

# Examination of organic grain productivity to support the Upper Peninsula organic livestock industry

## Project Summary

The Upper Peninsula of Michigan is experiencing an agricultural renaissance, which is being fueled by a new generation of farmers wanting to return to the land. Although many of these operations would be considered small in scale, they are often direct to market enterprises managed within an organic system. Furthermore, many operations contain stacked enterprises, integrating both crop and livestock production. As consumers continue to drive preferences within the marketplace, the demand for natural or organically produced meat has greatly increased, but no such grain market exists within the region to support this expanding industry. Organic grain production is virtually non-existent in the U.P., and sourcing outside of the region is quite costly and limits the growth potential for these operations – especially those wanting to market as certified organic. This project was led by a team of researchers and Extension Educators from Michigan State University whose goal was to develop a framework of research and knowledge of organic grain systems in the region, and to determine the market potential for farm adoption. This was achieved through both variety and crop management research, identification of need and marketing opportunities, and finally, dissemination of findings through field days and outreach materials. Research was hosted at an on-farm cooperator site, [Guindon Farms](#) (Cornell, MI) and at the [MSU Upper Peninsula Research and Extension Center North Farm](#) – a farm incubator focusing on sustainable farm development in the region (Chatham, MI). Generally, the research was successful and fruitful. Multiple outreach opportunities provided for greater engagement in the targeted community and the reception was overall very positive. The work certainly sparked curiosity and interest in organic grain production for the direct market. We hope this research will spur additional acreage of organic small grain in the U.P. to fill the documented need.

## Introduction to the topic

The Upper Peninsula (U.P.) of Michigan is a unique region and has a rich culture rooted in agriculture and natural resources. The population of the U.P. is 3.2% of Michigan's total spread over 29% of Michigan's land area. The northern latitude of the U.P. presents challenges for agriculture and related food systems. Additionally, significant regions of the U.P. are "food deserts" as defined by the USDA. The combination of being rural, remote, and food insecure has fueled a movement of new farmers working to strengthen and bring resiliency to the local food system. Much success has been gained in the area of vegetable production, as this new community of farmers has embraced season extension technologies and seasonal marketing strategies to deliver fresh produce into communities throughout the year. As these operations expand and diversify, many are branching into livestock – predominantly poultry and pork. Wanting to maintain a similar growing ethic as they do with their vegetable crop, these farmers seek out organic grain to feed their animals, but quickly find the supply is slim and comes at a high cost.

Through examination of this problem, it became evident that virtually no certified organic grain operations existed in the U.P. outside of one farm in Delta County. In fact, certified organic land is extremely limited throughout the entire region even though many farms and operations tout using either natural or organic practices. The lack of land is certainly a challenge, but so too is the lack of knowledge in

growing organic grains in the U.P., which experiences a very narrow growing season. In 2014, UPREC conducted variety trials on a wide variety of grains to better understand the opportunities and limitations each crop posed. Although managed conventionally, much success was achieved, which influenced many farmers to reconsider crops they once thought impossible to grow in this climate. A similar investigation was necessary using organic practices so that these crops can be vetted before variety and management recommendations can be made to farmers. Although many area farmers have inquired to MSU about organic livestock feed, research like this has not been conducted in Michigan before.

## Objectives Statement

The research objectives of this proposal were developed to answer whether or not organic grain production for use in livestock feed is feasible in the U.P. of Michigan and, if so, what are the recommended best management practices. It is understood that trial replication over multiple years is needed to draw conclusions, so this proposal focused only on the first year of work.

1. Establish organic grain variety and fertility trials at two locations (Guindon Farm, Delta County; The North Farm, Alger County)
  - a. Evaluate up to six varieties of each crop (barley, oats, corn), in a replicated trial
  - b. Conduct separate nitrogen fertility trials on barley and oats to determine the optimum N rate to maximize yield and profit
  - c. Collect data (lodging, disease, pest, fertility, yield, quality)
  - d. Demonstrate weed management tools at the field plots
  - e. Develop outreach tools – reports, field days, etc.

