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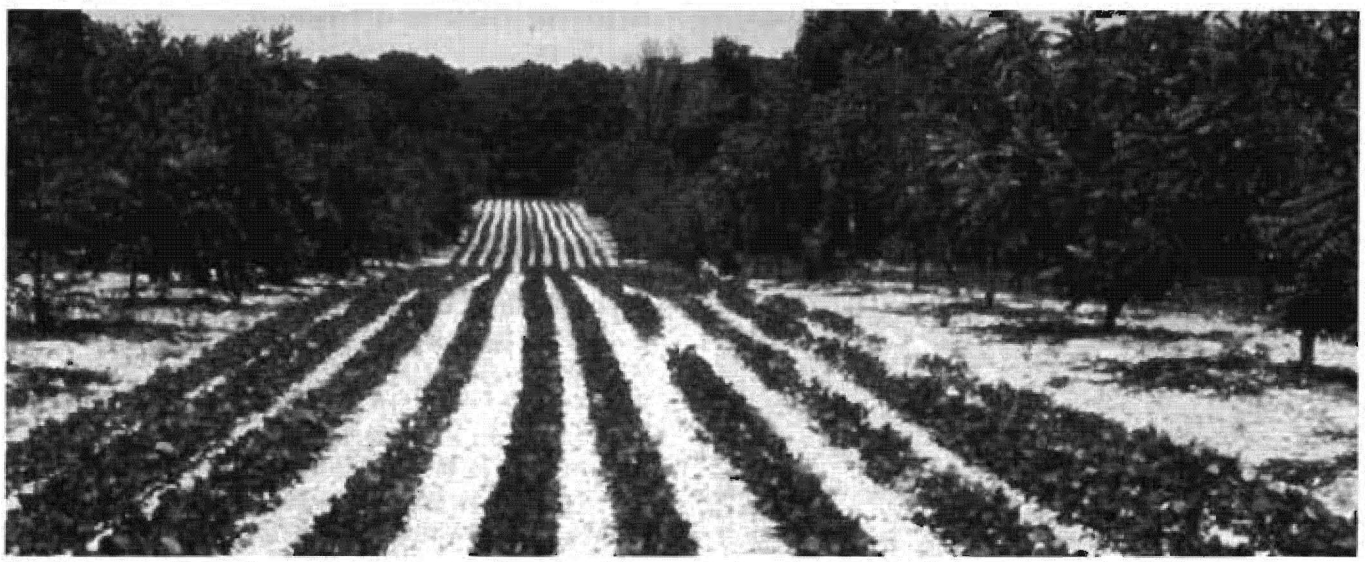

Walnut Agroforestry

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Agroforestry, or growing trees and other crops together on the same land, has been practiced for years in other countries to achieve more sustainable and productive use of limited land resources. In the U.S., forestry and agriculture historically have been considered mutually exclusive land use alternatives. But with clear management objectives, careful planning and skillful intensive management, combining crops and trees can provide advantages that outweigh any perceived disadvantages.

Agroforestry is a potential alternative to conventional mechanical methods for soil erosion control. It also allows for gradual removal of highly erodible cropland from row-crop production.

Advantages of walnuts

Black walnut *(Juglans nigra L.)* performs best on deep, well-drained soils. Because there are markets for both the wood and the nuts, black walnut traditionally has been the state's most commercially valuable tree.

Black walnut has growth and shade characteristics that enhance the production of several cool-season forages. It typically has a growth period of only 90 to 135 days, making black walnut one of the latest species to leaf out in the spring and one of the first to defoliate in the fall. The additional days of full sunlight in the spring are needed to maximize the yield of an intercrop species such as winter wheat. Early foliage loss in the fall means more direct sunlight and greater moisture availability for warm-season intercrop species. Even with full foliage, walnut admits sufficient light for most forage legumes and cool-season grasses grown in Missouri.

The black walnut's root system is ideal for agroforestry practices, in part because it reduces competition for soil moisture and nutrients between the trees and intercrops. While walnuts grow best on deep, well-drained soils with neutral pH, root characteristics are similar over a fairly wide range of soil conditions. Walnut typically produces a deep taproot that may penetrate more than 7 feet in the absence of bedrock, claypans or other physical barriers. The long lateral roots stay close to the surface, but most of the smaller roots turn down sharply into the soil. Feeder roots normally concentrate at a depth of 4 to 8 inches. This leaves a shallow zone near the soil surface for intercropped species to develop their own root systems.

Black walnut offers incentives that few other species can match. The potential for high returns on wood from individual trees, combined with regular

income potential from annual or periodic nut crops, makes walnut an attractive investment opportunity. However, artificial pruning of some tree limbs is essential to realize the wood potential.

The compatibility of black walnut with certain grasses, grains and other crops allows management options not possible with many other tree species. Intercrops provide immediate income while the walnut is growing to nut production age at 15 to 20 years and sawlog production at approximately 50 years. With conventional management practices, 80 or more years pass before walnut wood reaches its greatest commercial potential.

