Upper Midwest Hazelnut Development Initiative

HAZELNUTS 101

A Fact-Sheet Series for Beginning Hazelnut Growers in the Upper Midwest

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Fact Sheet #3—Can I Make Money Growing Hazelnuts?

Jason Fischbach, Agricultural Agent, University of Wisconsin

Introduction

Photo 1. Hedgerow hazelnut production is an emerging opportunity for farmers and food manufacturers in the Upper Midwest. For years, the bottleneck has been lack of proven genetics, but with new cultivars becoming available the future is looking bright.

Hazelnuts are an emerging new high-value crop for the Upper Midwest. Efforts to establish the industry began in earnest in the 1990s with early-adopter growers establishing plantings of seedling hazelnuts across the Upper Midwest. Due to the genetic variability, the average yields from these seedling plantings have been too low to support commercial production, but recent identification of superior genetics will revitalize development of the industry. The Hazelnuts 101 Fact Sheet Series is intended to provide prospective hazelnut growers with practical information they can use as they explore the hazelnut opportunity. This Fact Sheet provides an economic model for hazelnut production in the Upper Midwest and is accompanied by an enterprise budgeting spreadsheet tool growers can use to determine the costs, potential profits, and risks of growing hazelnuts. The enterprise budget spreadsheet can be found in the "For Growers" section of the midwesthazelnuts.org website. It is important to note that commercial hazelnut production does not yet exist in the Upper Midwest. The data and cost estimates in this fact sheet are based on production trials, grower experience, and in some cases, other shrub-crop production systems like blueberries. Major questions remain as to optimal planting density, plant size management, long-term yields, insect pest management, markets, and harvest costs. Any new crop presents risks and opportunities, known and unknown, and the hope is this fact sheet helps growers evaluate both to make good decisions on whether or how to pursue the hazelnut opportunity.

Hedgerow Production System

Commercial hazelnut production in the U.S. is centered in the Willamette Valley of Oregon and is based on tree-form cultivars of *C. avellana* where in-shell nuts fall free from the husk when ripe and are swept off the orchard floor. The system currently being used by growers in the Upper Midwest is modelled after bush-fruit systems where hazelnut shrubs are grown in continuous hedgerows with nut clusters mechanically harvested

direct from hazelnut hedgerows (Photo 1). There are important reasons for the hedgerow system. First, harvesting the nuts directly from the hedgerow allows for a more biologically diverse orchard floor that better protects water and soil quality. Second, harvesting nuts off the orchard floor, as is done in Oregon, is only an option in dry climates. In the Upper Midwest, where precipitation is likely throughout the harvest season of late-August and September, the chance of wet soils, and thus, the chance of nut spoilage and food safety problems is too high. Third, the plant material being developed for the Upper Midwest is based on American hazelnut. Its naturally bushy and relatively compact growth habit is perfect for mechanized straddle-type harvesters that don't require the kind of orchard floor preparation required for ground harvesting.

More detailed information about the hedgerow production system is provided in the other fact sheets in this series including fact sheets on choosing plants (#1) and establishment (#2).

The Economics of Hedgerow Hazelnut Production in the Upper Midwest

An economic model and cash flow projection for 1 acre of hedgerow hazelnut production in the Upper Midwest is presented here. The model includes only cash costs and assumes the operator pays for all expenses out of pocket. Actual costs will vary considerably from farm-to-farm, particularly as it relates to borrowing, land, and equipment costs. In addition, there remain unanswered questions as to best management practices for hedgerow hazelnut production such as initial planting density, fertilization, pest management, plant size management, and harvest. The assumptions used to build the cash flow model are listed below. These numbers will vary significantly by region, farm, and scale of production. Each producer should carefully analyze each assumption and determine numbers specific to their operation.

