Characteristics Of Good Growing Sites For Black Walnut

Felix Ponder, Jr.
USDA Forest Service, North Central Forest Experiment Station,
208 Foster Hall, Lincoln University, Jefferson City, MO 65102

Abstract: Black walnut (Juglans nigra L.) occurs as a minor component in stands of mixed deciduous forest in the eastern United States. Black walnut grows on a variety of soil textures and landscape positions, but grows best on soils having good drainage, aeration, moisture availability, and fertility. Areas being considered for planting walnut should be thoroughly investigated for site quality for the species before planting. Soil and site requirements for locating black walnut planting sites are presented.

Eastern black walnut is very demanding when it comes to site conditions required for good growth. It typically grows as scattered individual trees or in small groups throughout the central and eastern parts of the United States and southern Ontario. Black walnut can survive temperatures as low as -45°C in some areas of its natural range (Fowells 1965). It is genetically variable in growth and survival (Bey 1980; Funk et al. 1981).

Site selection should rank at the top of the walnut grower's list of important things to do when deciding to plant black walnut. The value of walnut wood has more to do with the number and size of high quality logs than with the amount of fiber produced. Good height growth is essential for extra logs and good diameter growth is essential for high value-logs. Neither good height growth or good diameter growth can be obtained on poor quality land.

Information on how soils affect black walnut nut production is lacking. However, because nut production is a nutrient- and moisture-drain on the tree, soil characteristics that encourage good growth and wood production, should also be important for nut production.

It would be very convenient for the potential walnut grower to select areas to plant if the "good and bad" soils for growing walnut in a county were identified and located on a map. Soils in Illinois, southeast Minnesota, Iowa, and Indiana were classified as suitable, questionable and unsuitable for growing black walnut (Losche et al. 1980, Ponder and Johnson 1984, Ponder and Johnson 1986, Ponder et al. 1989). But because all soils are not good or bad for the same reason, they should be evaluated individually with an on site investigation, even when the soil description indicates favorable characteristics for growing the species.

WHAT ARE THE IMPORTANT SITE REQUIREMENTS?

Black walnut will grow on a wide variety of soils and landscape positions (Table 1), but more important to the grower is the growth rate on each kind of soil. It grows best on deep, well-drained, nearly pH-neutral soils that are fertile and moist, but not wet. It should be protected against wind and against spring and fall frost. The most favorable sites are in well-drained bottomlands (Losche 1973). The better walnut sites on upland topography are located in the lower north- and east-facing slopes, in coves, and along narrow streams. South-facing slopes and narrow ridge tops are poor

walnut sites because soils are often dry, shallow, and highly susceptible to erosion. The soil must have good internal drainage and aeration. Avoid areas that remain flooded for 3 days or longer.

SOIL DEPTH

The soil profile on good black walnut sites should be at least 3 feet deep without obstructions that may affect the development of the root system. Shallower soils will not hold enough water to support satisfactory tree growth. Also, the grower must realize that even the 3-foot depth could limit growth and the final product to be harvested (Table 2). An effective soil depth of 5 feet (without restrictive layers) would better ensure plenty of room for root system development and water storage.

SOIL DRAINAGE

Excessively drained or poorly drained soils are unsuitable. These soils restrict air movement, inhibit root growth, and reduce tree height and diameter (Table 3). Soils that are poorly drained or have a high water table are likely to have an unpleasant odor and a blue or drab color composed of a mixture of gray and blue called mottling. Avoid soils with these colors or conditions within 2.5 feet of the soil surface. Soils with good internal drainage usually are brown, reddish brown, or yellowish brown.

A complacent attitude shouldn't be assumed if a new plantation is showing good growth. Hidden site problems may not express themselves until a much later age in the life of the plantation. It sometimes takes five or more years for the root system to be substantially affected by soil characteristics hidden below the surface. As a young walnut tree ages, its root system must develop properly. If during this period, a stratum of rock, gravel, fragipan, heavy clay or poorly drained soil is encountered, this development is restricted, resulting in the loss of vigor. The nearer to the surface the restricting factor is located, the sooner it will be evidenced by reduced top tree growth.