Two variety trials were established at the listed locations above, although only four varieties of barley and oats were grown due to available organic seed supply. Future planned trials intend to include other non-organic seed when the organic form is not available. Four corn varieties were planted twice with two failures due to bird depredation. Our region has a scattered pattern of agriculture and Sandhill cranes predate our agricultural plots frequently. Typically, in conventional systems this is handled with seed treatment, however that is not allowed in the organic system. The decision was not to plan a third time due to the unlikelihood of success, especially at the late date. The weed management trial was done with one variety of oats and the fertility trial was done with one variety of barley.

2. Develop cost of production document and investigate market demand and potential
  - a. Work with established organic grain grower (Rossman) to determine cost of production specific to the U.P. region
  - b. Utilize a summer intern to study and report supply and demand of organic grains
  - c. Incorporate resource pieces into research report and field day activities

The cost of production guide was produced; however, the team was unsuccessful in hiring a summer intern to complete the market survey. An informal survey was accomplished instead. Three field-days featured the research with results reported at two different conferences. Communication pieces are being developed, but the team opted to include one more year of research (established in 2018 and supported by other grant funds) before finalizing.

The above objectives all link to the support of organic grain production in the region by gaining agronomic understanding of the crops, establishing a framework for continued funding, and increasing the financial

literacy of the current and future market. The results from this work will inform organic farmers on the opportunities and challenges with organic grain production. For those that opt to integrate grains into their operation, optimum crops, varieties and management strategies will have been identified to improve successful cultivation.

## Materials and Methods

Research trials were established at two different locations – the MSU North Farm (Alger County, MI) and the Guindon Farm (Delta County, MI). Both operations are certified organic.

### North Farm Variety Trials

- Planted April 25<sup>th</sup> – small-scale research plot design with replication
- Plot area rototilled twice and cultipacked
- 300 lbs/acre Midwestern BioAg (4-1-11) top-dressed Feekes stage 7
- Corn planted twice, both lost due to bird depredation
- Each of the plots were challenged by weeds and lodging and experienced a cool, wet season that led to high moisture at harvest
- Oats
  - Seeding rate 96 lbs/acre
  - Harvested August 29<sup>th</sup>
  - Varieties: Betagene, Deon, Shelby 427, Streaker (hull-less)
- Barley
  - Seeding rate 120 lbs/acre
  - Harvested August 14<sup>th</sup>
  - Varieties: Quest, Robust, Conlon, Pinnacle

### North Farm Management Trials

Weed management trial with oats – small-scale research plot design with replication

- Test 5 treatments + control with Oats
  - Mechanical weed management
  - Underseeding Alsike clover
  - Underseeding Red clover
  - Underseeding Yellow blossom sweet clover
  - Plowdown (3-clover mix)
- Plot had to be replanted 5/23 due to poor emergence (also increased seeding rate)
- Tine weeder used on June 13<sup>th</sup>, oats Feekes stage 4.5, ran both directions
- Harvested September 12<sup>th</sup>
- Yellow clover treatment most difficult to harvest due to excessive green plant material

Fertility management trial with barley – small-scale research plot design with replication

- Test 2 treatments + control with Barley
  - Compost
  - Midwestern BioAg
- Planted on May 26<sup>th</sup>

- Compost and fertilizer spread and incorporated on June 1st – barley just starting to emerge
- Compost – screened, 3.5 lbs/plot applied by hand
- BioAg – 300 lbs/acre (4-1-11) with Gandy drop spreader
- Used tine weeder on June 13<sup>th</sup>
- No visual differences amongst treatments throughout growing season or at harvest
- Harvested September 12<sup>th</sup>

The North Farm trials are being replicated in 2018 to further inform recommendations and an organic grain publication. We greatly increased the number of oat varieties by sourcing conventional, untreated seed.

