on frozen or snow covered ground to minimize the possibility of damage by insects and equipment to crop trees in the residual stand.

Methods of Thinning

While several methods may be employed to accomplish thinning of pines for sawtimber (row thinning, basal area thinning, height thinning), the D+ formula for thinning pines works well for the small woodlot owner wishing to thin either planted or natural stands of pines. To use the D+ method of thinning pines, follow these steps: 1) determine the average DBH of dominant and co-dominant crop trees in the stand (in inches); and 2) determine the **minimum** spacing needed in feet by adding the constant: 4 to the measured average DBH in inches of crop trees in the stand. Example: Average DBH of dominant and co-dominant crop trees pine stand is 6 inches. Add this to the constant 4 and the result is: 10 or 10 feet by 10 feet = 100 sq. ft. per tree minimum required spacing. Thin trees to a **maximum** spacing of D+6 to allow space for crop tree growth.

General Rules For Thinning Pines

1. **Pines growing at D+4 or less should be thinned to a spacing of D+6.**
2. **Do not thin pines if they are growing at a spacing of D+6 or wider.**
3. **Never remove more than one half of the trees in the stand in one thinning (shock, ice, windthrow, insects, and snow are hazards to overthinned stands of pine).**
4. **Favor well-formed dominant and co-dominant crop trees.**
5. **Do not thin pruned crop trees.**

TABLE 2 - PINES				
Number of Crop Trees and Growing Space Recommended for Pine Sawtimber Based on DBH (Diameter at Breast Height - 4 1/2 feet above ground based on D+ formula: Ave. DBH of crop trees plus 6 = "thin to" spacing.)				
Ave. DBH (in.)	Basal Area Per Tree (sq. ft.)	No. Crop Trees (per acre)	Distance Between Trees (ft.)	Basal Area Per Acre (sq. ft.)
5	0.14	360	11	50.4
6	0.20	302	12	60.4
7	0.27	258	13	69.7
8	0.35	222	14	77.7
9	0.44	194	15	85.4
10	0.55	170	16	93.5
11	0.67	151	17	101.2
12	0.79	134	18	105.9
13	0.92	121	19	111.3
14	1.07	109	20	116.6
15	1.23	99	21	121.8
16	1.40	90	22	126.0
17	1.58	82	23	129.6
18	1.77	76	24	134.5
19	1.97	70	25	137.9
20	2.18	64	26	139.5
21	2.41	60	27	144.6
22	2.64	56	28	147.8
23	2.89	52	29	150.3
24	3.14	48	30	150.7

Improving The Forest For Wildlife, Aesthetics And Recreation

Forests containing a mixture of tree species and sizes are more visually appealing and generally provide excellent habitat for a wide variety of wildlife. The following practices may be used to improve the forest for recreation and selected wildlife species:

Clear Cutting

Small clearcuts (2 1/2-20 ac.) of aspen, white birch, and jack pine will improve habitat for grouse, woodcock, hares, rabbits, and songbirds. Larger clearcuts of 40-60 acres will benefit deer but are less visually appealing. Clearcuts with curved edges are more visually appealing and may produce greater "edge" effect than those with straight edges. Leaving 1 or 2 "drumming logs" and

1 or 2 standing snags for every 2 acres of clearcut will improve habitat for grouse and cavity nesting species.

Release Cuttings or Group Selection

Cutting small groups of shade tolerant trees to allow release of mast and fruit producing trees will benefit squirrels, grouse, turkey, deer, bear, and songbirds.

Single Tree Selection

Single tree (selective) cutting can be used to improve habitat for squirrels, turkey, bear, and grouse. One or two mast producing trees, den and cavity trees per acre may be selected as “leave” trees during harvest. Unusually large or unique trees may be selected as “leave” trees to improve the aesthetic appeal of the forest.

Other Improvements To Benefit Forest Wildlife

- Protect forest from livestock grazing.
- Retain or plant native fruit and mast bearing species such as: crabapple, wild grape, wild cherry, oaks, hickory, beech, walnut, butternut, hazelnut, hackberry, and ironwood.
- Leave hollow trees and logs for cover.
- Establish clump plantings of conifers for winter cover in hardwood stands.
- Seed grass or grass-legume mixtures in and along forest roads, landings, and harvest trails.
- Establish brush piles along forest edges.
- Establish cut-back borders along forest edges by removing edge trees to a width of 20 feet.

- Place 1-4 squirrel, raccoon, and bird nest boxes per acre to improve nesting habitat.
- Create or maintain openings of 1/4 acre or larger in large, unbroken tracts of forest to diversify habitat.
- Maintain core areas of old age stands.

For More Information

Information in this conservation sheet is intended to supplement and not replace professional forestry advice. Landowners with both large and small tracts of forest are encouraged to develop a management plan with the assistance of a resource professional trained in forest management. Field assistance in forest improvement is available through private consultant foresters, industrial foresters, Conservation Districts, Michigan Department of Natural Resources Forest Management and Wildlife Divisions, USDA Natural Resources Conservation Service, U.S. Fish and Wildlife Service, and Michigan State University Cooperative Extension Service.

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