

**Processing American and Hybrid Hazelnuts:
A Guide for Hazelnut Growers in the Upper Midwest**

Prepared By:

Jason Fischbach, UW-Extension Agriculture Agent
Kelsey Brasseur, UW-Extension Hazelnut Research Assistant

With Assistance From:

The Hazelnut Processing Steering Committee

Jeff Jensen

Norm Erickson

Mark Shepard

Roy Cerling

Jim Mickelson

Michael McNeil

Don Price

Last Updated

January 20, 2012



The Upper Midwest Hazelnut Development Initiative (UMHDI)

The Upper Midwest Hazelnut Development Initiative supports the growth and commercialization of the hazelnut industry in the Upper Midwest. In 2008, the UMHDI conducted a survey to identify the major issues and challenges facing hazelnut growers and the development of a commercial industry in the region. Growers identified the lack of suitably-scaled processing equipment as a primary bottleneck to the growth of their individual hazelnut enterprises and the Upper Midwest industry as a whole. In response to feedback received from growers during a strategic planning session at the 2010 Upper Midwest Hazelnut Growers Conference, the UMHDI formed the Hazelnut Processing Steering Committee to address the processing challenges.

The Hazelnut Processing Steering Committee is an open committee and anyone interested in helping develop suitable processing capacity is invited to join. The committee has been working to date on three objectives: 1) To better understand the extent of existing and projected hazelnut production in the Upper Midwest; 2) To develop organizational capacity to facilitate grower-owned processing and marketing infrastructure; 3) To assist in development of appropriately-scaled processing equipment engineered to the unique characteristics of the American and hybrid hazelnuts. The 2010 hazelnut growers survey and this processing guide are the first deliverables of the processing steering committee.

Industry background

Turkish hazelnuts currently account for 76% of the world hazelnut market, with 790,000 metric tons of production in 2006, while Italy, the next largest world producer, claims 13% with 138,000 metric tons in 2006. The US claims only 3% of the world market with 36,000 metric tons of production in 2006 (Chase-Landsdale, 2008; Melegos, 2010). Production in the Willamette Valley in Oregon, the primary production zone in the US, averages just over 33,000 tons annually (Chase-Landsdale, 2008) and has been increasing steadily over the last two decades. Midwestern growers reported a 2010 production of 4.3 tons (Fischbach and Brasseur, 2011). Although small compared to the annual production in Oregon, Midwestern production is expected to increase steadily as existing plantings mature and more growers report their yield data.

The market for fresh eating nuts is expected to increase as consumers improve their diets and recognize the health benefits of hazelnuts. Three primary markets have been identified. The primary market will likely be sales of in-shell nuts, whole kernels, and hazelnut salad oil direct to the consumer through farmers markets, on-farm sales or to retail grocery outlets. The demand for locally produced food and a growing awareness of the health benefits of hazelnuts is likely to drive this market. A second market will be sales to value-added processors making confections, baked goods, trail mixes, butters, etc. The smaller nuts produced by the hybrid and American hazelnuts grown in the Upper Midwest may be preferred over the larger nuts from European cultivars by processors making nut-cluster based products or trail mixes. This market is significant. Fischer-Nuts in Chicago alone is importing 20-60 tons of in-shell nuts from Turkey

each month (Melegos, 2010). A third market will be sales of hazelnuts as feedstock for production of biofuels and bioindustrials. Hazelnuts have better cold flow properties than annual oilseed crops such as soybeans and canola and preliminary research indicates the fatty acid profile of American hazelnut averages 86% monounsaturated oleic acid (Lane, personal communication).

Despite the market potential, growers have struggled with several obstacles to commercial production. The lack of proven hazelnut cultivars for Midwest production is the primary long-term challenge that is being addressed by private and, more recently, University plant development programs. Yields from the existing plant material, although variable, have been sufficient to allow growers to build hazelnut enterprises. Yields from eight hybrid plantings indicate an average yield of 294 lbs kernel per acre (Fischbach et al, 2011). For growers with producing plants, the most important challenge is the lack of suitable and affordable processing equipment. There is nut processing equipment scaled for European hazelnut production, but the equipment is cost-prohibitive for the current small production volumes for Midwestern growers. What is needed is low-cost, but effective equipment and infrastructure that will allow growers to process and sell their hazelnuts and eventually increase production in response to growing sales and demand.

Overview of Hazelnut Processing

The Oregon Industry

The hazelnut industry in Oregon relies heavily on its grower cooperative, the Hazelnut Growers of Oregon, which has over 150 members and is the largest processor of Oregon hazelnuts, and other large commercial processors such as Blue Diamond Hazelnuts. However, many growers are vertically-integrated and process on-farm. Such growers have relied primarily on equipment of their own design for all stages of processing. This equipment is fine-tuned to the specific needs of each grower's operation, and is generally not manufactured for sale. Growers have also had success using equipment adapted from the almond, pecan, and walnut industries. The most widely used processing equipment is manufactured by Wizard Manufacturing and Jessee Equipment Manufacturing.

