

Improving Barley for Organic Producers: What Do Organic Producers Want?

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Introduction

Barley is one of the oldest known domesticated crops and is the second most widely grown organic small grain in the United States. It is a versatile crop with three principal end uses: feed, food, and malting. Organic barley is produced for all three uses and fetches a premium over conventional barley. Most varieties grown by organic farmers were bred under—and for—non-organic production conditions. As a consequence, these varieties may require improvement for one or more of the following traits: disease resistance, weed competition, input use efficiency, flavor, and nutritional quality.

Additionally, there is fragmentation in barley production due to the presence or absence of hulls. Malt varieties have traditionally had hulls because in the US most brewers are not equipped for or familiar with naked barley malts. Conversely, food barley varieties are primarily naked or if hulled, require an additional pearling processing step. Feed varieties in the US are generally hulled. Plant breeders have set out to develop varieties that are suitable for all three end uses, adapted for organic farming systems, and naked (hull-less) so that they can be threshed freely without the need for dehulling or pearling equipment.

Survey methods

In order to assess the current state of organic barley production, organic barley producers in the US were surveyed as part of the USDA-NIFA-OREI funded project 'Developing Multi-use Naked Barley for Organic Farming Systems'. Certified organic barley producers were identified through the USDA's Organic Integrity Database (USDA / AMS / NOP 2019) as of February 2019. The population was supplemented by adding participants from field days and other events related to the project, and producers who expressed interest in the project.

The online survey was designed for ease of response as part of a mixed mode for data collection that will also involve follow-up telephone interviews for more in-depth questions of a subsample of the population. (Dillman, Smyth, and Christian 2014). The survey was pre-tested by one barley producer in each of the USDA's Northeast, North Central and Western regions, as well as by project cooperators at Cornell University and Oregon State University. On February 11, 2019, a survey was sent by Qualtrics to 374 email addresses. Nine of these emails were returned and three were added on February 26 for an adjusted target audience of 368.

Multiple contacts were used to increase the response rate (Dillman, Smyth, and Christian 2014). Reminders were sent at 15, 32, and 46 days after the initial survey was sent. The survey was closed on April 1, 2019. A total of 84 full or partial responses were received for a 22.8% response rate. Of these, 81 active farmers responded. Two respondents were researchers with certified organic experimental land. One was no longer farming. These three responses were

excluded from the responses reported below. Summary statistics and charts were produced using Qualtrics and Excel. Statistical analyses were conducted using SAS University Edition, 2018.

Respondent Characteristics

All respondents had certified organic operations under the USDA’s National Organic Program. Of those, 69% were all organic and 31% were split operations growing both organic and non-organic crops. Among the split operations, ten grew only organic barley in the past three years, five grew both organic and non-organic barley and three grew no barley at all. Other crops besides barley were grown conventionally in these cases. Table 1 summarizes the average barley acreage and yield for total, organically produced, and naked barley. The large difference in average barley acreage between total and organic reflects the fact that two operations that produced an average of over 1,000 acres of non-organic barley over the past three years did not grow any organic barley. Two other operations planted over 500 acres more non-organic than organic barley. Respondents included 70 producers who reported that they had grown barley at least once in the past three years. Of those, 15 had grown naked barley over that period.

Table 1: Average Barley Acreage and Yield

Characteristic	Total	Organic	Naked
Average Barley Acreage	220	123	23
Average Barley Yield lb/A	3,031	2,961	2,037

As shown in Table 1, for those farms reporting barley production over a three-year period, acreage planted to barley averaged 220 acres, with a three-year average yield of 2,667 lb/A and an adjusted yield of 3,031 lb/A. Those growing naked barley planted an average of 23 acres over a three-year period, with an average yield of 2,207 lb/A. Some responses appeared to be reported in bushels per acre, so any response of under “150” was suppressed. The highest three-year average for naked barley planted by any one producer was 62 acres. The highest yield reported for organic naked barley was 5,500 lb/A.

Most farmers responding managed over 100 acres, with over 30% managing over 1,000 acres. Given the acreage required to grow cereal grains, the distribution showed that organic farms that produce barley are more likely to be larger than the national median sized organic farm. Figure 1 shows the distribution of the amount of crop land managed by the respondents.

Figure 1: How many total acres of crop land do you currently manage?

