Chapter 45

Black Walnut Cover Type

Last Full Revision: 12/5/1990
Note- this chapter has not been fully revised since the restructuring of the Wisconsin Silviculture Guide, therefore some subject areas may be missing in the current version of this chapter.

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1 TYPE DESCRIPTION

1.1 Stand Composition and Associated Species

Stand Composition

The black walnut type is defined as having stand composition of 50 percent black walnut (*Juglans nigra*). However, it is present in southern Wisconsin to a very limited extent and is seldom abundant. Black walnut grows in many mixed mesophytic forests or less commonly forms pure stands along the forest edge.

Associated Species

Eastern red cedar (*Juniperus virginiana*), white oak (*Quercus alba*), red oak (*Q. rubra*), shagbark hickory (*Carya ovata*), American beech (*Fagus grandifolia*), sugar maple (*Acer saccharum*), white ash (*Fraxinus americana*), black cherry (*Prunus serotina*), basswood (*Tilia americana*), American elm (*Ulmus americana*), hackberry (*Celtis occidentalis*), boxelder (*A. negundo*), and green ash (*F. pennsylvanica*). In general where white ash or red oak grows well, black walnut also thrives.

1.2 Silvical Characteristics*

Table 45.1. Summary of selected silvical characteristics.

Species	Black walnut
Flowers	Monoecious. Male -- catkins; female -- erect terminal spikes. Depending on latitude, flowers appear between April 10 and June.
Fruit	Spherical fruit, 1 to 2 inches in diameter, with a thick, semi-fleshy husk enclosing a woody, corrugated nut and an edible sweet, oily seed. Fruit ripens in September or October and drops shortly after leaf fall.
Seed Dispersal	By gravity and animals.
Good Seed Years	Irregular, perhaps twice in five years. Open-grown trees may begin producing fruit as young as 4 to 8 years., but the minimum seed-bearing age for commercial quantities of seed is about 12 years. Best seed production begins at 30 years of age and continues for about 100 years.
Germination	Many seedlings germinate from the nuts buried by squirrels. Normal freezing and thawing usually break dormancy the following spring, but germination is often delayed until year 2. Seedlings emerge in April or May of the first or second spring.
Seed Viability	Up to four years if stored in outdoor pits. Losses to squirrels and other rodents severely limit the success of direct seeding unless mechanical barriers are used to protect seeds.
Seedling Development	On deep, rich, moist soils, young seedlings may grow as much as 3 ft. the first year and double in height the following year. Growth is not as rapid as that of white ash but surpasses growth of the oaks. Height growth peaks in late April to May and ends by middle July to early August.
Growth	On the best sites, young trees grow 2 to 3 ft. per year. On less favorable sites, trees can attain heights of 30 to 40 ft. and diameters of 5 to 8 inches in 20 years. Trees 130 ft. tall and 100 inches in diameter have been reported in Wisconsin. Black walnut matures in 150 yrs. but may live to 250.

Vegetative Reproduction	Stumps usually sprout freely, but sprouts will develop heart rot or other decay from parent trees if they originate high on older stumps.
Shade Tolerance	Intolerant
Root Zone Antagonism	The growth of many species is inhibited in the root zone of black walnut. This effect is attributed to a toxic substance, juglone, which is present in walnut leaves, roots, and nut hulls. This compound is known to affect tomatoes, alfalfa, and conifers.
Major Pests	Black Walnut Pest Management Guidelines are included at the end of this chapter.

* From Fowells (1965).

2 MANAGEMENT GOALS, LANDOWNER OBJECTIVES

The management objective should be identified in relation to other land management objectives and be based on site potential. Possible alternatives include managing to produce the maximum quantity and quality of veneer and sawtimber, maintaining black walnut where it exists, and expanding the type within ecological limits.

3 LANDSCAPE, SITE, AND STAND MANAGEMENT CONSIDERATIONS

3.2 Site and Stand Considerations

3.2.1 Soils

Good soil is perhaps more important for black walnut than for any other species. The most important soil characteristics are texture, depth, and drainage.

