

# NORTHWEST CROPS & SOILS PROGRAM



## 2021 Hulless Oat Variety Trial



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**2021 HULLESS OAT VARIETY TRIAL**  
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Oats (*Avena sativa* L.) have a long history of production in the Northeast. Although most oats grown in the Northeast are planted as a cover crop or forage, oats grown as a culinary grain are a potential revenue source for farmers. According to the 2017 census, about 80 acres of land in Vermont is cultivated for oat grain production, with an average yield of 1956 lbs. ac<sup>-1</sup>. Except for hullless varieties, oats need to be de-hulled before they can be used for human consumption and even further processing is required to make oatmeal, steel cut oats, or oat flour. Since 2009, the University of Vermont Extension Northwest Crops and Soils Program has conducted oat variety trials to provide yield comparisons in Vermont's climate. With the goal of improving processing efficiency and increasing local grain production, this trial focusing on hullless oat varieties was conducted to identify varieties that may be successfully produced in Vermont. Varietal selection is one of the most important aspects of crop production and significantly influences yield and quality potential. It is important to remember, however, that the data presented are from replicated research trials from only one location in Vermont and represent only one season. The goal of this project was to evaluate yields and protein of eighteen hullless oat varieties.

## MATERIALS AND METHODS

In 2021, the hullless oat variety performance trial was conducted at Borderview Research Farm in Alburgh, VT. Eighteen hullless oat varieties were evaluated for yield and quality (Table 1).

**Table 1. Oat varieties planted in Alburgh, VT, 2021.**

Variety	Seed Source
AC Gehl	Semican
Buff	Rocky Mountain Seed Alliance
Casino	Semican
Fuego	Semican
ND040341	Cornell University
Navaro	Semican
OA1456-2N	Cornell University
Paul	North Dakota State University
SD110853NO	South Dakota State University
SD111540NO	South Dakota State University
SD120582NO	South Dakota State University
SD120601NO	South Dakota State University
SD120622NO	South Dakota State University
SD120624NO	South Dakota State University
SD160149NO	South Dakota State University
SD160816NO	South Dakota State University
SD171242NO	South Dakota State University
Streaker	Albert Lea Seed House

The soil type was a Benson rocky silt loam, over shaly limestone, 8 to 15% slope (Table 2). The experimental design was a randomized complete block with four replications. The previous crop was soybeans. The research plots were 5' x 20' and the seedbed was prepared by conventional tillage methods including spring plow, disc and spike tooth harrow. The oats were planted on 9-Apr with 6" row spacing at a rate of 125 lbs ac<sup>-1</sup>.

**Table 2. Agronomic practices for the 2021 hullless oat variety trial, Alburgh, VT.**

Location	Borderview Research Farm, Alburgh VT
Soil type	Benson rocky silt loam, over shaly limestone, 8-15% slope
Previous crop	Soybeans
Tillage operations	Spring plow, disc, and spike tooth harrow
Row spacing (in)	6
Plot size (ft)	5 x 20
Seeding rate	125 lbs ac <sup>-1</sup>
Replicates	4
Planting date	9-Apr
Harvest date	27-Jul

Heading date data was collected through the month of June, recorded when 50% of the heads in each plot had fully emerged. Disease and pest scouting occurred on 23-Jun. The top two leaves from three plants per plot were examined, and percentage of the foliar surface that was damaged by several different pests and foliar diseases was recorded. Foliar diseases reduce photosynthetic leaf area, use nutrients, and increase respiration and transpiration within colonized host tissues. Diseased plants may exhibit reduced vigor, growth, and seed fill. Earlier occurrence, greater degree of host susceptibility, and longer duration of conditions favorable for disease development can increase the yield loss. When scouted on 23-Jun, each plot was assessed for several distinct diseases and disease symptoms. These individual disease ratings were combined into a single foliar disease rating for statistical analysis. Measurements of heights and lodging were taken prior to harvest. Heights were measured in centimeters for three plants per plot. Lodging was visually assessed on a scale from 0-5 with zero indicating no lodging and five indicating that the entire plot was too lodged to be harvested.