#### Guindon On-farm Trials

To improve weed management in organic production, we investigated using related species of fescue to suppress annual weeds. The underseeding then provides a forage for the following season. The replicated plots were planted using the cooperators equipment, maintaining production scale. A hullless oat variety, Streaker, was chosen to investigate the feasibility of growing hullless oats in northern climates. In the same field, a traditional variety, Deon, was also grown with a mixed legume/grass underseeding. Treatments consisted of Streaker planted with an underseeding of timothy, alfalfa and a fescue (Swaj, Minto or Perun).

- Streaker oats used in all treatments – 110 lbs/ac
- Planted May 11<sup>th</sup> at the following seeding rates (each treatment included a fescue with the timothy-alfalfa combination)
  - Tall fescue (Swaj) – 5 lbs/ac
  - Timothy (Climax) – 3 lbs/ac
  - Meadow fescue (Minto) – 4 lbs/ac
  - Festulolium (Perun) – 9 lbs/ac
  - Alfalfa (Viking) – 6 lbs/ac
- Treatment combinations:
  - Perun/Climax/Viking
  - Minto/Climax/Viking
  - Swaj/Climax/Viking
- Weed pressure rated July 7<sup>th</sup>
- Oats seemed to out-compete under-seeded grasses
- Alfalfa success directly correlated to weed suppression

A statistical AOV analysis was ran using ARM software for the 2017 data.

North Farm Plot Map (variety trials)

row	range				
	1	2	3	4	
1	Oats Border	Oats Border	Oats Border	Oats Border	oat var trial
	Betagene	Streaker	Shelby 427	Deon	
	Deon	Shelby 427	Streaker	Betagene	
	Betagene	Deon	Shelby 427	Streaker	
2	Oats Border	Oats Border	Oats Border	Oats Border	oat var trial
	Shelby 427	Streaker	Betagene	Deon	
	Deon	Shelby 427	Streaker	Betagene	
	Betagene	Deon	Shelby 427	Streaker	
3	Oats Border	Oats Border	Oats Border	Oats Border	oat var trial
	Shelby 427	Streaker	Betagene	Deon	
	Deon	Shelby 427	Streaker	Betagene	
	Betagene	Deon	Shelby 427	Streaker	
4	Oats Border	Oats Border	Oats Border	Oats Border	oat var trial
	Barley Border	Barley Border	Barley Border	Barley Border	
	Pinnacle	Robust	Conlon	Quest	
	Quest	Conlon	Robust	Pinnacle	
5	Oats Border	Oats Border	Oats Border	Oats Border	barley var trial
	Barley Border	Barley Border	Barley Border	Barley Border	
	Pinnacle	Robust	Conlon	Quest	
	Quest	Conlon	Robust	Pinnacle	
6	Oats Border	Oats Border	Oats Border	Oats Border	barley var trial
	Barley Border	Barley Border	Barley Border	Barley Border	
	Pinnacle	Robust	Conlon	Quest	
	Quest	Conlon	Robust	Pinnacle	
7	Oats Border	Oats Border	Oats Border	Oats Border	barley var trial
	Barley Border	Barley Border	Barley Border	Barley Border	
	Pinnacle	Robust	Conlon	Quest	
	Quest	Conlon	Robust	Pinnacle	
8	Oats Border	Oats Border	Oats Border	Oats Border	barley var trial
	Barley Border	Barley Border	Barley Border	Barley Border	
	Pinnacle	Robust	Conlon	Quest	
	Quest	Conlon	Robust	Pinnacle	

North Farm Plot Map (management trials)