The Upper Midwest Industry

As hazelnut orchards in the Upper Midwest have matured over the last decade and yields have increased, growers have been gradually shifting from hand-processing to using home-made husking, cracking, cleaning, and sorting equipment. The current need is to develop a continuous flow processing line capable of husking, cracking, and cleaning as required by State food safety regulations. At the same time, development of grower processing organizations would be helpful in sharing processing costs and pooling production volume to access and supply markets.

The purpose of this processing guide is to provide information to growers about existing hazelnut processing options. The hope is the information will help growers make decisions leading to a robust and sustainable hazelnut industry.



2. In-husk hazelnuts drying in an onion bag

Hazelnuts are generally dried in-husk using a variety of methods including drying tables, plastic mesh bags, or slotted bins.

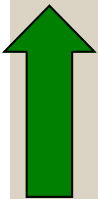
Drying



3. In-husk hazelnuts



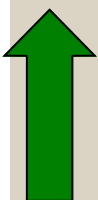
Post-Harvest Processing of American and Hybrid Hazelnuts



After harvest, hazelnuts need to be dried to facilitate husking.



1. In-husk hazelnuts from Rutgers Research Farm, NJ



Harvesting

From the bush to the market, hazelnuts go through many processing steps. This schematic is a basic outline of these steps and the purpose they serve in preparing hazelnuts for sale or consumption. Developing a processing line requires first developing the technology necessary to complete each step and then integrating each piece of equipment into a continuous flow line that requires only minimal manual product handling.



American and hybrid hazelnuts grow as a shrub and the nuts are harvested by hand in September. No mechanical harvest options currently exist, though a modified blueberry harvester may be feasible.

Photos courtesy of:
1. vilskogen at flickr.com
2. vilskogen at flickr.com
Lower left: Mark Shepard

Husking

Once dry, the clusters are run through a husking machine that removes the husk from the in-shell nut, leaving a mixture of husk pieces and in-shell nuts.



4. In-shell hazelnuts and husk pieces

Cleaning

Moving air (aspiration) is used to separate the husk pieces from the in-shell nuts.



5. Hazelnuts separated from husk pieces

A Finished Product!



7. Whole hazelnut kernels

Cracking

Hazelnuts can be sold in-shell, but many are run through a cracking machine which removes the kernel from the hard shell.



6. Kernels and shells after cracking

Cleaning

Shells must be removed from the kernels and kernel pieces and then the kernel pieces sorted from the whole kernels.



Drying

Hazelnuts are ready for harvest when they abscise from the involucre (husk) and are loosely enclosed in the husk. Like a loose tooth, the nut should wiggle around when you push on it with your finger. This typically occurs when the involucre is still green. If you wait until the involucre is dry the nut will have dropped to the ground or been eaten by wildlife. Thus, the nut clusters must be picked when green. The existing husking technology works best when the involucres are dry.

The main goal of the drying process is to dry the involucres before they start to mold while protecting them from rodents and other pests. Once the husks are dried the nuts can be husked or stored for later removal of the husk.



Onion Bags

Plastic mesh onion bags can typically be obtained for free from grocery stores. The hazelnut clusters are picked and put directly into the bags in the field. The bags are then put in a warm, drafty, and dry place free from rodents for drying. The main advantages of the onion bags are they are free, easy to handle, and allow for good air circulation. Some growers report poor drying and molding in the center of the bags, requiring periodic re-mixing of the nuts during the drying process. Photo courtesy of Norm Erickson.



Drying Tables

Some growers spread the harvested nut clusters on a drying table fitted with a hardware cloth bottom. The tables allow for excellent air circulation and quick drying. Once dry, the nuts can be husked or put in rodent free storage for later husking. Photo courtesy of John Cuddy.



Slotted Bins

For larger volumes, the nut clusters can be picked into pallet bins. The bins are put together, covered, and a large blower or drum fan is used to blow air through the crates similar to the way onions are dried. The picture to the left shows the standard plastic fresh-market vegetable bins and a homemade bin made of hardware cloth and 2x4 lumber.

Husking

Husking your hazelnuts is one of the most important processing steps, as most nuts are sold out of the husk, and the nut needs to be free of the husk to be cracked. Unlike European hazelnuts which fall from the husk, American and hybrid hazelnuts stay in the husk and must be physically removed. Most hazelnuts are husked after being dried, though it should be possible to remove green husks. After drying, the nut clusters are fed into machines that essentially beat or crush the husk off while leaving the in-shell nut intact.

Here we provide a few examples of small-scale Do-It-Yourself huskers, small scale commercial huskers specifically designed for American hazelnuts, as well as several high throughput models developed for other nut crops.