Economic Model Assumptions

- All labor is hired, hired on a custom-basis, or is provided by the owner/manager as outlined below.
- The owner/manager owns the land, but leases it to his/her hazelnut business at a rate of $100/ac/yr. This payment is intended to cover the financing, insurance, and tax costs of land ownership.
- The owner/manager owns the equipment and charges his/her hazelnut business an hourly or per acre rate for use of the equipment, or the work is custom-hired.
- The planting is self-financed with no interest costs.

Planting Layout

- The site is an average fertility site and the planting is arranged with a 12-foot row spacing and 5-foot plant spacing for a total initial plant density of 726 plants/acre. The plants will fully occupy their space by age 7 with a total per acre canopy coverage of 50%.

Site Preparation (Year 0)

- Site preparation is done in the summer prior to planting with a burn-down herbicide application to kill perennial weeds, followed by ripping and a finishing disk. The herbicide application is custom-hired at a cost of $30/acre. The tillage is also custom-hired at a cost of $30/acre.
- A cover crop is seeded in the row middles in the site preparation year immediately following the ripping and disking on a custom basis at a cost of $150 per acre, which includes seed.
- Potassium sulfate (K) and triple super phosphate (P) are strip applied and pre-plant incorporated in the summer of the site preparation year as necessary to bring phosphorus and potassium soil test levels to 25 and 175 ppm, respectively. For the model, a $75/acre fertilizer cost is used, but actual costs will depend

on soil test levels and fertilizer costs.

Planting (Year 1)

- The plants are micro-propagated liners of the top performing UMHDI selections (see Fact Sheet #1: Choosing Plants) grown in 4 inch x 4 inch x 6 inch pots and are planted in the fall of the site preparation year between September 15 and October 1. Plants cost $3.50 each. The exact cost of plant material is not yet known.
- Drip irrigation is installed immediately after planting using a 3/4" mainline, ½" feeder line per row, and two emitters per plant. The water source is a groundwater well with a basic screen filter and manual ball valves to create zones. The total drip irrigation supply cost is $1.25/plant. Refer to the micro-irrigation publication in the reference section for layout and design recommendations. No costs for the well, pump, or electricity are included in this budget.

Photo 2. Year 2 of a hazelnut planting with perennial vegetation between the rows and wood chips and spot-application of herbicides to control weeds within the rows.

- Roughly 0.1 yards of wood chip mulch is applied around each plant for a total per acre material cost of $400/acre.
- Planting, application of wood chips, and installation of the drip irrigation system is done on a custom-basis with a crew planting by hand (auger or shovel), and a skid steer to apply wood chips. Total cost for this custom work is $30/hr or $1.16/plant.

Weed Control, Fertility, Plant Size Management, Browse Prevention

- In-row weeds are controlled in years 1-4 with herbicide applied to the rows with a backpack sprayer. Grass weeds within the rows are controlled with selective grass herbicides and perennial broadleaf weeds are controlled as necessary with shielded applications of glyphosate using a backpack sprayer. Spot weed whipping is also done to knock down weed escapes. Annual weed control costs are estimated at $58/ year for herbicides and $120/year for labor. By year five, the plants are large enough and weed control within the rows is not necessary, though over time other woody plants brought in by birds will need to be removed.
- Row-middles are mowed as necessary each season with the work hired on a custom basis at $20/hr which includes the driver and riding-mower. In-row weed control and row-middle mowing costs are $280/year in years 2-4, $180/year in years 5-8, and $100 each year thereafter.
- ESN-protected urea is strip applied each spring at a rate of 80 lbs actual N per acre at a cost of $28/acre for the fertilizer and $45/acre for hired labor.
- There is a 3% mortality rate in the year of planting and the plants are replaced in year 2 at a total cost, including replant labor, of $10/plant.
- Renewal pruning begins in year 5, requiring roughly 20 hrs per year of labor to remove old wood and thin existing stems. The work is hired at $15/hr. The best strategy for managing plant size is not yet known and will depend on results from ongoing pruning and harvesting trials.
- Deer browse is minimized by application of Plant Skydd in the planting year and in years 2-4 with three applications per year using a backpack sprayer at a total cost of $105/ac.

