PART 5

HARVEST AND POST HARVEST

Traditional Methods Of Harvesting, Transporting, And Storage of Eastern Black Walnut Nuts

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INTRODUCTION

The eastern black walnut nut industry is based on a totally wild crop with the nut producing segment of the resource being generally made up of trees that are 8-10 inches in diameter and larger. These individuals have almost exclusively been planted by squirrels and have been permitted to survive in fence rows, field borders, lawns, and roadsides throughout the range of the species. Some of these individuals have been encouraged to grow and selected from competition, but are the remnants of prior selective log harvests. The nut crop is basically a gift of nature. Very few of these trees are impacted by fertilization, pest control, or other cultural practices and their crop size is highly variable from year to year.

BUYING STATIONS

Buying station contractors are a diverse group of businesses and individuals. Contractors receive the nuts in the husk and are responsible for operating the hulling machine, recording the weights of in-shell black walnuts that are purchased, storage of the black walnuts at their site until shipping, and also the disposal of the husk that is removed by the hulling machine. For operators to have a successful operation, all these areas of responsibility must be done efficiently and properly. Operators are paid a commission based on the number of pounds that they purchase on an in-shell weight basis. The current commission rate in 1998 paid to each operator is $3.00 cwt. based on the on-site scale weight. This weight is measured after the customers black walnut have been processed through the hulling machine which removes the outside husk off the in-shell nut. Most operators dispose of the husk on pastureland using a manure spreader to distribute the husks. Test show that the Ph level of husk material is neutral to alkaline. The husk tends to run approximately 1% in nitrogen and will also help to build up the organic matter within the soil. After hulling, the in-shell nuts are placed into mesh bags, tied and placed on the scales for weighing. Most buying locations use small platform scales to do the weighing of each individual's nuts that are purchased. The name of the picker and the purchase weight are then recorded on a buy sheet which is provided to the operator. Operators can mail these sheets daily, weekly, or monthly depending on their financial ability. Hammons Products Co. then returns payment through the mail with the amount for the purchased nuts along with their commission for the pounds that were purchased. If operators bring in their buy sheets into the main office at Stockton, Missouri they can receive payment immediately at the time.

Buying station locations need to have plenty of room for the receiving of nuts coming in, allowing traffic to move freely about without incident. Each location will also need plenty of space for storage of the in-shell purchased nuts along with the ability to dispose of the husk as the buying season progresses. Areas that drain properly and tend to dry out quickly help locations to be more effective and efficient as fall weather is unpredictable and usually wet as winter approaches.

HARVEST SEASON AND HARVESTING METHODS

The eastern Black Walnut buying season begins October 1st each year and extends into the second or third week of November. With the buy season only five to six weeks in length, this makes for very intense and aggressive harvest. The volume of nuts needed and purchased each year is not controlled by the length of the buying season, but more by the suggested purchase price of the nuts at the buying locations. Current pricing is based on supply and demand and flexible pricing is being implemented on a more regular basis each new year. However, Mother Nature plays a very large and important role in the volume and quality of crop that is available for purchase.

Through the years, the black walnut nut industry has not changed much in the way the nuts are harvested. Usually in late September to early October the nuts mature and drop to the ground where they are still picked up by hand one at a time. This is a very labor intense harvesting method and currently continues to remain that way. The nuts are picked from under trees located in fence rows, pasture land, lawns, and even black walnut orchards throughout the Midwest and eastern United States.

STORAGE AND TRANSPORTATION

Storage and handling of the bagged in-shell nuts is one of the most important areas of responsibility that the operator has. Operators need to place the bags on pallets, and store the nuts outside which helps air to circulate through out the mesh bags and begins the drying out process. Although the nuts may get rained on in an outdoor storage location, they will quickly begin drying as a result of outside air movements. When the in-shell nuts are stored in a confined space without air movement, the nut will begin showing signs of mold on the shell. The kernel will then begin pulling moisture from the outside shell into the kernel, thus increasing the kernels moisture content and prohibiting proper drying. Over extended periods of time in this situation, the kernel will begin turning darker in color and becoming poor in quality.