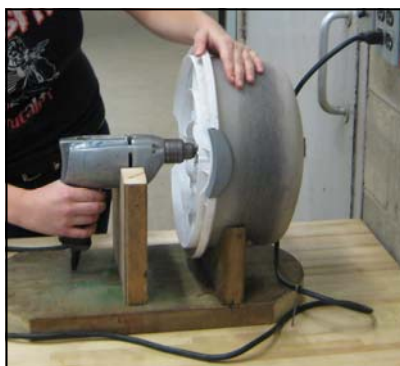
Do-It-Yourself Huskers

As hazelnut orchards in the Midwest have started to produce nuts, growers have developed some innovative means of removing the husks from their hazelnut crop using readily available materials. DIY designs are inexpensive, and can be a simple, effective way to process small volumes of hazelnuts yourself.



Stomp Husking

The cheapest husking method is to put the dried in-husk hazelnuts in a rubber bin and stomp with rubber soled shoes until the husks are removed. The husk is extremely brittle after thorough drying, and is easily crushed away from the hard shell of the nut after repeated stomping. This method is effective for small volumes, but impractical for larger production volumes.



Modified Cake Box

The drill is attached to a chain which spins inside the cake box. The chain beats against the dried nut clusters as it turns, breaking up the brittle husks. This is another good low volume option.



Bucket Husker

Similar to the cake box, a drill is used to turn an axle equipped with rubber flails, which when turned at high speeds beat the husks off the nuts. The concept can be scaled to a 40 gallon drum with a line trimmer. A full description of this bucket husker can be found in Appendix 1.



Small-Scale Commercial Huskers

A number of growers in the Upper Midwest currently have more production than can be husked with the small-scale huskers shown on the previous page. However, the production is not yet large enough for full-scale commercial huskers being used for other nut crops. Recently, smaller-scale huskers have been developed that are currently or will soon be available to Midwest hazelnut growers. Regardless of the design, each husker shown on Page 9 performs two main functions, 1) physically removes the husk from the in-shell nut, and 2) separates the husk material from the in-shell nuts.

The Problem of Stick-Ons

Typically, the nut separates from the husk during the ripening process and is loosely held in the husk as the husk dries. With physical agitation the brittle dried husk is easily removed. For some of the nuts, the husk remains attached to the nut and considerable abrasion is required to remove the husk. The goal of mechanical husking is to use sufficient force to remove as much husk as possible without cracking or damaging the nuts. Unfortunately, there are still a percentage of the nuts that are not fully husked. One of the criteria for evaluating husking equipment will be the percentage of nuts that are not fully husked. This percentage will have to be balanced against the percentage of nuts that are cracked.

Anecdotally, nuts that retain their husks are blanks (i.e. no kernel in the nut) or not fully mature. To test this assumption a sample of “stick-ons” was analyzed. Table 1 shows the nut quality data of 35 randomly selected “stick-ons” compared to 35 randomly selected nuts that husked clean. The samples were taken from the same bag of in-husk nuts that received the same post-harvest handling. Nearly half (48.6%) of stick-ons had viable whole kernels. If stick-ons are removed as a waste stream, that represents nearly a 14% loss of whole kernels. Reducing the stick-on percentage can be done by delaying harvest to maximize in-field abscission, increasing husking intensity (more abrasion), or re-circulating the stick-ons through the husking process.

Table 1. Kernel Quality of "Stick-On" and Fully Husked Hazelnuts*

	Whole Kernel	Deformed Kernel	Weevil Damage	Blank
Stick-On	48.6	14.3	17.1	20
Fully Husked	77.1	2.9	11.4	8.6

* Percentage of randomly selected in-shell nuts with whole kernels, deformed kernels, weevil damaged kernels, or no kernels (blank).



Dried In-Husk Hazelnuts

The primary goal of the husking process is to remove and separate the husks from the in-shell nuts without damaging the in-shell nuts.



Dried In-Shell Hazelnuts

Whether using a flail, belt, or rotating cylinder type husker, a portion of the nuts are not fully husked. Removing these “stick-ons” requires further processing, or removal by hand or an air column.



The Goal Is Clean Nuts

Producing nuts clean of husks is essential for the cracking step. Ideally, the husking process should require a single handling without manual cleaning.



The Southwest Badger RC&D Husker

This modified walnut huller uses rubber paddles attached to an axle to beat the hazelnuts against a screen. Driven by a PTO, this early prototype is only moderately successful at husking, is dangerous to use, and is inefficient as it requires processing batches at a time rather than a continuous flow. Newer huskers have been developed that are superior to the RC&D husker.



Bucket Husker with Air Column Separation

Don Price has developed an inexpensive system using a bucket husker (Page 7) to remove the husks and a dust collector and vacuum to separate the husks from the nuts. Appendix 1 includes a detailed description and photos of the system developed by Don Price.



SuperSquirrel Husker

Developed by Lee Pothast, the SuperSquirrel husker shown here uses two belts to remove the husk and a blower to separate the light weight husk material from the nuts. As shown in the photo, the husk material blows in the bag and the nuts drop into a bucket. Tests conducted with dried husks measured the throughput of the machine at 109 lbs of in shell nuts/hour. In other words, the machine delivered in-shell nuts into the bucket at a rate of 109 lbs per hour. Contact SuperSquirrel LLC regarding machine availability or for construction and sale of additional machines. Contact information can be found in the Index of Manufacturers.