Barley Border	Barley Border	Barley Border	Barley Border
3	4	2	7
6	5	8	1
5	1	6	8
3	7	4	2
5	1	2	7
4	6	8	3
8	2	3	4
1	5	7	6
Oats B	Oats B	Oats B	Oats B
Barley B	Barley B	Barley B	Barley B
1	3	2	FILL
3	2	1	FILL
2	1	3	FILL
1	2	3	FILL
Barley B	Barley B	Barley B	Barley B

weed mgt trial  
 weed mgt trial  
 weed mgt trial  
 weed mgt trial  
 weed mgt trial  
 weed mgt trial  
 weed mgt trial  
 weed mgt trial

Fertility trial  
 Fertility trial  
 Fertility trial  
 Fertility trial

Weed mgt ID

Trt #	TRT
1	Control
2	Mechanical
3	Oats/Alsike
4	Oats/Red clover
5	Oats/Yellow blossom sc
6	Oats/Plowdown
7	FILL
8	FILL

Fertility Mgt ID

1=Control
2=Compost
3=BIO-AG

Guindon Plot Map

Plot Map								
Perun/Climax/Viking	Minto/Climax/Viking	Swaj/Climax/Viking	Minto/Climax/Viking	Swaj/Climax/Viking	Perun/Climax/Viking	Swaj/Climax/Viking	Perun/Climax/Viking	Minto/Climax/Viking
101	102	103	201	202	203	301	302	303

## Project Results

### Organic oat variety results

Variety	Betagene	Streaker	Shelby 427	Deon
Yield (bu/acre)	96 <sup>a</sup>	42 <sup>b</sup>	90 <sup>a</sup>	101 <sup>a</sup>
% Moisture	16.9	17.7	17.3	15.5
Test Weight (lbs/bu)	38	50	39	40
% Crude Protein	11.3 <sup>b</sup>	14.3 <sup>a</sup>	11.6 <sup>b</sup>	11.3 <sup>b</sup>
DON (ppm)	<0.03	<0.03	<0.03	<0.03
Lodging	5	9	9	3
Height (in)	36	36	36	47
Heading Date	7/10/2017	7/10/2017	7/10/2017	7/13/2017

<sup>a, b</sup> Statistical significance across varieties with different letters

	Bu/ac	% H2O	TW (lbs/bu)	% Crude protein
<b>LSD P=0.5</b>	30.5	2.3	8.8	0.5
<b>Standard Deviation</b>	19	1.4	5.5	0.3
<b>CV</b>	23.2	8.7	13	2.76
<b>Grand Mean</b>	82	16.8	42.3	12.1

Robust the nicest to harvest. Tall, somewhat erect. Then followed by Quest. Pinacple and Conlon severely lodged. Held up by broadleaves and quackgrass. Predominate weeds-quackgrass, lambsquarters, then bindweed. Bindweed the worst-hard to harvest, wrapped around the entire plot area, then wrapped around combine reel.

Rated for lodging on a 1-9 scale. 1=0-10, 9=90-100% lodged.

Organic barley variety results

Variety	Pinnacle	Robust	Conlon	Quest
Yield (bu/acre)	15 <sup>d</sup>	57 <sup>a</sup>	28 <sup>c</sup>	46 <sup>b</sup>
% Moisture	16.6	15.7	15.9	15.4
Test Weight (lbs/bu)	46	49	51	49
% Crude Protein	11.4	12.1	11.6	11.5
DON (ppm)	<0.03	<0.03	<0.03	<0.03
Lodging Height (in)	9	4	9	6
Heading Date	6/30/2017	6/28/2017	6/30/2017	6/28/2017

a, b, c, d Statistical significance across varieties with different letters

	Bu/ac	% H2O	TW (lbs/bu)	% Crude protein
<b>LSD P=0.5</b>	11	0.6	1.6	0.7
<b>Standard Deviation</b>	6.9	0.3	1	0.4
<b>CV</b>	19.1	2.2	2.1	4
<b>Grand Mean</b>	36.2	15.9	48.4	11.7

Deon impressive. Streaker not. Streaker totally lodged, along with Shelby 427. Deon would be the pick out of the four for an organic system. Main weeds same as barley. Grass a big issue, along with green lambsquarter seed in the sample.