Locations which buy large amounts of black walnuts quickly realize how much labor and space is needed to handle and store large volumes of this tasty nut. Mesh bags are then loaded on or into trailers and transported to the shelling facility for further processing. All bags are normally loaded and unloaded by hand both at on-site buying location and at the shelling facility. Using this process on literally millions of pounds of in-shell nuts is a very strenuous and a highly laborious effort not only at the operator level, but at the shelling plant as well.

PLANNING FOR THE FUTURE

With more eastern black walnut orchards being planted each year, advanced harvest techniques along with improved handling practices must be improved upon in the near future. Implementations of new purchasing procedures dealing with percent yields, moisture content, and kernel color are all areas that will need to be explored and expanded on. Advancements in tree genetics for nut production will need to reach levels where land owners are willing and wanting to plant eastern black walnut trees for a cash crop with returns on a per acre basis being equal to other agricultural commodities. When all of these new practices and procedures are in place, the black walnut nut producing industry will truly reach commercialization levels.

Black Walnut Harvesting Costs--The 50 Percent Factor

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Ultimate success of agroforestry systems, especially those that incorporate nut tree plantations with intercropping, will depend on their profitability. As with more traditional crops, harvesting and labor costs are major considerations. As much as half or more of the nut crop income from a black walnut agroforestry system may be required to pay the harvesting costs.

It is commonplace that at least 50 percent of the nuts harvested from scattered native walnut or pecan trees goes to itinerant or contract hand nut pickers. Black walnut pickers often receive the whole crop. Contract pecan harvesters with mechanized harvesting equipment charge 50 to 70 percent of the crop for their services. However, they also may provide other pre-harvest labor such as pruning, stick picking and mowing, even spraying for insects.

While a 50 percent charge for contract harvesting may seem exorbitant to a plantation owner, it must be determined: "50 percent of what?"

A dedicated hand picker might harvest 500 pounds of hulled black walnuts in a day. At 10 cents per pound that's only $50 a day. It's quickly evident why most black walnut pickers do not want to share the proceeds. Even in a plantation setting where the nuts are abundant and pickers do not need to travel far between trees, the daily wage still would be quite small for the labor involved.

Plantation size and the ultimate growth of the industry are closely tied to how many pounds of nuts can be harvested in a day and at what cost.

If we accept that one person can hand harvest up to 500 pounds of hulled black walnuts in an 8-hour day, we can begin to measure nut harvest efficiencies. The 500-pound marker certainly isn't an average of what most hand pickers actually harvest. Most do not or cannot or will not work 8 hours a day. It has been proven on the Hammons Sho-Neff Plantation at Stockton, Mo., that dedicated pickers can harvest that amount.

It also has been shown from historical weather records that there are an average of 20 excellent harvesting days in the fall. Of course, there can be more in some years, less in others and growers will definitly extend the season by working some "not so good" days. But for purposes of comparison, lets stick with the 20 days and 500 pounds per day for each worker. That means that a single picker can harvest only 10 acres of black walnut trees that produce an average annual crop of 1,000 pounds per acre (20 x 500 = 10,000 pounds).

If the plantation yields 2,000 pounds of nuts per acre, a single picker could harvest only 5 acres. The reality then is that a plantation owner can plant only the number of acres he or she has labor or equipment available for the harvest.

If hand labor is not available, and it probably won't be; who else but the plantation owner is going to work 8 hours a day for $6.25 an hour (500 x 10cents = $50 / 8 = $6.25), then mechanical

harvesting no longer is an option, but a necessity. In fact, hand labor other than family labor for picking nuts for their own use or a limited niche market, probably isn't an option at all. The only time hand labor would be attractive would be in the case of a limited acreage of high-value nuts, processed and direct-marketed to special buyers. The price would have to be set so it covers production, harvesting, processing and marketing costs plus a reasonable profit.

However, for this example, let's assume we are producing for the commercial nut market (Hammons Products Co.).

It is a foregone conclusion among pioneering black walnut plantation owners that some kind of mechanical harvesting is necessary. Several approaches have been tried.

Some of these systems do little more than remove some of the back-breaking stooping and bending work. Spreading tarps around trees to collect falling or shaken nuts may actually increase labor costs. A more mechanized approach of mounting tarps on a tractor frame may also increase costs and not gain any economies.

The modified golf ball retrieving units offered by Bag-A-Nut may be handy for harvesting a small orchard, but the efficiency of these small push-type or lawn tractor-mounted units is questionable. Cost of the 16-inch model is about $250 while larger units may cost several hundred dollars.