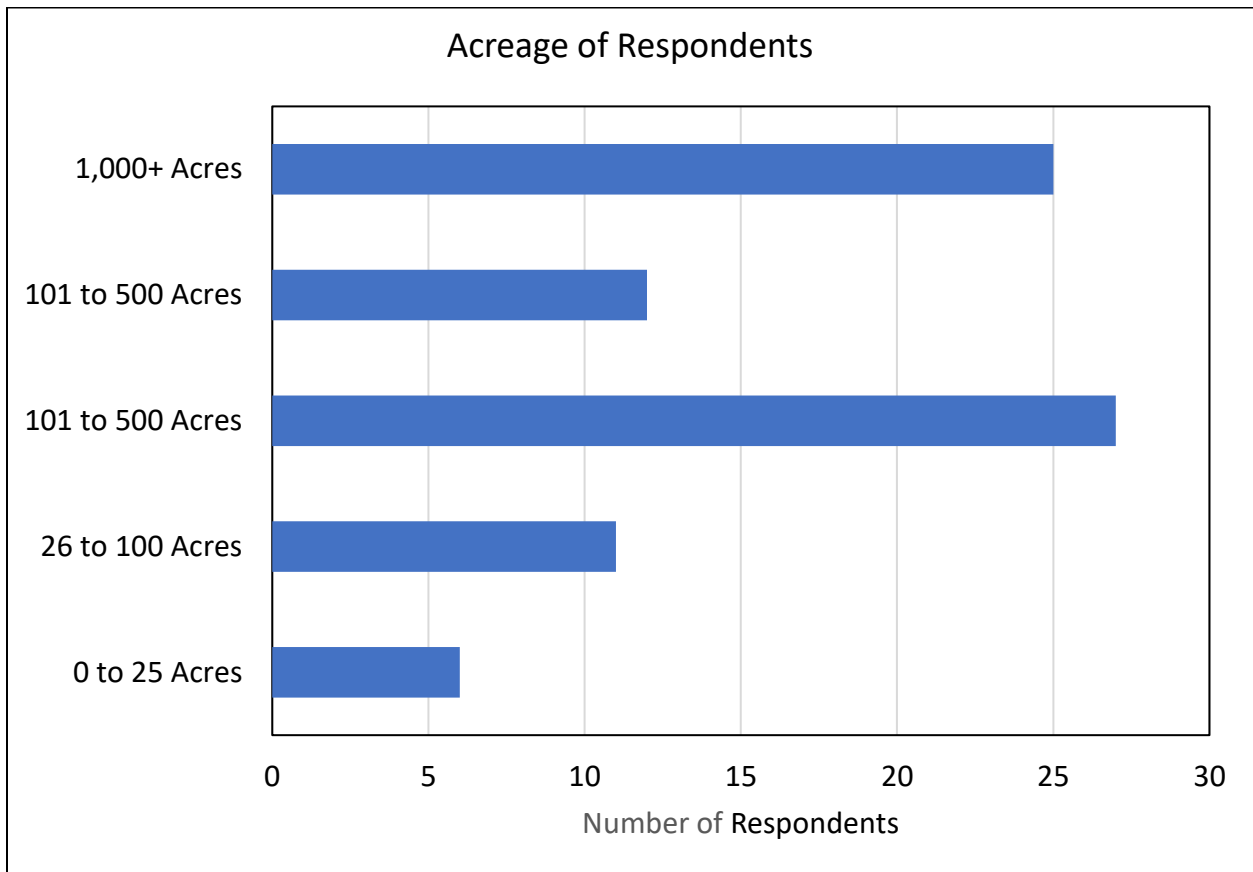


Figure 2 shows the geographical distribution of the survey respondents. Most respondents who answered the question were farming primarily in the Western region (43), as defined by USDA's National Institute of Food and Agriculture. California, Idaho, and Oregon each had nine producers respond. The second most-represented USDA region was North-Central (24), followed by the Northeast (14), and a few responses from the Southern region (3) as defined by the USDA.

Figure 2: Location of respondents



The distribution of income for organic barley producers responding was skewed towards higher income than the national census figures. For example, 75% of all US farms in 2017 reported farm income of less than \$50,000 compared with 19% of the respondents from this survey (USDA / NASS 2019). The median farm income of the respondents was between \$50,000-249,000. Figure 3 provides a distribution of the income categories of the respondents.