Harvest and De-Husking

- All plants begin producing by age 6 with 5%, 50%, and 85% of the plants producing nuts in the third, fourth, and fifth years, respectively.
- Nuts from the planted genotypes average 40% kernel by weight.
- Table 1 shows the projected per acre kernel and in-shell yields. By year 10, the plants are fully mature and a biennial yield pattern is established with slightly lower yields every-other-year. Yields at ages 4-8 are based on measured average yields of the top performing genotypes in the UMHDI Germplasm Performance Trials and yields at age 9-15 are best-guess projections. The age 4-8 yields are calculated based on extrapolating the average yield density (lbs/sq ft of canopy coverage) of the top 8 genotypes to a per acre basis.

Year	canopy coverage	lbs kernel/ac	lbs in-shell
3	15%	8	20
4	25%	116	289
5	40%	305	762
6	45%	515	1286
7	50%	844	2110
8	50%	898	2246
9	50%	980	2450
10	50%	980	2450
11	50%	1157	2893
12	50%	980	2450
13	50%	1157	2893
14	50%	980	2450
15	50%	1157	2893

Table 1. Per acre in-shell and kernel yields from age 4 through 15. Yields from age 4 through 8 are the average measured yields of the top genotypes in the UMHDI Germplasm Performance Trials. Yields for ages 9-15 are estimated.

- The plants are harvested by hand in year 3 at a rate of 13 lbs of in-shell per hour at a cost of $15/hr. This rate is based on hand-harvesting time trials using tree planting shoulder bags emptied into bins.
- Starting in year 4, the plants are harvested by machine on a custom-basis at a rate of 1850 lbs/hr and a cost of $250/hr. This rate is based on an estimated yield at maturity of 0.70 lbs of in-shell per lineal foot of hedgerow and a machine harvest rate of 1 mile/hr with two passes necessary per year to harvest the nuts due to uneven ripening within the hedgerow. These rate and cost estimates are expected to change pending ongoing field trials.
- The nuts are harvested in the cluster and must be de-husked. Currently, this is done by growers by drying the clusters and using a barrel husker to break apart the dry husk and an aspirator to separate the husk from the in-shell nuts. Proof of concept testing has shown that husks can be removed without drying. Work is underway to design de-husking equipment that can be used to remove green husks and integrate the de-husking into the harvest process. As such, no costs are estimated in this model for the de-husking as it is assumed to be part of the harvest process.
- No insecticides or fungicide applications are included in this model, however, it is possible that Japanese beetle, big bud mite, and kernel-feeding insects will eventually require control via an integrated pest management strategy. EFB is managed with plant resistance.
- The final product sold in this model is in-shell nuts. The nuts are sold to a grower-owned processing company at a price of $1.50/lb in-shell. This price is based on the fluctuating Oregon in-shell pay price and the price paid by the American Hazelnut Company. Hazelnut prices can fluctuate widely due to weather and the biennial bearing habit of hazelnuts.

Cash Flow Projections

Table 2 (page 8) shows the annual cash flow for hedgerow hazelnut production and Figure 1 shows the

cumulative net income over a 15 year period. Positive cash flow begins in year 5 when gross revenue exceeds total cash costs, but the break-even point doesn't occur until year 8. For comparison, the cash flow analysis for Oregon hazelnut production by Miller et al. (2013) projects positive cash flow starting in year 5 and a break-even point in year 8. The total working capital necessary to establish and manage the 1-acre planting is estimated at $6700. The model shown assumes no borrowing costs associated with this $6700. The majority of this expense is incurred in the establishment year and is driven largely by plant, drip irrigation, and custom site preparation expenses. Growing crops between the rows in the pre-production years is a good option for improving cash flow. Once the plantings mature, annual net income is estimated at $2700/acre in low yield years and up to $3300/acre in high yield years. As with other woody perennial crops there is significant profit potential for hazelnuts in the Upper Midwest, but the establishment, working capital, and opportunity costs will be an obstacle.

