



DESIGNING PLANTATIONS

FOREST STEWARDSHIP MANAGEMENT NOTE #8

INTRODUCTION

Because of the costs involved, plantations are generally established to produce future income from timber. However, tree planting is sometimes justified for other reasons (e.g., visual quality, wildlife habitat), and like natural forests, plantations can provide multiple benefits simultaneously.

This Note first discusses factors to consider when designing any plantation, including ways to address non-timber benefits. Then, basic guidelines are given for various types of plantations. Sources of further information are given throughout.

CONSIDERATIONS FOR ALL PLANTATIONS

When designing a plantation, the first consideration should be the location of the prospective site(s) in relation to the surrounding landscape. Next, consideration should be given to the conditions of the site itself. After these factors have been studied, decisions must be made regarding tree species and planting patterns.

1. **LANDSCAPE CONTEXT** - Depending on where it is located, a plantation will have different effects on wildlife populations, water resource quality, and many other aspects of the environment. For example, plantations that form corridors between isolated blocks of woodland are likely to be more beneficial to wildlife than plantations that create additional isolated blocks (FSMN #39).
2. **ACCESSIBILITY** - The difficulty of vehicular access should be carefully considered as many types of plantations require use of equipment for site preparation, planting, maintenance and harvesting.
3. **BROWSING PRESSURE** - If browsing is a problem in the area, consider the feasibility of fencing and other methods of discouraging browsers (#12, FSMN #3,13,42).
4. **SOIL TYPE** - Because each type of tree grows well only on certain soil types, it is essential to determine the nature of the soils in the areas being considered for planting (FSMN #4). For example, it would not be wise to plan a Christmas tree plantation on low-lying, poorly drained soil.
5. **SPECIES SELECTION** - Tree species should be selected that are adapted to the soil conditions and that are, of course, matched to the purposes for which the plantation is being established. Another consideration is whether to plant more than one species. Single-species plantations (monocultures) are generally preferable for commercial production of conifers, but multiple-species plantations (polycultures) are less susceptible to disease and pest outbreaks and are usually better suited for producing wildlife and aesthetic benefits. Even small inclusions of conifers within hardwood plantations or hardwoods within conifer plantations can have large wildlife benefits (#6). See References #9 and #12 for further discussion of mixed plantings.
6. **TREE SPACING** - The general principles of tree spacing are summarized in this section. In short, the best spacing is a compromise involving growth responses of the species, the purpose of the plantation, and economic factors. More specific recommendations are given below and in the References. To account for mortality, more trees should be planted than are required at maturity. It is usually better to thin out extras than to have to replant.

The advantages of close spacing include straighter trunks with fewer branches (resulting in more and higher-grade lumber), earlier canopy closure (resulting in less competition from weeds and understory trees), more efficient use of sunlight and growing space, better chance of enough seedlings surviving.

The advantages of wide spacing include more rapid diameter growth (spacing has little effect on height growth), lower costs (site preparation, seedlings, planting, etc.), fewer or delayed thinnings, more ground and understory vegetation (an advantage for wildlife), and easier access with equipment.

Although plantations are normally thought of as stands that will develop closed canopies, excellent conditions for many kinds of wildlife and for recreational activities can be provided by planting trees on very wide spacings that will develop savannah-like habitats (e.g., see discussion of red pine below and FSMN #33).

7. OTHER SPATIAL DESIGN CONSIDERATIONS

PLANTATION SHAPE - The overall shape of plantations can be varied according to the landowners' objectives. For aesthetic purposes, shapes other than rectangular blocks are generally preferable. For wildlife habitat, long and narrow plantations provide more edge habitat that may be desirable (#6).

ACCESS LANES - For vehicular access, lanes may be needed that are wider than the normal tree spacing. In some cases, it may be better to create lanes at the first thinning rather than when the trees are planted.

ROW SHAPE AND TREE SPACING UNIFORMITY - From a timber production perspective, using straight rows and a consistent tree spacing within rows is more efficient. From a wildlife perspective, curved or zig-zag rows with irregular tree spacing will enhance habitat quality. From an aesthetic viewpoint, straight rows and uniform tree spacing should generally be avoided, but beauty is in the eye of the beholder.