The best walnut sites are deep loams, loess soils, and fertile, well-drained alluvial deposits. Good agricultural soils are generally the most favorable sites. Soils should be deep (preferably four feet or more to bedrock or water table), well-drained, moist (either floodplain, or northerly or easterly aspect), fertile, and nearly neutral in pH.

Other limiting characteristics include solum depth, and the presence of sand and gravel or clayey layers. Soils that are somewhat poorly to poorly drained are not suitable. External factors such as frost hazard, slope, aspect, and possibility of prolonged flooding are also important in site selection.

3.2.2 Site Quality

A general method (in the absence of known habitat types) for determining site quality is the use of site index curves (See Chapter 15 of this Handbook). The site index for black walnut can be determined from if walnut trees 15 years of age or older are present in the stand of interest. Do not manage for walnut if the site index is less than 40.

5 SILVICULTURAL SYSTEMS

5.2 Intermediate Treatments

5.2.1 Stem Quality

Pruning: Open-grown trees, as well as forest-grown trees, can always benefit from lateral pruning. Pruning should start before branches are two inches in diameter but should be suspended in closed stands as branches grow larger than three inches. Since a larger pruning wound can be tolerated by open-grown walnuts because of their faster growth, branches up to four inches in diameter may be pruned on open-grown trees. Dead branches of all sizes may be removed at any time.

5.2.2 Thinning

Release: Any walnut tree that is healthy, has a bole likely to make veneer or a high-quality log, and is small enough that it can be left to grow for at least ten more years should be considered for release. Three-fourths of the released crown should be at least five feet from the crowns of adjacent trees. The crowns of released trees, as well as the surrounding crowns, should be expected to expand rapidly.

Bole sprouting should also be expected on released trees. However, most of the sprouts will occur above the butt log so little extra pruning will be required.

5.3 Natural Regeneration Methods

Managing Natural Stands

Regeneration: If the walnut trees to be harvested are scattered individuals in a mixed forest, the recommended regeneration methods for the specific forest type should be followed.

If the soil type appears adequate for good walnut growth, planting should be done the year following the regeneration cut. Fifty seedlings per acre should be sufficient.

If walnut is to be harvested from a pure stand or plantation, the surest way to regenerate is by planting seedlings. Not enough is known yet about regenerating a pure stand or plantation by other methods to ensure success. Natural or planted seedlings must be released from shade after a few years, otherwise the number of surviving seedlings will decrease by two-thirds each year.

Fertilization: Research on this subject is not completely consistent, but in general:

a. release often increases diameter growth as much as fertilization does, if not more, and

b. nitrogen stimulates diameter growth more than phosphorous or potassium does.

If fertilizing is mandated, select sawlog-sized trees (greater than 15 inches) and spread 10 pounds of urea around the base of the tree over an area about 10 yards in diameter.

Treatments can be repeated at five-year intervals. Several similar trees should be left unfertilized to verify that the fertilized trees are responding to treatment.

Harvesting: Timing of the final harvest depends on market conditions and the potential increase in value if harvesting is deferred.
Most black walnut is grown to produce veneer and sawlogs. There are no standardized specifications for veneer trees. Veneer buyers have their own systems for selecting and evaluating potential trees. The seller can obtain a fair market value for his timber through competitive bidding, but there is no objective procedure for assessing market value of walnut veneer logs. Sawlogs can be evaluated more objectively using standard tree grades and current selling prices.

Although black walnut matures in about 150 years and may live to 250 years of age, economic maturity is the consideration for private landowners.

a. Slow-growing trees should be harvested as soon as they reach sawlog size (12 to 14 inches DBH).

b. Trees with average growth rates on medium sites (estimated at 8 to 12 rings per inch) should be left until they are greater than 16 inches DBH.

c. On good sites (estimated at 3 to 8 rings per inch), diameters of 20 to 24 inches DBH can be achieved. Leaving trees to grow larger than 24 inches DBH does not appear to be economically feasible for a reasonable return on a landowner's investment.

5.4 Artificial Regeneration Methods

In plantations, even-age management with periodic thinnings based on crown competition factor (CCF) control. In natural stands, single tree selection.

