



UNIVERSITY OF MISSOURI CENTER FOR AGROFORESTRY

GROWING BLACK WALNUT FOR NUT PRODUCTION: BEARING YEARS MANAGEMENT

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Care of Bearing Trees

Once your black walnut orchard is established and begins bearing, the goals for caring and maintaining the orchard will evolve as the trees continue to mature and yields increase. The orchardist's focus turns toward maximizing yield potential of the trees, managing disease and monitoring insect pests, and planning for harvest and post-harvest activities. The following document is a guide which outlines the steps and operations required to care for bearing and mature black walnut orchards. For information on planning and establishing a new black walnut orchard please refer to the "[Growing Black Walnut for Nut Production: Orchard Establishment and Early Management](#)" guide.

Water and Nutrients It is important to provide a sufficient supply of water throughout the growing season and ensure adequate plant nutrition when black walnut trees reach bearing age. The production of nuts requires substantial resources from your trees, and you as the orchardist must replenish these resources each year to achieve the yield potential.

Selecting the best possible site during the orchard planning and establishment phase is the best way to ensure adequate water supplies for black walnut tree growth. Once trees are established, maintaining a weed-free area around each tree is important to preserve soil moisture. A weed-free zone beneath the

trees can be maintained using herbicides and/or the application of wood chip mulch. Do not use hay or grass clippings to mulch your trees, as these types of "soft" mulches can provide an excellent shelter for tree-gnawing rodents. Planting a cool season perennial, low-growing grass that can tolerate frequent mowing is recommended to conserve moisture between tree rows.



Nut clusters on a mature black walnut tree

The ability to irrigate a black walnut orchard, especially for orchards planted on marginal soil sites, will increase yield, nut size and annual production. Black walnut trees of bearing age should receive at least two inches of water each week throughout the growing season. Installing automatic drip irrigation will help ensure adequate and consistent water supply, even during prolonged periods of drought. The infrastructure required to supply automatic



drip irrigation can be an expensive up-front cost depending on the dimensions of the orchard, and especially when retrofitting a mature planting. The economy of scale on larger plantings can make the expense of the irrigation system more manageable and worthwhile when the orchard design plan includes an irrigation system. It is best to make the decision to install such a system during the planning phase of orchard establishment. Critical information including the location of the orchard, the amount of rainfall at that location, and an economic analysis of the orchard production system will contribute to this planning process.

Nitrogen fertilization is essential for stimulating nut production in black walnut trees. Added nitrogen will stimulate leaf growth and increase annual pistillate (female) flower production. It is recommended to apply nitrogen fertilizers two times during the year on bearing trees: 60 lbs. actual nitrogen/acre in early-March and 40 lbs. actual nitrogen/acre in early-October. Apply urea 46-0-0 fertilizer (46 percent nitrogen) with conventional equipment across the entire orchard floor. Use leaf analysis of leaflets collected in late-June to early-August to determine your trees' needs for phosphorus, potassium and micronutrients. Optimum nutrient concentrations are listed in Table 1.

Thinning Mature Trees Decisions on initial spacing and when and how to thin your black walnut orchard need to be planned for your orchard layout before you ever plant a tree. But there is a high likelihood that your trees will begin to bear nuts for several years before the time comes to begin thinning the orchard. Figure 1 shows a diagram of a planned orchard layout and thinning schedule. Depending on the orchard site and initial layout, your thinning schedule may commence following several years of bearing, such as in the case with planting a high-density orchard at 15 x 30 ft. spacing. Beginning with a standard

Element	Dry weight conc.	Normal range
Nitrogen (N)	Percent	2.2 to 3.5
Phosphorus (p)	Percent	0.2 to 0.33
Potassium (K)	Percent	0.9 to 2.0
Calcium (Ca)	Percent	1.2 to 2.5
Magnesium (Mg)	Percent	0.3 to 0.6
Iron (Fe)	ppm	50 to 200
Manganese (Mn)	ppm	25 to 220
Zinc (Zn)	ppm	20 to 80
Boron (B)	ppm	30 to 80
Copper (Cu)	ppm	5 to 20

Table 1: Optimum or normal concentrations of mineral nutrients in walnut foliage in late-June through July

spacing of 30 x 30 ft., your first thinning will likely occur 15 or 20 years after planting (Fig. 1, next page).

