# PART 2

# ESTABLISHING THE WALNUT PLANTATION

# Characteristics Of Good Growing Sites For Black Walnut

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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


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**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 |

# Why Nut Evaluation?

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## EARLY OBSERVATIONS

Early evaluations were based on visual observation with a descriptive analysis of the nut and usually the tree. For example, Thomas black walnut was discovered in 1881. It was described as being a prolific bearer, cracked much better than the average black walnut, and was larger in size and better flavored than other black walnuts. Kernel extraction was very good because of the roomy chambers of the shell. (5)

Other early descriptive terms used were as follows: A large nut; 19 nuts per pound; bears at an early age; thin shelled; cracks well; kernels easily extracted; kernels plump; good shell structure; and color and flavor of kernel is good.

These terms describe what the eye was seeing when the nuts and tree were compared to other native nuts and trees or other named cultivars.

## JUDGING NUT SAMPLES

Judging nut exhibits at fairs and shows differs from evaluation contests. In exhibition judging, the classes are usually set up to include only a single cultivar or clone. The problem here is to judge a sample in comparison with the other entries of nuts of the same clone, and to rank these as 1st, 2nd, 3rd, etc. Here the schedule is concerned with such characteristics as size and uniformity of nuts in the sample, the color and attractiveness of the shell, and the color, plumpness, and quality of the kernels. In these exhibits, much depends on the showmanship of the exhibitor and the selective skills. The entry does not give information as to the intrinsic value of the clone as related to the other clones. (3)

The first judging schedule of points was devised by Professor E. R. Lake in 1915.

| | |
|---|---|
| General Values: | |
| Size | 10 |
| Form | 5 |
| Color | 5 |
| Shell Values: | |
| Thinness | 15 |
| Cracking | 20 |
| Kernel Values: | |
| Plumpness | 5 |
| Color | 10 |
| Flavor | 10 |
| Quality | 20 |
| Total | 100 |

Note: For insect or fungus injuries deduct 5-20 points.
Other score cards were established for chestnut, filbert, pecans, and Persian walnuts.

It was pointed out at the time that it was important at all times to have in mind the idea of working to keep the quality very high.

More recently, L.H. MacDaniels (4) offers a suggested judging schedule as follows:

## JUDGING SCORECARD

| | Points | Comments: |
|---|---|---|
| External Nut Characters: | | |
| Size | 15 | The larger nuts are preferable. |
| Condition | 10 | Sutures not split. Not excessively dry. Free from fiber. |
| Color | 10 | Bright, attractive, not stained. |
| Uniformity | 15 | Uniform size. |
| Internal Kernel Characters: | | |
| Plumpness | 25 | Plump, smooth, and free from high oil content (except chestnuts). |
| Color | 10 | The lighter the better. |
| Flavor | 15 | Not rancid or astringent, high in fat. |

Upon comparing the two score cards the original card places 55% weight on external characters and 45% on kernel characters. The newer card places equal value on external and kernel values.

## EVALUATION OF NUTS

Evaluation is a means of improving nut culture by finding, describing, and comparing the trees; which consistently produce abundant nut crops of superior quality. (2)

There are two parts necessary to completely evaluate a given clone. The first part is an evaluation of a sample of nuts according to an accepted schedule that will determine the relative merit of the sample of nuts. The second part of the evaluation has to do with characteristics of the tree itself, such as hardness, productivity, leaf health, branch angles, tree form, vigor, susceptibility to pests, regularity and volume of cropping, and response to propagation techniques.

In Nebraska, we have thus far limited our evaluation to ranking samples of nuts submitted by members and others either in-state or out-of-state.

We are using the Iowa scoring system, which we modified by adding taste as a factor of kernel quality. Our formula for scoring black walnut would be as follows:

> Final score = % kernel divided by (seal + appearance + usability + size + separation + pieces + kernel size + kernel color + kernel veining + shrivel + taste grade) X 100.

The reason taste was added to the scoring is the fact that the two score cards previously shown used taste as part of the scoring for shows. Also, in the survey of NNGA members conducted by Doug Campbell several years ago, eating quality ranked very high on the list of traits. (1)

Under the direction of Dr. Bill Gustafson, a scoring program called "NUT EVALUATION" has been devised. The raw data is fed into the IBM-AT Computer. The computer performs all of the calculations and will rank samples in descending order, from the highest score to the lowest score. It also prints out the various scores assigned by the grading committee so that a person can make comparisons between various samples. This makes it easy to convey the information to the newsletter, and saves much time in making hand calculations.

## WHY EVALUATE NUTS?

1. It provides a method of finding new cultivars of superior quality.
2. It provides a method of rating named varieties in your area.
3. It is a good method to develop enthusiasm among members of a state association.
4. It is only as the nuts themselves have merit that other characteristics are worthy of further consideration.
5. Educational value of nut evaluation process and visual comparison of various nut samples.

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## NUT EVALUATION ENTRY

Date_____ Tree I.D. Number_____

TREE DESCRIPTION Species_____

1. a. _____Native _____ Planted_____ Grafted
   b. Clone/Cultivar name: _____

2. a. Estimated age:_____ years
   b. Circumference @ 4½ ft: _____ inches
   c. Estimated height: _____ feet
   d. Average crown spread: _____ feet

3. Location (legal description, directions or town address)
   _____
   _____
   _____

4. Average interval between nut bearing: _____ year(s)

5. Estimated production: (husked nuts)

| | #Nuts or | Bushels or | Pounds |
|---|---|---|---|
| This year | _____ | _____ | _____ |
| Last Year | _____ | _____ | _____ |
| 2 Years Ago | _____ | _____ | _____ |

6. Have nuts from this tree been entered in past evaluations?
   Yes_____ No _____ What year _____ Entry #_____

Special Notes

I enclose 15 nuts from above tree to be evaluated by the Nut Growers Association.

Return to: Nut Evaluation Committee

Name: _____

Address: _____

_____Zip _____

Phone: (_____)_____

## NUT EVALUATION

The Nut Growers Association annually conducts a "Nut Evaluation Program" to locate nut trees which produce superior quality nuts. Common species for evaluation include: Black Walnut, Persian (English) Walnut, Pecan, Hickory, Butternut, Hazelnut, and Heartnut, but other tree entries will be accepted and evaluated.

