Hazelnut Production in the Upper Midwest

Results of the 2010 Regional Hazelnut Growers' Survey

Upper Midwest Hazelnut Development Initiative

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Last Updated: November 18, 2011

UW Extension

Upper Midwest Hazelnut Development Initiative

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The Upper Midwest Hazelnut Development Initiative (UMHDI) is a collaboration of Universities, growers, and NGOs working to support the emerging hazelnut industry in the Upper Midwest. In 2008, the growers of Wisconsin were surveyed by UW-Extension to better understand the extent of hazelnut production in Wisconsin and the issues faced by the growers. The results of that survey are published in the "2008 Wisconsin Hazelnut Growers Survey Report" which is available at www.midwesthazelnuts.org.

In 2010, UMHDI convened the Hazelnut Processing Steering Committee, composed of hazelnut growers in Wisconsin, Minnesota, and Iowa. The purpose of the Committee is to coordinate development of suitably-scaled processing equipment and infrastructure for the emerging hazelnut industry in the Upper Midwest. To that end, the Committee initiated a survey of hazelnut growers in the Upper Midwest to better quantify the number of growers and plants as well as current and anticipated nut production.

Acknowledgements

Funding for this survey project was provided in part by grants from the Specialty Crop Block Grant Program of the Wisconsin Department of Agriculture Trade and Consumer Protection. Many thanks to Jeff Jensen and Dr. Lois Braun for their assistance collecting survey data from growers in Minnesota and Iowa.

Background

The emerging hazelnut industry in the Upper Midwest is based on seed-propagated plants from early selections of crosses of *C. americana*, *C. cornuta,* and *C. avellana.* These hybrid plants have been sold to early adopters in the Upper Midwest since the 1990s. Collectively, these early-adopters of bush-type hazelnuts have deployed a significant population of genetically unique hazelnut plants. The diversity in these plantings has created unique opportunities for researchers and growers to select high performing plants and further develop the hybrid hazelnut germplasm. However, this diversity has also meant hazelnut plantings consist of a mix of productive and unproductive plants, making it difficult to estimate and plan for nut yields in a given year. Over the last few years, these plantings have begun to mature and produce significant nut crops, ushering in a new set of challenges for growers as they figure out how to take this crop from the field to the market.

Survey work conducted by the Wisconsin Hazelnut Research Team in 2008 identified 66 hazelnut growers with 17,339 living hazelnut plants on roughly 24 acres across the state of Wisconsin (Fischbach, 2009). As the first survey of its kind and no grower organization in place in WI, the survey almost certainly underestimated both the number of growers and number of plants in Wisconsin. That said, the survey identified some important characteristics and issues within the industry. First, growers are scattered across WI, with a concentration in Southwest Wisconsin. Second, most growers have fewer than 50 plants with a handful of larger growers with more than 1000 plants. Lastly, plant mortality is a major issue for all growers and averaged 58%. That is, of the 41,706 plants established by the growers only 17,339 were still alive at the time of the 2008 survey.

The 2010 Hazelnut Growers' Survey was conducted in an effort to broaden the scope of the 2008 Wisconsin survey to include growers in Iowa and Minnesota. The purpose was to identify the number of growers and living plants, as well as existing and projected nut production. Such information is important toward developing an appropriately scaled hazelnut processing infrastructure.

Methods

The 2010 Hazelnut Growers' Survey was developed by the Hazelnut Processing Steering Committee as part of the Upper Midwest Hazelnut Development Initiative. The two page survey is included in this report as Appendix A. The survey was sent by mail to 290 individuals in WI, MN, and Iowa who had previously indicated that they were hazelnut growers or had an interest in growing hazelnuts. These names were taken from mailing lists maintained by UW-Extension, Rural Advantage, the Minnesota Hazelnut Foundation, Dr. Lois Braun, and Forest Agriculture Enterprises. Individuals were asked to return the survey within 3 weeks. In addition, growers were given instructions on how to complete the survey electronically using the online survey tool, Zoomerang. The survey was also distributed at the 2010 and 2011 Hazelnut Growers' Conferences held in Lacrosse, WI and St. Paul, MN, respectively.

In total there were 65 responses to the 2010 survey, including 28 responses using the online survey option. Only 4 respondents reported having no living hazelnuts. There were also 31 surveys returned as undeliverable for which a new address was not found. As with the 2008 survey, the relatively low response rate of 25% (65/259) is a problem that must be improved upon in future years.