The thinning process can be done all at once, or it can be done in stages over multiple years. Such decisions depend on the size of the orchard and the growth rate of the trees across the orchard. The greatest source of grower hesitancy to thin trees comes from the idea of reducing yields in the near-term. It is important to remember that overly crowded trees will also reduce yield, but more importantly, such a delay can ultimately impact the long-term health and production capacity for an orchard. Thinning an orchard before crowding begins will increase the orchard productivity in the long run.



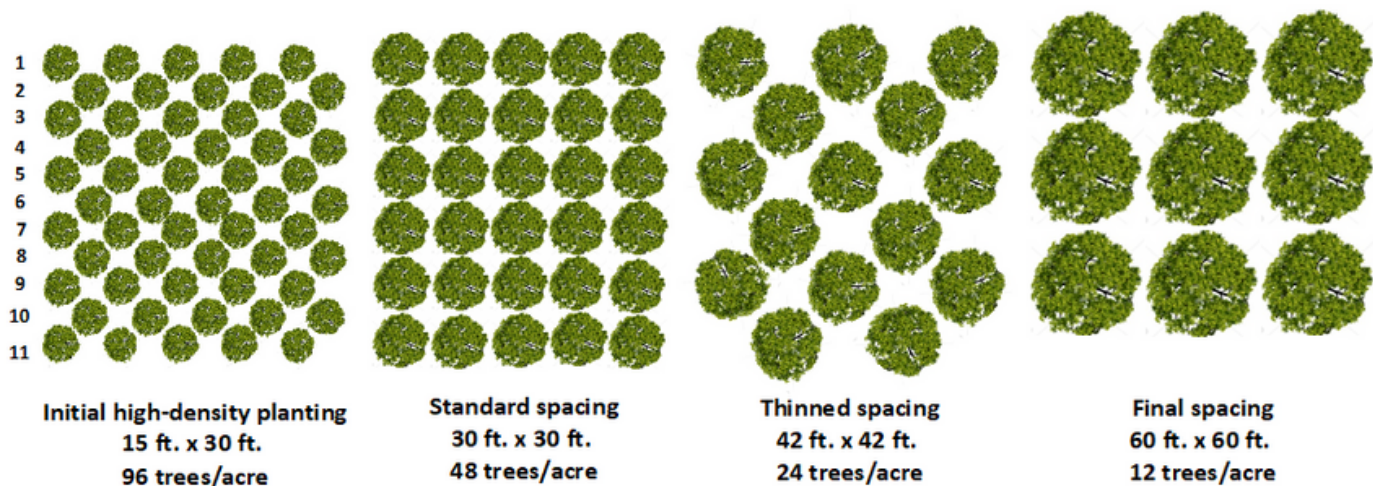


Figure 1: Orchard thinning will begin after the trees enter bearing years. It is important to monitor the orchard canopy to determine when the tree crowns begin to touch. Orchard thinning can be done in stages. It is important to begin the thinning process before canopy dieback from crowding occurs. Orchard thinning to manage the light that enters the canopy will help to maximize nut production for the life of the orchard.

Pruning Mature Trees Pruning should be done during winter while the trees are dormant. Dormant winter pruning will promote new growth, while summer pruning will inhibit growth. Careful pruning during the establishment of the orchard will lead to the development of desirable canopy structure of the trees, while pruning at bearing age will help maintain that structure and promote nut production (see right image). Pruning bearing trees can also help to facilitate mechanical harvest. Prune mature trees to remove low hanging, broken, weak, or diseased branches, as well as eliminate any water sprouts. Remove branches that are crossing or rubbing together. Every time you prune walnut trees (dormant or summer pruning), look to correct tree structural problems. If a branch has formed a narrow crotch at the point of connection with the trunk, remove the entire branch to eliminate future problems with limb breakage. The goal is to promote two or three well-spaced lateral branches that are oriented evenly around the trunk and staggered with respect to those below them to create a well-balanced crown. Avoid cutting branches that are greater in size than one-third of the main trunk. It is not recommended to paint cut wounds.