Managing Plantations
Most plantations have been disappointing due to poor growth or quality of the trees. This may be partly due to off-site planting or overstocking, but livestock grazing has also contributed to plantation failure, especially in the Midwest (Fowells, 1965).

Seed Source: Studies have shown that walnut trees from seeds originating south of the plantation site grow for a longer period during the growing season than those of local or northern origin. Seed sources located up to 200 miles south of the intended plantation site should be used (Schlesinger and Funk, 1977).

Seedling Selection: Only large, vigorous, well-balanced seedlings should be planted. Large seedlings outgrow small ones on a wide variety of sites. Seedlings 1/4-inch or larger in diameter (measured above the root collar) are recommended. The root may be pruned to 8-10 inches prior to planting but this step is not essential.

Site Preparation: In old fields, it is neither necessary nor desirable to destroy all herbaceous vegetation before planting. Strips mowed at the same spacing as the intended planting will expedite the planting job and create strips of weeds providing wind protection for developing seedlings. In brushy fields, however, brush should be removed before planting.

For grass and weed control, an herbicide may be used. Confirm your choice of herbicides with the state herbicide specialist before beginning, however. Be aware of the dangers in using herbicides. Read and follow label directions. Keep post-emergent herbicides off trees.

Planting Methods: Several planting methods are suitable for planting walnut seedlings. The KBC planting bar, a 12-inch tractor-mounted post hole auger, or a standard tree planting machine can be used. Care must be taken in all cases to ensure that seedlings are planted at the proper depth (the root collar should be about one inch below ground line). All seedlings should be checked after planting to make sure they are upright. Spring planting is recommended to aid in controlling competing vegetation around newly planted seedlings.

a. Spacing: In plantations intended for timber and veneer production, trees should be planted on a 10 ft. x 10 ft. grid. Plantations established at this initial spacing can be thinned from 436 to 23 trees per acre through a sequence of five thinnings (Figure 45.2. Black walnut stocking per acre for tree 8 to 25 inches in diameter (Schlesinger and Funk, 1977).

b. (Table 45.2). Irregular spacings such as 8 ft. x 12 ft., 6 ft. x 8 ft., or 7 ft. x 9 ft. may be preferable in some situations.

c. Interplanting: Other trees or shrubs may be interplanted with walnut for any number of reasons: to meet aesthetic goals, to provide wildlife cover or food, to yield an intermediate crop such as Christmas trees, or to serve as trainers or nitrogen-fixing species to stimulate black walnut growth.

White pine appears to be best suited for forcing height growth and providing an intermediate Christmas tree crop.

Maintenance:

a. Weed Control: After site selection, weed control is the next most important factor in establishing walnut plantations. Weeds and grasses must be controlled around each walnut seedling for the first 3 to 5 years to increase survival, promote faster growth, and to prevent insect and meadow vole damage. Walnut trees grow faster when weeds are controlled by herbicides rather than by mulching or cultivation.

b. Corrective Pruning: Corrective pruning should not be confused with lateral pruning; the latter is intended to develop knot-free wood, whereas the former is to help the tree develop a strong central leader and grow upright with few forks. Corrective pruning is needed when terminal damage has occurred from late spring frosts, insects, or deer browse.

Corrective pruning is best done during the dormant season after late spring frosts and winter deer browse. Some pruning in June or July may be done to remove multiple stems. The guiding principle when pruning is overall tree balance. Any leader at the same height as the central leader will force the central leader away from it. When the competing leader is removed, the central leader has the opportunity to adjust and regain balance.

c. Lateral Pruning: To produce a stem free of knots, it is necessary to periodically remove lower branches as the walnut tree increases in height until 17 ft. of bole are limb-free. Branches should be pruned before they are 2 inches in diameter to minimize damage and promote rapid healing. Pruning wounds made during the dormant season tend to heal more rapidly and sprouts from dormant buds are less likely to develop. If sprouts do develop, they should be promptly removed.