Plots were harvested on 27-Jul with an Almaco SPC50 plot combine. After combining, oats were cleaned with a small Clipper cleaner (A.T. Ferrell, Bluffton, IN). Harvest moisture and test weight were determined for each plot using a Dickey-john Mini GAC meter. An approximate one-pound grain sample per plot was collected for quality analysis. Quality measurements included standard testing parameters used by commercial mills. Plot samples were ground into flour, using the Perten LM3100 Laboratory Mill, and at this time, flour was evaluated for its crude protein content (CP) and mycotoxin levels. Grains were analyzed for CP using the Perten Inframatic 8600 Flour Analyzer. CP is reported at 12% flour moisture. Deoxynivalenol (DON) analysis was analyzed using Veratox DON 2/3 Quantitative test from the NEOGEN

Corp. This test has a detection range of 0.5-5 ppm. Samples with DON values greater than 1 ppm are considered unsuitable for human consumption. DON testing was performed on one replication, and all samples tested were below the quantifiable limit for the test (data not shown).

All data were analyzed using a mixed model analysis where replicates were considered random effects. The Least Significant Difference (LSD) procedure was used to separate cultivar means when the F-test was significant ( $P < 0.10$ ).

Variations in yield and quality can occur because of variations in genetics, soil, weather, and other growing conditions. Statistical analysis makes it possible to determine whether a difference among varieties is real or whether it might have occurred due to other variations in the field. At the bottom of each table a LSD value is presented for each variable (e.g. yield). LSD at the 10% level of probability are shown. Where the difference between two varieties within a column is equal to or greater than the LSD value at the bottom of the column, you can be sure in 9 out of 10 chances that there is a real difference between the two varieties.

In the example, variety A is significantly different from variety C, but not from variety B. The difference between A and B is equal to 725, which is less than the LSD value of 889. This means that these varieties did not differ in yield. The difference between A and C is equal to 1454, which is greater than the LSD value of 889. This means that the yields of these varieties were significantly different from one another. The asterisk indicates that variety B was not significantly lower than the top yielding variety shown in bold.

Variety	Yield
A	3161
B	3886*
C	<b>4615*</b>
<b>LSD</b>	889

## RESULTS

Weather data was recorded with a Davis Instrument Vantage Pro2 weather station, equipped with a WeatherLink data logger at Borderview Research Farm in Alburgh, VT (Table 3). Precipitation was below average from April through July; overall there was nearly 5 inches less rain during that four-month period. A warm April & May led to 84 more Growing Degree Days (GDDs) than the 30-year average, followed by a cooler than normal July. It was over 4 degrees cooler than normal in July. A total of 3583 GDDs were accumulated April through July, 36 more than the 30-year normal.

**Table 3. Temperature and precipitation summary for Alburgh, VT, 2021.**

Alburgh, VT	2021			
	April	May	June	July
Average temperature (°F)	48.1	58.4	70.3	68.1
Departure from normal	2.52	-0.03	2.81	-4.31
Precipitation (inches)	3.52	0.66	3.06	2.92
Departure from normal	0.45	-3.1	-1.2	-1.14
Growing Degree Days (32-95°F)	497	818	1149	1119
Departure from normal	85	-1	86	-134

Based on weather data from a Davis Instruments Vantage Pro2 with WeatherLink data logger. Historical averages are for 30 years of NOAA data (1981-2010) from Burlington, VT.

Oat varieties were significantly different in terms of height and lodging (Table 4). The average height was 95.9 cm and ranged from 83.6 cm (SD120601NO) to 109 cm (SD171242NO). The tallest variety, SD171242NO was statistically similar to three other varieties (Fuego, SD111540NO, and SD160149NO). Lodging was assessed on a scale from 0-5 where 0 indicated no lodging and 5 indicated the entire plot was too lodged to be harvested. The average lodging was less than 1 and ranged from 0 (no lodging) for several varieties, to 3 in the tallest variety (SD171242NO) indicating that more than half of the plants of this variety were lodged. There were four varieties that had no lodging (SD120582NO, OA1456-2N, Navaro, ND040341). Disease and arthropod pest damage were both minimal. SD160149NO had the highest disease burden, with 4.22% of the foliar surface affected by foliar disease symptoms. All other varieties in this trial had 0.33% or less of their foliar surface affected by foliar disease. Arthropod pest damage was low, with all varieties exhibiting 7% or less of the foliar surface damaged by pests. SD120582NO had the least pest damage, with 1.56% of foliar surface affected on average. Overall, neither disease nor arthropod damage were at rates high enough to affect yield or quality.