At least two commercial nut harvesting systems lend themselves for adaptation to black walnut. The first is English walnut harvesting equipment, manufactured mostly in California where the English walnut is most prevalent. It appears to perform well enough, but initial cost may be more than the black walnut market can bear. The system now in use at Hammons Products Company at Stockton, Mo. is made by Weiss-McNair. This sweeper-harvester combination costs about $35,000 new. A tree shaker would add another $5,000. Total system cost would be about $40,000 not including tractor and transport equipment necessary. We assume most multi-crop farming operations would already have this equipment. The purpose here is to compare only the costs of equipment specific to the nut harvesting operation.

The second harvesting system under consideration is a modified pecan harvesting machine manufactured by NH Savage of Medill, Oklahoma. In preliminary trials using the company's smallest model, it was determined that the harvester will pick up walnuts (with hulls on), but needs several modifications. A larger screening chain with at least 3.5-inch openings is necessary to allow the largest black walnuts to pass through while still screening out the largest sticks and other trash. The augering system, both the horizontal transport and the elevating augers, should be increased in diameter to handle the large walnuts with hulls on. It might be possible to replace this augering system with a conveyor belt that would be useful for both walnuts and pecans.

The trash screen on the elevator auger also must be opened up to 3/4 inches to allow more trash, especially crushed hull, to be expelled. However, some of the crushed hull would be eliminated by the larger augers or conveyor.

It also is suggested that the pickup header on the machine needs to be free-floating with a gauge wheel to accommodate uneven ground.

With these adaptations, it is felt that the NH Savage equipment would perform well enough. Savage recently introduced a new model pecan harvester with 6-foot header that incorporates some of these design changes. However, it has not been tested on black walnut.

It is roughly estimated that an NH Savage harvester of equivalent size to the Weiss-McNair unit could harvest up to 30,000 pounds of black walnuts with hulls in an 8-hour day. That would yield about 12,000 pounds of hulled nuts per day (40 percent of total weight).

Now we have to get back to the question: "50 percent of what?"

The capability of the harvester mentioned above would allow an operator to cover 8 to 10 acres per day when the per-acre yield is between 1,000 and 1,500 pounds of hulled nuts. From experience in pecan plantations, it is estimated that 10 to 12 acres a day is about all that can be covered no matter what the yield may be. Therefore, our harvesting capability may set the minimum yield goals we strive for.

Harvesting capability also will largely determine the number of acres needed to reach the economic potential for ownership of the equipment. The harvesting capacity used above would allow an operator to harvest 40 acres yielding 1,000 to 1,500 pounds of black walnuts per acre in 3 to 5 days. Long-term weather records indicate that most areas of Missouri have an average of 20 days of open harvesting weather each fall. We could extrapolate that we might be able to use the harvesting equipment for at least 20 days most years on at least 160 acres. That number of acres, whether owned or under custom harvest, would spread the cost of the equipment over the most economic time period.

Cost of machinery ownership based on 160 acres, or better yet, 160,000 pounds of hulled nuts, would be figured by the following formula: Original cost of machine minus salvage value (10 years) divided by 10 plus interest [original price plus salvage value divided by 2 to get an average annual interest value] times 10 percent plus maintenance [2 percent of original investment].

The annual cost of a harvesting machine selling for $15,000 would be $2,300. A more useful cost figure is cost per pound. If an operator could harvest 160,000 pounds annually, the per-pound cost would be almost 1.5 cents.

Of course, there are other machines and expenses in this harvesting system. A tree shaker at a cost of approximately $5,000 would be necessary. How the nuts are marketed, whether in the hull and transported to a buying station, or hulled on the farm for retail or wholesale marketing will determine the need for buying a huller and washer. These two items could add $1,500 each, perhaps more. As trees become more mature, it likely will become necessary to use a trash or stick rake to remove debris before harvest. This could add another $3,000. Total cost for new equipment with the NH Savage unit could reach $26,000 or 2.5 cents per pound or more cost.

Labor to operate the machinery also must be added. It most likely would require a three-man team, especially if the hulling is done on the farm simultaneously as the harvesting. Taking the nuts to a commercial huller might reduce farm labor but would increase per-pound cost by 3 cents (normal huller operator compensation).