To better quantify the number of growers and number of plants in the Upper Midwest, the data from the 2010 hazelnut growers' survey results were combined with the results from the 2008 survey, internal survey data collected by the Minnesota Hazelnut Foundation in 2009, and grower data collected by Dr. Lois Braun at the University of Minnesota as part of her on-farm hybrid yield evaluation project. Each of these additional data sets includes growers and estimates of number of living plants maintained by each grower. Growers that responded to these other surveys but did not respond to the 2010 survey were compiled with the 2010 survey results to better estimate the number of growers and number of living plants in the Upper Midwest. The rest of the data reported here are from only the 65 responses to the 2010 survey.

Results and Discussion

Number of Growers:

The compiled survey work between 2008 and 2010 has identified 127 growers across Iowa, Minnesota, and Wisconsin (Figure 1). Of these, more than half are in Wisconsin, which could be more a sampling anomaly than an accurate assessment of the geographic distribution of hazelnut growers in the Upper Midwest. The two primary plant suppliers are Badgersett Research Corporation in Canton, MN and Forest Agriculture Enterprises in Viola, WI.

	Number of Growers			
# of Plants	**IA**	**MN**	**WI**	**Total**
1000+	1	6	9	**16**
100-999	7	11	17	**35**
50-99	2	0	6	**8**
1-49	1	15	52	**68**
Total	**11**	**32**	**84**	**127**

Figure 1. Number of hazelnut growers by number of living plants. (n= 130)

The 2008 survey was sent to Wisconsin customers of both Badgersett Research Corporation and Forest Agriculture Enterprises. The 2010 survey was only sent to customers of Forest Agriculture Enterprises. As a result, the 2010 survey was likely missing Badgersett's Minnesota customers and, thus,

underestimates the number of MN hazelnut growers. However, with the University of Minnesota, Rural Advantage, and the Minnesota Hazelnut Foundation operating in Minnesota and providing their grower data, it is possible that the relative distribution of growers is, in fact, accurate.

The data for Iowa growers almost certainly underestimates the number of growers. There is no good mailing list for Iowa growers within the UMHDI, primarily because there are no University or NGO collaborators within Iowa. The Iowa Nut Growers Association has recently formed a hazelnut sub-committee and that should increase the awareness and outreach to Iowa hazelnut growers in coming years.

Number of Plants:

Figure 2 shows the total number of living plants reported by the respondents across the compiled surveys for each grower size class. Assuming an average plant density of 484 plants per acre (15' row x 6' plant spacing), the 66,252 living plants represent roughly 137 acres of production. The data show two groups of growers. There are growers that have invested significant resources and have established 100 or more plants and those that are trialing the hazelnuts and have less than 50 plants (Figure 1). Ninety-seven percent of the total living hazelnuts are grown by 40% of the growers. The largest 16 growers in the survey data account for 81% of the reported living plants. This is important moving forward as decisions are made regarding processing. There will likely be a handful of growers with significant nut volume that will look to develop suitably-scaled processing lines and many small growers without enough volume to warrant investment in processing equipment, and will, therefore, rely on the larger growers to process their nuts.

	Number of Plants			
# of Plants	**IA**	**MN**	**WI**	**Total**
1000+	1100	19398	33425	**53923**
100-999	2071	3622	4710	**10403**
50-99	164	0	385	**549**
1-49	40	398	939	**1377**
Total	**3375**	**23418**	**39459**	**66252**

Figure 2. Number of living hazelnut plants by grower size class. (n=127)

Plant Source and Mortality:

In the 2010 survey, growers were asked to report where they sourced their plants, how many were planted by year, and how many of those were still alive. Figure 3 shows the reported sources for hazelnut plants, and the number planted and still alive for each source. *The figure only shows the data from the 65 respondents to the 2010 survey. Such data was not collected in the other surveys used to compile the total grower and living plant data reported in Figures 1 and 2.* However, unlike the 2008 survey which only surveyed Wisconsin growers, the data shown here are for growers across IA, MN, and WI.

Averaged across all plant sources and planting year, the mortality rate was 54%, which is close to the 58% reported in the 2008 survey. This high mortality rate is a major concern, especially given the seedling costs of between $4 to $10 per plant. The high mortality rate is likely caused by a combination of poor seedlings, poor site preparation, poor weed control and watering, and the slow rate of aboveground growth in the first few years after planting.