UW-Extension Hazelnut Husker

This machine developed by UW-Extension, Pendragon Fabrication, and Forest Agriculture Enterprises, utilizes a spinning cylinder to physically remove the husks, an air-column to remove husk material, and a shaker box and auger to recirculate and remove stick-ons. Preliminary tests conducted with dried husks, measured the throughput of the machine at 500 lbs/hr. The complete drawings and parts list are included in Appendix 2. The prototype shown here is co-owned by UW-Extension and Forest Agriculture Enterprises. The design for this machine is in the public domain and freely available to all.

Commercial Scale Huskers

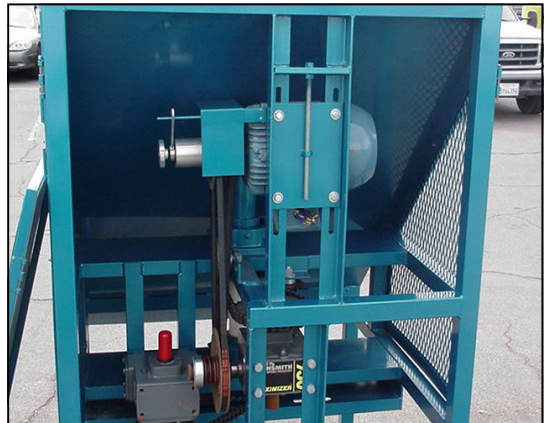
Processing technology and equipment developed for processing other nuts can be adapted to American hazelnuts, particularly for husking. Shown here are commercial-scale units that should work for husking hazelnuts. However, given the costs, it is unlikely the units are commercially viable for the current scale of hazelnut production in the Upper Midwest.

Both the DS-30 and DS-40 are flat wire huskers sold by Southern Nut and Tree, which can husk green or dry nuts. The DS-30 runs at about 1000 lbs per hour, and the DS-40 runs at about 4000 lbs per hour. These units are priced between \$9K to \$15K each. Growers that have trialed these machines report that they work well for American hazelnuts, but the wire brushes can scratch the surface of the nuts. Furthermore, additional equipment is needed to separate the husks from the nuts, further increasing the processing equipment costs. The percentage of stick-ons is not known for this equipment.

Pictured at right:
The DS 40 Shucker

Pictured at left:
The DS 30 Shucker

Photos courtesy of
snt.pecans.com



Pictured at left:
The Wizard R12 Huller

Pictured at right:
**The Wizard DR Series
Huller**

Photos courtesy of
wizardmanufacturing.com



The DR series hullers are Wizard's high volume hulling equipment. They use a rotary brush system, and are available in 4 widths from 27-60'. The R12 huller is their original design, and has been continually refined throughout the years. It also uses steel hulling knives and has a built in washing cage. The machines are shown here primarily as an example of the kind of equipment used in larger nut industries and likely could be refined to work with American hazelnuts.

Crackers

Cracking is necessary processing step if you intend to sell hazelnut kernels or kernel pieces. Hand cracking is a time consuming endeavor, and if you plan to process large volumes of nuts, a mechanical cracker will be essential. Furthermore, because the kernels are a food product, the cracking and downstream processing of the kernels must be done with a food processing plant license that requires approved facilities and equipment and a HACCP plan. The exact requirements will vary by State. Check with your State Department of Agriculture for exact requirements.

Cracking is a delicate procedure that must remove the shell without damaging kernels. Thus, regardless of the machine it has to be calibrated to the nuts being cracked. Furthermore, the machine has to be generally engineered to work with the specific nuts. A great number of small-scale huskers are available, but none have so far proven viable for the American hazelnut. Growers in the Midwest are developing their own crackers that may soon be commercially available.

Small-Scale Crackers

The internet is full of small-scale crackers primarily designed for almonds, walnuts, pecans, and other European hazelnuts. Although Midwest hazelnut growers have trialed many of these, none have so far proven effective for the challenging American hazelnuts due primarily to the nut's variable shape and size and thick shells. Two examples of small-scale equipment are shown below. Growers are encouraged to trial other available smaller-scale equipment and report their efficacy to the Hazelnut Processing Steering Committee.



The Universal Nut Cracker:

Although advertised to work with hazelnuts, growers that have tried the Universal Nut Cracker indicate that it doesn't work with the thick shells and variable size of the American hazelnut.

Photo courtesy of www.universalnutcraacker.com



The Universal Nut Sheller:

The Instructables website includes drawings for a Universal Nut Sheller that is built out of concrete and minimal hardware. It works by grinding the nuts between two concrete cones. It is unknown how well it works with American hazelnuts.

Photo courtesy of www.instructables.com.