Figure 3: Average Annual Farm Income of Respondents (2016-2018)

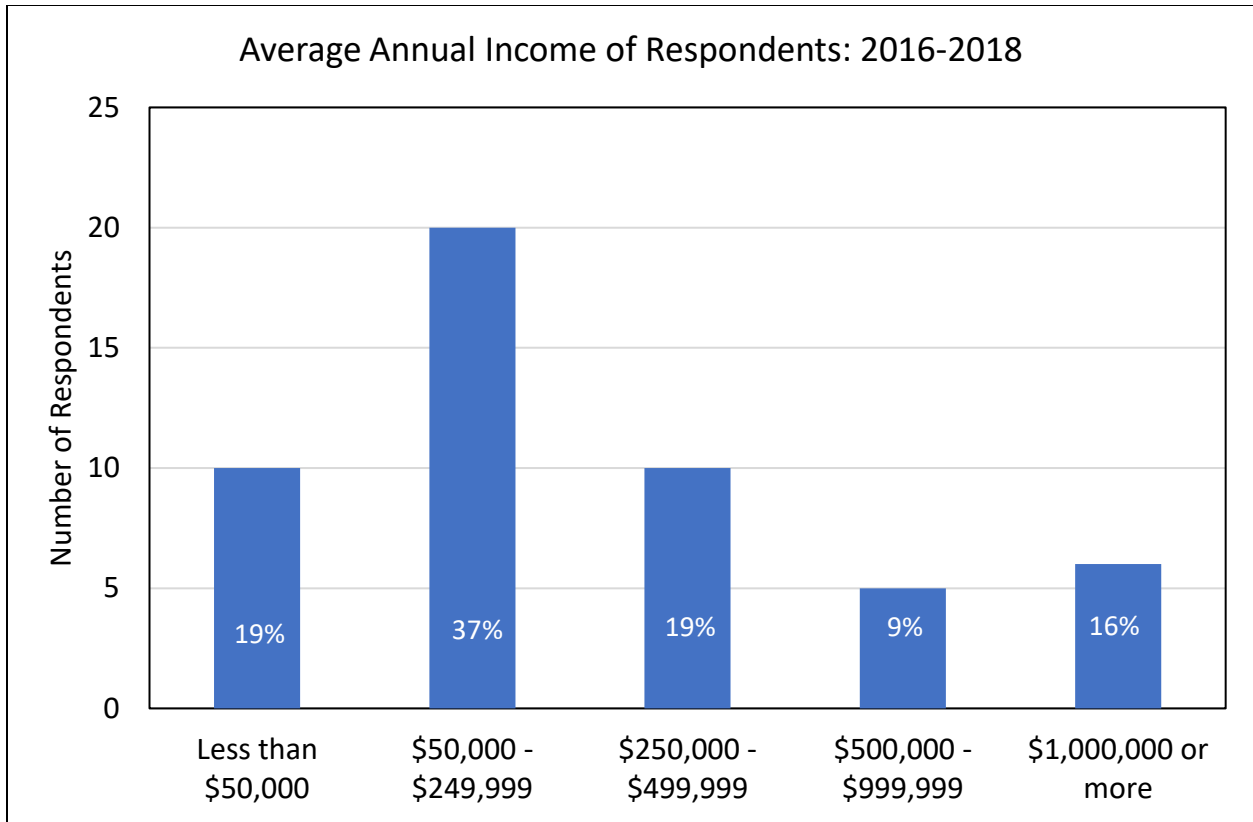


Figure 4 gives the reported primary uses of barley. The primary use of barley (61%) was for feed, with food and malting for beverages accounting for less than a third of the organic barley used. The remaining “other” was mostly production of seed. Of that, some of the producers indicated that they produce barley for on-farm use as feed or haylage and do not market it. It was not clear in some cases whether producers grew barley with the intention to sell into the feed market or that they sold it as feed because the higher value food, malting, and seed markets were not available to them due to quality issues. Most of the respondents indicated that they were willing to grow a multi-purpose barley suitable for malting, food and feed.