Plant Source	Planted	Alive	Mortality	# of Plantings
Arbor Day Foundation	41	19	54%	9
Audobon Society	12	12	0%	1
Badgersett Research Corporation	51458	15957	69%	41
Cascade Nursery	400	375	6%	1
County Agent	125	95	24%	2
Forest Agriculture Enterprises	15190	12470	18%	28
Grimo Nut Nursery	10	10	0%	2
Halsey, Nebraska	20	20	0%	1
Hazelnut Valley Farm	2250	2068	8%	4
Jungs	12	12	0%	2
Lincoln Oakes Nursery	25	24	4%	1
Ozaukee County	75	0	100%	3
Red Fern Farm	2460	2147	13%	7
Total Plants	**72078**	**33209**	**54%**	**102**

Figure 3. Hazelnut sources and survival as reported by survey respondents. (n=65) "# of Plantings" is the number of separate plantings from a given source reported by the growers. Any single grower may have reported multiple plantings if they were planted in different years, at different sites, or consisted of different sources of plants.

Badgersett Research Corporation and Forest Agriculture Enterprises continue to be the major suppliers of hazelnut plants for growers. Interestingly, the reported mortality varies among nursery sources. The 69% total mortality reported for plants sourced from the Badgersett Research Corporation (BRC) is a concern. Badgersett Research Corporation sells primarily tubelings that are shipped fully leafed-out throughout the growing season. There were 41 separate plantings of BRC tubelings reported by the growers with a range of 0-100% mortality and an average of 44% (standard deviation=33%). The tubelings are less forgiving than bareroot dormant seedlings or potted plants because they have small root systems and are shipped leafed-out during the growing season. Without proper care including good site preparation, careful plant handling, watering, and weed control, the tubelings can be difficult to establish.

Despite the reported high total mortality rate of 69% for the Badgersett tubelings, it is important to recognize the high variability of the mortality rate among the plantings. Some have had great success establishing BRC tubelings with very low mortality rates and other have had poor success with high mortality rates. As such, grower knowledge and management are likely the primary determinant of the establishment success of the tubelings. Better education of growers, particularly those with little agricultural or horticultural experience would likely reduce the mortality rate of the tubelings.

The number of plant sources shown in Figure 3 reflects the diversity of hazelnuts sourced and planted in the Upper Midwest and also reflects the lack of proven clonal hazelnut cultivars for the Upper Midwest. Identifying the highest performing plants from this population of open-pollinated hybrids, cloning them, and testing them in replicated performance trials will be essential toward development of viable cultivars.

As growers identify top performing plants in their own plantings, there will be incentive for the growers to use the seed from such plants to produce and sell seedlings. This practice currently forms the basis of the hazelnut plant industry. Forest Agriculture Enterprises, Badgersett Research Corporation, and Hazelnut Valley Farm are currently selling seedlings from seed collected from their best plants. This practice is likely to expand as additional growers enter the nursery business. Ideally, the plants from

which seed is being saved should be cloned and tested in replicated performance trials to separate the genetic by environment interaction. Without doing so, it is impossible to know if the plant is high-performing due to heritable genetics or a favorable micro-site. Such testing is underway, but with a 10+ year evaluation timeline for a given plant, the process will be slow. In the meantime, the emerging hazelnut industry will be driven by the seed origin nursery stock from un-proven parent plants.

Figure 4 shows the number of plants established and alive by planting year. Though both Figures are derived from the same set of data, there are fewer plants shown in Figure 3, because not all respondents included the source of their plants in their completed survey. As seen in Figure 4, the number of plants established by year has been fairly steady since 2003 with the exception of 2005.

Planting Year	Planted	Alive	Mortality
Prior to 2002	43525	11174	74%
2002	735	622	15%
2003	2455	1508	39%
2004	1649	1651	0%
2005	12942	8545	34%
2006	3942	3269	17%
2007	4609	3123	32%
2008	4373	3139	28%
2009	1527	1445	5%
2010	3141	3014	4%
Total Plants	**78898**	**37490**	**52%**

Figure 4. Mortality of hazelnuts by planting year. (n=65)

However, the mortality rate has been variable from year-to-year ranging between 0 and 39%. It is unclear why the mortality is so high for plants established prior to 2002. The respondents were not asked when the plants died, just how many were still alive as of 2010. Anecdotally, once a hazelnut plant is established it is very difficult to kill, thus, it is likely the bulk of the mortality in the plants established prior to 2002 happened in the first few years after planting.