DaveBilt Nut-Cracker:

A number of growers use this hand-crank nut cracker. Growers report a throughput of 50 lbs per hour. Pre-sorting the hazelnuts into size classes increases the effectiveness as the machine has to be adjusted to the size of the nut. Retail prices are around \$150.

Photo courtesy of Roy Cerling

American Hazelnut Crackers

Processing American and hybrid hazelnuts is a challenge given the lack of uniformity in the hazelnut crop. There are no commercially-viable cultivars available for Midwestern growers. Instead, plantings consist of genetically-unique seed origin plants. The size and shell thickness of the nuts varies from plant to plant, making it difficult to efficiently crack the nuts. The other challenge is scale. Despite their low cost, the existing home-scale crackers developed for other nut crops are both too small for the scale of hazelnut production in the Upper Midwest and have not proven effective. On the other hand, the scale of production is too small to justify the large-scale cracking equipment developed for European hazelnuts. As a result, growers in the Midwest are working to develop their own technology and equipment, matched to the current scale of production and unique characteristics of the American and hybrid hazelnuts.



The Terminutter

Developed by Mark Shepard and John Bashaw, the Terminutter is designed as a continuous flow cracker that works by throwing the nut against an angled piece of metal. The size of the nut doesn't matter, only the force necessary to crack the shell. Both the speed of the nut and the angle of the metal can be adjusted and, thus, the machine is able to handle the variability within the American hazelnut crop without pre-sorting.



The Crack-M-All™

Developed by Norm Erickson, the Crack-M-All™ works by squeezing the nut just enough for the shell to crack. As such, the “squeeze” has to be adjusted to match the width of the nut being cracked. This requires that the hazelnuts be pre-sorted into size classes. A low-cost sorting machine (Sort-M-All™) is being developed by Norm (prototype shown in bottom-left photo) to accompany the cracker. Although the Crack-M-All™ requires pre-sorting to work with hazelnuts, it will be able to crack the full range of nuts grown in the Upper Midwest. The prototype shown in the picture will undergo further development with planned commercial release in the near future.

Commercial Nut Crackers

Processing nuts is a major food business in the United States and a wide range of nut-cracking equipment has been developed for hazelnuts and other nut crops. The Index of Manufacturers included at the end of this guide provides a directory of companies manufacturing nut processing equipment. It is unknown how well the equipment would work for American hazelnuts. Once sufficient scale is achieved it may be possible to use such equipment with only minor modifications.

Cleaning

Cleaning equipment is an important part of the processing line and is used at multiple points in the process. After husking, the husk pieces must be removed from the in-shell nuts before the nuts can be run through a cracker. Likewise, after the nuts are cracked cleaning equipment is used to remove the shell pieces from the kernels.

There are several different kinds of cleaners. Aspirators use moving air to separate the lighter debris from the heavier nuts. Some aspirators work by moving the material across an air column and blowing off the lighter material, while others use a vacuum to pull off the lighter material while the heavier material falls out of the vacuum. Shaker tables are also useful for both cleaning and separating. The debris falls through the grates as they shake or vibrate, leaving the nuts behind. Aspirators and shaker tables can be effective at removing husk material, but are not very good at separating shell fragments from kernel pieces as both have similar weight and size.

Color sorters, such as the SORTEX Z+, use multiple spectra of light, including UV, to detect flawed or defective product by color, form, and other optical properties. Once programmed, the light is used to direct puffs of air that clear away the debris. Such technology can be used to separate shell fragments from kernels and kernel pieces. Shown below are examples of cleaning equipment.



Vortex Aspirator

The vacuum system pulls off the lighter weight husks and blank nuts allowing the heavier nuts to drop through. The aspirator shown here is used by Norm Erickson to clean the husks from the in-shell nuts. Appendix 1 shows the aspiration system used by Don Price.



Jessee Shaker Deck:

Shaker or vibrating tables can be used to both sort or clean material. A shaker box is used in the UW-Extension husker to remove the stick-on nuts from the clean nuts.

Photo courtesy of:
www.jesseeemfg.com



SORTEX Z+ from Buhler:

Although still cost-prohibitive for the Midwest hazelnut industry such optical sorting equipment may be the only feasible method to separate the shell fragments from the whole and piece kernels.

Photo courtesy of
www.buhlergroup.com

The Future of Midwest Hazelnut Processing

As the volume of hazelnut production and number of hazelnut growers increase in the coming years it will be important to address the future of hazelnut processing. How the processing is done, who owns the processing, and how much it costs will greatly influence the economics of the industry and the percentage of the hazelnut dollar that is received by the grower. For example, if a bottle of hazelnut cooking oil is sold to the end consumer, only a portion of that retail value will filter back to the grower. How much will depend on how the industry is organized and what portion of the value-chain is owned by the growers. Outlined below are some business structure options for growers to consider.