Contest Rules

1. Each entry consists of 15 nuts (no limit on number of entries).
2. Nuts must be clean. Remove all husks (hulls); wash the nuts and allow to dry for about two weeks. A steel brush works well to remove residue.
3. A "Nut Evaluation Entry" form (or copy) must accompany each entry.
4. Entries should be received by December 31 or stored under refrigeration prior to the evaluation.

Please complete and return each entry form to: Nut Growers Association, Nut Evaluation Committee.

Name: _____ Address:_____

Entry Number:_____ Code:_____

# BLACK WALNUT EVALUATION SHEET

Native:_____ Seedling:_____ Clone:_____ Cultivar:_____

| | **Nut Quality** | **Grade** |
|---|---|---|
| SEAL: Number of nuts: _____ | #1 All Sealed tightly<br>#2 1 or 2 defective nuts/5 nuts<br>#3 2, 5 or more defective/5 nuts | _____ |
| APPEARANCE: | #1 Uniform size, symmetric, smooth<br>#2 Intermediate<br>#3 Variable size, asymmetric, rough | _____ |
| USEABILITY: _____Nuts out of__ | #1 5 out of 5 nuts useable<br>#2 5 out of 6 nuts useable<br>#3 5 out of 6.5 or more nuts useable | _____ |
| SIZE: Sample Weight _____grams | #1 > 20 gms./nut<br>#2 15-19.9 gms./nut<br>#3 < 14.9 gms./nut | _____ |

## Cracking Quality

YIELD: Sample total Kernal wgt ._____ total nut wgt._____ x 100 = % kernel_____

| | | | |
|---|---|---|---|
| SEPARATION: | Kernel recovered 1st crack = _____ gms. | #1 > 90% 1st crack | _____ |
| | Kernel recovered 2nd crack = _____ gms. | #2 60-89% 1st crack | |
| | Total kernel recovered _____ gms. | #3 < 59% 1st crack | |
| PIECES: | Kernels that are in ½ s =_____ ¼ s = _____<br>(½ s x 2 + ¼ s = No. of ¼ s) | #1 > 19/20 ¼ s<br>#2 12-18/20 ¼ s<br>#3 11/20 ¼ s | _____ |

## Kernel Quality

| | | |
|---|---|---|
| SIZE: Kernel wgt./nut = _____ gms. | #1 > 5 gms./nut<br>#2 4.0-4.9 gms./nut<br>#3 < 3.9 gms./nut | _____ |
| COLOR: #1 Light & bright<br>#2 Intermediate<br>#3 Dark and dull | | _____ |

VEINS: #1 Slight _____
#2 Moderate
#3 Prominent

SHRIVEL: #1 > 19/20 ¼ ŝ nonshriveled _____
#2 15-18/20 ¼ ŝ
#3 < 14/20 ¼ ŝ nonshrivelled

TASTE: Classed as #1 exceptional _____, #2 average_____, #3 inferior_____, _____

REMARKS: Total Grade _____

Final Score: _____

% Kernel
---------- x 100
Total Grade Placing: _____

*Forms for nut species can be obtained from the Iowa or Nebraska Nut Growers Association.

## SCORING FORMULAS

1. MacDaniels Score*
   a. weight of a 10-nut sample in grams
   **b.** weight of kernels obtained by first crack
   **c.** total weight of all kernels in sample
   **d.** number of whole quarters of kernel in sample

The sample score is the sum of the weight of kernels from first crack in grams, the total weight of kernels divided by 2, and the number of quarters divided by 2. Pg. 436, Nut Tree Culture in North America.

2. Iowa Score No 1**
   Final Score = (crackout %) divided by (nut size + seal + appearance + useability + separation + pieces + kernel size + color + veins + shrivel grades) x 100

3. Iowa Score No 2
   Final Score = (crackout %) divided (nut size + seal + appearance + useability + seperation + pieces + kernel size + color + veins + shrivel grades) x 100

Iowa adds all three of the above scores together to get their final score.

*MacDaniels score favors large size nuts.
**Iowa Score No 1 favors the percentage of kernel in a nut.

4. Nebraska Score:
   Final Score = (crackout %) divided by (nut size + seal + appearance + useability + separation + pieces + kernel size + color + veins + shrivel + taste grades) x 100

## BLACK WALNUT CULTIVARS
## With greater than 35% kernel to shell ratios

### Nebraska Evaluations 1987-1996

| Source | Cultivar | Grams per Nut | Grams of Kernel/ nut | % Kernel | Nuts per pound | Lbs. Of Nuts per Lb kernal | Score | Rank |
|---|---|---|---|---|---|---|---|---|
| **1987** | | | | | | | | |
| Baker (MO) | Emma K | 16.00 | 6.0 | 37.50 | 28.35 | 2.666 | 234 | 2 |
| Bently (NE) | Krouse | 12.80 | 4.6 | 35.94 | 35.44 | 2.783 | 200 | 4 |
| **1988** | | | | | | | | |
| No Cultivar scored over 35% | | | | | | | | |
| **1989** | | | | | | | | |
| Bauman (OH) | Myers | 15.60 | 5.66 | 36.28 | 29.08 | 2.756 | 259 | 1 |
| Bauman (OH) | Emma K | 18.00 | 6.70 | 37.22 | 25.20 | 2.686 | 248 | 2 |
| Gardner (MO) | Emma K. | 18.40 | 6.52 | 35.43 | 24.65 | 2.822 | 221 | 4 |
| **1990** | | | | | | | | |
| UNL, M-7 (NE) | Sparks 147 | 17.15 | 6.07 | 35.39 | 26.45 | 2.825 | 236 | 3 |
| **1991** | | | | | | | | |
| UNL L-9 (NE) | Sparks 147 | 17.20 | 6.64 | 38.58 | 26.37 | 2.590 | 276 | 1 |
| UNL O-5(NE) | Wrights G-4 | 19.67 | 7.10 | 36.08 | 23.06 | 2.770 | 258 | 2 |
| Lane (MO) | Jackson | 13.38 | 4.85 | 36.29 | 33.90 | 2.759 | 242 | 6 |
| UNL M-7(NE) | Sparks 147 | 13.43 | 5.06 | 37.67 | 33.77 | 2.654 | 222 | 9 |
| **1992** | | | | | | | | |
| UNL P-7 (NE) | Sparks 127 | 12.00 | 4.46 | 37.26 | 37.80 | 2.691 | 233 | 3 |
| **1993** | | | | | | | | |
| Lane (MO) | Sparks 127 | 17.34 | 6.19 | 35.68 | 26.16 | 2.801 | 223 | 2 |
| UNL M-7 (NE) | Sparks 147 | 16.00 | 6.14 | 38.41 | 28.35 | 2.606 | 202 | 8 |
| UNL L-3 (NE) | Sparks 127 | 11.55 | 4.11 | 35.58 | 39.27 | 2.810 | 198 | 9 |
| UNL L-1 (NE) | Sparks 127 | 11.40 | 4.26 | 37.36 | 39.79 | 2.610 | 197 | 10 |
| UNL L-9 (NE) | Sparks 147 | 15.07 | 5.77 | 38.29 | 30.10 | 2.806 | 191 | 12 |
| UNL O-5 (NE) | Wright's G-4 | 13.90 | 4.94 | 35.51 | 32.63 | 2.814 | 178 | 26 |
| **1994** | | | | | | | | |
| UNL P-3 (NE) | Myers | 16.06 | 5.62 | 35.00 | 28.24 | 2.858 | 233 | 2 |
| UNL P-7 (NE) | Sparks 127 | 15.34 | 5.40 | 35.20 | 29.57 | 2.841 | 207 | 7 |