SOIL AND WATER CONSERVATION - Where soils are easily eroded, do not orient rows straight up and down slopes.

TREE SPACING GUIDELINES FOR SELECTED PLANTATION TYPES

The SIP Specs Manual (#11) gives the following spacings:

Species	Spacing in Feet Between Rows	In Rows	Approx. No. Trees Needed Per Acre	Acceptable Range of Trees/Acre
Jack Pine	8	5	1,050	900 - 1,200
Spruce	8	6	900	800 - 1,000
N.W. Cedar	8	6	900	800 - 1,000
Red Pine	8	7	800	700 - 950
White Pine	8	7	800	700 - 950
Hardwoods	10	10	430	400 - 500
Shrubs	6	5	1,450	1,200 - 1,800

The following tree spacings are commonly used to reach recommended planting densities (#9):

Feet apart	Number of trees per acre
6 x 6	1,210
6 x 10	726
7 x 7	889
7 x 10	622
8 x 8	681
9 x 9	538
10 x 10	436
12 x 12	302

ADDITIONAL NOTES BY PLANTATION TYPE

1. CHRISTMAS TREE PLANTATIONS - Christmas trees are generally planted on a 6 x 6 foot spacing (about 1,000 trees/acre). Michigan produces about one of every five plantation grown Christmas trees in the United States. Growing Christmas trees has become a highly intensive business that requires significant knowledge, time and effort on the part of growers (#8).
2. RED PINE PLANTATIONS - In many older red pine plantations, the trees were planted to close for good growth. Current recommendations are as follows. For maximum production of merchantable wood volume (pulp, fuel), 800-1,000 trees/acre should be established; for maximum board-foot production for lumber, about 200-500 trees/acre should be established (#10,17). Industrial foresters currently favor planting 500-600 trees per acre (8 x 9 or 9 x 10 ft.) with expectations of at least 400 established survivors at age 5 (# 2). Wide spacing of red pine appears to benefit wildlife and recreational values (#5,6).
3. HARDWOOD PLANTATIONS - Most hardwood species prefer deep, fertile, moist, but well drained loamy soils. On such sites, competition from weeds tends to be severe. Thus, intensive site preparation and several years of weed control are generally required to ensure survival and good growth (#12). Closer tree spacing will reduce the number of years weed control will be needed, but earlier thinning will then be required. Either way, successful hardwood planting is generally more difficult and expensive than conifer planting.
4. BLACK WALNUT PLANTATIONS - Due to their potentially very high value, black walnut plantations have been extensively studied, and landowners interested in growing this species should consult the specialized publications listed in the References (#3,13,14,16) and seek the assistance of experienced growers in their area. Note that black walnut in Michigan is native to only the southern part of the lower peninsula and efforts to grow it farther north are risky.
5. FUELWOOD PLANTATIONS - Guidelines are available for establishing fuelwood plantations in Michigan (#5), but managing an existing hardwood woodlot is generally recommended for people who want to grow their own firewood (#7, FSMN #19).
6. WHITE SPRUCE PLANTATIONS - As with red pine, early white spruce plantations were generally planted with trees too closely spaced. Current recommendations for planting densities are about 800 trees per acre versus the 1,200 plus trees per acre formerly used (#15).

REFERENCES

FSMN #'s refer to other Forest Stewardship Management Notes in this series.

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- #5 Johnson, D.J. 1989. Wildlife considerations of red pine management. Michigan State University Extension, Forestry Fact Sheet 09.
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- #10 Michigan Department of Natural Resources, Forest Management Division. 1992. Stewardship Incentive Program (SIP) practice standards & specifications manual.
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- #12 Michigan Department of Natural Resources. 1989. Intercropping black walnut plantations. Forest Management Bulletin No. 1-1.
- #13 Michigan Department of Natural Resources. 1986. Intercropping black walnut plantations. Forestry Information Bulletin No. 10-3.
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- #15 Schlesinger, R.C. and D.T. Funk. 1977. Manager's handbook for black walnut. USDA Forest Service GTR-NC-38.
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