Vertical Integration

Perhaps the simplest option for a hazelnut grower is to purchase and operate the processing equipment necessary to produce whatever saleable product the grower chooses. The main advantage of this option is the simplicity. The grower has full control and ownership of the processing. The main disadvantage is cost. To finance the full acquisition and ownership costs of even the most basic processing equipment with hazelnut sales, the grower would need significant hazelnut production. It is important to note that the independent spirit of farmers, although noble, can cause problems when the farmer absorbs the full costs of equipment ownership rather than sharing it with other farmers.

Processing Sole Proprietorships

If a grower did decide to vertically integrate and purchase and operate a processing line, it would make financial sense to either purchase hazelnuts from other growers or offer custom hazelnut processing. Because only one grower is involved, this option is very simple and likely the most viable for someone with the necessary financial resources. The danger of this option, however, is that other growers have little say in the price that is paid for their product or the processing service, particularly if there aren't other processing options. Furthermore, the processor will be adding the majority of the value to the hazelnut and, therefore, capturing the larger share of the retail dollar, particularly if the processor is buying the hazelnuts from other growers.

Grower Partnerships

If a limited number of growers wanted to work together, a formal partnership incorporated as a Limited Liability Company (LLC), would be a good option. The growers would each contribute a share of the capital necessary to develop and operate the processing business and share in the profits of the business proportional to their capital contribution. The exact details of the partnership would be outlined in an operating agreement among the partners. As a processing business, it would make financial sense to either purchase hazelnuts from other growers or provide a custom processing service.

The main advantage of a grower partnership is that the capital costs would be shared, making entry into the processing business more affordable for an individual grower. The operational arrangement of the partnership is less cumbersome than a formal Cooperative as there are fewer "cooks in the kitchen" and no required Board, bylaws, annual meeting minutes, etc. The main disadvantage is that the success of the partnership depends greatly on the personal relationships among the partners. If there are problems that develop between the partners it can be nearly impossible to continue operating the business or even dissolving the business. The potential problems can be mitigated by developing a comprehensive operating agreement BEFORE entering into the partnership, especially an agreement that binds the partners to a conflict resolution

process. Partnership businesses that fail, typically do so because there is no clear written agreement of how to handle the inevitable conflict that will arise during the course of business.

Grower Cooperatives

A formal legally-incorporated processing Cooperative is another option that provides equal control of the processing business to the growers. A Cooperative consists of Producer Members that each have one vote in the decision-making of the Cooperative. The Cooperative is operated by a Board of Directors and often has committees that advise the Board. A general manager with or without staff is typically hired to carry out the day-to-day business of the Cooperative. Cooperatives can either be open (such as the typical retail grocery Coop or feed mill) or closed where members apply and are voted in.

The primary advantage of the Cooperative processing option is that the capital costs to establish and operate the business are spread across the Membership or paid through sale of non-voting capital stock. In addition, it is perhaps the best way to ensure the growers collectively receive a fair price for their hazelnuts and capture a significant portion of the retail-value of the sold products. The primary disadvantage is that the business can be cumbersome to operate with Board Meetings, Committees, Bylaws, Annual Meetings and other bureaucratic necessities requiring more time from growers than they are willing to commit, particularly early in the process. Furthermore, because each member has an equal say in the business of the Cooperative there may be problems when not every member has the same financial stake in the Cooperative. For example, a member that sells 100 times the volume of hazelnuts to the Cooperative as another member may have very different ideas of how the Cooperative should be operated. Disparity in financial stake can be mitigated somewhat by membership classes or by closing the Cooperative and only offering membership to similar sized growers.

Hybrids

Another option is to divide the hazelnut processing strategically and develop businesses that best match the unique circumstances of each step in the processing. For example, it will be cheaper to ship in-shell nuts than in-husk nuts. Likewise, the most expensive part of the hazelnut processing will be cracking the nuts and processing the food-grade kernels into value-added products. For these reasons it might make sense for a grower Cooperative to purchase in-shell nuts from grower partnerships that husk and aggregate their in-shell nuts geographically. For example, a cluster of growers in a corner of Wisconsin might form an LLC that operates as a partnership and owns and operates a husker. The partnership would then sell their in-shell nuts to a processing Cooperative that cracks the nuts and makes and sells value-added products. The partnership or the individual growers could be members of the Cooperative. The Cooperative could function to produce custom-label products for the Members, a product line produced and sold by the Cooperative, or both.

Alternatively, the partnerships could contract with a private processing business to produce custom-label value-added products. The growers would still retain ownership of the hazelnuts all the way through the value-chain and would, therefore, stand to capture a larger portion of the retail dollar, while avoiding the hassles of a formal Cooperative.

There are any number of options for developing the businesses of processing. The important thing is that growers start thinking about these options now and fully consider the long-term consequences of their business decisions with respect to what portion of the final hazelnut retail dollar is retained by the growers. Any sort of hybrid approach would, ideally, start with advanced planning and coordination.

Index of Manufacturers

Forest Agriculture Enterprise: Mark Shepard is one of Wisconsin's largest hazelnut producers and has developed the Terminutter cracker. He is working to develop a full processing line. He has also assisted with development of the UW-Extension husker and is a co-owner of the prototype of that husker.