Rated for lodging on a 1-9 scale. 1=0-10, 9=90-100% lodged.



Organic oat weed management trial

Treatment	Oat/Legume Seeding Rate (lbs/acre)	% Weed infestation	Lodging	Yield (bu/acre)
Control	96/NA	2	3	71
Mechanical	96/NA	3	3	66
Oats/Alsike Clover	96/6	4	4	70
Oats/Red Clover	96/8	2	4	68
Oats/Yellow Blossom Sweet Clover	96/10	2	4	76
Oats/Plowdown	96/10	4	4	68
			LSD P=0.5	16.4
			Standard Deviation	10.9
			CV	15.6
			Grand Mean	69.6

Tine weeder used 6-13-17 at crop stage feekes 4.5. Tine weeded in both directions-due north, then due south. Learned that when using tine weeder it is imperative to go in both directions, as it aids in weed removal. Crop was in the correct stage for using tine weeder, in the oat variety trial the growth stage was feekes stage 7, which was too advanced for the tine weeder, as it plucked out some of the oat plants. The trick for the tine weeder is the proper plant growth stage for both the crop and the weeds. Also need to run the tines aggressively, along with a higher mph (6-7). Just don't look back. Best time is when the weeds are in the early stages of growth. Recommendation would be using tine weeder as needed up to feekes stage 7. Soil also needs to be at field capacity for best results-excessive soil moisture likely contributed to uprooting of more advanced oat plants.

Rated for lodging on a 1-9 scale. 1=0-10, 9=90-100% lodged.

Main weed species present at time of rating were lambsquarters, redroot pigweed and quackgrass.

The yellow sweet blossom treatment was the hardest to harvest, due to the growth of the sweet clover. Had to drive the combine extremely slow throughout that treatment, as there was a large amount of green material running through the combine, which it didn't like. Sweet clover and red clover seemed to do the best job in weed suppression, but I would recommend using red over sweet due to harvest difficulty. Also noted was the effect green lambsquarter seed has on the harvested grain-it keeps the moisture at an undesirable level and also heats the grain. Even

though lambsquarter pressure was minimal, the green seeds played an adverse role with respect to overall grain moisture and temperatures. This may be mitigated with an aerated grain bin that has adequate airflow.

#### Organic barley fertility management trial

Treatment	Yield (bu/acre)	% Moisture	Test Weight (lbs/bu)	% Crude Protein
Control	53	14.4	47	12.3
Compost	55	14.4	47	12.5
Midwestern BioAg	59	14.2	47.5	12.0
LSD P=0.5	10.4	0.3	0.3	0.69
Standard Deviation	6	0.17	0.22	0.4
CV	10.8	1.21	0.47	3.2
Grand Mean	55.5	14.3	47.7	12.3

#### Guindon on-farm organic oat underseeding trial

Treatment	ID	Rep	plot wt	% moisture	TW (lbs/bu)	bu/ac	bu/ac @ 13.5%
Deon	D1	1	2.76	14.2	42.8	47.0	47.1
Deon	D2	2	3.07	13.8	42.1	52.2	52.2
Deon	D3	3	3.02	14	41.9	51.4	51.4
Streaker/Perun	G101	1	2.67	13.9	53.8	20.2	20.2
Streaker/Minto	G102	1	2.33	14.1	53.7	17.6	17.6
Streaker/Swaj	G103	1	3.28	14.1	54.7	24.8	24.7
Streaker/Minto	G201	2	2.58	14.2	54.5	19.5	19.5
Streaker/Swaj	G202	2	2.5	14.2	55.9	18.9	18.9
Streaker/Perun	G203	2	1.9	14	51.1	14.4	14.3
Streaker/Swaj	G301	3	1.81	14.2	53.3	13.7	13.7
Streaker/Perun	G302	3	1.59	14.1	54.9	12.0	12.0
Streaker/Minto	G303	3	1.17	14.3	51.6	8.8	10.3