Hazelnut Yield:

The total hazelnut yield reported by the 65 survey respondents by year since 2002 is shown in Figure 5. This data shows a significant increase in nut yield for 2010 at 8,675 pounds, or 4.3 tons; more than double the yield reported in 2008. It is still unclear how much of the nut production in a given year is actually harvested by the growers and how much is left on the plant. It is also unclear whether the weight reported is a measured weight or estimation. Most likely, the accuracy of these numbers differs greatly from grower to grower.

Harvest Year	lbs (in-shell)
2002	0
2003	0
2004	0
2005	0
2006	476
2007	1588
2008	4059
2009	3436
2010	8675

Figure 5. Total hazelnut yield by year. (n=65)

In addition to reported yields, it is possible to use the number of living plants to estimate potential yields from the hazelnut plantings. As shown in Figure 2, the growers report more than 66,000 living plants. If

the average yield of a mature hazelnut plant were known and multiplied by the number of mature plants it would be possible to calculate current and projected yields. Dr. Lois Braun at the University of Minnesota has been measuring individual plant yields in on-farm plantings throughout the region since 2004. Based on those yield data and averaged across location and plant age, the researchers report an average plant yield of 0.45 lbs kernel/plant (Fischbach et al, 2011). That estimate includes an over-sampling of the top-yielding plants, however, and, thus, overestimates the average yield across all plantings. If the yield data from only the plants selected at random are included, the average yield is 0.2 lbs kernel/plant (Braun, personal communication). Assuming 33% kernel yield, and that all plants reported in Figure 2 were mature and bearing, the extrapolated average annual potential yield from the 66,000 living plants is 19.8 tons of in-shell nuts.

Clearly, not all 66,000 plants are the same age. Knowing the approximate maturity of the plants would help refine the yield projections. Of the 66,000 living plants, 37,000 are accounted for in the 2010 survey, which asked growers to report how many plants were planted by year (Figure 4). Figure 6 shows the projected yields of those 37,000 plants through year 2015 assuming: 1) the average yield of each plant is 0.6 lbs of in-shell nuts/year (0.2 lbs kernel/yr), and 2) the plants start bearing at age 6. Using this methodology, the projected yield for 2010 was 7.1 tons of in-shell nuts. The total reported yield for those 37,000 plants for 2010 was 4.3 tons (Figure 5). The reason for the difference is likely due to: 1) survey respondents are either not harvesting or reporting their yields in the 2010 survey, 2) the plants are not yielding the average of 0.6 lbs of in-shell nuts by age 6, and/or 3) the average yield of 0.6 lbs of in-shell nuts/plant over-estimates the average yield.

The data set used in Fischbach et at (2011) is fairly robust with yields from hundreds of plants across eight sites in the Upper Midwest over multiple years. That said, the eight sites are all well-maintained plantings with better weed control and plant management than at most plantings. As a result, the average plant yield even when measuring yield from random plants likely over-estimates the average across all hazelnut plantings.

If it is assumed the remaining 29,000 living hazelnut plants reported in the other survey compilations are of roughly the same age distribution as reported in the 2010 hazelnut growers' survey, the projected yield for 2010 can be increased by another 5.5 tons, giving a total projected 2010 harvest of 12.6 tons of in-shell nuts spread across 127 plantings in the Upper Midwest. Using the harvested yield reported by the 2010 survey respondents of 4.3 tons and assuming a proportionally similar yield for the 29,000 plants reported in the other survey compilations, the total actual reported yield would be roughly 7.7 tons of in-shell nuts in 2010. Thus, a reasonable yield estimate for current hazelnut production would be between 7.7 and 12.6 tons of in-shell nuts or 2.5 and 4.2 tons of kernels. This is a wide range, but does show the current scale of hazelnut production in the Upper Midwest. Put in context, Fisher-Nuts in Chicago imports roughly 45 tons of hazelnut kernels per **month** from Turkey.

As the industry develops processing technology, the yield ranges reported should be used to guide scale-up decisions. Because of the time it takes for new plantings to begin bearing nuts, it is important to recognize that Midwestern yields will increase slowly. Using the same methodology as shown in Figure 6 and assuming the 29,000 additional plants identified in other survey work have roughly the same age distribution, the projected total Upper Midwest hazelnut yield in 2015 is 20 tons of in-shell nuts (6.6 tons of kernel).