Figure 4: Primary Uses of Barley

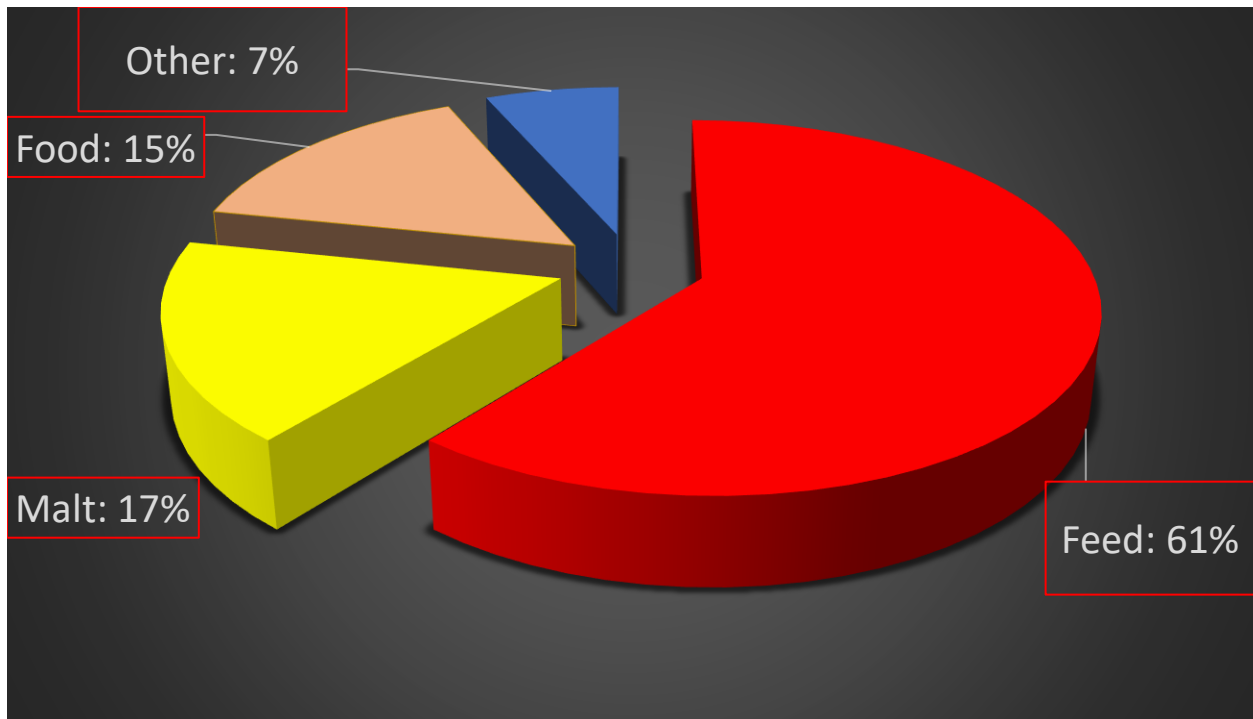
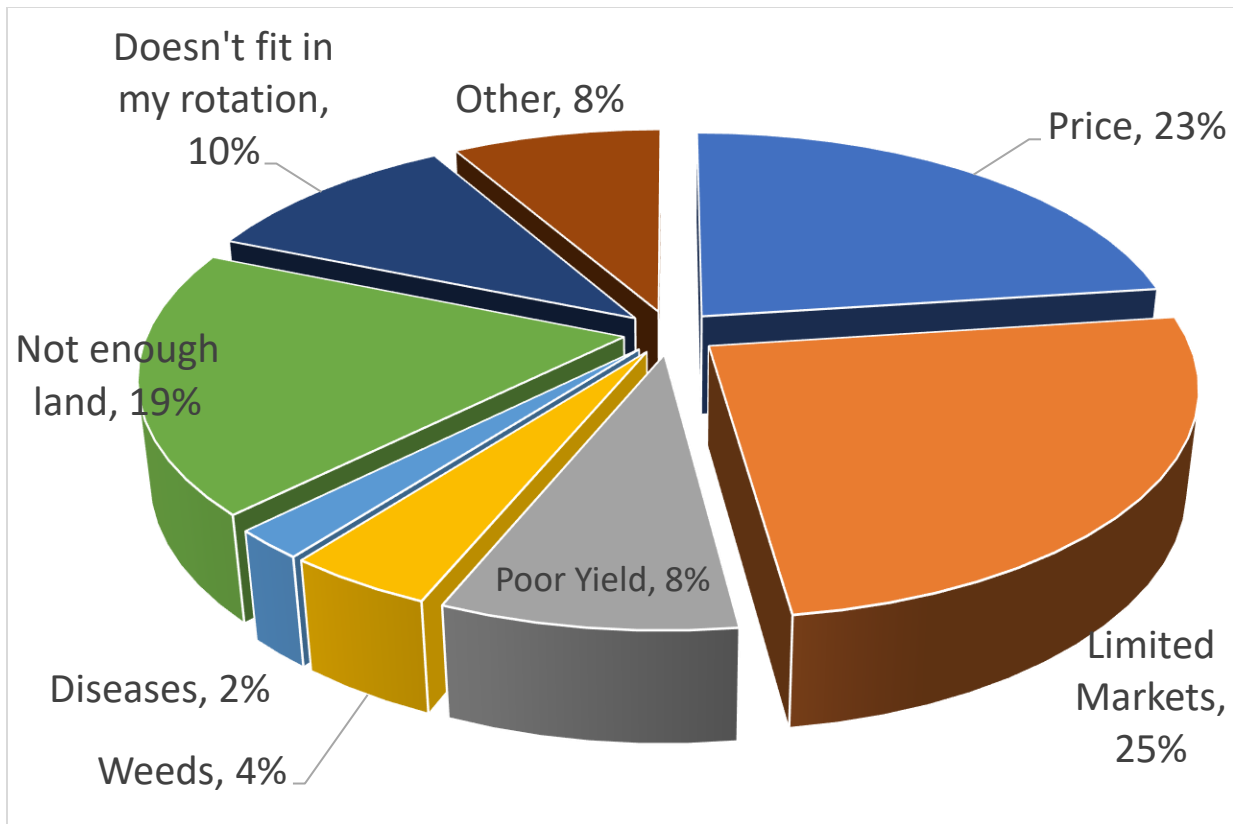