## Conclusions and discussion

The various organic grain trials that were managed under this project were a tremendous learning experience for the project team who had very little experience growing grains in an organic system. Although it was clear what varieties did not perform well in this system, further investigation is needed with additional varieties. That data was inconclusive on the weed management trial, but lessons learned in 2017 will make the 2018 trial more robust. Early planting is key, along with tine weeding at appropriate crop stage. A more detailed investigation

is also needed for fertility recommendations. If nothing else, this research sparked a lot of discussion about the opportunity for organic small grains and a lot of farmers got to interact with the trial and researchers through the various field days. I believe we will see an increase in farmers experimenting themselves with organic grain and the continued research in 2018 will support that.

At the Guindon trial, hullless oats yielded poorly regardless of the fescue variety used, averaging 16 bushels per acre compared to the average Deon yield of 50.3 bushels per acre. Although weed management was achieved, none of the fescue varieties performed better. It was observed that greater population of alfalfa resulted in a decrease in weed population. With respect to stalk strength and kernel retention, the Streaker variety performed poorly in the 2017 growing season. Although oats did a fantastic job of suppressing weeds, and throughout the duration of the trial the team's opinion on their effectiveness evolved, by November it was clear that in the treatments where oats were used, the forage establishment was not as successful. On the contrary, where there were no oats, there was excellent growth on the cool season grasses. A different variety, such as Quest or Robust, would be better to learn more about the impact of underseeding to weed control.

## Outreach

1. MSU Upper Peninsula Research and Extension Center Field Day, July 29<sup>th</sup> – nearly 30 attendees toured the organic grain plots and learned more about the objectives of the trial and was able to see the plots mid-season.  
[http://msue.anr.msu.edu/news/msu\\_upper\\_peninsula\\_research\\_and\\_extension\\_center\\_field\\_day\\_upcoming](http://msue.anr.msu.edu/news/msu_upper_peninsula_research_and_extension_center_field_day_upcoming)
2. MSU North Farm Small Grain Short Course, July 9<sup>th</sup> – about 25 people participated in the small grain short course hosted by the MSU North Farm. Their short course series is a very popular educational series with beginning and established farmers. The five-hour course discussed the trial, included a tour of the plots, showed market opportunities including personal milling, demonstrated how the industry tests for quality, and providing a networking opportunity for participants.  
[http://msue.anr.msu.edu/events/msu\\_north\\_farm\\_on\\_farm\\_short\\_courses](http://msue.anr.msu.edu/events/msu_north_farm_on_farm_short_courses)
3. Guindon Organic Grain Field Day, August 2<sup>nd</sup> – about 15 farmers came out to the certified organic Guindon Farm operation where the on-farm component of the research was hosted. This site investigated organic oat varieties and their utility in establishing forage stands. The event provided the opportunity for farmers to walk the plots, hear from the research team, and network with other farmers throughout the supply chain.  
<http://www.uppermichiganssource.com/content/news/Field-Day-August-2-at-Guindon-Farms-in-Cornell-437207353.html>
4. PRESENTATION – Michigan Organic Food and Farm Alliance Organic Intensives Course, January 6<sup>th</sup> – McFarland presented on the organic grain research in the U.P. along with the trials she has collaborated on throughout southern Michigan. Over 20 attendees

participated in the day-long event, which included other speakers as well, including certified organic growers. Participants included home gardeners, commercial growers at various scales, and processors. <http://www.moffa.net/f/OI-2018-flyer-grain-embedfonts.pdf>

5. PRESENTATION – Northern Michigan Small Farms Conference, January 27<sup>th</sup> – researchers Jean, Kapp, and Thompson presented on the organic grain research and results at a local small farm conference boasting 1,000+ attendees. <http://www.smallfarmconference.com/2018-presentations/>
6. A publication summarizing results is planned for late-2018 or early -2019 once the data is summarized from the 2018 trial. The research team preferred to release more than one year of data and felt more confident basing decisions on additional experience.