| Source | Cultivar | Grams per Nut | Grams of Kernel/ Nut | % Kernel | Nuts per Lb. | Lbs. of Nuts per Lb. of Kernel | Score | Rank |
|---|---|---|---|---|---|---|---|---|
| **1995** | | | | | | | | |
| Lane (MO) | Emma K | 15.91 | 5.72 | 35.94 | 28.51 | 2.781 | 239 | 2 |
| UNL L-9 (NE) | Sparks 147 | 14.19 | 5.06 | 35.65 | 31.97 | 2.804 | 178 | 16 |
| **1996** | | | | | | | | |
| Lane (MO) | Emma K | 17.67 | 7.00 | 37.92 | 25.67 | 2.524 | 253 | 1 |
| Lane (MO) | Sauber 1 | 13.74 | 4.84 | 35.19 | 33.01 | 2.839 | 207 | 5 |
| L. Hay (MO) | Myers | 13.88 | 5.28 | 38.01 | 32.68 | 2.629 | 165 | 23 |

**BLACK WALNUT CULTIVARS**
**with greater than 35% kernel to shell ratios**

**Kansas and Missouri Evaluations 1984-1996**

| Source | Cultivar | Grams per nut | Kernel weight/nut | Percent Kernel | Nuts per lb. | Lbs of nuts per lb. Kernel |
|---|---|---|---|---|---|---|
| **1984** | | | | | | |
| G. Gardner (MO) | Emma K | 19.30 | 6.99 | 36.21 | 23.5 | 2.761 |
| **1985** | | | | | | |
| G. Gardner (MO) | Emma K | 20.58 | 7.55 | 36.21 | 22.04 | 2.726 |
| G. Gardner (MO) | Surprise | 22.75 | 8.03 | 35.33 | 19.94 | 2.833 |
| **1986** | | | | | | |
| G. Gardner (MO) | Clermont | 16.88 | 6.01 | 35.59 | 26.88 | 2.809 |
| G. Gardner (MO) | Emma K | 19.75 | 7.13 | 36.09 | 22.97 | 2.770 |
| J. Williams (MO) | Emma K | 15.54 | 5.58 | 35.89 | 29.20 | 2.785 |
| **1987** | | | | | | |
| J. Williams (MO) | Emma K | 14.79 | 5.30 | 35.85 | 30.66 | 2.791 |
| B. Lane (MO) | Sauber | 15.76 | 5.69 | 36.08 | 28.79 | 2.700 |
| J. Williams (MO) | Sparks 127 | 12.30 | 4.59 | 37.30 | 36.89 | 2.697 |
| J. Williams (MO) | Bowser | 14.03 | 5.01 | 35.70 | 32.34 | 2.800 |
| P. Baker (MO) | Emma K | 14.52 | 5.40 | 37.19 | 31.23 | 2.689 |
| **1988** | | | | | | |
| No cultivar scored over 35% | | | | | | |
| **1989** | | | | | | |
| R. Curtis (KS) | Emma K | 14.97 | 5.58 | 37.25 | 30.31 | 2.681 |
| B. Lane (MO) | Jackson | 11.62 | 4.32 | 37.14 | 39.04 | 2.690 |

| Source | Cultivar | Grams per Nut | Kernel Weight / Nut | Percent Kernel | Nuts per lb. | Lbs. of Nuts per lb. of Kernel |
|---|---|---|---|---|---|---|
| **1990** | | | | | | |
| No Cultivar scored over 35% | | | | | | |
| **1991** | | | | | | |
| Ks. Exp. St. (KS) | Emma K | 15.11 | 5.30 | 35.09 | 30.03 | 2.851 |
| B. Lane (MO) | Jackson | 13.09 | 4.73 | 36.16 | 34.66 | 2.767 |
| **1992** | | | | | | |
| J. Williams (MO) | Surprise | 20.85 | 7.43 | 35.62 | 21.75 | 2.806 |
| T. Blaufuss (KS) | Surprise | 18.33 | 6.78 | 36.97 | 24.75 | 2.704 |
| J. Williams (MO) | Emma K | 16.18 | 5.78 | 35.72 | 28.03 | 2.799 |
| T. Blaufuss (KS) | Emma K | 14.84 | 5.32 | 35.83 | 30.56 | 2.784 |
| J. Williams (MO) | S-127 | 12.56 | 4.81 | 38.32 | 36.10 | 2.611 |
| **1993** | | | | | | |
| Ks. Exp. St. (KS) | S-147 | 18.43 | 7.07 | 38.34 | 24.61 | 2.604 |
| B. Lane (MO) | S-127 | 15.43 | 5.61 | 36.39 | 29.40 | 2.750 |
| **1994** | | | | | | |
| No cultivar scored over 35% | | | | | | |
| **1995** | | | | | | |
| B. Lane (MO) | Emma K | 17.50 | 6.22 | 35.53 | 25.92 | 2.815 |
| E. Provost | Surprise | 16.89 | 5.97 | 35.37 | 26.86 | 2.829 |
| Ks Exp. St. (KS) | Emma K. | 17.74 | 6.62 | 37.31 | 25.57 | |
| Ks Exp. St. (KS) | S-147 | 14.96 | 5.78 | 38.61 | 30.32 | |
| **1996** | | | | | | |
| Ks Exp. St. (KS) | DuBois 8201 | 17.92 | 6.35 | 35.42 | 25.31 | 2.822 |
| Ks Exp. St. (KS) | Emma K | 20.25 | 7.36 | 36.35 | 22.40 | 2.751 |
| B. Lane (MO) | Sparks 147 | | | 37.63 | 33.31 | |
| E. Williams (MO) | Emma K | | | 35.48 | 30.21 | |