An extendable pole saw, or pole pruner may be used to remove low-hanging, water sprouts, broken, weak, or diseased branches during dormant winter pruning in a mature black walnut orchard.

Pest and Disease Management

Several key pests can limit the production of nuts from black walnut trees. Strategies for controlling these pests will depend on the goals you have set for the orchard. All major pests can be controlled through the judicious use of pesticides; however, not all growers can afford the equipment needed for spraying large trees. The backyard orchardist and black walnut hobbyist can meet their goals for producing walnuts without pest control measures. In contrast, growers with the intent



Table 2: Recommendations for Black Walnut Insect Control

Insect Pest	Timing	Pesticide	Rate/Acre
Acrobasis Moths	Leaf burst	Asana XL(R)	4.8 - 14.5 oz.
		Confirm 2F	8 - 16 oz.
		Lorsban 4E(R) or Nufos 4E(R)	1.5 - 4.0 pts.
		Warrior (R)	2.56 - 5.12 oz.
Walnut Curculio	After pollination	Asana XL(R)	4.8 - 14.5 oz.
		Imidan 70WSB	1.0 - 3.13 lbs.
		Sevin 80W	2.5 - 6.25 lbs.
		Warrior (R)	2.56 - 5.12 oz.
Fall Webworm, Walnut Caterpillar and Yellow-Necked Caterpillar	When colonies appear	Asana XL(R)	4.8 - 14.5 oz.
		Confirm 2F	8 - 16 oz.
		Dipel ES	1 - 4 pt.
		Imidan 70WSB	1.0 - 3.13 lbs.
		Javelin WG	0.25 - 4 lbs.
		Lorsban 4E(R) or Nufos 4E(R)	1.5 - 4.0 pts.
Aphids and Walnut Lace Bug	If 25 or more adults are found per compound leaf	Warrior (R)	2.56 - 5.12 oz.
		Asana XL(R)	4.8 - 14.5 oz.
		Guthion 2L(R)	6 - 8 pts.
		Lorsban 4E(R) or Nufos 4E(R)	2.0 - 4.0 pts.
		Sniper 2E(R)	1.5 - 2.25 pts.
Walnut Husk Fly	Shortly before harvest; include a feeding attractant with the insecticide	Warrior (R)	2.56 - 5.12 oz.
		Asana XL(R)	4.8 - 14.5 oz.
		Lorsban 4E(R) or Nufos 4E(R)	1.5 - 4.0 pts.
		Imidan 70WSB	1.0 - 3.13 lbs.
(R) = Restricted use pesticide			

Table 3: Recommendations for Black Walnut Disease Control

Disease	Timing	Pesticide	Rate/Acre
Walnut Anthracnose	After pollination	Abound	9.2 - 12.3 oz.
		Flint	2 - 4 oz.
		Pristine	10.5 - 14.5 oz.
		Syllit	4 lbs.
	Additional applications at 2-week intervals based on weather conditions	Abound	9.2 - 12.3 oz.
		Flint	2 - 4 oz.
		Pristine	10.5 - 14.5 oz.
		Syllit	4 lbs.



to produce walnuts for profit must learn how to identify key pests and when to apply pest control measures. Although applicable for all black walnut producers, this section on pest control provides recommendations primarily for the commercial orchardist. Pesticide recommendations are given in Tables 2 and 3, page 4. The commercial orchardist must control one major disease, three major insect pests, and carefully monitor for two leaf feeding caterpillars.