## Financial accounting

Provided by the Contract and Grant Administration office at Michigan State University.

## Leveraged resources

Approximately \$15,000 has been leveraged through internal grants from the Michigan State University Project GREEN fund. These additional funds supported the purchase of a tine weeder and covered the expenses for a replicated trial at the MSU North Farm in 2018, which is now underway. In addition, a \$20,000 Organic Valley Farmers Advocating for Organics grant was acquired this past year that helped expand the organic grain research specific to oats and the fresh milling market in southern Michigan. The project team plans to continue to solicit funding to establish a long-term organic grain trial in the U.P.

## Photos and other addenda

North Farm Oat Variety Trial (L-R: Betagene, Deon, Shelby 427, Streaker)



North Farm Barley Variety Trial (L-R: Quest, Robust, Conlon, Pinnacle)



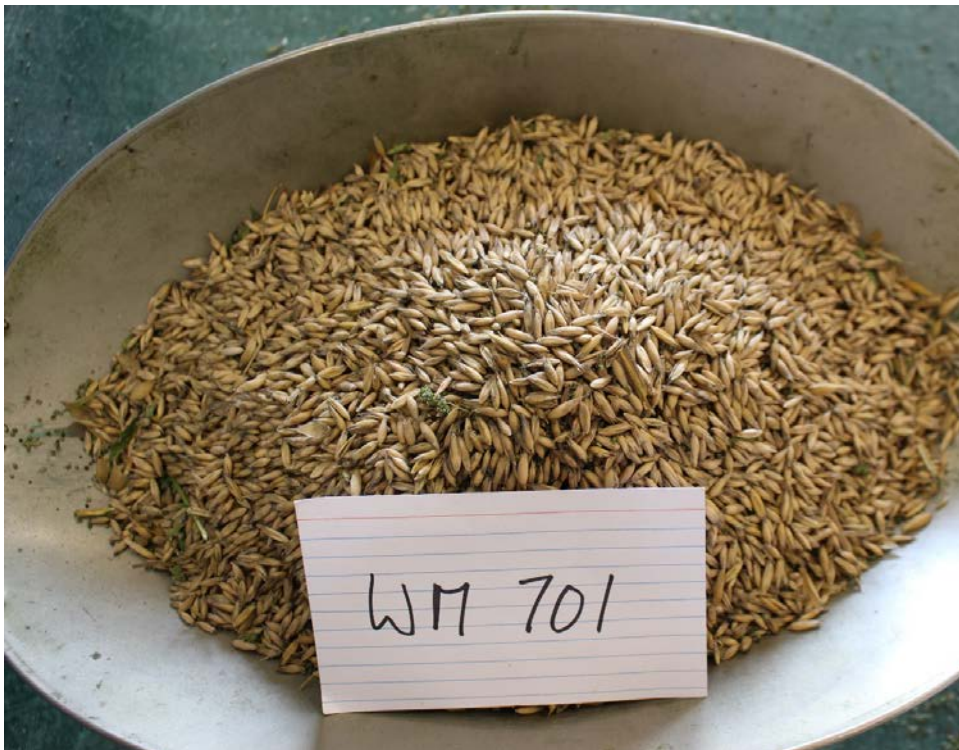


North Farm Oat Weed Management Trial

Groundcover after harvest



Uncleaned oats from weed management trial





Barley from fertility trial





Guindon underseeding trial



Quadrat sampling to determine establishment and weed pressure





Guindon oat stand



Guindon field day





Guindon field day



## Publications

The project team felt it was best to include one more year of data before publishing the cost of production and organic grain management guide. Those pieces will be passed on to OFRF once they are completed. Also, the PowerPoint files from the two presentations are also available upon request.