Figure 5 describes the main obstacles identified for the greater production of organic barley. The main obstacles to increasing barley acreage were more related to economic as opposed to agronomic issues. Limited markets and price were given as the main obstacles by nearly half of all respondents, followed by “not enough land” with 19% and “doesn’t fit in my rotation” by 10%. Less than 10% reported poor yield, weeds, or diseases as an obstacle, with no respondent giving insect pests. “Other” reasons given were also more often economic than agronomic. Producers reported lacking the equipment or having insufficient on-farm storage as obstacles.

Figure 5: Obstacles to Growing Barley



About 78% of all producers indicated that they received a premium for organic barley over the conventional (non-organic) commodity price. The average premium was 115%, but individual farms reported a wide range of variation from no premium to a four-fold (400%) premium over conventional. Segmenting the data into primary markets, those whose crop went mostly or exclusively to feed received an average premium of 97%. Some of those using barley exclusively for feed were livestock producers who used it on farm, sometimes in the form of haylage not harvested as mature grain. Those who were primarily malt producers received a premium of 131% on average. Those selling into the food market reported only a 68% average premium over non-organic. Seed producers reported a consistent premium of 120% over conventional.

Desired Traits

Table 2 describes the barley traits most desired by organic barley producers. Yield was the most desirable trait by a wide margin. Nearly half the producers responding made it the first priority, with 82% naming it as one of the top three. The second and third most desirable traits had strong regional preferences. Many western growers—particularly in California—said that varieties that had drought tolerance or a low irrigation requirement were a desirable for their systems. On the other hand, barley growers in the North Central and Northeast regions, as well as in some of the colder areas in the Intermountain West such as Montana and Colorado, named winter hardiness as a trait that they wanted to see improved. A producer in the Appalachian part of the Southern region also cited winter hardiness as a priority second to

yield, underscoring barley’s importance as an overwintering crop in organic farming systems throughout the US.

Competitiveness with weeds was either the second or third choice for nearly half the respondents and was selected in all regions. Disease resistance was a high priority for those producers who had problems with specific plant pathogens. Nutritional quality and early germination were also desired by over 10% of the respondents.

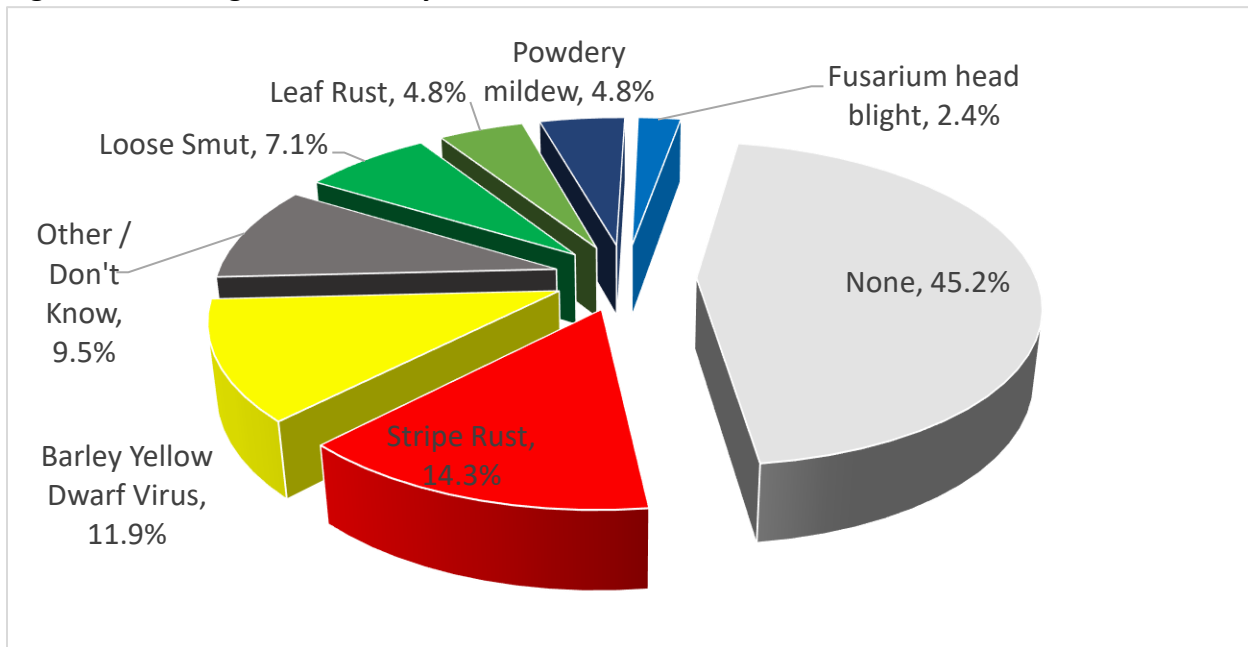
The following traits were named by fewer than 10% of the producers: malting quality, sensory quality, seed coat color, fiber content, and “Other”. Some of these may be a priority for maltsters, millers, retailers, and livestock producers. Several producers in the “Other” category specifically cited lodging as a problem that they hoped to have resolved by barley breeding.