**BLACK WALNUT CULTIVARS**
**With greater than 35% kernel to shell ratios**

**Kansas Evaluations 1959-1988**

| No. of Samples | Cultivar | % K. High | Nuts / Lb Low | Nuts / LB Mean |
|---|---|---|---|---|
| 8 | Emma K | 36.56 | 21.34 | 26.93 |
| 7 | Bowser | 36.29 | 26.34 | 29.82 |
| 6 | Clermont | 35.59 | 24.70 | 34.00 |
| 4 | Brown Nugget | 35.50 | 27.10 | 29.07 |
| 2 | Surprise | 35.33 | 19.94 | 20.24 |
| 6 | Myers | 35.10 | 29.14 | 33.24 |

# BLACK WALNUT–LATERALLY FRUITFUL CULTIVARS

By Cyril Bish
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Some eastern black walnut cultivars posses a characteristic known as lateral bud bearing. (Sparks, 1982) These cultivars produce pistillate flowers on a profusion of short, spur type branches distributed along main scaffold limbs. With this growth pattern, both leaves and nuts are born throughout the tree canopy resulting in increased yield potential. (Reid 1986)

To produce a black walnut cultivar for a commercial orchard, this characteristic is desirable and essential. In Persian walnuts, lateral bud bearing has resulted in significant yield increases. They also tend to be more precocious and are better suited to high-yielding and high-density plantings. (McGranahan, Leslie, Dandekar, Uratsu)

A cross breeding program needs to be done to develop a black walnut cultivar that will retain the lateral bud bearing characteristic. The resulting selection should also be anthracnose resistant, contain a kernel of at least six grams, crack out 40% kernel, and have a light colored kernel of excellent quality.

**LATERALLY FRUITFUL BLACK WALNUT CULTIVARS**

| Cultivar Name | State | % Kernel | Grams / Nut | Anthrac-nose * | Reported By | Year reported resist. |
|---|---|---|---|---|---|---|
| Sparks 127 | IA | 37.4 | 17.3 | MR | Archie Sparks | 1982 |
| Davidson | IA | 28.0 | 21.5 | R | “ | 1982 |
| Crantz | OH | 32.3 | 15.3 | MR | “ | 1982 |
| Beck | MI | 31.5 | 13.6 | R | “ | 1982 |
| Pfister | NE | 27.0 | 18.8 | R | “ | 1982 |
| Football | MO | 30.0 | 19.6 | MS | William Reid | 1996 |
| Emma K | IL | 37.5 | 16.2 | R | “ | 1996 |
| Kwik-Krop | KS | 31.0 | 17.4 | MR | “ | 1996 |
| Sparks 147 | IA | 38.0 | 18.4 | MR | “ | 1996 |
| Surprise | MO | 34.0 | 19.9 | MR | “ | 1996 |
| Sauber | OH | 33.0 | 16.9 | R | Cyril Bish | 1997 |
| Vandersloot | PA | 28.0 | 19.3 | MR | “ | 1997 |
| Hay #1 | MO | 32.0 | 19.2 | R | Brian Sparks | |

*R= Resistant, MR=Moderately Resistant, MS= Moderately Susceptible

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# BLACK WALNUT ANTHRACNOSE REPORT

By Cyril Bish
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The eastern black walnut cultivars in the Cyril Bish Nut Tree Orchard, University of Nebraska – East Campus, Lincoln, Nebraska have been evaluated by Cyril Bish for Anthracnose resistance the past four years.

Tree leaves were observed to see if they showed evidence of the disease. Each tree was observed and given a rating as follows:

1. Resistant (R) Leaves healthy, and green to first killing frost.
2. Moderately resistant (MR) Leaves show a few spots on leaves. No leaf drop early.
3. Moderately susceptible (MS) Leaves show moderate amount of leaf spot. Some leaf drop early. Leaves yellow.
4. Susceptible (S) Most leaves show spots. Most leaves dropped early.

During the four year study there was a quite a variation in rainfall. This may have some affect on the amount of disease present during each year.

In 1994, we had 22.56 inches of rainfall which was below our normal of 28.26 inches.

In 1995, we had 23 inches of rainfall with a very wet May and June.

In 1996, we had 35.89 inches of rainfall. This was the 15$^{th}$ wettest year in 110 years or record keeping.

In 1997, we are about five inches below our normal rainfall with 21.84 inches reported as of November 2 and the normal for this date is 26.11 inches.

In 1995 only the top producing cultivars were rated for anthracnose.

It is important that black walnut retain healthy leaves the full season in order that the tree can produce a good crop of nuts each year. A late spring freeze can prevent pollination some years.

If a commercial orchard is to be established, it is important to plant cultivars that evaluate well and have good leaf health.

## ANTHRACNOSE RESISTANCE
## Black Walnuts – Lincoln, Nebraska

| Location | Cultivar | Month, Day and Year of Observation | | | |
|---|---|---|---|---|---|
| | | 10/8/94 | 10/5/95 | 9/18/96 | 10/4/97 |
| G-19 | Pammel Park #20 | MR | | MS | MS |
| H-18 | Wisconsin #1 | S | | S | S |
| I-18 | Hare | MR | | MS | MS |
| I-19 | Lee Lowder | R | | MS | MS |
| J-16 | Vandersloot | R | | MR | MR |
| J-17 | George | R | | MR | MR |
| J-18 | Welch Rope | MS | | MS | MR |
| K-9 | Throp | MR | | MR | R |
| K-10 | S-127 | MR | R | R | MR |
| K-11 | Thatcher | MR | MR | MR | MR |
| K-22 | Pamel Park #14 | MR | | S | MS |
| K-23 | Pamel Park #20 | MR | | MS | |
| K-01 | Sparks 328 | R | | R | R |
| K-02 | Football 1 | MS | | MS | MR |
| K-03 | Surprise | R | | R | R |
| K-04 | John Thordutti 1 | R | | R | R |
| K-05 | Farm Thomas | R | | MR | R |
| K-06 | Sauber #1 | R | | R | R |
| K-07 | M18 | R | | R | R |
| K-08 | Burd | MR | | MS | MS |
| KK14 | Pammel Park #20 | MR | | MS | MS |
| KK15 | Lee Lowder | MS | | MS | MR |
| KK17 | Mullinix | S | | MS | MS |
| L-1 | Sparks 127 | R | R | R | MR |
| L-2 | Farrington | MR | MR | MR | MR |
| L-3 | Sparks 127 | MR | | R | MR |
| L-6 | Krause | R | R | R | R |
| L-7 | Burson | S | | S | S |
| L-8 | Stabler | MR | MR | MR | MR |
| L-9 | S147 | MR | MR | MR | MR |
| L-11 | Ohio | R | R | R | R |
| L-12 | George | R | | | MR |
| L-22 | Pamel Park #14 | MR | | S | MS |
| L-05 | Sparks MXS #4 | R | | R | R |
| L-06 | Football | MR | | MR | R |
| M-1 | Sparrow | R | R | R | R |
| M-2 | Hay | R | R | R | R |
| M-3 | Ogden | R | R | MR | R |
| M-6 | Davidson 629 | R | R | R | R |
| M-7 | Sparks 147 | MR | MR | R | R |
| M-9 | Crantz | MR | MR | MR | MR |
| M-9 | Rock | MR | MR | MR | MR |
| M-10 | Spilchal | MR | | MR | MR |
| M-12 | Thielenhaus | S | | MS | MS |
| M-13 | Davis #2 | S | | | |