Many types of crops, including Christmas trees, can be grown in conjunction with walnut trees.

Alley cropping

Alley cropping is an agroforestry management system that permits the production of a variety of crops in the alleys between widely spaced rows of trees. When row crops such as wheat, soybeans and milo are used, the spacing between the intercrop and the trees is an important consideration. Winter wheat requires a minimum of 3 feet between trees and crop while establishment is occurring. This removes about 13 percent of the field from wheat production. As the trees grow, the amount of lost space must be increased to as much as 7 feet to avoid damaging tree branches and root systems.

At a spacing of 40 feet between tree rows, 45 rows of wheat spaced at 7-inch intervals can be positioned between two rows of trees. An advantage of winter wheat is that it grows during walnuts' dormant season, minimizing competition for water, nutrients and light. However, with soybean or other warm-season row crops, grass and herbaceous vegetation become a serious problem near the trees. It is necessary to leave 6 or 7 feet between these intercrops and trees to permit mechanical and chemical weed control during the growing season. For soybeans, only 10 30-inch rows can be planted within the 40-foot lanes between trees. Thus only 62 percent of the land is used for the intercrop.

The landowner is not limited to traditional row crops during the early years of walnut establishment. Vegetables, blackberries, raspberries, blueberries, Christmas trees, landscaping plants and red clover are just some possible intercrops. Many plant species are compatible with black walnut and unique agroforestry combinations can be designed to take advantage of regional or local markets.

Intercropping with row crops obviously is not feasible for the entire walnut rotation period even under ideal conditions. At best, intercrops can be grown for 8 to 10 years before shade seriously limits production. It is possible to increase the spacing between tree rows and lengthen the intercropping period, but this reduces nut and wood values.

Research indicates that some grass species perform well in walnut shade and are ideal for replacing row and specialty crops when shade reduces their yields. Studies of intermediate-aged black walnut stands on yields from six forage species indicate potential increases of up to 33 percent due to growth under the cool shade conditions. Increased forage yields, improved digestibility and increased steer days per acre have all been demonstrated in studies relating to forage production under the shade of black walnuts.

Walnut management

Spacing of trees

Tree rows must be planted at wide spacings to accommodate the biological needs of intercrops in alley cropping management systems. Within rows, however, trees must be close enough to produce a 'training effect' while providing a surplus of plants from which one can select the final crop trees. Since the top (crown) of a mature walnut tree covers an area approximately 40x40 feet and maximum nut growth is a top priority, suitable space for full crown development should be provided.

Unfortunately, genetically proven stock at affordable prices is not available to the average landowner. Therefore, a large number of genetically unproven trees must be planted initially to achieve 27 to 35 high-quality stems per acre by the end of the growing cycle. In the early planting stages, more trees also are needed to control erosion.

Tree spacing will vary with individual management objectives (i.e., emphasis on wood production vs.

nuts), light requirements, growth period required for the intercrop and even available farm equipment (e.g., width of header, disk etc.). However, studies have demonstrated that a 40x10-foot spacing (108 trees/acre) is a good compromise. Forty feet between rows provides sufficient light for most intercrop species. Ten feet between the trees within the row provides an additional 73 to 81 trees from which the final 27 to 35 quality trees per acre can be selected. The additional trees also serve as "trainer" trees to encourage straight, single stem development while reducing lower stem branching. An east-west row orientation provides maximum light for the intercrop species.

Walnut is ideally suited for improving upon the production of many cool-season grasses.

Weed control

Weed control is critical for maximum walnut growth and is necessary to earn a profit from walnuts. Most herbaceous weeds inhibit walnut growth due to increased competition for available water supplies. Walnuts are intolerant of competition for moisture and suffer when forced to compete for water. If other conditions are equal, the effect of competition on growth is less on a deep, high-quality site than on a shallower, low-quality site.

Mechanical weed control appears to be as effective as chemical control in maintaining vigorous trees. However, caution is needed to avoid root damage from tilling or damage to the lower portion of the stem from contact with the tiller. Operating conventional farming equipment close to trees is not recommended.

Weed control around the base of individual stems should be achieved chemically when conventional farm tilling equipment is employed. Complete weed control by mechanical means is advocated only if some form of precision in-the-row tiller is used. Equipment of this nature is specifically designed to minimize damage to young trees. It also may prove superior to chemical weed control as a result of the increased aeration and moisture penetration benefits derived from soil-surface scarification. Where conventional equipment is used between rows, depth of tilling should be regulated to 6 inches or less.

Because of application ease and past success, **chemical weed control** is more popular than mechanical weed control in walnut management. Following planting, herbicides may be applied in a circle around each seedling creating an opening 6 feet or more in diameter or, as is advocated in agroforestry management, along both sides of a row of trees.

The width of the control zone along the row will vary among landowners, but should be a minimum of 6 feet (3 feet along both sides of a row). As the trees grow, the width of vegetation-free zones should increase to about 15 feet (7.5 feet on both sides of a row). Due to potential chemical build-up, landowners should watch for leaf curling, dead zones along leaflet margins and other indicators of chemical problems. Care should be taken to avoid creating bare areas running up and down slopes, which can result in serious erosion problems. Where sites are erodible, consideration should be given to planting on the contour.