   Lateral pruning should begin when the trees are 10 ft. in height. Prune approximately 100 potential crop trees per acre. No more than 25 percent of the live crown should be removed in a single year. The live crown/length ratio should be maintained at no less than 50 percent.

d. Thinning Objectives:
   i. to maintain rapid growth of all potential crop trees for as long as possible while the trees intended for the final harvest are being selected, and
   ii. to grow the trees that will be removed in thinning operations to a size sufficient to yield saleable intermediate products.

   The rules for thinning black walnut are based on the Crown Competition Factor (CCF), a measure of competition that integrates tree size and the number of trees per unit area. Management objectives for timber and veneer production should maintain a CCF near 110. For optimum growth of individual trees on dryer sites, lower stocking levels may be required.

   In using CCF to guide the thinning decision, the manager must select upper and lower CCF levels between which the plantation stocking will be maintained. When the upper level is reached, the plantation should be thinned back to the lower level. The difference between the upper and lower levels determines how often thinnings will be required (Figure 45.1 and Figure 45.2).

   Use CCF to determine when to thin and how many trees to leave. The selection of crop trees must be made on-the-ground. In contrast to initial conifer thinning strategies, strict mechanical spacing for black walnut would defeat the purpose of leaving the best possible crop trees for eventual harvest. Thinning should also be planned so that each remaining crop tree will have had at least one competing neighbor removed.

   For mixed stands, and for overstocked plantations (i.e., CCF = 160 or more), stocking guide thinnings are not appropriate. The better approach for both mixed stands and

overstocked plantations is crop tree release following the guidelines for single tree culture (see below, "Natural Stands - Release"). The reason for this precaution is that reducing the stocking level to the lower CCF in one operation may result in epicormic branching. After overstocked plantations have been thinned, they can be brought under the stocking guide procedure.

e. Fertilization: On high quality sites, soil nutrients are not usually limiting to walnut growth. On mediocre sites, tree growth may be increased by fertilization, but the results may not be worth the investment. As a rule, fertilizing walnut plantations is not recommended.