Walnut Anthracnose Walnut anthracnose is the most common foliar disease of black walnut. It is caused by a fungus which results in the premature loss of foliage in late summer. This accelerated defoliation can stress a walnut tree by effectively decreasing a tree's photosynthetic activity during the critical nut filling period, resulting in a reduction of both nut crop quantity and quality. In some cultivars, this anthracnose susceptibility can also contribute to alternate bearing. For commercial orchardists, the control of anthracnose is essential for promoting annual nut production. Maintaining healthy leaves until fall is the only way a tree can retain an adequate supply of carbohydrates to fill both the current season's nut crop and reserve additional stored carbohydrates to sustain next season's flower production, pollination and fertilization. The anthracnose fungus overwinters on decaying leaves or small twigs, and its spores will begin to infect new leaves as they fully expand in the spring. Some walnut cultivars have displayed notable resistance to infection while other cultivars are highly susceptible (see top right image). Research to provide resistant cultivar recommendations is under way.

Often a single, well-timed fungicide application can provide season-long control of this disease. It should be applied after pollination as soon as the pistillate flowers are pollinated (when stigmas turn brown/black,

see bottom right image). Timing of this application is critical, so cultivar differences in flowering date must be considered. The earliest flowering trees may require a second fungicide application 10 to 14 days after the first spray. During an unusually wet spring, additional fungicide applications may also be necessary.



Green, anthracnose resistant tree (center) surrounded by yellowing, partially defoliated anthracnose susceptible trees in late summer.



Pistillate flowers are pollinated when the ovule begins to swell, and the stigmas turn brown/black. Fungicides for season-long anthracnose control may be applied at this stage.

Walnut Shoot Moth The walnut shoot moth overwinters as an egg in a protective structure called a hibernaculum attached to a scale of a dormant bud. As these buds start to swell in early spring, newly hatched larvae will emerge from these hibernacula and bore into the newly developing, succulent shoots, killing the terminal shoot. Since female (pistillate) walnut flowers are borne on the ends of the current season's new growth, the destruction of an entire terminal branch can be devastating to nut production. To control this pest, a properly timed insecticide must be applied at bud swell.

Walnut Curculio After nuts are pollinated in mid- to late- May depending on cultivar, adult walnut curculios, which overwinter in the soil, crawl or fly up into the tree canopy searching for young black walnut fruit to lay their eggs. Adult curculios are small, brownish-gray, beetles that feature a long snout (rostrum) nearly one-half the length of their body. The female curculio carves a crescent-shaped gouge into the small, developing nutlets, then lays her eggs inside.

As curculio larvae hatch, they begin to feed on the developing nutlets. In some years, curculios have the potential to remove a large portion of the nut crop very early in the season. In the Midwest, these damaged nutlets are aborted in early- to mid-June. This phenomenon is called the "June nut drop" by some growers. Sanitation in the orchard is an important management tool for this insect pest to avoid pesticide use. These aborted nutlets should be collected and removed from the orchard as soon as they drop. This will help to reduce the buildup of curculio populations in your orchard.

Fortunately, the timing of an insecticide application to control walnut curculio overlaps with the timing of the fungicide application to control walnut anthracnose. Commercial growers should follow pesticide labels for rate, timing, and whether insecticides and

fungicides can be combined in the same sprayer to be applied during the critical spray window after pollination. Trunk-mounted cone traps should be used to monitor any additional curculio activity following the first insecticide application (see image below). A second insecticide treatment may be necessary if traps indicate significant curculio populations.



This trunk-mounted cone trap is used to monitor walnut curculio activity.

Walnut Husk Flies Another major insect pest attacks as the nuts begin to ripen. Walnut husk flies lay a large number of eggs inside softening walnut husks. Legless larvae (maggots) hatch and feed throughout the husk from late-summer to early-fall, causing the husk to prematurely turn black, thus staining the nut meat. For growers concerned with delivering the highest possible quality nut, husk flies must be controlled. There are two strategies for managing husk flies. First, if a grower can efficiently harvest, hull and wash nuts before husk fly larvae can cause significant husk decay, insecticide applications are not necessary. But this strategy relies on the grower's ability to harvest each cultivar quickly and as soon as they start ripening.