Company information: Forest Agriculture Enterprises
15662 County Hwy I
Viola, WI 54664
forestag@mwt.net
www.forestag.com

SuperSquirrel, LLC: Lee Pothast is the designer and developer of the SuperSquirrel prototype. For more information on custom husking, leasing options, or machine fabrication and sales contact SuperSquirrel LLC at 507-352-5000.

Company information: SuperSquirrel, LLC
507-352-5000

Hazelnut Valley Farm: Norm Erickson is a hazelnut grower in Lake City, MN and has been working to develop a low cost hazelnut processing line. He currently has prototypes of a husker, sorter, and cracker. The Crack M All™ cracker is designed to work with American and hybrid hazelnuts, but also a full range of tree nuts. Norm is working to finalize the Crack M All™ design with commercial release of the unit.

Company information: Hazelnut Valley Farm
Norm Erickson
1186 W Lakewood Ave.
Lake City, MN 55041
hazelnutsource@gmail.com
507-319-4085

The Universal Nutcracker: The Universal Nutcracker Model 750 is a “commercial grade, industrial strength, high volume and [high] quality shelling machine”. The company states that it will shell about 60 lbs of nuts in five minutes with 75-85% of nuts cracking out as whole kernels. The Nutcracker costs \$3,500 plus shipping. This company also sells a shell sorter/separator which uses a variable speed blower system to separate and remove the shells from the cracked nuts. This machine cost \$3,000 plus shipping, In addition to these two separate machines, they also sell a combination cracker/sorter for around \$2,500.

Company information: The Universal Nutcracker
www.universálnutcracker.com
P.O. Box 68
Dexter, OR 97431 USA
(541) 954-8588

The Full Belly Project: The Full Belly Project is an international initiative which supports rural communities in developing nations through the design and distribution of innovative agricultural technologies. They work with global communities to develop agricultural devices that are appropriate to specific needs. A major project was the development of The Universal Nut Sheller in rural Mali in 2008. The project sells the plans for this sheller, along with the necessary fiberglass molds and enough hardware for 3 individual machines, for around \$700. The step-by-step plans are also available in PDF form from *Instructables* online. This is a DIY project.

Project information: The Full Belly Project
thefullbellyproject.org
PO Box 7874 Wilmington, NC 28406
1020 Chestnut Street Wilmington, NC 28401
1-910-452-0975
info@thefullbellyproject.org
Instructables
www.instructables.com/id/Universal-Nut-Sheller

Pearce Brothers: Based in Bailey, North Carolina, the Pearce Brothers hand build both a pecan cracker and cleaner which can also be used for other nuts. Though they do not specifically list hazelnut as one of these nuts, it is likely that they would make a custom model. The crackers runs at around 100 lbs per hour and requires one operator. The Brothers tout this machine as a perfect mobile processing set-up.

Company Information: Pearce Brothers
www.pearcebrothers.com
11738 Liles Rd.
Bailey, NC 27807
252-230-0224
pearcebrothers@yahoo.com

Jessee Equipment Manufacturing: Jessee Equipment Manufacturing is based in Chico, California and caters primarily to the almond and walnut industries. They do, however, make equipment that is suitable for hazelnuts including: the All Nut Cracker (a cone sheller), aspirators, sizing decks, and inspection tables. The Jessee husker is reputedly bullet proof, husking even dirty or muddy nuts efficiently. It is also known to produce some nut scarring, however, and is probably not the best choice for the in-shell market. They manufacture processing lines for both small volumes, up to 500 lbs/hr and large volumes, around 1200 lbs/hr.

Company Information: Jessee Equipment Manufacturing
www.jesseemfg.com
2434 Dayton Road,
Chico, CA 95928
530-342-2909

Wizard Manufacturing: Also based in Chico, California, Wizard Manufacturing produces a line of nut processing equipment that includes: hullers, washers, sorting tables, aspirators, and drying systems. Their husker tends to need cleaner material, but they do not seem to have the same issues with nut scarring as the Jessee husker.

Company Information: Wizard Manufacturing INC
wizardmanufacturing.com
2244 Ivy Street
Chico, CA 95928-7172
(530) 342-1861

Savage Equipment: Based in Madill, Oklahoma, Savage Equipment produces commercial scale processing equipment used primarily by the pecan industry. They currently manufacture an air powered nut cracker which is capable of cracking 500 nuts per minute. They also manufacture a vacuum separator for removing shell pieces and a nut meat sizer which sorts kernels and pieces into size categories.

Company Information: Savage Equipment
www.savageequipment.com
400 Industrial Rd.
Madill, Oklahoma 73446
866-572-8243

Southern Nut'n Tree: Based in Goldthwaite, Texas, SNT produces equipment used primarily in the pecan industry, though researchers in Nebraska have used their pecan deshucker successfully with hazelnuts without making any modifications to the design. SNT also sells refurbished equipment of both their own brand and other manufacturers. All new and used equipment is listed on their website by category with specs and pricing. They make two huskers, capable of 1000 lb/hr and 4000 lbs/hr, respectively.