8 APPENDICES

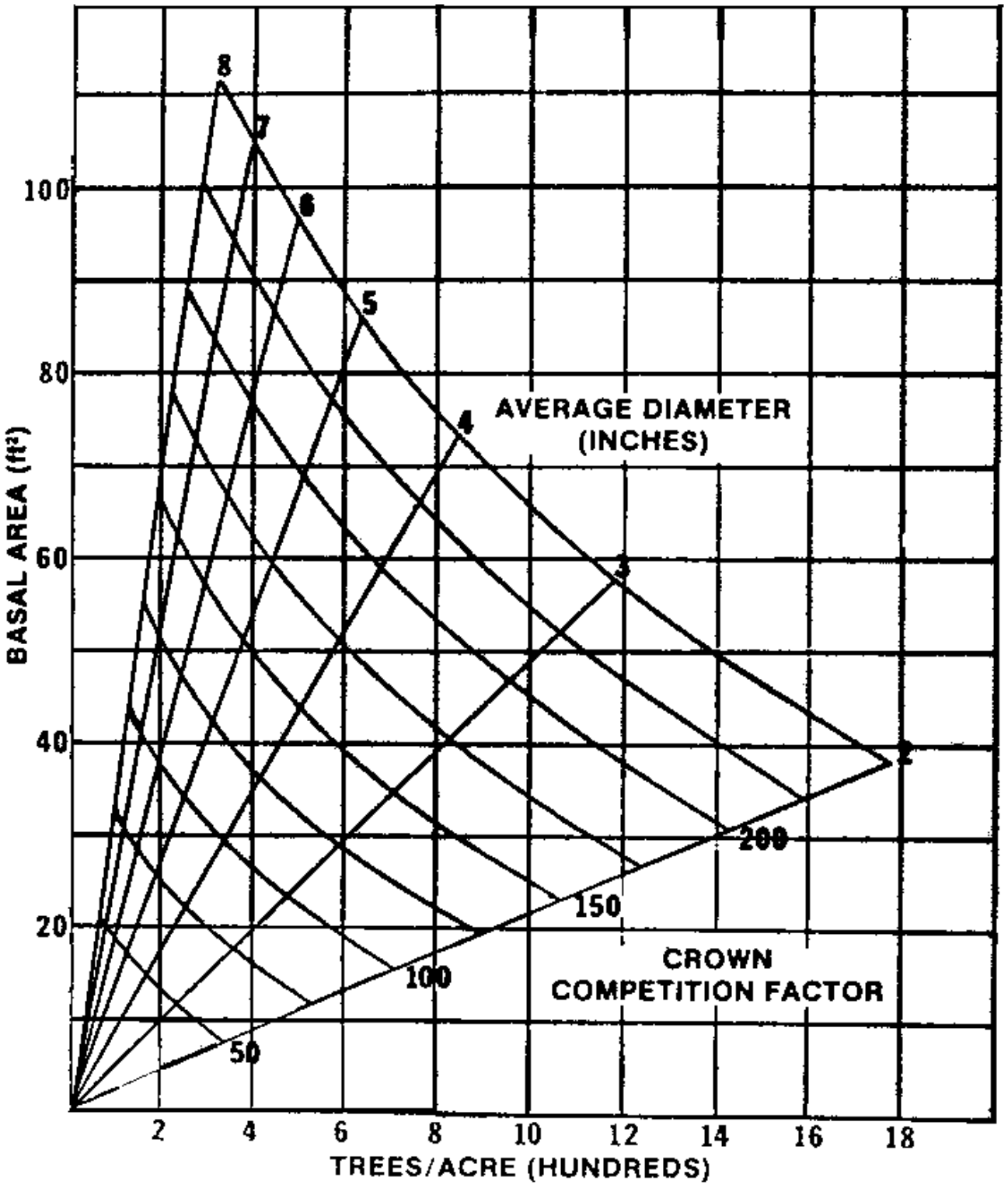

Figure 45.1. Black walnut stocking per acre for trees 2-8 inches in diameter (Schlesinger and Funk 1977).

