NORTHWEST CROPS & SOILS PROGRAM

# 2023 Hulless Oat Variety Trial

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THE UNIVERSITY OF VERMONT EXTENSION

**2023 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 $ac^{-1}$. Except for hulless 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 hulless oat (also referred to as "naked" oats) 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 twenty-four hulless oat varieties.

# MATERIALS AND METHODS

In 2023, the hulless oat variety performance trial was conducted at Borderview Research Farm in Alburgh, VT. Twenty-four hulless oat varieties were evaluated for yield and quality (Table 1).

**Table 1. Oat varieties planted in Alburgh, VT, 2023.**

| Variety | Seed source |
|---|---|
| AC Gehl | SemiCan |
| Buff | Rocky Mountain Seed Alliance |
| Buff Sylvia | Sylvia Davatz, private breeder |
| Casino | Semican |
| Fuego | Semican |
| ND040341 | Cornell University |
| Navarro | Semican |
| Nitro | SemiCan |
| Nusso | Johnny Seeds |
| OA1456-2N | Cornell University |
| Paul | North Dakota State University |
| Pennuda | Southern Exposure Seed Exchange |
| 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 |
| Shelly | Solstice Seeds |
| Streaker | Albert Lea Seed House |
| Terra Hulless | Fedco Seeds |

Plots were managed with practices similar to those used by producers in the surrounding area. Agronomic information is displayed in Table 2. The experimental design was a randomized complete block with four replicates. The previous crop was milkweed. The field was prepared with a Pottinger TerraDisc® prior to planting. Plots were seeded in 5' x 20' plots with a Great Plains Cone Seeder on 14-Apr at a seeding rate of 350 live seeds $m^{-2}$.

**Table 2. Agronomic and trial information for spring barley variety trial, 2023.**

| Trial Information | Borderview Research Farm Alburgh, VT |
|---|---|
| Soil type | Benson rocky silt loam |
| Previous crop | Summer annuals |
| Tillage Operations | Pottinger TerraDisc® |
| Harvest area (ft) | 5x20 |
| Row spacing (in) | 6 |
| Seeding rate (live seeds $m^{-2}$) | 350 |
| Replicates | 4 |
| Planting date | 14-Apr |
| Harvest date | 2-Aug |

Field season data were collected on all the 24 varieties. Heading date data was collected through the month of June, recorded when 50% of the heads in each plot had fully emerged. Heights and lodging were determined on 1-Aug. Heights were measured three times per plot, excluding awns. Lodging was assessed visually as percent lodged, with 0% indicating no lodging and 100% indicating the entire plot was lodged.

Plots were harvested on 2-Aug with an Almaco SPC50 small plot combine**.** Grain moisture, test weight, and yield were determined at harvest (DICKEY-john Mini GAC moisture and test weight meter, Auburn, IL). Seed was cleaned with a small Clipper M2B cleaner (A.T. Ferrell, Bluffton, IN) and a one-pound subsample was collected to determine quality characteristics. Grain quality was determined at the E. E. Cummings Crop Testing Laboratory at the University of Vermont (Burlington, Vermont). Grains were analyzed for crude protein and starch content using the Perten Inframatic 9500 NIR Grain Analyzer. Samples were then ground using the Perten LM3100 Laboratory Mill.

Stand characteristics were analyzed using mixed model analysis using the mixed procedure of SAS (SAS Institute, 1999). Replications within the trial were treated as random effects, and treatments were treated as fixed. Treatment mean comparisons were made using the Least Significant Difference (LSD) procedure when the F-test was considered significant ($p<0.10$).

