2022 MI Craft Beverage Council Final Report
Proposal Title: Variety Selection for Oat Malting
(grant# 210000001194-A)

Principle Investigator: Dennis Pennington (MSU Wheat Extension Specialist)
Collaborators: Dr. Eric Olson (MSU Wheat Breeder), Vince Coonce (Independent Barley and Malt)

Abstract: Oats continue to gain in popularity among Craft Beverage producers. Traditionally used in oatmeal stouts (Great Britain) and Triples (Belgium), where they provide interesting and unique flavors and lend a soft, silky mouthfeel, oats today are used as flavor and texture contributors to many different Craft beer styles, and also to create a sensation of creaminess to Craft distilled beverages. Oat malts are among the most expensive brewing raw materials. Although a common crop in Michigan and the U.S., the majority of oats used in brewing are imported from Europe and Canada, where varieties are bred and grown specifically for their superior brewing characteristics. There are currently no oat varieties grown in the U.S. specifically for malting and brewing.

The lack of oat varieties in the U.S. bred specifically for brewing presents an opportunity for small grain breeders. However, developing new varieties is time consuming and expensive. As an alternative, existing oat varieties can be selected for a combination of their superior Michigan farm yield performance and their ability to produce high quality oat malts.

Specific methods and procedures: Oat varieties were selected for this trial by reaching out to our partners (Jim Sheppard, Legacy Seed Company, Paul Richter, Oat breeder for General Mills). Forty-five oat lines from the Midwest, northern plains and southern Canada were selected to be tested. Research plots were established and managed by the MSU wheat research team. Small plots (5 foot x 18 foot) were planted at three sites:

1. Saginaw Valley Research and Extension Center (SVREC) near Richville, MI;
2. Bartle Farm near Brown City, MI
3. Milligan Farm near Cass City, MI.

Plots were planted with an Almaco HD grain drill equipped with a packet planter in a randomized complete block design. Twenty-two of the varieties were experimental lines that have not yet been released for production. Testing these lines lets us get a sneak peak at the newest material coming out of breeding programs. The seeding rate was 1.5 million seeds per acre across all trials. Cass City and SVREC trials were planted on April 12, 2022 and Brown City trial was planted on April 22, 2022. Urea was applied at a rate of 70 pounds actual nitrogen per acre across all trials just prior to stem elongation. The Brown City trial was harvested on July 30, 2022; Cass City and SVREC were harvested on July 31, 2022. At harvest, grain samples were collected and submitted to General Mills and analyzed for grain protein content and plumpness. These two traits will be used as a proxy for malting quality. Twenty-three of the varieties were tested (experimental lines were removed to save cost).

Results and Discussion: Yields at SVREC and Brown City were highest. Cass City location was wet at planting, which affected emergence and yield suffered. A field day was held on June 16, 2022 at SVREC where about 125 farmers learned about this project and walked through the varieties and asked questions.

Table 1 contains yield, moisture and test weight data as well as an overall average across all three locations. Data is sorted descending, by overall yield. The overall average yield was 92.2 bushels per acre and a test weight of 35.6 pounds per bushel. The standard test weight for oats is 32. Most millers want to see test weight of 36.

Table 1. Oat harvest data for three locations in MI for 45 oat varieties.