Table 2: Barley Traits Ranked in Importance by Organic Producers

Weighted Rank	Trait	% 1st	%2nd	%3rd	Total %
1	Yield	48	24	10	82
2	Drought Tolerance	10	7	23	40
3	Winter Hardiness	8	21	15	44
4	Competitiveness with Weeds	2	19	20	41
5	Disease Resistance	8	10	10	28
7	Nutritional Quality	8	5	3	16
8	Early Germination	2	5	10	17

Regional differences were pronounced with secondary priorities. Drought tolerance/low irrigation requirements was the second highest priority for the Western region, with 61% of producers in the region saying it was a priority and 19% saying it was the top priority. None of the producers in the other regions made it a top priority, and no respondent in the Northeast or Southern regions put it in their top three. Winter hardiness was the second most important trait for selection to producers in the North Central region, with 29% making it their top priority. For the Northeast region, resistance to disease was the second priority, with a third making it their top priority and over 50% saying it was one of the top three. Winter hardiness was the third ranked trait for the Northeast region. In the West, winter hardiness was ranked sixth, and was no producer’s top priority. Competitiveness with weeds was third ranked in the Western and North Central regions. The Southern region was notable for its low response rate and singular focus on yield.

Figure 6: Most Significant Barley Diseases



Powdery mildew and loose smut were the most significant diseases reported in the Northeast, but these were not seen as major problems in the other regions. Stripe rust was the most important disease reported in the North Central region and tied with barley yellow dwarf virus for being the disease of greatest concern in the Western region. While leaf rust was not the most important disease in any region, it was the most common pathogen reported as the second and third most significant disease on a national basis. As a result, it had a higher weighted score than any other pathogen.

Naked Barley

Nearly 25% of the respondents had grown naked barley in the past three years. Average plantings were significantly smaller, with the average being 22.5 acres. Yields were also lower, with an average yield \ of 2,037 lb/A. Producers were also asked about the obstacles to growing naked barley. When asked why they did not grow (more) naked barley, half the respondents chose a reason other than was provided in the list of potential obstacles. Many indicated that they had no experience or knowledge of naked barley, so they were unable to answer the question.

Among those who had grown or were aware of naked barley, the primary obstacle was access to seed. Yield was the second greatest obstacle. Other reasons given were lack of winter hardiness, no or inadequate premium above what is paid for hulled varieties, and the lack of dedicated storage capacity. Two producers commented that seed sold as naked barley will produce grain that does not completely free-thresh.

Despite the obstacles identified, most of the respondents (55%) said they would be willing to grow a multi-purpose naked barley suitable for malting, food, and feed. Another 42% said they may be willing to grow it.

Varieties

Most producers did not declare what varieties they planted. About half who responded said that they planted seed from “variety not stated” or VNS. The most popular named variety was ‘CDC Copeland’. This was followed by a virtual tie between ‘Baronesse’, ‘Criton’, and ‘Quest’. Thoroughbred was the next most popular named variety followed by ‘Millennium’ and ‘Stockford’. ‘Streaker’ and ‘Transit’ were the leading naked barley varieties listed, followed by ‘Julie’ and ‘Tamalpais’.

Note on Demographics and Respondent Bias

The respondents were overwhelmingly (95%) male, with three female producers responding, which was higher than the 2017 USDA Census of Agriculture figure of 71% male principal producers (USDA / NASS 2019). Most respondents were over 55, with the median age bracket being 56-65. The distribution was consistent with census figures and a principal producer average age of 58.6 (USDA / NASS 2019). Over half had a college, advanced, or professional degree as the highest level of education. The on-line only survey may have biased responses towards better educated farmers who are more likely to adopt technologies such as the internet.