| Location | Cultivar | Month, Day and Year of Observation | | | |
|---|---|---|---|---|---|
| M-15 | Bentley | S | | MS | MR |
| M-02 | Sparks 228 | R | | R | R |
| N-1 | Beck | R | | R | R |
| N-2 | Hare | MR | R | MR | MR |
| N-3 | Grundy | MS | | MR | MR |
| N-4 | Bowser | MR | | R | R |
| N-5 | Rowher | R | R | R | R |
| N-6 | Kitty | MS | | MS | MR |
| N-7 | Caba Ohio | R | | MR | R |
| N-8 | Todd | R | R | MS | R |
| N-9 | Leavenworth | R | | R | R |
| N-10 | Pfester #1 | R | | R | R |
| N-11 | Bentley | MS | | MS | MS |
| N-03 | Scrimger | R | | R | R |
| O-1 | Sparks 328 | R | | R | R |
| O-2 | Sparks 228 | R | | R | R |
| O-3 | Pritchett | R | | R | MR |
| O-5 | Wrights | MR | R | R | R |
| O-6 | Pritchett | R | | R | R |
| O-23 | Surprise | R | | | |
| P-2 | Peanut | S | S | MS | MR |
| P-3 | Meyers | R | R | R | R |
| P-6 | Hare | R | | R | R |
| P-7 | Sparks 127 | R | R | R | R |
| P-8 | Cochrane | MS | | S | MS |
| P-9 | Kitty | MS | | MS | MR |
| P-10 | Crantz | MS | MS | S | MR |
| P-01 | Tom Roe | R | | R | MR |
| Q-4 | Elkhorn | S | | S | S |
| Q-5 | Demming Purple | MS | | R | MS |
| Q-6 | Card | MR | | R | MR |
| Q-7 | Eldora | MR | MR | R | R |
| Q-8 | McGinnis | R | R | R | R |
| Q-9 | Sparks 128 | MR | | R | R |
| R-8 | Thomas | MR | MR | MR | MR |
| R-10 | Davidson 629 | R | | R | R |
| S-9 | Sparks MS #2 | R | | MR | R |

# Propagating Eastern Black Walnut

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## GROWER RECOMMENDATIONS

Use the best possible planting stock to establish a new black walnut orchard. Start with a vigorous rootstock grown from a known seed source. Chose black walnut cultivars with proven records of nut production for grafting onto your rootstock trees. Graft only well-established trees during the spring flush of growth. Select your propagation method based on the size of your stock tree. Use the 3-flap graft on small trees and the bark graft on larger trees. Support young grafts with a stake to prevent wind damage. Train the new graft to a central leader tree by trimming all growth to a single central leader.

## INTRODUCTION

Black walnut trees will reach their full nut bearing potential only if careful consideration is given to the rootstock and cultivars used to establish the orchard. To ensure top quality orchard trees, many growers choose to grow their own rootstock trees and graft those trees with superior nut cultivars. In this chapter, black walnut propagation, from germinating seeds to grafting large trees will be discussed.

## SEED PROPAGATION

Black walnut trees are easily grown from properly stratified nuts. Collect nuts for planting during the fall harvest season. Hull and wash the nuts as soon as you collect them. During the washing process, discard all nuts that float to the top (these floaters are poorly filled and won't germinate well). Even though many seed sources can be used, 'Kwik-Krop', 'Sparrow', and 'Thomas' nuts have proven to produce excellent rootstock trees. Stratify the nuts in moist sand by placing them in layers about 3 inches deep and holding them in a refrigerator (33 to 40º F) for 120 days. Be sure the nuts are kept moist throughout the stratification process to ensure uniform germination after planting. Three methods can be used for growing seedlings for later use in establishing a black walnut orchard:

1. Growing trees in place
2. Establishing a nursery
3. Growing trees in containers

## GROWING TREES IN PLACE

Prepare a fine seedbed in the areas you intend to plant black walnut seed. During early spring,plant 3 to 5 stratified nuts, 2 to 3 inches deep, at each tree location. Be certain to mark the area where nuts are planted and to keep the area weed-free. During the first year, select the strongest-growing tree and remove the others by cutting them off below the root collar. Fertilize the seedlings in mid-

July with 1/4-cup of a slow release fertilizer per tree location. Water trees when conditions become dry.

## ESTABLISHING TREES IN A NURSERY

Choose a deep, sandy loam soil for a black walnut nursery to facilitate digging and transplanting. Prepare a fine seed bed for the nursery area in early spring. Plant stratified seed 2 to 3 inches deep, 2 feet apart, in rows 4 feet apart. Keep the nursery weed-free and well watered. Sidedress the nursery rows with a slow release fertilizer in mid July. Nursery-grown trees should be dug for transplanting in March of the following year. When digging one-year-old seedlings, be sure to dig at least 16 to 18 inches deep and preserve as many fibrous roots as possible.

## GROWING TREES IN CONTAINERS

There are several sizes and shapes of containers that can be used for growing black walnut seedlings. Choose a container with an open bottom. When placed on a screen wire bench, walnut roots will grow to the bottom of the pot and then become "air-pruned". The air-pruning process prevents root circling--a common problem in container grown trees.