SOIL TEXTURE

Soil texture affects soil water-holding capacity, influences the ease at which water moves into and through the soil, and root penetration. A soil's texture is determined by the amounts of sand, silt, and clay particles it contain. Ideal soil textures include loam, sandy clay loam, silt loam, and clay loam (Table 1). Soils with moderately fine textures (more silt than clay or sand), such as a silt loam, will generally have sufficient amounts of nutrients, yet will be reasonably well drained. Sandy soils often are low in nutrients and are excessively drained; heavy-textured soils, such as clays, may limit water movement and root growth of black walnut. The intermediate textured soils such as the loams have better moisture holding capabilities combined with good aeration. A loam textured soil also has the best structure (arrangement of soil particles to form aggregates or peds) because of the various sizes of particles, even in a loose structure, have large pores between aggregates allowing for both moisture and aeration. Good planting sites also include limestone soils with silt loam over clayey subsoil and deep rocky soils unsuited for cultivation because of their rockiness.

SOIL NUTRITION

Black walnut is demanding in terms of soil nutrients. The size of the soil particles affects the availability of nutrients. In general, finer textured soils provide more nutrients than coarser soils. The nutrient requirements of black walnut are generally the same as it is for non-irrigated corn. The pH of the soil helps to regulate nutrient availability. The upper 6 inches of the soil should have a pH of 6.5 to 7.2 (Table 4). It is recommended that the surface soil (A horizon) has an organic matter content near 3.5 percent and has an adequate supply of nutrients (Parker et al. 1992). Fertilization is usually not needed or recommended at the time of planting. The money will be better spent if used to add limestone to correct the pH and to provide 3 to 4 years of weed control. Eliminating grasses or preventing their development within 3 feet of the trees until crown closure will reduce competition for nutrients and moisture, thereby creating an ideal condition for tree growth.

CLIMATE

The local climate is an important part of the site. Avoid low areas where cold air settles at night and might cause night frost in late spring or early fall. The cold air drainage problem becomes worse near the northern part of black walnut's distribution range. In such cases, the warmer southern slopes may be more favorable than the northern cooler slopes. Avoid areas that may be subject to unusual night frost. However, these areas may not be easily identified. Avoid sites that are noted for late spring frosts. In the northern part of walnut's distribution range, plantation success may be enhanced by planting seedlings developed from seed of cold hardy parents (Li et al. 1992). Cold hardiness in black walnut is under strong genetic control (Parrot 1971).

Wind affects the establishment of black walnut. Seedlings planted in level, windswept, open fields are less vigorous, have smaller leaf areas, and suffer more foliage damage than those planted in similar soils in either forest openings or protected fields (Schneider et al. 1970). The impact of wind on nut production is not known.

SITE IMPROVEMENTS

Can black walnut be grown successfully on land that lacks one or more of the recommended characteristics of suitable soils for growing black walnut? Several practices have been tried in an effort to increase the productivity of marginal sites. Most attempts such as fertilizing sites believed depleted of nutrients and refilling deep trenches and title drainage in poorly drained soil have resulted in limited success. An alternative to fertilization may be to interplant with nitrogen-fixing plants (Van Sambeek and Rietveld 1981). Also, planting companion trees and forage legumes on walnut sites may provide an alternative to chemical weed control.

Cultural practices designed to increase soil moisture might promote walnut growth. These practices include irrigation, terracing, mulching, and control of undesirable moisture using vegetation. Practices designed to improve subsoil drainage and aeration might include surface and title drainage and, in addition, deep tillage may promote better rooting in the subsoil.

Prevent mistakes, get help. Soil survey reports are available for most counties where black walnut can be grown and can be obtained from local Natural Resource Conservation Service Centers. They are the best source of information for judging the suitability of a site for black walnut. They contain

detailed map of soil units with descriptions of each soil including woodland suitability groupings for different tree species. A pre-planting soil analysis and soil survey will reveal the presence of limiting nutrients as well as other undesirable soil features and prevent much frustration and delayed hope.

The local district foresters with the Missouri Department of Conservation are another good source of assistance. They can help interpret the soil survey report and provide additional assistance on site selection. In many instances, they are familiar with the species/soil relations for the soils in the district.

The other tool needed for checking the soil on the site is a shovel or a soil probe. Findings should be compared to the recommended site requirements for black walnut. When properly interpreted, the combination of site requirements and the characteristics of the site being investigated should yield success in selecting the ideal black walnut planting site.