Conclusion and Follow-up

Organic producers see the value of barley as a crop in their rotation and see the potential to expand production. However, the main reasons that more organic barley is not grown were stated as market conditions, lack of demand, and low price and profit margin compared with other crops in rotation. Yield was by far the most important trait for organic producers. Diseases and weeds were not considered significant obstacles to most farmers, but disease resistance and competitiveness with weeds were identified as secondary priorities to overall yield.

The shortage of organic feed and the demand for organic grain for livestock production is a strong driver of demand in the short-run. Malting and food-grade barley processing capacity is limited; these markets are not able to pay a reliable premium to organic farmers at the present time. The organic feed market is the easiest to meet in terms of quality criteria and market access. However, price volatility may be expected due to continued instability in the organic dairy market. Growing a premium quality organic malting barley under contract offers a more attractive price and return. Demand is expected to increase with an expansion in the certified organic beer market. Organic food barley processing capacity exists and is growing; the challenge is to increase demand. Export opportunities to Japan are particularly encouraging. The current organic feed, malt, and food markets are constrained by the dichotomy between

the hulled varieties used for feed and malt vs. naked varieties used for food. Most farmers surveyed are supportive of the development of a multi-use naked barley and are interested in growing it or at least learning more. However, there is a lack of knowledge about naked barley and its advantages.

Forty-five respondents provided their names and contact information for a follow-up interview. The response was more than double the target of twenty. Interviewees will be providing more detailed information on production practices and barriers to expanded barley production. The interviews will also follow up with questions to determine any respondent bias. Follow-up work will be done on the relative economic and ecological advantages and disadvantages of naked barleys based on data gathered in the interview and from secondary sources.

The results from this survey will allow researchers to determine breeding priorities for organic naked barley and develop new varieties suited to the needs of organic producers.

References

- Dillman, Don A, Jolene D Smyth, and Leah Melani Christian. 2014. *Internet, Phone, Mail, and Mixed-Mode Surveys: The Tailored Design Method*. New York, NY: Wiley.
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- USDA / AMS / NOP. 2019. "USDA Organic Integrity Database." <https://organic.ams.usda.gov/integrity/>.
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Appendix 1: Survey Questions

Hello,

You are receiving this survey because you attended an event or otherwise indicated that you were interested in organic barley. The survey is being conducted as part of a USDA-funded project to develop multi-use naked barley suitable for organic farming, food, and beverage systems. We greatly appreciate your feedback. The survey is expected to take 5-15 minutes to complete. Your individual response will be anonymous unless you choose to identify yourself. Your responses to individual questions will be kept confidential and reported as aggregated with other responses so they will not be identifiable as yours.

Click the → button to get started!

Q1 Are you currently farming?

- Yes (1)
- No (3)

Skip To: End of Survey If Are you currently farming? = No

Q2 How many total acres of crop land do you currently manage?

- 0 to 25 Acres (3)
- 26 to 100 Acres (4)
- 101 to 500 Acres (5)
- 501 to 1,000 Acres (6)
- 1,000+ Acres (7)

Q3 Have you grown barley in the past three years?

- Yes (1)
- No (2)

Skip To: Q4 If Have you grown barley in the past three years? = Yes

Skip To: Q16 If Have you grown barley in the past three years? = No

Q4 How many acres have been planted to barley on average over the past three years?

Acres (2) _____

Q5 What has been your average barley yield in pounds per acre over the past three years?

Lb / A (6) _____

Q6 What were the main varieties of barley planted in the past three years? Please rank the drag-and-drop boxes in order of planted area (1=most, 3=least).

_____ Variety 1 (1)

_____ Variety 2 (2)

_____ Variety 3 (3)

Q7 Have you grown *naked (hull-less)* barley in the past three years?

Yes (1)

No (2)

Skip To: Q8 If Have you grown *naked (hull-less)* barley in the past three years? = Yes

Skip To: Q10 If Have you grown *naked (hull-less)* barley in the past three years? = No

Q8 How many acres have been planted to *naked (hull-less)* barley on average over the past three years?

Acres (4) _____

Q9 What has been your average *naked (hull-less)* barley yield in pounds per acre over the past three years?

Lb / A (4) _____

Q10 Which of the following best describes the organic status of your operation?

- Some or all of it is managed organically and certified organic (1)
- Some or all is managed organically but not certified (2)
- Some or all is in transition but does not qualify for organic certification (3)
- None of it is managed organically (4)

Skip To: Q11 If Which of the following best describes the organic status of your operation? = Some or all of it is managed organically and certified organic

Skip To: Q15 If Which of the following best describes the organic status of your operation? = Some or all is managed organically but not certified

Skip To: Q15 If Which of the following best describes the organic status of your operation? = Some or all is in transition but does not qualify for organic certification

Skip To: Q15 If Which of the following best describes the organic status of your operation? = None of it is managed organically

Q11 What percentage of your acreage managed is *certified organic*?