Secondly, in large plantings, the harvest operation will be a time-consuming task, and efforts to harvest faster than the growing maggots can destroy the husks becomes a losing battle. Chemical control of husk flies is aimed at killing adult flies. Growers should scout their orchard for fly activity and spray an insecticide shortly before nuts begin to ripen. To increase the effectiveness of the insecticide treatment, a fly-feeding-attractant such as a protein bait or molasses should be added to the spring mix.

Fall Webworm and Walnut Caterpillar Fall webworm and walnut caterpillar are two foliage-feeding insects that, in some years, can completely defoliate infested trees. While both of these gregarious caterpillars are only problems during outbreak years, growers should still monitor their orchards carefully for signs of colony development. Fall webworm larvae feed in large colonies protected by dirty, white webbing. In contrast, the walnut caterpillar also feeds in large colonies but does not build a protective web. Both insects have two generations per year. An insecticide treatment is warranted when an average of 10 colonies can be sighted per acre of trees.

Walnut Aphids and Walnut Lace Bugs Walnut aphids and walnut lace bugs feed on the underside of black walnut foliage, sucking plant sap from the leaves. When populations of aphids and lace bugs build to outbreak proportions, the combined feeding of thousands of insects will effectively destroy leaf photosynthetic capacity, ultimately leading to reduced tree vigor. Fortunately, these insects are rarely a problem in most years, but nevertheless, growers should scout their orchards carefully throughout the summer for signs of an aphid or lace bug outbreak (>25 insects per compound leaf). Outbreaks of these insects usually occur during hot, dry summers.

Harvest

Walnut harvest is the most time consuming and costly part of black walnut orchard production. Prompt harvest is key for maintaining peak kernel quality and color. The longer a fully ripened husk remains on the nut, the darker the kernels will become and greater the risk of post-harvest spoilage. Information on harvest timing and season length is now available for recommended cultivars: extension.missouri.edu/publications/xm1001. These tools may provide a useful timeline to plan when harvest will begin and how long it will last. Nuts are ripe and ready to harvest when you can press your thumb into the hull and leave an indentation. Commercial orchardists use tree shakers to remove the crop from a tree when 50 percent of the nuts are ripe. Small-scale producers can allow nuts to fall naturally, but nuts should be picked up regularly for prompt hulling to preserve kernel color and decrease husk fly problems.

Large-scale growers have successfully modified commercially available pecan harvesters for picking nuts up from the ground. The hand-operated Nut Wizard® can make hand-harvesting more efficient for the small-scale producer. Once the nuts are gathered, they should be hulled promptly. Small-scale walnut growers can use homemade tire and cage hullers to remove nut husks. Commercially manufactured nut hullers used in the Persian walnut industry can also be adapted for use by black walnut producers.

Following hulling, the nuts should be washed in a 1,000 ppm chlorine solution bath (1 teaspoon regular bleach/gallon water) to remove any remaining hull and to disinfect the nuts. Most washing systems are homemade, but all involve an agitation system to stir up the nuts during the cleaning process. Freshly hulled nuts that float to the top of the water bath are poorly filled and should be discarded. Washed nuts should be

placed on screen racks and allowed to air dry. Large drying bins with a forced air system can be used to dry walnuts, but heated air should never be used.

Marketing Nuts

For many black walnut enthusiasts, harvesting enough nuts for personal use and sharing as gifts to family and friends, is the extent of their marketing plan. However, commercial growers must develop a ready market for the tons of nuts they produce. Currently, there is only one commercial black walnut processor in the U.S., Hammons Products Company of Stockton, MO. They currently operate 196 buying stations at locations across the Midwest, which are set up to purchase walnuts harvested from native, wild trees. In addition, they will purchase clean and dry walnuts from orchards of improved cultivars at a premium price, based on kernel percentage, kernel quality, and moisture. Premium prices range from \$0.50 to \$1.20 per pound in-shell. Some walnut producers have discovered that they can add value to their crop by marketing either cracked nuts or cleaned black walnut kernels directly to the consumer, such as at farmers markets or through online platforms. For small producers, this can be very labor intensive, but prices for locally grown, cracked out kernels advertised on these platforms can range from \$10 to \$20 per pound, making the extra labor worth the effort.