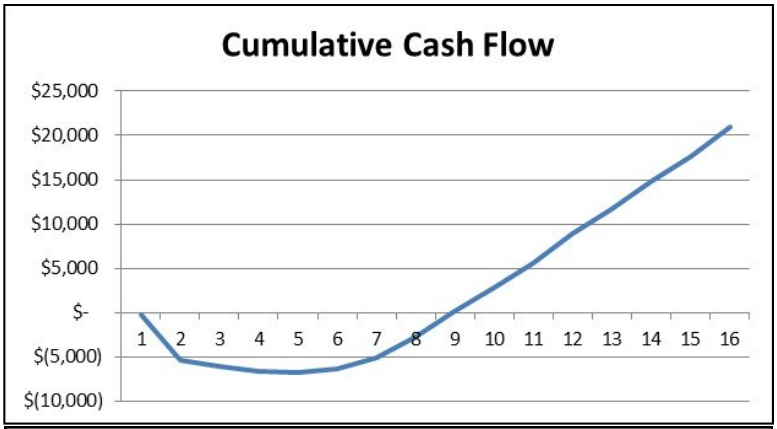

Figure 1. Projected cumulative cash flow for the hedgerow hazelnut system in the Upper Midwest.

It is highly recommended that growers use the Hazelnut Hedgerow Enterprise Budgeting Tool available at the UMHDI website to build out personalized enterprise budgets. The tool and this Fact Sheet will be updated as new production cost and yield information is obtained from ongoing field trials.

Equipment and Scale Considerations

Small scale hazelnut production of a few acres or less is possible, but is limited by the labor involved in hand-harvest. At an average rate of 13 lbs of in-shell nuts per hour, hand harvesting is just not economically feasible. Hobby or small-scale growers can make it work using free labor from family and friends, but commercial production will require mechanical harvest. As such, the minimum scale of commercial hazelnut production is based, in part, on the cost of mechanical harvest, a cost that is still being determined. Once cost of the equipment and harvest rates are known, then it is a matter of determining the annual ownership and operating costs to determine the number of acres of hazelnuts necessary to cover those costs.

Harvesting trials are being conducted in 2019/2020 with over-the-row harvesters equipped with rotary-shaker and slapper-action harvesting heads. Preliminary results show that this older model used equipment originally developed for blueberries (Photo 1) is effective at removing the clusters without significant damage to the shrubs. Modifications do need to be made, however, to better move material through the conveyance systems. Pioneering growers have been able to acquire these units for $20,000 or less. New and faster equipment will cost more, but the good news is existing technology appears to work. The challenge right now is the plant material. Current production in the Upper Midwest is based on seedlings that all ripen at different times with clusters that have different detachment force thresholds. Thus, harvesting a row requires 2-4 passes with the equipment. As the industry shifts to cultivars or more uniform seedlings, mechanical harvest will become much more efficient.

Consideration must also be given to harvesting speed. For example, with 12 ft row spacing there are 3650 row-feet per acre. Assuming a 1 mph operating speed for the harvester, it will take 41 minutes per acre minimum to harvest. That equates to roughly 14.5 acres per day in a 10 hour day assuming continuous operation. A single cultivar has roughly a 2 week ripening window. If harvesting 10 hours a day for 14 days straight, a grower would need 1 harvesting unit per roughly 200 acres.

Almost certainly, growers will benefit by co-owning the equipment or working with a custom operator. Straddle-harvesters are wide and not particularly mobile, which means moving the equipment long distances requires lowboy trailers capable of handling 10 to 12 foot wide equipment. For this reason, growers should consider geographically clustering their plantings to minimize travel costs between the plantings.

Though there are many buyers and users of hazelnuts in the Upper Midwest, because hazelnuts are a new crop for the region, growers will need to develop market relationships. One key decision for any grower will be whether to sell in-shell nuts (top) or to shell the nuts and sell kernels or value-added products from the kernels (bottom).