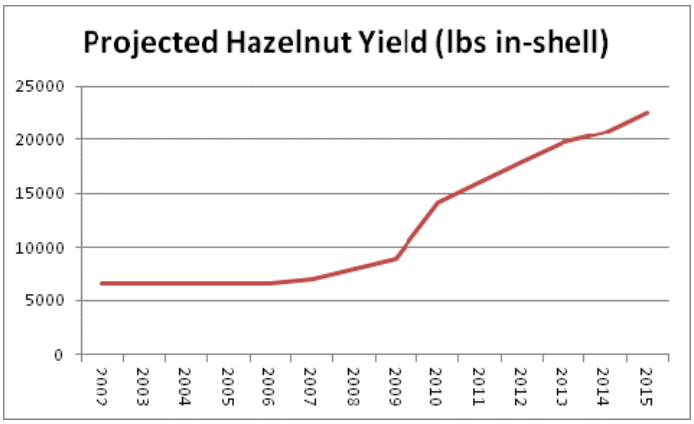

Figure 6. Projected hazelnut yields by year for 37,000 plants as identified in Figure 4. The projections are based on the assumption of an average annual per plant production of 0.6 lbs of in-shell nuts starting at age 6.

This estimation is based on plants in the ground as of 2010. The projected yields would increase if future surveys identify growers and plants not included in previous surveys. Continuing to identify existing growers will be important to more accurately quantifying current and projected hazelnut yields in the Upper Midwest.

Processing Methods:

The 2010 survey asked growers to indicate how they are currently processing their hazelnuts. Of those that responded, 10 of 18 were husking by hand, 11 of 18 were cracking by hand, and 12 of 18 were sorting shells from kernels by hand. The remaining respondents were using homemade equipment in various stages of development. The Upper Midwest Hazelnut Processing Guide (Fischbach and Brasseur, 2011) provides a detailed description of hazelnut processing options, including updates on the development of the equipment being designed by the growers themselves.

As yield increases in the coming years, particularly for the larger growers, it will be important to develop appropriately-scaled equipment. Equally important for the industry will be development of processing infrastructure, including business development, that meets the needs of both the larger producers (1000+ plants) and the many smaller producers (<50 plants).

Figure 7 shows the methods of commercial processing that respondents would prefer to use in the future if such options were available. Growers were able to choose multiple options. Processing through a grower Cooperative was the most popular option with 61% of respondents indicating they would prefer to process through a Cooperative. Processing preferences didn't differ significantly between the larger and smaller producers with roughly the same proportion of large and small growers preferring to process through a grower Cooperative. It is important to note that some growers chose multiple options, such that the husking process, for example, might be done on farm with grower-owned equipment and the in-shell nuts sold to a grower Cooperative that does the cracking, sorting, and manufacture of the end products such as nut spreads or salad oils. Regardless, based on these data, the feasibility and structural details of a grower Cooperative should be explored.

Processing Options	Number of Growers
Through a grower Cooperative	25
By myself with my own equipment	15
By renting a mobile processing unit	13
By sending my in-husk hazelnuts to a processor	12
By sending my in-shell hazelnuts to a processor	7

Figure 7. Preferred processing options indicated by growers. (n=41)

	Number of Growers	
Processing Options	100+ plants	<100 plants
Through a grower Cooperative	15	10
By myself with my own equipment	8	7
By renting a mobile processing unit	7	6
By sending my in-husk hazelnuts to a processor	9	3
By sending my in-shell hazelnuts to a processor	4	3

Figure 8. Preferred processing options by grower size class. 100+ plants = growers with 100 or more plants (n=23). <100 plants = growers with less than 100 plants (n=18).

Current Markets and Annual Revenue:

Six of the 65 survey respondents reported currently selling hazelnut products. Of those, three reported selling to family and friends, two reported selling to Cooperative retail grocery stores, and two reported selling to multiple markets. Six of the respondents reported selling in-shell hazelnuts at prices that ranged from $2.75 to $5.50 per lb. Two respondents reported selling whole kernels between $6.25 and $8.00 per lb. Total reported revenue from sale of hazelnut products for 2010 was $4625. A number of growers reported hazelnut production volumes but did not provide sales data, as a result, total hazelnut product revenue almost certainly underestimates actual sales revenue.

Conclusions:

Despite the considerable interest in hazelnut production in the Upper Midwest with continued planting of hazelnut plants there remain challenges toward development of a commercially viable industry. Average per plant yields will remain low until higher-yielding clonal material is developed. Even if such genetics were introduced next year, the impact wouldn't be realized until at least 2016 when they begin to produce. Until future survey work identifies additional growers and plants, an Upper Midwest yield range of between 8 and 13 tons of in-shell nuts/year for 2010 and growing to around 20 tons per year by 2015 should be used to guide processing and scale-up efforts.