Use a potting soil mixture that allows free movement of water through the pot. Mix in a slow release fertilizer that can provide both macro- and micronutrients for 7-9 months. Plant a single, stratified nut in each pot. Black walnut seedlings grown in containers need daily waterings and the careful attention demanded by all containerized nursery plants.

Container grown stock can be transplanted into the field in the early fall. The fall planting season starts 3-4 weeks before the first killing frost in the fall and continues until mid-November. Containerized stock can also be planted during the traditional spring planting season. However, if you are holding container trees over the winter, you must protect the trees from freezing during the winter. After trees become dormant in the fall, lay the pots down on the ground and cover the trees with an insulating cover.

## GRAFTING TREES

The only way a walnut grower can ensure that each tree in his orchard produces quality nuts is to graft superior cultivars onto his rootstock trees. Trees grown from seed will, in most cases, bear nuts that are inferior to the nut planted. The seed grown tree exhibits characteristics from both male and female parents. Since walnut trees are wind pollinated, the source of male pollen is usually unknown. The pollen that fertilized the flower and resulted in the nut you plant may have come from a small, hard-shelled "wild" tree. As a consequence a seedling tree often produces nuts that are intermediate between that small, hard nut and the big nut that was planted.

Grafting is an age old horticultural technique that can be defined as attaching a twig from one tree to the stem of another in such a way that the twig continues to grow and become a permanent part of the tree. All of the branches that grow from that twig will have the identical characteristics of the tree from which the twig was taken. Grafting is one method nut growers can use to propagate trees that bear large, easily cracked nuts. Grafting a twig (the scionwood) from a tree that produces high

quality nuts onto a seedling tree (the stock) is the only way to assure that your tree will produce desirable nuts.

## COLLECTING SCIONWOOD.

The first step in the grafting process is to obtain scionwood from trees of known performance. There are hundreds of cultivars of black walnut that have been selected by nut growers over the last 100 years but only a few are frequently recommended for commercial nut production (see chapter on cultivar selection). Scionwood should be collected during the late dormant season. Cut scionwood from the previous season's new growth making sure there is an ample supply of large plump buds on the twig. Store scionwood in plastic bags under refrigeration ($35^{o}$ F) until the spring grafting season. Make sure the scionwood does not dry out during storage by wrapping the wood with moistened paper towels. Check stored scions frequently and rewet the paper towel if it become dry.

## TOOLS FOR GRAFTING TREES

Before the grafting season begins you should collect all the tools and equipment you will need to graft walnut trees. The necessary supplies are listed below:

* Sharp grafting knife (sheep's foot blade)
* Pair of pruning shears (with by-pass blades)
* Pruning saw (turbo style)
* Light duty staple gun (Arrow model JT 21)
* Tack hammer
* 4-mil plastic grafting tape
* Plastic sandwich bags
* Aluminum foil
* Bottle of white glue
* 5/16" staples for staple gun
* 5/8" brad nails

With this equipment you will be prepared to graft trees from 1/2" to 4" in diameter.

## SEASON FOR GRAFTING

During the spring flush of growth, rapid wood and bark growth allows the bark to be easily removed from the wood. We use this natural phenomenon to our advantage during the grafting process. But because the bark of the stock tree must 'slip', grafting season is largely confined to a six-week period during the spring. Graft small trees as soon as the emerging buds are one inch long. Start grafting larger trees when the leaves begin to unfurl. You can continue to graft until the leaves of the stock trees are completely expanded. During certain periods of the grafting season you will note excessive sap flow when black walnut stock trees are cut. This 'bleeding' will inhibit callous formation and cause graft failure. To avoid 'bleeding' problems, cut stock trees off just above the location you intend to graft. Wait a couple of days, and then make a fresh cut one-inch below your previous cut before grafting.

When you are ready to start grafting, take your scionwood out to the field in a small cooler. Ice down your scionwood to keep it fresh. Avoid leaving bags of scionwood out in the sun, where the wood can become very hot.

## THE THREE-FLAP GRAFT

The three-flap graft is best method for propagating walnut cultivars onto stock trees three to six feet in height. The three-flap graft works best when both scion and stock are approximately the same diameter. Take a piece of scionwood out of your cooler and hold it up to the stock tree and choose the proper height for grafting (Fig. 1). Cut off the top of the stock tree at that point with hand shears. As a general rule, the scionwood should be large enough to allow you to cut off at least 1/3 of the stock tree.

After choosing the site for grafting, set your scion back in the cooler and prepare the stock. Begin preparing the stock by making three vertical incisions, three inches long, through the bark at the top of the stock. Space these evenly around the diameter of the stock. If a bud and leaf scar are present, rub off the bud and make the first vertical cut directly through the bud (Fig. 2). To facilitate tying the graft union during a later step, tie an 18-inch piece of plastic grafting tape on the stock just below the three vertical cuts.

Now turn your attention to preparing the scion. First, trim 1/2 inch off the bottom of the scion to fresh, green wood. With a sharp grafting knife, make a shallow cut through the bark and into the wood approximately 2 inches long at the bottom end of the scion (Fig. 3). This cut should expose a long "U" shaped area of cambial tissue with woody tissue inside the "U" (Fig. 4). Repeat this step two more times so that the scion has three evenly spaced cuts around its diameter. Leaving a strip of bark between each cut ensures maximum cambial exposure (Fig. 5).

Sometimes, a bud and leaf scar are found in a position where cuts are to be made. If so, make the first shallow cut so that it removes the bud. Before moving back to working on the stock, hold the cut end of the scion in your mouth (away from tongue and teeth) to keep the scion from drying and to free your hands.

Using the tip of your knife, separate the bark from the wood at the top of the stock. With your fingertips, carefully peel the bark away from the wood in three flaps, each 2.5 to 3 inches long. Use shears, blade side down, to hold the three flaps down while clipping out the wood on the inside of the flaps (Fig. 6). Avoid excessive fingering of the flaps--oily fingers can impair graft callus formation.

Next attach scion to stock. Place the scion inside the three flaps, lining up each cut surface with a flap. Hold the three flaps up over the cut surfaces with one hand and begin wrapping the graft union with grafting tape (already in place) (Fig. 7). Wrap the graft spirally up the stem, making certain the flaps and scion do not twist (Fig. 8). Tie the tape above the three flaps. Push straight down on the scion to ensure that the scion is firmly seated against the wood of the stock.