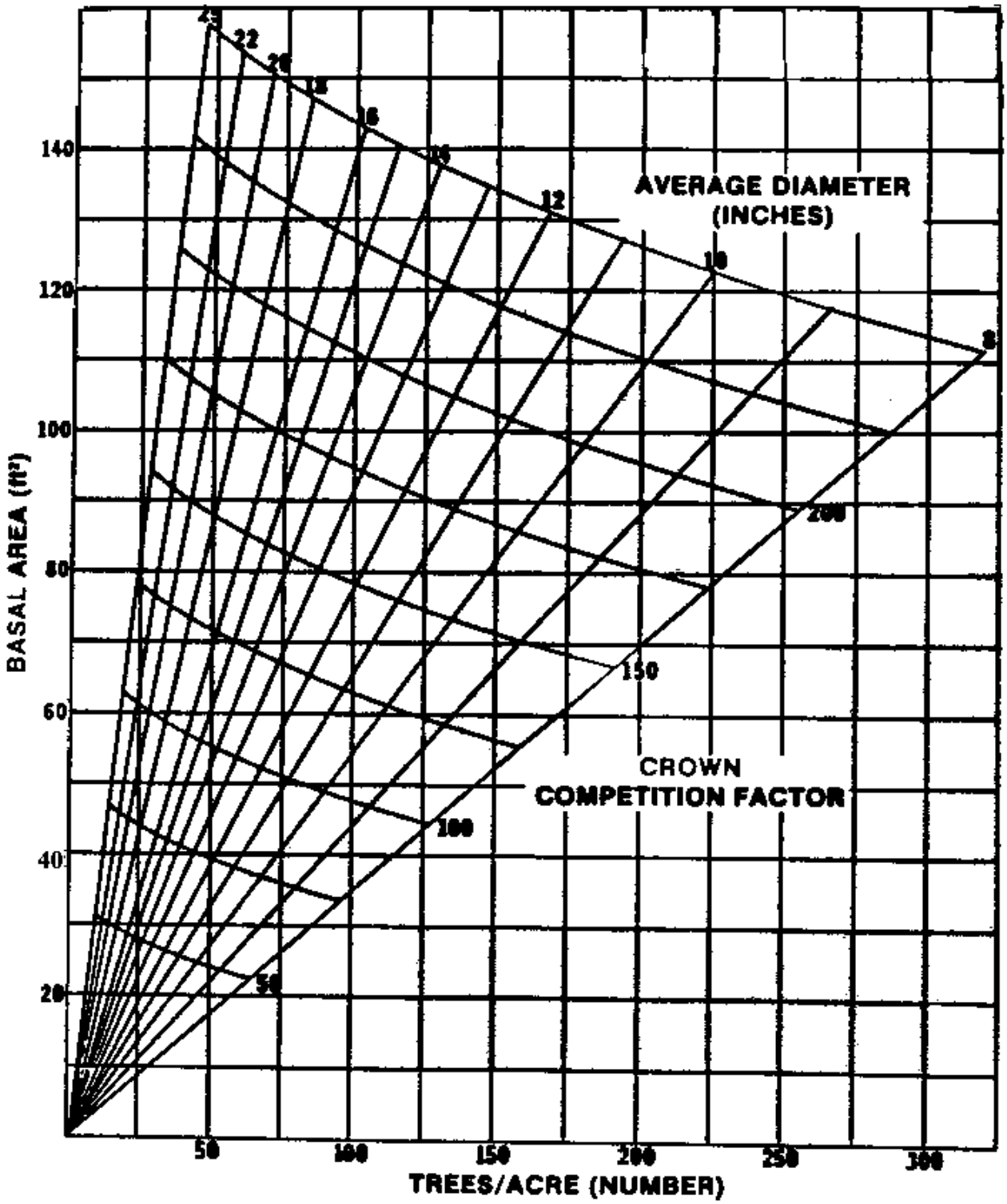

Figure 45.2. Black walnut stocking per acre for tree 8 to 25 inches in diameter (Schlesinger and Funk, 1977).

Table 45.2. Black walnut thinning schedule for timber and veneer production.*

	Before thinning Trees/acre (number)	Average DBH (inches)	After thinning Trees/acre (number)	Average DBH (inches)
1st Thinning	436	3.5	235	4.0
2nd Thinning	235	5.6	131	6.2
3rd Thinning	131	8.4	73	9.1
4th Thinning	73	12.1	41	13.0
5th Thinning	41	16.9	23	18.0
Harvest	23	23.4	---	---

* For timber and veneer production, an upper CCF of 110 and a lower CCF of 70 appear best. Assuming a 10 ft. x 10 ft. spacing at time of planting the above thinning schedule would be applied. The first two thinnings will most likely be non-commercial (fuel wood or possible home use). The third thinning could be used for small specialty products.