**Table 4. Height and lodging by oat variety prior to harvest, Alburgh, VT, 2021.**

Variety	Heading date <sup>†</sup>	Height cm	Lodging 0-5	Foliar disease % foliar surface affected	Arthropod damage % foliar surface affected
AC Gehl	12-Jun	99.2	2.00	<b>0.00</b>	5.22
Buff	7-Jun	95.0	0.33*	<b>0.00</b>	3.67
Casino	15-Jun	92.0	0.33*	0.11*	3.00
Fuego	12-Jun	100*	0.67*	0.11*	6.00
ND040341	12-Jun	99.6	<b>0.00</b>	0.22*	3.00
Navaro	14-Jun	84.7	<b>0.00</b>	<b>0.00</b>	2.11
OA1456-2N	16-Jun	93.3	<b>0.00</b>	0.11*	5.00
Paul	11-Jun	99.6	0.67*	0.33*	3.78
SD110853NO	10-Jun	99.1	1.67	<b>0.00</b>	4.00
SD111540NO	9-Jun	103*	1.00*	<b>0.00</b>	5.33
SD120582NO	7-Jun	87.6	<b>0.00</b>	0.33*	<b>1.56</b>
SD120601NO	12-Jun	83.6	0.67*	<b>0.00</b>	4.67
SD120622NO	9-Jun	99.1	1.33	<b>0.00</b>	7.00
SD120624NO	9-Jun	91.8	2.00	<b>0.00</b>	5.89
SD160149NO	7-Jun	99.7*	0.33*	4.22	3.22
SD160816NO	9-Jun	96.7	1.00*	0.11*	6.89
SD171242NO	11-Jun	<b>109</b> ‡	3.00	0.22*	2.67
Streaker	7-Jun	94.2	0.33*	0.11*	5.33
LSD (0.10)	NS§	8.96	1.23	0.85	NS
Trial Mean	10-Jun	95.9	0.85	0.33	4.35

<sup>†</sup> No optimal value or range has been determined for heading date.

<sup>‡</sup> Treatments with an asterisk (\*) are not statistically different from the top performer, shown in **bold**.

<sup>§</sup> NS indicates that there was no statistical difference between varieties.

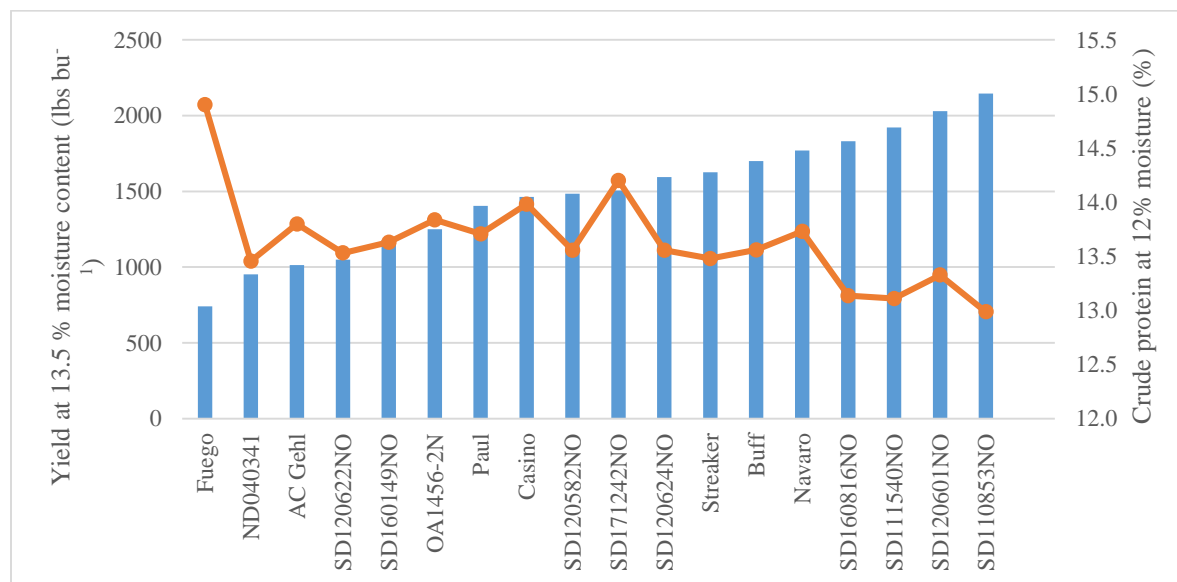
There were significant differences in harvest and quality measures between varieties (Table 5, Figure 1). The average yield this season was 1481 lbs ac<sup>-1</sup> and ranged from 742 lbs ac<sup>-1</sup> (Fuego) to 2145 lbs ac<sup>-1</sup> (SD110853NO). The highest yielding variety, SD110853NO, was statistically similar to eleven other varieties. The average harvest moisture was 18.5%. The variety with the highest harvest moisture was