Protect the graft from sunburn by wrapping it with a small piece of aluminum foil (Fig. 9). Foil also acts as a splint, protecting the graft from wing injury. Next, tear the corner out of a plastic sandwich bag and place the bag over the graft (Fig. 10). Tie the bag above and below the graft union with

grafting tape. The plastic bag helps prevent moisture loss and speeds graft callusing. Cover the cut surface at the top of the scion with a drop of white glue (Fig. 11), which prevents moisture loss from the scion.

Three to four weeks after grafting, scion buds should start to break (Fig. 12). After the scion has made three to five inches of new growth, carefully remove the plastic bag, aluminum foil, and grafting tape to prevent graft girdling. A strong graft should have callous tissue growing between each flap.

Wrap up the graft again in reverse order, first with the plastic bag, then aluminum foil, and finally grafting tape. This wrapping will not girdle the graft but provides wind protection. Force scion growth by pruning back growth below the graft and by fertilizing with nitrogen.

## THE BARK GRAFT

The bark graft is an effective way to propagate walnut cultivars onto trees one to four inches in diameter. Select a point on the stock above the first whorl of branches and at a comfortable working height (Fig. 13). Retain lower branches to help maintain tree vigor until the new graft becomes established. Leaves on these branches will also shade the trunk to prevent sunscalding. Remove the top of the stock tree with your turbo saw. Check for excessive sap flow, and be prepared to graft another day if necessary.

Inspect the cut surface of the stock. You'll notice that the stem is not perfectly round. Choose the flat side of the tree to make your graft. At this point, remove some of the rough bark with your knife. Pare down the bark until it becomes about 1/8 in. thick in an area 1.5 in. wide and 3 in. long. Reducing bark thickness will make the bark more pliable and more able to conform to the scion. Use your grafting knife to make a 2.5-inch long vertical slit through the bark (Fig. 14). The stock is now ready to accept the scionwood.

Scionwood approximately 3/8 in. in diameter works best for the bark grafting. Trim 1/2 inch off the bottom of the scion with your pruning shears to expose fresh, green wood. If a bud is found near the base of the scion, your first cut should remove the bud (Fig. 15). Draw your knife through the scion starting about 2.5 inches from the base. Carve the scion down through the pith to less than half its original thickness using several passes of your knife (Fig. 16). This deep cut should be parallel to the scion and feature a right angle shoulder. Be certain that two buds remain above the cut.

Turning the scionwood piece over, make a shallow cut into the wood of the backside your first cut (this cut is similar to preparing a scion for three-flap grafting). This cut is not made parallel to the deep cut but angled to one side (Fig. 17). When finished, you should have a thin piece of bark adjacent to the deep cut on one side and a much thicker strip on the other. The cut on the backside of the scion should start just below the shoulder of the deep cut and should give the scionwood a wedge shape when completed (Fig. 18). A third cut is made perpendicular to the deep cut along the thick bark strip edge. This cut should be made just deep enough to expose the cambium. Be certain to leave a strip of bark between the backside cut and the perpendicular cut. At this point your scionwood should have a triangular shape (Fig. 19). Complete scionwood preparation by making a

chisel point on the end of the bud stick (Fig. 20). This final cut should be made on backside of the scion.

Use your grafting knife to gently pull the stock's bark away from the wood on the right side of the bark slit (Fig. 21). Insert the scion between the bark and the wood of the stock (Fig. 22). Tap the scion down into the stock until the shoulder of the deep cut fits snugly against the upper side of the stock (Fig. 23). The deep cut should be facing the wood, while the shallow cut should be covered by the raised bark flap and perpendicular cut should fit snugly against the bark slit. Secure the graft union with staples (Fig. 24) or brad nails (Fig. 25). It is important to nail down the bark firmly against the scion and to be sure that all air pockets are removed. Use as many staples as needed but be careful not to split the bark.

Like the three-flap graft, cover the graft union with aluminum foil. Place the foil over the cut surface of the stock and around the base of the scion. Next, cut the corner out of a sandwich bag and place over the scion. Tie the plastic bag with grafting tape to the base of the scion and bellow the aluminum foil on the stock (Fig. 26). Place a drop of white glue on the cut surface at the top of the scion to prevent moisture loss.

When you see about six inches of new growth from the scion, attach a piece of lath wood (1/2 x 1 inch) to the tree to prevent the wind from blowing out the graft. Nail the lath to the stock and tie the new shoot to the lath with twine or plastic grafting tape. The young graft will need support until new wood grows over the cut surface on the stock (two or more years).

## GRAFT AFTER CARE

One year after grafting, prune the growth on the graft to a central leader. If more than one bud grows from the bud stick, leave only the growth coming from the strongest bud to form the new top of the tree. During this same time, prune off about one third of the lower limbs to force more of the trees energy to the graft. In subsequent years, continue pruning the top of the tree to a central leader and remove limbs below the graft.

# Project Planning, Design and Planting

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In order to develop an economic viable enterprise producing Black Walnuts one needs to consider basic criteria that will effect the overall success or failure of the enterprise. We should consider a relatively long period of time i.e. 35 to 50 years or longer. This can be quiet a challenge in an era where as producers we much constantly be market responsive and subject to change.

In planning an orchard that hopefully will encompass efficient, quality production we should first look at four basic points and build an outline from these points with as much input form everyone as possible.

Point I - Produce the crop, harvest it, process it
Point II - Market It
Point III - Deliver it
Point IV - Collect your money

## I. PRODUCING THE CROP

A. Orchard site selection
   1. Identify soil
   2. Soil amendments
      a. Should be based on soil tests showing the nutrient status.
      b. Necessary amendments should be made prior to tree planting.

B. Variety selection
   1. Genetic improvement
      a. A decision should be made where primary emphasis is to be focused, nut production only or a combination of nut and timber. It is my personal belief that in theory it sounds possible to do both, but management practices dictating maximum yields, efficient harvesting, (both dependant on proper spacing,) crown development, and branching structure for shaking, make this impractical. This is not to say that the exceptional individual who is willing to accept the challenge cannot do both but this will be the exception and not the rule.
   2. What does the market want
   3. Regional adaptability
   4. Precocious selections
   5. Planting stock
      a. Understock should be selected and grown from known parentage proven to be superior in root development and growing vigor. A one year stock will respond best and should be about 3/8 inch – ½ inch in caliper. Younger understock has definite advantages provided

desired size can be attained, whether being planted bare-foot or containerized. Planting of containerized understocks or grafted varieties in containers can be done either in the spring or fall. Fall has several advantages over spring. Soil and weather conditions nearly always allow favorable planting conditions. Roots will grow at soil temperatures at 50 degrees or above so establishment will begin immediately allowing the tree to be in a better condition to withstand usual spring competition and summer drought. Ideal fall planting time for containerized walnuts in Missouri would be from October 20th to Thanksgiving. (Soil temperatures will remain above 50 degrees into Dec.) Fall planting alone can result in a one year gain in establishment and growth.