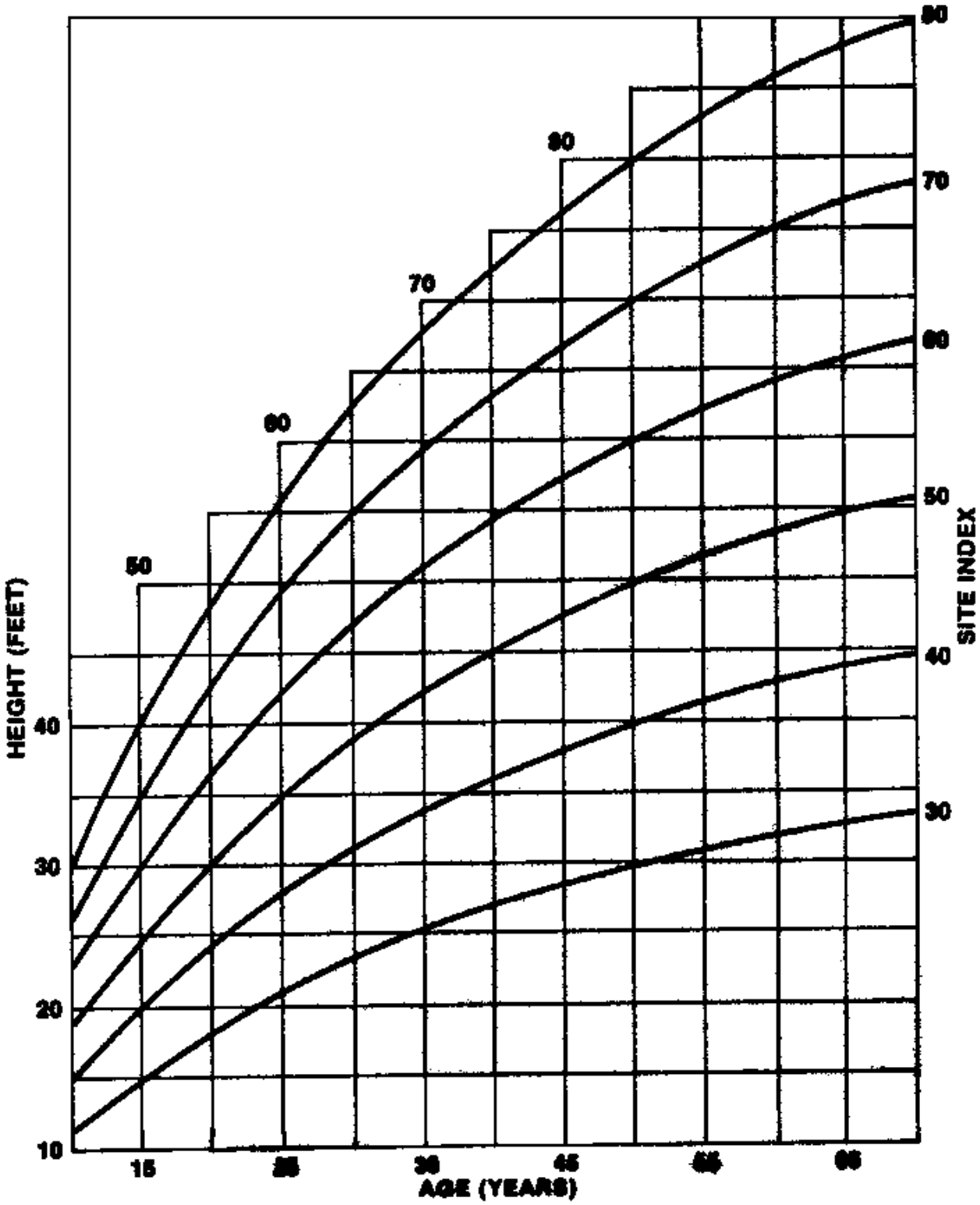

Figure 45.3. Site index curves for black walnut (Schlesinger and Funk 1977).

8.1 Forest Health Guidelines - Forest Health Protection (FHP)

HAZARD	LOSS OR DAMAGE	PREVENTION, MINIMIZING LOSSES AND CONTROL ALTERNATIVES	REFERENCES
Walnut caterpillar	Late summer defoliation. Normally an individual branch may be defoliated by a single colony and little growth loss occurs. During outbreaks, heavy defoliation may occur in closely spaced sap-lings and in individual, large open-grown trees, but seldom in closed natural stands. Heavy growth loss and twig dieback may occur. Following seed crops may be stunted. Trees heavily defoliated 2 years may die.	1. Do nothing and accept defoliation. 2. Clip off twigs with colonies or larvae. 3. Scrape caterpillars off molting mat on tree trunk. 4. Spray small larvae with the biological insecticide, ***bacillus thuringiensis***. 5. Spray medium to large larvae with chemical insecticide.	How to Identify and Control the Walnut Caterpillar. M. Farris, et al. 1978. USDA Forest Service.
Fall webworm	Mid- and late-summer defoliation of individual branches. Seldom serious.	1. Do nothing and accept defoliation. 2. Pull webs off branches. 3. Spray with chemical insecticide.	How to Diagnose Black Walnut Damage. B.C. Weber, et al. 1980. USDA Forest Service. Gen. Tech. Rep. MC-52.
Walnut Anthracnose and ***Mycosphaerella*** Leafspot	Discoloration and loss of foliage in mid and late summer. Causes growth loss and reduces nut quality.	Control is seldom required. In stands with repeated heavy damage, consider: 1. Nitrogen fertilization. 2. Disking down leaves in autumn (fungus overwinters in leaf stems). 3. Interplant walnut with autumn olive or Russian olive. 4. Control weeds when trees are young to reduce humidity.	How to Identify and Control Leaf Spot Diseases of Black Walnut. W.M. Black, et al. 1977. USDA Forest Service. How to Identify and Control Black Walnut Mycosphaerella Leaf Spot. K. Kessler. 1985. USDA Forest Service NCFES.