SD160149NO (20.4%). None of the varieties had a harvest moisture below 14%, which is the ideal storage moisture for oats. The variety with the lowest harvest moisture was SD120624NO at 16.9%. The average test weight was 39.4 lbs bu<sup>-1</sup> and ranged from 35.3 lbs bu<sup>-1</sup> (SD120601NO) to 42.5 lbs bu<sup>-1</sup> (SD120622NO). The average crude protein was 13.6%. Fuego and SD171242NO had a significantly higher crude protein (14.9% and 14.2% respectively) than the other varieties (Table 5, Figure 1).

**Table 5. Harvest and quality measures, Alburgh, VT, 2021.**

Variety	Yield @ 13.5% moisture lbs ac <sup>-1</sup>	Harvest moisture %	Test weight lbs bu <sup>-1</sup>	Crude protein @ 12% moisture %
AC Gehl	1013	20.2	41.1*	13.8
Buff	1701*†	18.3*	42.4*	13.6
Casino	1464*	19.2	39.5	14.0
Fuego	742	20.1	35.7	<b>14.9</b>
ND040341	953	18.6*	41.3*	13.5
Navaro	1770*	18.5*	41.6*	13.7
OA1456-2N	1251	18.2*	37.8	13.8
Paul	1405*	18.3*	40.7*	13.7
SD110853NO	<b>2145</b>	17.2*	39.4	13.0
SD111540NO	1921*	17.1*	38.4	13.1
SD120582NO	1485*	18.5*	39.6	13.6
SD120601NO	2029*	17.5*	35.3	13.3
SD120622NO	1050	18.4*	<b>42.5</b>	13.5
SD120624NO	1594*	<b>16.9</b>	37.4	13.6
SD160149NO	1178	20.4	39.3	13.6
SD160816NO	1830*	17.9*	37.9	13.1
SD171242NO	1505*	19.0*	38.7	14.2*
Streaker	1627*	18.2*	40.3*	13.5
LSD (0.10)	698	2.16	2.61	0.77
Trial Mean	1481	18.5	39.4	13.6

† Treatments with an asterisk (\*) are not statistically different from the top performer, shown in **bold**.



**Figure 1. Yield and crude protein of 18 oat varieties evaluated in Alburgh, VT, 2021.**

## DISCUSSION

In the 2021 hullless oat variety trial, the mean yield was 1481 lbs ac<sup>-1</sup>. The season started out slightly warmer than average, but by July, temperatures decreased and the monthly average for July was more than 4 degrees below normal. Precipitation was below the average through the growing season, with almost 5 inches less of rain between April and July. Despite the lack of rain, there was a large increase in thunderstorms in July, making it near impossible to harvest the hullless oat samples at the preferred moisture level. As a result, the average harvest moisture in this trial was 18.5%, with some varieties having harvest moistures as high as 20%. Figure 1 shows the relationship between yield at 13.5% moisture and crude protein. Small grains often have an inverse correlation between yield and crude protein. This was evident in the 2021 hullless oat trial (Fig. 1). Fuego had the lowest yield at 742 lbs bu<sup>-1</sup> and the highest crude protein at 14.9%, with an overall trend in the variety trial with higher yielding varieties having lower protein concentrations. It is important to remember that the results only represent one year of data. As you make variety choices on your farm, it is important that you evaluate data from test sites that are as similar to your region as possible.

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