Company Information: Southern Nut 'N' Tree Equipment, Inc.
snt.pecans.com
324 SH 16 South
Goldthwaite, TX 76844
(800) 527-1825
(325) 938-5460

Weiss McNair: Based in Chico, California, Weiss McNair manufactures the 836 Hazelnut Harvesters which they have designed specifically to serve the hazelnut industry. They also manufacture several other harvesters, all of which clean the crop during pickup.

Company Information: Weiss McNair
www.weissmcnair.com
531 Country Drive
Chico, CA 95928
530-891-6214

Flory Industries: Based in Salida, California, Flory Industries manufactures harvesting equipment for the nut industry. Their harvesters are not specific to hazelnut, but many growers in Oregon use them with success. They have several models, all of which separate debris from nut clusters during harvest.

Company Information: Flory Industries
www.floryindustries.com
4737 Toomes Road
P.O.Box 908
Salida, CA 95368
800-662-6677

Buhler Group: An international manufacturer and supplier of agricultural and food service products. Buhler manufactures a line of high-tech optical color sorters which are used to distinguish defective product in high volume batches.

Company information: Buhler INC
www.buhlergroup.com
13105 12th Avenue North,
Plymouth, MN 55441-4509
P.O.Box 9497
Minneapolis, MN 55440-9497
1 (763) 847 99 00

BEI International, LLC: Based in South Haven, Michigan, BEI is an innovative manufacturer of equipment for the fruit and berry industries. They manufacture a line of high-bush blueberry harvesters which may be useful for harvesting bush-form hazelnuts.

Company information: BEI International, LLC
beiinternational.com
1375 Kalamazoo St.
South Haven, MI 49090
1-800-364-7425

Machine Design Incorporated: Based in West Columbia, South Carolina, Machine Design, Inc. produces and sells the Quantz RX-6 Rotary Air Crackers and the newer Millenium series of pecan crackers.

Company information: Machine Design, Inc.
2413 Leaphart Road
West Columbia, SC 29169
803-791-0241

Overseas Manufacturers

Brovind—An Italian Company that makes large scale processing lines for a variety of nuts.

Company information: Brovind—GBV IMPIANTI SRL
Via Valle Bormida 7
12074—Cortemilia—CN—Italy
+39-0173-81439
www.brovind.com

Jose Borrell, SA – A Spanish manufacturer that has been a leader in agricultural equipment since the 1940s. They just opened a USA branch in Merced, CA. They manufacture primarily industrial scale machines, but do cater to hazelnuts. They generally install large processing lines capable of running thousands of lbs per hour.

Company information: Jose Borrell, USA Division
jborrell.com
260-262 Riggs Ave
Merced, CA 95340

Literature Cited:

Chase-Landsdale, C. *Hazelnut Overview: Presentation to PTNPA*. Hazelnut Growers of Oregon. January 2008.

Fischbach, J. *Results of the 2008 Statewide Hazelnut Growers Survey*. Upper Midwest Hazelnut Development Initiative. June, 2009.

Fischbach, J., Brasseur, K. *Results of the 2010-2011 Hazelnut Growers Survey*. Upper Midwest Hazelnut Development Initiative. March, 2011

Fischbach, J., Demchik, M., Braun, L., Wyse, D., *Hazelnut Production Potential in the Upper Midwest: A Report On Hybrid Hazelnut Yields*, UW-Extension Research Bulletin #17. January, 2011

Melegos, L. *Filberts*. Presentation at the 2010 Upper Midwest Hazelnut Growers Conference, March 13, 2010.

Many Thanks to The Following Individuals For Their Information and Assistance Toward Preparation of This Guide:

Troy Pabst
Norm Erickson
Tim Newkirk
Mark Shepard
Steve Bertjens
Jeff Jensen
Lois Braun

UMHDI Primary Contacts:

Wisconsin

Jason Fischbach
UW-Extension Agriculture Agent
Ashland and Bayfield County
PO Box 218
Washburn, WI 54891
jason.fischbach@ces.uwex.edu
715-373-6104 ext 5

Minnesota and Iowa

Jeff Jensen
Marketing Program Assistant
Rural Advantage
jeff@ruraladvantage.org
1243 Lake Avenue, Suite 222
Fairmont, MN 56031-1942
507-238-5449

**Upper Midwest
Hazelnut
Development Initiative**

The Upper Midwest Hazelnut Development Initiative is a collaboration of researchers in Wisconsin and Minnesota working with early-adopter hazelnut growers to develop the fledgling Upper Midwest hazelnut industry.



www.midwesthazelnuts.org

Appendix 1

Don Price Bucket Husker—A Description and Assembly Guide for a Low-Cost Husking Machine

X2000 Hazelnut Husker—Technical Drawings, Materials List, and Description of a Mobile, High Throughput Husking Machine