Another consideration with respect to how big a planting needs to be is post-harvest processing. If the intent is to only sell in-shell hazelnuts than no processing license or food processing facility is needed. However, depending on the relationship with the buyer, the in-shell nuts may need to be dried and stored. Selling kernels wholesale requires a processing plant license and expensive cracking and sorting equipment. The UMHDI Hazelnut Processing Accelerator in Ashland, WI is a public/private partnership working to develop a pilot-scale processing facility that can be copied by growers. Work is continuing to determine the capital and operating costs for a turnkey facility so that growers will know what volume of hazelnuts will be necessary to cash flow such a facility and, thus, how many acres of production are needed. A Hazelnut Processing Enterprise Budgeting Tool is available for growers interested in cracking hazelnuts. As with harvesting equipment, it will be advantageous for growers to pool their volume and work together on processing.

There is no definitive answer at this point as to how many acres of hazelnuts are required to be economically viable. It depends on access to equipment (owned, rented, custom). It depends on whether there are neighboring farms with which to share harvesting costs. It also depends on whether there is access to shared post-harvest processing and storage infrastructure or whether the grower has to provide it all.

Markets

Globally, it is a good time to be entering the hazelnut industry as demand currently exceeds supply and demand is expected to continue growing, especially in North America. Currently, Americans consume less than 0.25lbs of hazelnut per year, compared to almost 4.0 lbs/year by Europeans. This low consumption rate is not due to consumer preference as American consumers consistently respond positively to hazelnuts in consumer preference surveys. Instead, the problem is limited hazelnut availability. Hazelnuts have not been commonly available in grocery stores, but that is changing fast as companies are introducing new hazelnut

products. In response to the growing demand, new production is being established across the world, including in Oregon, where growers have added more than 40,000 acres of production in the last 5 years.

Marketing options for new growers entering the marketplace in the Upper Midwest will be driven largely by volume of production. Big food processing companies like General Mills or Mars, Inc. are currently buying hazelnuts, but they require large volumes (shipping container loads) and typically have very specific quality specifications. Selling to large companies typically also means selling at global commodity prices. Until sufficient scale of production and supply chains are established, selling to big companies isn't likely a viable option.

Instead, the first wave of growers in the Upper Midwest will likely start by making branded food products and selling direct to consumers from the farm, at farmers markets, or online. As volumes grow and production costs fall, growers can then expand into wholesale markets by supplying retail grocery stores, restaurants, and small value-added processors, such as local bakers. Who knows, today's small direct marketer could one day be selling a branded food product nationwide!

Cracking hazelnuts is considered food processing, which means a food processing plant license is required. Obtaining such a license requires a facility and equipment that meets food codes, and that can mean considerable expense. But, some states have cottage food laws that waive licensing requirements for very small operations. Check with your State's department of agriculture for all the rules.

Launching and running a food product company will likely be too much work and too much risk for most growers to do it on their own. So, as small and mid-size processing companies get up and running, one option will be to sell in-shell nuts (or kernels) to these companies. The American Hazelnut Company in Gay Mills, WI is a grower-owned processing and marketing company launched in 2014 that is currently buying in-shell hazelnuts from growers in the Upper Midwest, turning them into value-added products, and selling them direct and to retail stores across MN and WI. As the industry grows, other processing companies may form as well. Regardless, growers should try to have an ownership stake in these companies so they own a part of the value chain and have some control over prices received. Otherwise, as has happened with so many other crops, the growers just end up getting what the processors are paying.

Conclusion

Hazelnuts offer a new high-value cropping opportunity for farmers in the Upper Midwest with potential for annual net income of $2500 per acre or more. However, as with any new crop there are significant risks and unknowns that will create uncertainty until more growers get involved and gain experience. As with all woody crops, there is also a significant establishment cost with a breakeven period that can be 8 years or longer. This fact sheet series and the accompanying enterprise budgeting tool provide growers with a starting point in evaluating the hazelnut opportunity.