BUD, SHOOT AND TWIG PESTS			
Case bearers (***Acrobasis*** sp.)	Destruction of buds and shoots in spring cause main stem deformity, height growth loss of saplings, and loss of nut crop.	1. Do nothing; accept deformity. 2. Apply corrective pruning to improve form. 3. Plant at close spacing (or interplant with another species) to force trees to grow straight regardless of shoot damage. 4. Apply chemical insecticide shortly before bud break in late April.	Walnut Insects and Diseases. Workshop Proceedings. USDA Forest Service. 1979. Gen. Tech. Rep. NC-52. 100pp.
Tree hoppers	Egg laying under bark may kill twigs. Normally not serious; occasional heavy damage causes stunting of saplings.	Control seldom necessary.	How to Diagnose Black Walnut Damage. B.C. Weber, et al. 1980. USDA Forest Service. Gen. Tech. Rep. NC-52.
White-tailed deer	Browsing causes deformity and height growth loss of seedlings and young saplings.	1. Intensive hunting. 2. Repellents (variable success). 3. Corrective pruning to improve form. 4. Remove heavily damaged stems during thinning. 5. Use protective tubes.	Deer. Scott Craven. 1983. In: Prevention and Control of Wildlife Damage. Univ. Neb. Ext. Publ.
Frost damage	Late frosts in low lying areas. Kills foliage and new shoots causing growth loss and deformity of main stem.	1. Avoid establishing walnut stands in known frost pockets. 2. Apply corrective pruning to improve form. 3. Establish dense stand to force trees to grow straight regardless of shoot damage.	How to Diagnose Black Walnut Damage. B.C. Weber, et al. 1980. USDA Forest Service. Gen. Tech. Rep. NC-52.

MAIN STEM PESTS			
Stem canker	Canker on main stem, usually kills whole tree or top. Sprouts develop below canker. Canker usually more prevalent on bottomland sites than upland. Outbreaks may cause severe mortality.	1. Remove diseased material. 2. Prune trees when dormant. 3. Prune dead branches as well as live. Do not allow dead branches to remain on tree. Dead limbs may provide an entry point for canker infection. 4. Inter-plant with other species.	How to Diagnose Black Walnut Damage. B.C. Weber, et al. 1980. USDA Forest Service. Gen. Tech. Rep. NC-52.
Perennial target canker (***Nectria***)	Canker on main stem causes wood defect, stunting or mortality of sapling to sawlog sized trees.	Cut and remove infected material from stand including other infected hardwoods before April 1.	How to Diagnose Black Walnut Damage. B.C. Weber, et al. 1980. USDA Forest Service. Gen. Tech. Rep. NC-52.
Yellow-bellied sapsucker	Wounding of thin bark of saplings and pole-sized trees causes wood defect. May kill tree directly, may allow entry of canker or decay fungus.	Leave attacked tree in place. Birds will attack same tree repeatedly and limit damage to one tree at a time.	How to Identify and Control Sapsucker Injury on Trees. M. Ostry, et al. 1976. USDA Forest Service.
Meadow vole/meadow mouse	Gnawing on bark at base of tree during winter results in mortality of trees up to 5 years old. Heavy grass concentra-tions support population build-up and may result in heavy tree mortality.	1. Control grass and weeds first 5 years after planting. 2. Apply rodenticide baits.	Meadow Mouse Control. Scott Craven. 1981. Univ. Wisc. Ext. Leaflet A2148.

9 REFERENCES

Fowells, H. A. 1965. Agric. Handbook No. 271, *Silvics of forest trees of the United States*. USDA-Forest Service: Wash., D. C. p. 203-7.

Schlesinger, R. C., and D. T. Funk. 1977. General Technical Report NC-38, Manager's handbook for black walnut. USDA-Forest Service: North Central For. Exp. Sta., St. Paul, MN. 22 pp.