Three men at $6 per hour times 8 hours equals $18 times 8 equals $144 times 20 days equals $2,880 divided by 160,000 pounds equals 1.8 cents a pound.

Other machinery costs such as farm tractors (most likely two) plus wagons or truck for transportation must also be added. That most likely would increase harvesting costs another cent or two.
Harvesting costs could easily mount to 5 or 6 cents per pound or more under the best of conditions, depending on total pounds picked. That's half or more of the current commercial price of 8 to 10 cents a pound for hulled nuts at a commercial huller. Add 3 cents to that if nuts are hulled on the farm.

The best of conditions dictate that a harvester must be operating in a plantation environment where nuts are conveniently accessible and plentiful. A crop of at least 1,000 pounds per acre seems to be a necessity just to make mechanical harvesting feasible.

These figures are predicated on a minimum yield of 160,000 pounds harvested in 20 days. Any change in that figure, i.e. less than 160,000 pounds, increases rather dramatically the cost of harvesting equipment on a per-pound basis. Extending the acreage or the season is not a real option since days of optimum harvesting conditions are limited.

Although a reduced yield likely would result in reduced labor costs (fewer days), the annual machine ownership costs would be the same.

It would appear that under current nut pricing conditions, even with ownership of harvesting equipment, the cost of harvesting is likely to be at least half the crop.

The solution to this dilemma does not lie in higher yields, at least not a big part of the solution. The machine's capacity is limited to the number of nuts that can be picked up in 20 harvesting days. A heavy crop might increase that capacity somewhat.

The real solution lies in pricing the crop at a reasonably profitable level.

BLACK WALNUT AGROFORESTRY -- MISSOURI BASIC SYSTEM (ALTERNATIVES)

This system information sheet can be used to collect alternative agroforestry system cost, income and timing information needed to calculate profitability and make comparisons with the basic system.

Alternative System Design:

Row and tree widths -- (40 by 20 feet = 54 trees/acre)
Site Index -- (65)
Rotation = number of years to final harvest -- (60)
Tree species -- (Eastern Black Walnut)
Planting method -- (post hole digger)
Rootstock -- (selected cultivar bareroot seedlings)

Field grafted -- (custom grafted = $3/tree)
Alley crop -- (orchard grass/red clover)
Salable crops -- (nuts, timber, hay)

Crop Yields:

Nuts: (Year 11-15 = 500 pounds/ac.)
(Year 16-20 = 750 pounds/ac.)
(Year 21-30 = 1,000 pounds/ac.)
(Year 31-40 = 1,500 pounds/ac.)
(Year 41-60 = 2,000 pounds/ac.)
Price: (25 cents/pound)

Timber:
(Commercial Thinning at Year 26. Remove 27 trees at 12 in. DBH with 9 ft. log = 16 board ft.)
Price: (50 cents/board ft.)

Final Harvest:
(27 trees @ 25 inches DBH with 9-ft log = 180 board feet)
Price: ($1/board foot)

Hay: Annual net income ($60/acre/year)

(Livestock = annual net income)
(Annual crops = annual net income)
(Long-term crops--ornamentals, ginseng, etc. use cost and income by Years.)
(Services--lease hunting, etc, use annual net income)
(Government programs and cost share = annual net income)

Costs of individual practices:

Site preparation: ($10/ac.)
Rootstock: ($1/seedling = $54/ac.)
Planting: ($1/seedling = $54/ ac.)
Grafting: ($3/tree) (70% success rate annually)
(Year 3 = 54 trees x $3 = $162/ac.)
(Year 4 = 16 trees x $3 = $48/ac.)
(Year 5 = 4 trees x $3 = $12/ac.)
Herbicide: Application cost ($5/ac.)
Chemical cost (Year 1 thru 6 = 3-ft. strip on each side of row = $8/ac.)
(Year 7 thru 8 = 4-ft. strip each side of row = $9/ac.)
(Year 9 thru 60 = 6-ft. strip each side of row = $11/ac.)
Fertilizer: (60-30-30 annually beginning Year 2 = $27/ac.)
(Application cost: $5/ac.)
Overseeding: (Red clover overseeded every 4 Years at 8 pds/ac. x $2 = $16/ac.)
(Application cost: $4/ac.)
Pruning: (Year 7 = $14/ac.)