The Upper Midwest Hazelnut Development Initiative is a collaboration of the University of Wisconsin, University of Minnesota, and early-adopter hazelnuts growers across the Upper Midwest. For more information about the UMHDI visit www.midwesthazelnuts.org. For questions about this Fact Sheet contact jason.fischbach@wisc.edu.

	Establishment		Pre-Production			Early Production				Full Production						
Revenue	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
In-shell nut sales																
Market 1				$ 31	$ 434	$ 1,143	$ 1,930	$ 3,165	$ 3,369	$ 3,675	$ 3,675	$ 4,339	$ 3,675	$ 4,339	$ 3,675	$ 4,339
Market 2				$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Market 3				$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Gross Revenue	**$ -**	**$ -**	**$ -**	**$ 31**	**$ 434**	**$ 1,143**	**$ 1,930**	**$ 3,165**	**$ 3,369**	**$ 3,675**	**$ 3,675**	**$ 4,339**	**$ 3,675**	**$ 4,339**	**$ 3,675**	**$ 4,339**
Expenses																
Land Cost																
Owned	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Rented	$ 100	$ 100	$ 100	$ 100	$ 100	$ 100	$ 100	$ 100	$ 100	$ 100	$ 100	$ 100	$ 100	$ 100	$ 100	$ 100
Supplies and Materials																
Plants	$ -	$ 2,554	$ 109	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Drip Irrigation	$ -	$ 894	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Tree Tubes	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Fertilizer	$ 103	$ -	$ 28	$ 28	$ 28	$ 28	$ 28	$ 28	$ 28	$ 56	$ 56	$ 56	$ 56	$ 56	$ 56	$ 56
Herbicide	$ -	$ 98	$ 58	$ 58	$ 58	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Organic mulch	$ -	$ 365	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Synthetic mulch		$ -														
Total Supplies and Materials	**$ 103**	**$ 3,910**	**$ 195**	**$ 86**	**$ 86**	**$ 28**	**$ 28**	**$ 28**	**$ 28**	**$ 56**	**$ 56**	**$ 56**	**$ 56**	**$ 56**	**$ 56**	**$ 56**
Custom Equipment and Operator	$ 60	$ 1,050	$ 280	$ 280	$ 280	$ 100	$ 100	$ 100	$ -	$ 100	$ 100	$ 100	$ 100	$ 100	$ 100	$ 100
General Labor	$ -	$ 45	$ 90	$ 90	$ 90	$ 345	$ 345	$ 345	$ -	$ 375	$ 375	$ 375	$ 375	$ 375	$ 375	$ 375
Custom Harvest Cost				$ 24	$ 39	$ 103	$ 174	$ 285	$ 304	$ 331	$ 331	$ 391	$ 331	$ 391	$ 331	$ 391
Drying and Husking				$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Expenses	**$ 263**	**$ 5,105**	**$ 665**	**$ 580**	**$ 595**	**$ 676**	**$ 747**	**$ 858**	**$ 432**	**$ 962**	**$ 962**	**$ 1,022**	**$ 962**	**$ 1,022**	**$ 962**	**$ 1,022**
Annual Cash Flow	**$ (263)**	**$ (5,105)**	**$ (665)**	**$ (549)**	**$ (161)**	**$ 467**	**$ 1,183**	**$ 2,307**	**$ 2,938**	**$ 2,713**	**$ 2,713**	**$ 3,317**	**$ 2,713**	**$ 3,317**	**$ 2,713**	**$ 3,317**
Cumulative Cash Flow	**$ (263)**	**$ (5,368)**	**$ (6,034)**	**$ (6,583)**	**$ (6,744)**	**$ (6,276)**	**$ (5,094)**	**$ (2,787)**	**$ 151**	**$ 2,864**	**$ 5,577**	**$ 8,894**	**$ 11,608**	**$ 14,925**	**$ 17,638**	**$ 20,955**

Table 2. Cash flow projection for hedgerow hazelnut production in the Upper Midwest.