REFERENCES

Bey, C.F. 1980. Growth gains from moving black walnut provenances northward. J. For. 78:640-645.

Fowells, H.A. 1965. Silvics of forest trees of the United States. U.S Dep. Agric. Agric. Handb. 271.

Funk, D.T., D. Neely, and C.F. Bey. 1981. Genetic resistance to anthracnose of black walnut. Silvae Genet. 30:115-117.

Li, P., L. Parrot, and J. Bousquet. 1992. Introduction of black walnut in southern Quebec: evaluation of 21-year-old full-sib families. Can. J. For. Res. 22:1201-1204.

Losche, C.K. 1973. Black walnut growth better on deep, well-drained bottomland soils. USDA For. Serv. North Cent. For. Exp. Stn. Res. Note NC-154, 3 p.

Losche, C.K., M.C. Clark, E.E. Voss, and B.S. Ashley. 1980. Revised guide to the selection of soil suitable for growing black walnut in Illinois. Spec. Pub. Northeastern Area, State and Private Forestry, Upper Darby, PA. 38 p.

Parker, D.,J. Bockheim, and D. Meyer. 1992. Soil and site selection. Fact Sheet No. 68, Walnut Tips. Wisconsin Walnut Council.

Parrot, L. 1971. Le climat, facteur selectif, et l'adaptation genetique de Juglans nigra L., espece exotique au Quebec, Canada. Silvae Genet 20:1-9.

Ponder, F., Jr. and P. Johnson. 1984. Guide to selecting black walnut planting sites in southeast Minnesota. USDA SCS, Rochester, MN, 27 p.

Ponder, F., Jr. and P. Johnson. 1986. Guide to selecting soils for black walnut planting sites in Iowa. Iowa Conservation Com., For. Section, Des Moines, IA, 85 p.

Ponder, F., Jr., P. Johnson, and W. Beinke, 1989. Guide to selecting soils for black walnut planting sites in Indiana. Purdue Univ. Press. Purdue Agricultural Exp. Stn. Station Bul. 562.

Schneider, G., G. Khattak, and J.N. Bright. 1970. Modifying sites for the establishment of black walnut. pp. 155-169. In: C.T. Youngberg and C. B. Davey, eds. Forest Soils Conf., Raleigh, NC.

Van Sambeek, J.W and W.J. Rietveld. 1981. Seeding forage legumes in black walnut plantations. Walnut Council Bull. 8:6-8.

Table 1. Significant soil/site characteristics for black walnut growth

Soil/site characteristics	Suitable	Questionable	Unsuitable
Slope Exposure	North or east		South or west
Position on Slope	Middle, or lower with good drainage		Upper, or lower with poor drainage
Slope	0 to 15%	15 to 30%	>30%
Depth to bedrock, gravel or clay layer	> 3 feet	2 to 3 feet	< 3 feet
Drainage class	Well drained to moderately well drained	Somewhat poorly drained	Excessively drained, poorly to very poorly drained
Duration of flooding	Standing water up to 4 days in early spring		Standing water more than 4 days
Soil texture	Loam, silt loam, silty clay loam, silt, clay loam, sandy loam, sandy clay, fine sandy loam	Silty clay	Clay, sand, loamy sand, loamy fine sand

Table 2. Effect of depth to gravel layer on height and diameter at breast height (d.b.h.) growth of 25-year-old black walnut.[1]

Depth to gravel layer	Height growth	D.b.h. growth
	----Inches----	
< 40	34.1	3.9
> 40	51.4	6.4

[1]Losche, C.K.1973.

Table 3. Effect of soil drainage on mean height and diameter at breast height (d.b.h.) of 25-year-old black walnut.[1]

Drainage class	Depth to mottling	Height	D.b.h.
	----------	Inches	----------
Well-drained	> 30	52.2	6.8
Imperfect	6 - 30	50.2	5.8
Poorly	< 6	47.1	5.3

[1]Losche, C.K. 1973.

Table 4. Recommended soil nutrient concentration ranges for suitable black walnut planting sites

		Anaylsis				
pH	Organic matter (%)	N(%)	P(lbs/a)	K(lbs/a)	Ca (lbs/a)	Mg (lbs/a)
6.5 - 7.2	2.0 - 3.5	0.25 - 0.3	60 - 80	225 - 275	2500 - 4000	300 - 600