(Year 12 = $14/ac.)
Management: (All those odd annual jobs we hadn't counted on: $7/ac./Year)
Other specific practices needed for this alternative system: (Cost/ac, Years performed)

SPECIALIZED AGROFORESTRY PRACTICES COSTS

Planting: Dibble Bar -- .20/tree
Transplanter -- .12/tree
Post Hole Digger -- .50/tree
(Double these rates if have custom contractor perform service)

Seedlings: Missouri State Nursery -- .50 ea. (after culling half)
Selected cultivar -- $1 ea. (greenhouse grown)
RPM selected cultivar -- $8 ea. (in 2-gal. pot)
RPM grafted cultivar -- $12 ea. (in 2-gal. pot)

Weed mats/inc. installation:
$1 ea. (no herbicide application until Year 5)

Field Grafting: (Includes scionwood) $3/tree

Pruning/hauling debris: .26/tree

Labor: $7/hour

(The accompanying table demonstrates the economic necessity of harvesting as many pounds of nuts as possible within the ideal harvesting period. Machinery ownership cost (interest, depreciation and maintenance) are the same each year no matter how many pounds of nuts are harvested. Hourly tractor and labor costs vary with the amount of time required to harvest the crop.)

MECHANIZED HARVESTING COST (PER POUND) FOR EASTERN BLACK WALNUT

Number of Harvesting Days	**1**	**2**	**3**	**4**	**5**	**10**	**15**	**30**
Machinery Ownership Costs	$4,500.	$4,500.	$4,500.	$4,500.	$4,500.	$4,500.	$4,500.	$4,500.
Hourly Tractor/Labor Costs	$288.	$576.	$864.	$1,152.	$1,440.	$2,880.	$4,320.	$8,640.
Total Annual Cost	$4,788.	$5,076.	$5,364.	$5,652.	$5,940.	$7,380.	$8,820.	$13,140.
Cost per pound @ 5,000 lbs.	$.96	$.50	$.36	$.28	$.24	$.14	$.12	$.08
Cost per pound @ 10,000 lbs.	$.48	$.25	$.18	$.14	$.12	$.07	$.06	$.04

Mechanical Harvesting of Eastern Black Walnut Nuts

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INTRODUCTION

It is generally accepted that for the commercial production of Eastern Black Walnut nuts to be successful that mechanized harvesting will be a must. Most, if not all, commercial tree nut crops in North America are now harvested by machine. This is an important consideration for the introduction and development of Eastern Black Walnut nut harvesting systems. It will not require the industry to start at ground zero, but rather to learn from others and make rapid gains. The purpose of this paper is to review recent machine harvesting experiences, field needs for mechanical harvesters, machines necessary for a successful harvest and cultural practices to facilitate the process.

HARVESTING EXPERIENCES

The harvest of Eastern Black Walnut nuts is not unlike any other agricultural crop. The crop matures within a specific time period and an optimum time for harvest occurs. With a planting of unknown genetic material the maturity dates will be fairly widespread. However, with blocks of improved varieties the maturity issue will be much less complicated and the grower will quickly be able to determine an optimum harvest schedule. The basic goal for harvest should be to remove the nuts from the trees, remove the husk from the nuts and reduce the moisture content to a storable level as soon as possible after maturity has been reached. The traditional harvest season is basically October 1st to November 15th when dependent upon the natural fall of the nuts. It is believed that this schedule could be advanced by perhaps a week or more through the use of a tree shaker. Here again single variety blocks would simplify the decision making.

One of the major benefits of machine harvesting is employee acceptance. In today's society and work environment this is very important. Managers must be able to create productive, efficient and economical harvest systems.

A Weiss-McNair harvest systems has been used at Hammons Sho-Neff Plantation and two other projects for the past four years (not all sites all years). The system includes a tractor mounted blower and sweeper and a tractor powered harvester. The retail price 4 years ago was approximately $35,000.00 for the package. These machines have been used to harvest as little as 350 lbs./acre and as much as 1200 lbs./acre. They are manufactured in Chico, California and have been widely used by the English walnut, pecan, almond and other tree nut industries. Each year similar machines cover hundreds of thousands of acres. In harvesting several hundred acres of less than perfect sites the machines have proven to be quite durable and dependable.