	Brown City			Cass City			SVREC			Overall Average			
Line Name	Yield (bu/ac) Oats Mn	Moisture (%)	Test Weight (lb/bu)	Yield (bu/ac) Oats Mn	Moisture (%)	Test Weight (lb/bu)	Yield (bu/ac) Oats Mn	Moisture (%)	Test Weight (lb/bu)	Yield (bu/ac) Oats Mn	Rank	Moisture (%)	Test Weight (lb/bu)
CDC_ENDURE	127.6	10.8	33	94.8	12.2	34.3	121.8	10.7	34.8	114.7	1	11.2	34.1
OT3112	131.1	10.5	31.8	92.4	11.8	32.8	98.6	10.6	30.8	107.3	2	11	31.8
AAC_DOUGLAS	124.1	10.8	36.1	82.5	13.1	35.2	113.3	11	35.8	106.6	3	11.6	35.7
CDC_NORSEMAN	110.4	10.6	30.8	94.8	12.6	34.5	112.9	10.8	33.4	106.0	4	11.3	32.9
CDC_ARBORG	104.3	10.6	32.6	92.1	12.4	33.2	119.0	10.8	34.2	105.1	5	11.3	33.3
SD Buffalo	112.7	10.9	36.5	85.6	13.9	36.9	116.5	10.9	38	104.9	6	11.9	37.2
2018Y4811	110.7	11	33.9	92.9	13.6	34.5	110.9	10.9	35.7	104.8	7	11.8	34.7
2018Y0689	120.2	10.4	35.3	83.4	12.3	31.6	109.4	10.9	36	104.3	8	11.2	34.3
Hayden	107.0	10.8	38.2	87.0	12.2	37.8	112.7	10.6	37.5	102.2	9	11.2	37.8
CS_CAMDEN	113.0	10.5	34.2	83.3	12.3	34.8	109.7	10.8	34.7	102.0	10	11.2	34.6
ORe3541m	123.4	10.6	36.8	80.9	12.6	36.1	101.2	10.7	37.4	101.8	11	11.3	36.8
MN_PEARL	116.6	11	33.4	98.3	13.7	35.6	88.0	11	35.4	101.0	12	11.9	34.8
2015Y3857	127.6	10.8	35.6	69.8	12.0	34.6	103.7	10.7	35.7	100.3	13	11.1	35.3
ND131603	124.0	10.5	31.9	74.9	11.9	33.3	99.2	11.1	32.2	99.4	14	11.2	32.5
ND141338	107.2	10.7	36.1	85.5	13.1	35.9	104.0	10.8	35.9	98.9	15	11.5	36
ROCKFORD	102.7	11.1	37.1	83.4	13.2	37.4	110.6	11	37.7	98.9	16	11.8	37.4
ORe3542m	115.8	10.6	34.1	69.5	12.5	34.2	105.2	11	34.8	96.8	17	11.4	34.3
SD160067	97.8	10.9	36.7	91.0	13.4	37.5	100.2	11.2	37.7	96.3	18	11.8	37.3
SD170463	105.3	10.7	39.1	91.1	12.8	38.9	92.0	10.8	39.6	96.1	19	11.5	39.2
DEON	113.5	10.7	36.7	81.0	12.6	37.1	92.7	11.2	37.1	95.8	20	11.5	37
2018Y1334	120.9	10.7	33.9	68.2	12.9	34.7	97.5	11.1	34.7	95.6	21	11.5	34.4
KWS_Ocre	112.7	10.6	36.9	60.1	12.7	35.4	113.0	10.9	38.2	95.3	22	11.4	36.8
CDC_SKYE	110.3	10.7	33.3	76.8	12.5	34.8	93.1	11.1	35.8	93.4	23	11.5	34.6
2018Y2803	99.7	10.9	35.4	75.5	14.5	34.0	104.3	11.3	36.4	93.1	24	12.2	35.3
2018Y0255	108.9	10.8	31.2	64.9	14.8	34.0	101.7	10.8	34.2	91.8	25	12.1	33.1
Goliath	100.2	10.7	37.4	95.6	14.5	36.3	77.4	11.3	35.8	91.1	26	12.2	36.5
2018Y3614	99.3	10.8	35.5	92.7	12.5	33.9	80.1	11.2	34	90.7	27	11.5	34.5
Warrior	106.6	10.8	36.7	62.7	9.6	35.0	101.7	11.6	36.3	90.3	28	10.7	36
2018Y0147	107.6	10.9	33.7	63.0	13.2	31.5	100.2	10.5	32.9	90.3	29	11.6	32.7
Alka	112.5	10.4	32.4	85.6	12.7	32.4	72.1	10.8	35	90.1	30	11.3	33.3
RON	107.7	10.5	36.4	62.3	12.0	36.1	95.9	10.9	37	88.6	31	11.1	36.5
2018Y4019	99.2	11	35.3	70.5	12.6	33.2	91.5	10.9	35.5	87.0	32	11.5	34.7
IDA	93.5	10.7	35.8	67.3	11.9	33.0	99.3	10.8	35.9	86.7	33	11.1	34.9
2018Y1315	102.0	10.6	34.1	52.4	13.4	31.9	103.2	10.8	34	85.9	34	11.6	33.3
2018Y0435	106.0	10.9	35	60.3	14.3	33.2	90.9	11.4	34.9	85.7	35	12.2	34.3
NEWBERG	88.9	10.3	34.7	73.7	21.0	27.5	92.4	10.1	36	85.0	36	13.8	32.7
Betagene	92.7	11	34.8	73.5	14.8	34.4	82.7	12	34.5	83.0	37	12.6	34.6
2018Y5609	100.3	11	35.4	71.1	13.6	35.0	76.4	11.6	34.2	82.6	38	12.1	34.9
SABER	92.9	10.9	37.8	55.2	13.0	35.3	93.2	11.4	36.3	80.4	39	11.8	36.5
Rushmore	89.8	11.1	37	59.7	13.1	37.0	83.4	12	35.9	77.6	40	12.1	36.6
Horsepower	84.1	10.6	37.4	57.4	12.0	37.5	86.0	11.7	38	75.8	41	11.4	37.6
STREAKER	68.8	12.2	47.5	69.6	13.9	44.2	69.6	12.6	49.4	69.3	42	12.9	47
Reins	78.3	10.7	35.9	54.3	12.6	36.6	68.4	11.4	34.6	67.0	43	11.6	35.7
ND040341	72.8	12.1	42.7	54.5	14.2	42.5	69.2	12.4	44.3	65.5	44	12.9	43.2
Saddle	73.8	11	37.7	52.3	12.7	35.4	69.5	12.3	34.7	65.2	45	12	35.9
Mn	105.0	10.8	35.6	75.4	13.1	35.1	96.3	11.1	36.1	92.2		11.7	35.6
CVErr	8.9	2.1	3.7	19.3	18.2	7.7	12.0	3.5	3.2	7.5		6.9	3.0
LSD(.05)	15.1	0.4	2.1	23.6	3.9	4.4	18.7	0.6	1.9	9.4		0.9	1.1