Bare-root walnuts are planted spring only to avoid winter desiccation and heaving problems from alternate freezing and thawing. Very early spring planting will give best results, however spring conditions often delay plantings so severe weed competition, and moisture competition often occur at a critical time period when the plants are trying to become established.

C. Orchard design

1. Nut production only or timber combination: (Is this feasible)

a. The primary goal should be production of high volumes of high-quality nuts, in both yield and color. The market will pay a higher price and the bottom line will improve. Net return per acre is of primary importance.

Optimum crown development:

(1) Spacing to accommodate crop production will vary to some extent by the cultivar, pruning methods, thinning and other management factors. Optimum bearing potential is realized when the space over the soil is completely occupied by nut-bearing tree canopies with sufficient light penetration to maintain lower fruiting wood. A practical median spacing based on the above criteria would be 30 x 30 requiring forty-eight trees per acre.

Walnut breeding and generic improvement will likely develop dwarf cultivars that should be planted at closer spacings or possibly in hedge rows. Here are some sample spacings showing number of trees required per acre.

| | |
|---|---|
| 20 x 20 | 109 |
| 20 x 24 | 90 |
| 22 x 22 | 90 |
| 24 x 24 | 75 |
| 25 x 25 | 69 |
| 30 x 30 | 48 |
| 40 x 40 | 27 |
| 50 x 50 | 18 |

(2) Facilitate efficient harvesting and handling of crop.

2. Pollenizer Trees
   a. Use of pollenzier varieties may be desirable in many walnut orchards. It is essential to place these trees correctly for maximum benefit. Since walnuts are wind pollinated the pollenizer trees should be planted in solid rows perpendicular to the direction of prevailing winds at regular intervals. They should be planted in solid rows so they can be harvested separately.

D. Husbandry
   1. Pruning - Do you desire a single straight log or a broad crown that will produce more nuts?
   2. Early life of orchard requires checking each tree several times each growing season for all essentials to provide maximum health of trees.
   3. Always be aware of the Five essentials for plant growth: Light, Temperature, Water, Air, Nutrients:
   4. Competition
      a. Weed control
      b. Spacing
   5. Disease and Pest Control
      (What is pre-harvest cost per acre to establish? $1,000 - $1500.00/per acre using cultivars.)
      (Goal should be to produce 1,000#/per acre as quickly as possible to approach profitability with an ultimate goal to produce twice this amount per acre in 5-7 years.)

## II. MARKETING

A. Specialty markets and outlets
   1. Must yield prices that will support and provide return on orchard investments:

B. Keep cultivar selection in line with market demands:
   1. Market changes may require top working to new and better cultivars.

C. Continually be aware of market changes, wants, and needs:

D. Collectively or individually we need to target specific markets then make personal contacts, promote through advertising and make use of new technologies as the internet to market our product:

E. Good packaging and point of sale merchandising.

## III. DELIVER

A. Gain a reputation as a consistent dependable supplier of quality product:
   1. This may necessitate storage and other ways to have the product available on a year round basis:
      a. Seed with a moisture content of 20 to 40 percent can be stored at 34/ – 37/ F for one year.

B. Certainly in season customers may be encouraged to come to you direct:
   1. Farmers markets may be viable outlets in certain instances.

## IV. COLLECT YOUR MONEY

A. No sale is complete until you are paid:
   1. If shipping on credit have firm understanding of terms of sale:
   2. By producing a quality product, with innovative marketing and techniques, and on time delivery, collecting your money is made much easier.

# Landowner Assistance Through State and Federal Programs

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## GROWER RECOMMENDATIONS

Contact your local natural resource government agency. They can help you formulate a management plan, and will have suggestions about which government programs are available to help you accomplish your goals.

Knowing your soils is a key to being successful with your trees. Each county has a Natural Resources Conservation Service (NRCS) office to serve the needs of that county, and soils is one of their areas of expertise. They will have soils information about your property, and will be able to interpret which soils are best suited for your purposes. This will help in the decision of where to plant, and what kind of growth you can expect.

The local Missouri Department of Conservation (MDC) forester can provide a list of contractors to assist with planting, pruning, or removing trees. Similar agencies in other states should be able to provide the same service.

There are a wide variety of government programs that could be used to establish and maintain your trees. Which program to utilize will depend on individual situations, but this brief description of the programs currently available should help in deciding which option you should pursue.

The Conservation Reserve Program (CRP) contains options for planting trees. This program is administered through the Farm Services Agency (FSA). The Forest Incentive Program (FIP) was designed to improve the productivity of the forest resource. Because the program is focused on productivity, the land enrolled in this program must meet a minimum productivity rate of 50 cubic feet of wood per acre per year. This rate is determined by soil type. FIP can be used to establish trees, and to maintain or improve trees. The program is administered through the NRCS.

The Stewardship Incentive Program (SIP) is the cost-share companion to the Forest Stewardship Program, which helps a landowner achieve their goals for their property. Establishing and improving trees is a component of this program that is administered through both the FSA and the MDC.

The Soil and Water Conservation Program is commonly called State Cost-Share. The DFR-4 part of the program has the goal of establishing trees on land previously used for agriculture. Because it is administered through local Soil and Water Conservation Districts (SWCD), the availability of this program can vary from county to county.

The Missouri Agroforestry Program was created to promote the use of trees with other crops". Walnut plantings are commonly used in agroforestry in conjunction with grains, grass, cattle, berries, and even medicinal plants. The program is administered by the MDC.

The Wildlife Habitat Improvement Program (WHIP) is a cost-share program designed to improve wildlife habitat on private lands. Tree planting and timber stand improvement are eligible practices. NRCS administers the program.

The Environmental Quality Incentive Program (EQIP) is designed to address soil, water and related natural resource concerns on private lands. Cost-share practices can include tree planting if specified in the state or local priority area plan. NRCS has technical responsibility for the program.

Whether or not you use any of these programs, the agencies mentioned are available for providing free technical assistance, and an on-site visit if necessary. You, the landowner, are the key to good conservation and the future of our natural resources, and government agencies really are "here to help you" - use them.