FIELD NEEDS

To successfully harvest with the shaker-blower-sweeper-harvester system requires a relatively smooth surface. The fields at Hammons Sho-Neff Plantation have been carefully prepared and cropped in an agroforestry management system for as many as 24 years. The best harvest conditions require the grass to be 4 inches or less in height, relatively smooth soil surface, no dead branches and a minimal rise within the tree row.

One must remember that the Southwest Missouri region receives 40+ inches of precipitation per year. Wet field conditions can keep nut harvesting machines out of the field for a week at a time. When the nuts are fresh, firm, green and round they can be easily moved with a blower and the sweeper. However, when these same nuts are older, black, somewhat flattened and frozen to the ground they do not roll very easily. Another argument for a speedy, early harvest. In addition to these challenges is the need to remove dead branches from the harvest areas prior to hay and nut harvest.

Machine harvesting in Southwest Missouri has demonstrated the importance of soil conditions and a quality ground cover. With regional rain fall conditions it would appear that bare soil IS BASICALLY OUT OF THE QUESTION FOR THIS AREA. While harvesting at Sho-Neff Plantation the weed control band must be avoided with the tractor tires to prevent creating ruts during most seasons. It is believed that a well managed ground cover of bluegrass and white Dutch cover provide a near ideal harvest surface.

On some harvest sites with sparse ground cover and a gravely soil it is somewhat difficult to keep the small stones from entering the nut cart along with the nuts. Without a de-stoner tank the stones create real problems in the hulling machine.

SUMMARY

Mechanical harvesting systems for Eastern Black Walnut nuts should allow the grower to take advantage of new technology and reduce personnel requirements. To do a satisfactory job of harvesting will require proper management of the soil surface and the ground cover used to prevent soil erosion and provide harvest and access support. One of the negatives associated with the machine harvest is that additional vehicles in the planting create more soil compaction.

The machines to mechanically harvest Eastern Black Walnut nuts are now basically available with some new products yet to come. Machines are just one piece of the puzzle. Improved genetics and improved cultural practices will blend with the machine to make the Eastern Black Walnut nut crops in the future a viable land management enterprise for growers.

EQUIPMENT LIST FOR MACHINE HARVESTING

Weiss-McNair	
Blower-Sweeper-Harvester	$35,000.00
Savage	
Shaker (PTO driven)	$5,000.00
Tractors	
John Deere 4020 (harvester)	$7,500.00
John Deere 3020 (sweeper & blower)	$7,500.00
Hesston 780 (shaker)	$8,000.00
Total Equipment Costs	$63,000.00

MANUFACTURES OF NUT HARVESTING EQUIPMENT

Harvesters, Sweepers and Blowers:

- Weiss-McNair, Inc.
  531 Country Drive
  Chico, CA 95928
  Tel: 916-891-6214

- Flory
  PO Box 908
  4737 Toomes Rd.
  Salida, CA 95368
  Tel: 209-545-1167
  Fax: 209-545-4924

- Ramacher
  531 Country Drive
  Chico, CA 95928
  Tel: 916-891-6214
  Fax: 916-891-5905

- Savage Equipment
  400 Industrial Drive
  Madill, OK 73446
  Tel: 405-795-3394

Catchment Frames:

- Weldcraft Industries, Inc.
  PO Box 11104
  Terra Bella, CA 93270
  Tel: 209-784-4322
  Fax: 209-784-4620

Shakers:

- Compton Enterprises
  2434 Dayton Road
  Chico, CA 95928
  Tel: 530-895-1942
  Fax: 530-895-0760

- Orchard-Rite
  1816 South Van Ness
  Fresno, CA 93721
  Tel: 209-237-3222

- OMC
  2700 Colusa Highway
  Yuba City, CA 95993
  Tel: 916-673-2822
  Fax:916-673-0296

Beyond The Nuts.....