The need for appropriately-scaled and efficient processing equipment and infrastructure will become greater each year as hazelnut plantings mature. Development efforts should focus on higher volume equipment for the producers with 1000 or more plants and either very small equipment or access to processing services for the smaller growers with 50 or fewer plants. Further information and updates on the processing equipment and infrastructure for Upper Midwest hazelnut production can be found in the Upper Midwest Hazelnut Processing Guide.

Development of high-quality nursery stock by hazelnut producers combined with increased grower knowledge and refined agronomic recommendations will be essential to increase the establishment

success of new plantings. Although plant survival has improved in recent years, with continued interest in hazelnut production by beginners and others new to management of woody perennial plants it will be important to provide outreach education specific to the agronomics of hazelnut establishment. In addition, as more growers look to propagate and sell seedlings from their best plants it may be helpful to train and equip these growers to produce high quality nursery stock.

The four primary objectives of the 2007 Strategic Plan of the Upper Midwest Hazelnut Development Initiative remain well aligned with the challenges currently facing the emerging hazelnut industry. That said, because the low average per plant yield is the primary limitation to the hazelnut industry, speeding the development of improved hazelnut genetics may be the most effective use of limited resources. Expanding the Hazelnut Improvement Program (HIP) (www.midwesthazelnuts.org/about-hip.html) to include more plantings would improve the probability of finding superior plants. Concurrently, cloning and evaluating the superior plants in replicated performance trials would help ensure the superior plants are in fact genetically superior.

Continued outreach efforts should focus on finding existing hazelnut growers in order to improve survey response rates and our understanding of the emerging hazelnut industry in the Upper Midwest.

Please direct any comments or questions regarding this report to Jason Fischbach at:

715-373-6104 ext. 5 or jason.fischbach@ces.uwex.edu

Appendix A – 2010 Hazelnut Growers' Survey

Return this completed survey no later than December 10, 2010 to:

Jason Fischbach
Bayfield County Courthouse
PO Box 218
Washburn, WI 54891

Please answer only the questions you are comfortable answering. The individual information you provide is strictly confidential and will only be used as input for a final report. This report will be prepared and made available upon request. Individual grower information will ***not*** be made available. This survey can also be accessed and completed online at:
http://www.zoomerang.com/Survey/WEB22B976ZXQYS/

Name: _____

Address: _____ City, State, Zip: _____

Phone Number: _____ Email address: _____

1. Please list the location of your hazelnut planting(s):

State: _____ County: _____

2. How many *living* hazelnut plants do you *currently* have in your planting(s)?_____

3. For each of the listed years please indicate how many hazelnuts you planted and where you purchased them from:

Year Planted	# Planted	Supplier	# Still Alive Today
2010			
2009			
2008			
2007			
2006			
2005			
2004			
2003			
2002			
Prior to 2002			

4. Are your hazelnut plants producing nuts? If so, how many total pounds of *in-shell* nuts have you harvested in each of the last five years?

Year	lbs harvested
2010	
2009	
2008	
2007	
2006	

5. How do you currently process your hazelnuts? Please answer for each of the following, listing equipment where applicable:

Husking: _____

Cracking: _____

Sorting kernels from shells: _____

_____

6. What hazelnut products do you currently sell? (circle all that apply)

In-husk nuts
Whole kernels
Oil
None
In-shell nuts
Kernel pieces
Value added products: _____

7. Where do you currently sell your nuts? (circle all that apply)

I don't currently sell
Family and friends
Retail stores
Confectioners/bakers/processors
Mail/internet order
Farmers market
Cooperative grocery stores
Other:_____

8. At what prices do you currently sell the following products?
(list unit of sale and price per unit, e.g. $5/lb)

In-husk nuts_____
Whole kernels_____
Oil_____
In-shell nuts_____
Kernel pieces_____
Other:_____

9. What is your total annual revenue for each of the following products?

In-husk nuts_____
Whole kernels_____
Oil_____
In-shell nuts_____
Kernel pieces_____
Other:_____

10. How do/would you prefer to process your hazelnuts? (circle all that apply)

By myself with my own equipment

Through a grower Cooperative

By renting a mobile processing unit

By sending my in-shell hazelnuts to a processor

By sending my in-husk hazelnuts to a processor

Please return completed surveys to:

Jason Fischbach, Bayfield County Courthouse, PO Box 218, Washburn WI 54891