The commercial processing of black walnuts requires specialized equipment that is either custom manufactured (crackers) or modified from other nut processing industries (sorters, inspection tables, baggers). The processing of black walnuts is a technologically complicated activity that is outside the scope of this publication, although many innovative growers have documented their successes and equipment in videos, online resources, and on social media.

Final Thoughts

Black walnut orcharding is a niche specialty crop business which presents a unique opportunity to add low-input value to many acres of underutilized, suitable land throughout the Midwest. Like any business, successful black walnut growers have been innovators, both in producing a high-quality walnut crop and marketing that crop to consumers. They are adept in modifying machinery from other nut industries for use in black walnut orchards, and they are innovative in developing markets for their crop.

For ideas on marketing and guidelines for budgeting a black walnut orchard, contact the UMCA at blackwalnut@missouri.edu. The UMCA offers additional information on marketing specialty crops and has designed an [Agroforestry Black Walnut Financial Model](#) to assist with decisions including tree spacing, nut harvest and whether to use improved (grafted) or unimproved trees. This convenient spreadsheet tool will help make estimates about future nut production and tree diameters. Visit centerforagroforestry.org to access more information.



Black walnut and corn alley cropping



Check out more black walnut resources on the "[Mizzou Agroforestry](#)" YouTube channel!



Black Walnut Grower's Calendar

Month	Non-bearing Trees	Bearing Trees	Pest Management
January	Plan spring grafting	Maintain equipment	Maintain equipment
February	Collect scion wood; tip prune trees	Prune orchard	
March	Fertilize trees; plant bare-root or grafted trees; tip prune	Prune orchard; fertilize trees	Scout for walnut shoot moth
April	Apply weed control	Apply weed control	Spray for walnut shoot moth as needed at budburst
May	Graft trees to recommended cultivars	Keep groundcover mowed	Scout for curculio; spray for anthracnose & walnut curculio, as needed, after pollination
June	Water newly planted trees; stake new grafts	Keep groundcover mowed; thin nut crop if needed	Scout for walnut aphids and lacebugs
July	Prune off suckers below new grafts; tip prune	Keep groundcover mowed; irrigate as needed	Scout for caterpillar & fall webworms
August	Make sure newly planted trees have adequate water	Keep groundcover mowed; irrigate as needed	Scout for walnut husk fly
September	Establish cool season cover crops	Harvest promptly; clean and market nuts; irrigate as needed	
October	Plant container-grown trees	Finish nut harvest; market crop	
November		Market crop	
December		Market crop	



Black Walnut Resources

Black Walnut Suitability Index, NRCS

websoilsurvey.nrcs.usda.gov/app/

(Use the Web Soil Survey for Missouri and find the black walnut mapping under the "Vegetative Productivity" function)

Diseases of intensively managed eastern black walnut, USDA Forest Service

nrs.fs.fed.us/pubs/4717

Freeze/Frost Maps, National Climatic Data Center

www.weather.gov/rah/FrostFreezemaps

Hammons Products Company: World's largest processor and distributor of eastern black walnuts

www.black-walnuts.com.

How to diagnose black walnut damage, USDA Forest Service

nrs.fs.fed.us/pubs/122

Insects attacking black walnut in the Midwestern United States, USDA Forest Service

nrs.fs.fed.us/pubs/4719

Missouri Nut Growers Association

<https://missourinutgrowers.org/>

Northern Nut Growers Association (NNGA)

www.nutgrowing.org

Propagating Pecan and Black Walnut in Missouri, Center for Agroforestry

<https://centerforagroforestry.org/landowners/resources/agroforestry-in-action-technical-guides/>

The Walnut Council

<https://walnutcouncil.org/>

In the Library

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<http://nrs.fs.fed.us/pubs/4702>

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<http://nrs.fs.fed.us/pubs/103>



Black walnut nut meat and shells



Nuts maturing on the limb of a black walnut tree

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