Percent Acres Certified Organic (4)

Skip To: Q13 If What percentage of your acreage managed is certified organic? = Percent Acres Certified Organic

Skip To: Q12 If What percentage of your acreage managed is certified organic? < Percent Acres Certified Organic

Q12 How many acres of barley have you grown *organically* on average over the past three years?

Acres (1) _____

Q13 What was your average yield of *organically grown* barley in pounds per acre over the past three years?

Lb / A (1) _____

Q13 Do you receive a premium for *organic* barley above the conventional price?

Yes (1)

No (2)

Q14 If yes, what has been the average percentage premium paid for *organic* barley above the conventional price over the past three years?

Percent (2) _____

Q15 What diseases are most problematic for production? (Please Rank up to 3 with 1 as the most problematic)

- _____ Don't know / haven't grown barley (1)
- _____ None (2)
- _____ Stripe rust (3)
- _____ Leaf rust (4)
- _____ Scald (5)
- _____ Powdery mildew (6)
- _____ Loose smut (7)
- _____ Covered smut (8)
- _____ Barley yellow dwarf virus (9)
- _____ Net blotch (10)
- _____ Spot blotch (11)
- _____ Fusarium head blight (12)
- _____ Other (please explain) (13)

Q16 What are the main obstacles to growing (more) barley? (Please Rank up to 3 with 1 being the biggest obstacle)

- _____ Price (1)
- _____ Limited Markets (2)
- _____ Poor yield (3)
- _____ Weeds (4)
- _____ Diseases (5)
- _____ Insects (6)
- _____ Lack of equipment (7)
- _____ Not enough land (8)
- _____ Doesn't fit in my rotation (9)
- _____ Insufficient on-farm storage (10)
- _____ Other (please explain) (11)

Q17 What obstacles do you face that are specific to naked barley? (Please Rank up to 3 with 1 being the biggest obstacle)

- _____ Germination (1)
- _____ Emergence (2)
- _____ Access to seed (3)
- _____ Threshability (4)

_____ Ability to harvest without damaging seed (5)

_____ Yield (6)

_____ Other (please explain) (7)

Q18 What traits or characteristics of barley are you most interested in seeing improved?
(Please Rank up to 3 with 1 being the most important trait or characteristic)

_____ Yield (1)

_____ Sensory quality (2)

_____ Malting quality (3)

_____ Nutritional value (4)

_____ Fiber content (5)

_____ Seed Coat Color (6)

_____ Competitiveness against weeds (7)

_____ Resistance to diseases (8)

_____ Early germination and vigor (9)

_____ Drought tolerance / low irrigation requirements (10)

_____ Adapted for organic fertilization (11)

_____ Winter hardiness (12)

_____ Other (specify other) (13)

Q19 What are the primary intended end-uses of the barley you produce? Please rank the drag-and-drop boxes with 1 as the most important and 4 as the least important.

_____ Feed (1)

_____ Malt (2)

_____ Food (3)

_____ Other (please explain) (4)

Q20 Would you be willing to grow a multi-purpose barley suitable for malting, food, and feed?

Yes (1)

Maybe / Need to know more (2)

No (3)

Q21 What is your age?

- 18-35 (4)
- 36-45 (5)
- 46-55 (6)
- 56-65 (7)
- 66+ (8)

Q22 What is your gender?

- Male (1)
- Female (2)

Q23 What is your educational level?

- High school (2)
- High school graduate (3)
- College (4)
- College graduate (5)
- Graduate / Professional School (6)
- Advanced degree (7)

Q24 What has been your average annual gross farm income over the past three years?

- Less than \$50,000 (1)
- \$50,000 - \$249,999 (2)

\$250,000 - \$499,999 (3)

\$500,000 - \$999,999 (4)

\$1,000,000 or more (5)

Q25 In what state is your farming operation (primarily) located?

State: (1) _____

Q26 Would you be willing to share information about barley production with the researchers working on the project? If you sign up, we will send you a free sample of barley seed.

Yes (1)

No (2)

Skip To: Q25 If Would you be willing to share information about barley production with the researchers working on... = Yes

Skip To: End of Survey If Would you be willing to share information about barley production with the researchers working on... = No

Q27 If Yes, Please provide your name and contact information.

Name (1) _____

Email (2) _____

Phone (3) _____

Address (4) _____

Address 2 (5) _____

City (6) _____

State (7) _____

Zip / Postal code (8) _____

Country (9) _____