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The information presented in this paper is based on the assumption that you have planted your walnut trees, are interested in harvesting nuts (to provide a modest, annual income) and eventually are interested in harvesting the trees and selling the wood. While the production of these two basic products (nuts and wood) from the same tree is quite possible and very common, there are also several potential pitfalls. Remember, tree growth and wood quality are controlled by three factors: genetics, age, and environment (this includes management). To a large degree, nut production is controlled by these same three factors! However, a good nut producing tree may have certain characteristics that may not make a high-quality walnut veneer tree! With that in mind, let us look at the probable impact of some common management practices on tree growth and wood quality. While there have been many examples of guidebooks discussing walnut stand management -- USDA General Technical Report NC-38 by Schlesinger and Funk (1977) as an example -- none of these discuss wood quality. In the Fourth Black Walnut Symposium, Phelps (1989) addressed the tree growth-wood quality relationship from the wood properties perspective.

Size -- Bigger logs bring higher prices assuming that stem quality is the same. As a guideline, sawlogs should be at least 8'6" feet long (the 6" is trim allowance) and 12 inches in diameter inside the bark (DIB) at the small end of the log. You may have a niche or specialty market for smaller logs but usually smaller logs are best suited for firewood. Typical veneer logs should be larger in diameter, at least 18 inches DIB. As a good guideline, the bottom or butt log of the tree usually contains the highest quality wood – either lumber or veneer. There is a direct relationship between log grade and lumber grade.

Logs should be round, straight, and have as many defect-free faces as possible. "A face" is a quarter of the tree's circumference. Defects include cracks, knots, bird peck, fire damage, logging damage, etc. Top grade veneer logs will have four defect-free faces. The better sawlog grades should have two, adjacent defect-free faces. The higher in the stem the log is taken from, the more knots and branches and the lower the amount of heartwood. Sapwood and knots are not desirable characteristics in walnut!

Pruning -- As an example, the most desirable veneer logs would have a long clear bole, say 17 feet or more. However, veneer buyers may buy material that is only six feet or longer in certain circumstances. Assume you have planted these walnut trees on a 10' x 10' spacing. You have chosen the site well, you have used improved or selected planting stock, you've done the weed control, you've done everything imaginable to get the stand well-established. You notice that some of the trees are starting to have branches shooting off to the side, so you prune them back. How high are you going to prune? When is the best time to prune? How big a branch should I prune?

What most people overlook is the fact that pruning is actually a deliberate wounding of the tree! Even when the pruning is done following all the well-established guidelines for pruning, you've

wounded the tree. Depending on the tree itself, this wound may heal quickly, it may heal slowly, or -- worst case -- it may never heal.

The general recommendation that may be made is that pruning should be done at an early age and limited to small diameter branches (say less than 1" in diameter). Early pruning will allow the production of the maximum amount of clear wood. As to how many limbs to remove, there are no absolute rules. Limbs hold leaves which are the photosynthetic factories for growth. The more limbs (e.g. leaves) you remove, the more the impact on growth. No more than 25% of the crown area should be removed at a time. While limbs larger than 1" can obviously be removed, the wound's ability to heal in a timely fashion is questionable. Vigorous healthy trees will heal wounds faster than trees in poor health. Pruning height may be practically limited. You may want to prune high enough to allow passage for tractors, etc. through the stand.

Thinning -- Typically, thinning is thought of as removal of poorly formed trees, low vigor trees, diseased trees, etc. From a traditional forest management standpoint, thinning is either pre-commercial (i.e. the cut trees are left on the ground) or commercial (the removed trees are large enough for some type of product recovery). In either event, the result is increased water and nutrient availability for the crop trees. In some instances, there have been reports of increased levels of limb-related defects associated with heavily thinned hardwood stands.

In the 1940s, Benson Paul , a US Forest Service silviculturist, reported that open-grown black walnut had higher density than did forest-grown walnut. Open-grown was defined at that time as "trees growing singly or in small scattered groups in pastures and relatively open farm woodlots". This might be analogous to stand densities seen in many agroforestry configurations. Later Paul recommended that management practices producing conditions similar to those where open grown walnut occurs be followed.

In 1973, other scientists suggested that open grown walnut would tend to be forked and limby while forest grown walnut would have a straight, clear stem. According to them, the forest grown stems would have a dark colored heartwood with a narrow sapwood band while open grown trees would have lighter heartwood and wider sapwood rings.

One of the more desirable traits of walnut wood is its even texture. Some studies have suggested that faster-growing plantation trees had wider growth rings which in turn have wider latewood zones. This results in a reduction in vessel area in the cross-section which results in poorer wood texture. On the other hand, stand management favors a more uniform wood texture.