This evaluation of already existing oat lines shows promise for Michigan where good yields and malt quality can be achieved. Historically, oat prices have been low and farmers have not planted large acreages in Michigan. The low prices make this a low input crop where management practices have been lowered in order to make a profit at the lower commodity price. Oat yields may respond to higher management similar to wheat. Additional nitrogen, sulfur and fungicide application may increase yields, but prices have to be higher in order for farmers to make these investments.

This project has been the first step toward developing an oat malting industry in Michigan. There are existing oat varieties that have the potential for high yield and good test weight. Table 2 identified oat lines that are already grown for certified seed here in Michigan. There are several varieties outside of our area performed well and would be worth working with seed companies to introduce seed production and sales here. CDC Endure, AAC Douglas and CS Camden are Canadian lines that had high yield in our trials and had good plumpness.

Table 2 contains malting quality data including protein, plumpness and test weight. Samples were composited from three replications at Brown City to run malt quality analysis on. Experimental lines were not included because many of them may not even make it to the market. Plumpness is generally inversely related to test weight in our trials. Plump is a proxy used by maltsters to estimate extract. The test is relative inexpensive to run and only involved passing grain over a set of sieves. The interest in oats for malting comes from the unique flavor profiles, not yield of extract. Ideally, oat lines would be dual purpose – providing high yield for farmers and high quality for maltsters.

Protein levels are about double compared to wheat and barley, which reduces the extract output. This is a concern to maltsters because that means more oats have to be malted in order to obtain the same volume of fine extract. The tradeoff is flavor profile. While oats are not a primary malt grain, there could be specialty brews that meet market demands for unique flavors.

Table 2. Malting parameters from 23 oat lines. Percent plump is the amount of kernels retained on a 5.5/64 screen.

Line Name	Test Weight (lb/bu)	Plump[1] (%)	Protein (%)
Alka	32.4	88.5	17.8
CDC_Endure	33.0	84.9	16.7
CS_Camden	34.2	83.7	17.7
Hayden[2]	38.2	81.8	16.9
CDC_Arborg	32.6	80.4	17.4
Betagene	34.8	79.9	17.9
MN_Pearl	33.4	77.5	16.1
RON	36.4	77.3	19.9
Goliath[2]	37.4	76.1	17.2
Rockford	37.1	75.6	17.0
AAC_Douglas	36.1	75.0	17.3
CDC_Norseman	30.8	74.4	17.8
CDC_Skye	33.3	73.8	18.6
Rushmore	37.0	72.6	18.9
Warrior	36.7	70.2	17.9
Reins	35.9	69.3	18.4
Ida[2]	35.8	69.2	18.1
Deon	36.7	68.3	17.2
Newberg	34.7	64.9	17.3
Saber	37.8	60.5	18.3
Horsepower[2]	37.4	55.8	18.4
Saddle	37.7	51.5	18.4
Streaker	47.5	18.8	18.1

[1]Plump is percentage of kernels retained on 5.5/64th screen.
[2]Denotes lines currently grown in MI.

Future work on oats should include agronomic factors including higher nitrogen rates, fungicides and sulfur. This project provides a starting place for what lines of oats can be produced in Michigan.