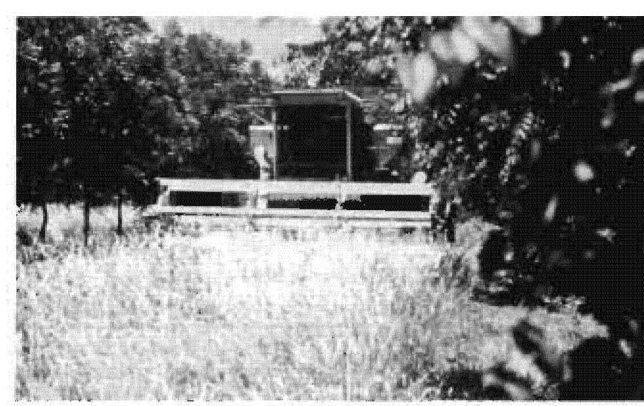
Fertilization

Limited understanding of fertility needs is perhaps the greatest weakness in managing black walnut as a component of an agroforestry regime. Little research exists on the development of sound fertilization prescriptions, especially relative to nut production. In most instances, proper fertilization of the intercrop will provide sufficient nutrients to the trees if weed control practices are maintained.

Nitrogen, generally the element needed most by walnut trees, is often the one that is most lacking. Due to nitrogen loss from harvesting intercrops and removing tree prunings, N supplements must be added to maintain favorable tree growth rates. If trees are to be fertilized independently of an intercrop, a good rule of thumb is to apply, within the dripline, 1 pound of triple thirteen (13-13-13 NPK) per inch of stem diameter.

Pruning recommendations

In contrast to conventional management systems that emphasize walnut wood production, agro-



You should carefully consider types of machinery to be used when you are determining the distance between tree rows.

forestry management advocates shorter trunks with larger crowns. Numerous analyses have demonstrated that larger profits can be made through some sacrifice of clear log length in favor of greater crown area for nut production.

On soils of lower productivity (usually upland or dry, less fertile soils) pruning heights providing 8- to 10-foot logs are recommended. On the more productive locations (bottomlands, or deeper, more fertile upland soils) an attempt should be made to produce 12- to 16-foot logs. This is accomplished by gradually pruning lower limbs during the first 20-plus years. However, at least 50 percent of the tree's height is always maintained in living branches and no more than 1/3 of the crown should be removed at any one pruning. Failure to follow these two rules will reduce growth drastically.

Cuts should be made to the outside of the branch collar during late winter but prior to sap movement in the spring. It is not enough to concentrate only on clear-pruning the lower trunk. Attention must also be given to eliminating weak branches coming off the central stem well above the current year's pruning height. These are branches forming angles of less than 45 degrees with the main stem.

The cost of pruning and removing branches from the site must be considered if a landowner plans to have a large number of trees. A mobile pruning tower and a chipper may be economically justified in large agroforestry programs.

Tip pruning (the removal of the growing tip of the branch) of lower lateral branches is a practice unique to agroforestry management. As trees develop, lower branches grow into the open areas on either side of a row and can become entangled in farm equipment operating between rows. This often results in irreparable damage to the trees. Tip pruning prevents damage and enables the landowner to maintain greater live crown ratios early in the life of the stand. The result is a better growth rate. While there are no set rules on when to begin tip prunings or how much of the branch to remove, both should be based on minimizing the danger of damage from equipment.

For additional information about proper pruning techniques, see MU Guide G5160, "Pruning Forest Trees."

Thinning

In agroforestry management, the first thinning can be delayed longer than in conventional management,

With wide row spacings, some limb pruning will be necessary to develop high-value logs.

since two sides of each tree are in open space between rows. However, depending upon the site and initial spacing within a row (but assuming that spacing within a row will not exceed 20 feet), the first thinning will become necessary between years 10 and 15.

Thinnings are designed to select trees for removal based upon stem quality (straightness, diameter, height and form), and nut production characteristics (bearing regularity, percentage crackability, quality and quantity of nuts produced). Records should be kept as soon as trees begin bearing nuts to determine which trees are most productive over a period of time. Thinnings should be conducted on an ongoing basis. The eventual goal is to reduce the walnut plantings to the 27 to 35 most valuable trees per acre.

Walnut agroforestry economics

Agroforestry provides black walnut growers with the opportunity to develop a portfolio of short- and long-term investments, thus allowing for some risk spreading through diversification. Agroforestry also provides a cost-effective way to remove erodible land from crop production over an extended time period. Thus it is particularly promising for farmers with land that is unsuitable for crop production due to high soil erosion.

A number of federal, state and private programs are designed to assist landowners in managing their agroforestry acreages. Both technical assistance and cost-sharing programs exist. For additional information, see "Sources of Assistance for Landowners," MU Guide 5999.

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