Variations in project results can occur because of variations in genetics, soil, weather, and other growing conditions. Statistical analysis makes it possible to determine whether a difference among treatments 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). Least Significant Differences (LSD's) at the 10% level of probability are shown. Where the difference between two treatments 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 values. Treatments that were not significantly lower in performance than the highest value in a particular column are indicated with an asterisk. In the previous example, treatment A is significantly different from treatment C but not from treatment B. The difference between A and B is equal to 200, which is less than the LSD value of 300. This means that these treatments did not differ in yield. The difference between A and C is equal to 400, which is greater than the LSD value of 300. This means that the yields of these treatments were significantly different from one another.

| Treatment | Yield |
|---|---|
| **A** | **2100*** |
| B | 1900* |
| C | 1700 |
| LSD | 300 |

# RESULTS

Seasonal precipitation and temperature recorded at a weather station at Borderview Research Farm are displayed in Table 3. This growing season was wetter than past years with a total of 22.1 inches, 6.9 inches more than normal. The average temperature of the growing season (April to July) was 7.01°F below the 30-year average. The number of growing degree days (GDDs) was 44 above normal.

**Table 3. Temperature and precipitation summary for Alburgh, VT, 2023.**

| **Alburgh, VT** | April | May | June | July |
|---|---|---|---|---|
| Average temperature (°F) | 48.3 | 57.1 | 65.7 | 72.2 |
| Departure from normal | -1.28 | -1.76 | -0.24 | -3.73 |
| | | | | |
| Precipitation (inches) | 4.94 | 1.98 | 4.40 | 10.8 |
| Departure from normal | 1.87 | -1.78 | 0.14 | 6.69 |
| | | | | |
| Growing Degree Days (32-95°F) | 524 | 766 | 1027 | 1274 |
| Departure from normal | 112 | -53 | -37 | 22 |

Based on weather data from a Davis Instruments Vantage Pro2 with WeatherLink data logger.
Historical averages are for 30 years of data provided by the NOAA (1991-2020) for Burlington, VT.

This year all varieties of hulless oats headed between 10-Jun and 21-Jun (Table 4). Compared to last year, this window was extended by 8 days with 2022 hulless oats that headed between June 15 and June 18, despite being similar varieties. This could be a result of the cooler growing conditions during May, extending the period for flower production.

The hulless oat varieties ranged between 84 and 117 cm at the time of harvest with Nusso reaching 117 cm, comparable to Buff Sylvia, ND040341, Paul, and SD171242NO. While many of these tallest varieties did correspond with severe lodging, particularly Nusso, Buff Sylvia, and SD171242NO, a few of the taller varieties remained stalwart with low lodging akin to the top performer which included Paul and ND040341. Other varieties that saw minimal lodging included the top performer Nitro (at 1.25% lodging), AC Gehl, Casino, Fuego, Navaro, and OA1456-2N. In years such as this past one which experienced severe rain events leading up to harvest, susceptibility to lodging becomes increasingly important as highly lodged crops become difficult or impossible to harvest.

**Table 4. Heading date, heights, and lodging of hulless oat varieties, Alburgh, VT, 2023.**

| Variety | Heading date† | Height | Lodging‡ |
|---|---|---|---|
| | | cm | % |
| AC Gehl | 15-Jun | 106 | 15.8* § |
| Buff | 16-Jun | 92.0 | 85.0 |
| Buff Sylvia | 11-Jun | 114* | 92.5 |
| Casino | 13-Jun | 107 | 5.00* |
| Fuego | 19-Jun | 104 | 37.5 |
| Navaro | 19-Jun | 97.0 | 5.00* |
| ND040341 | 15-Jun | 109* | 2.50* |
| Nitro | 20-Jun | 101 | **1.25** |
| Nusso | 20-Jun | **117** | 91.3 |
| OA1456-2N | 21-Jun | 105 | 18.8* |
| Paul | 21-Jun | 115* | 18.0* |
| Pennuda | 10-Jun | 84.0 | 43.8 |
| SD110853NO | 15-Jun | 101 | 95.0 |
| SD111540NO | 19-Jun | 106 | 55.0 |
| SD120582NO | 10-Jun | 98.0 | 66.3 |
| SD120601NO | 20-Jun | 96.0 | 61.3 |
| SD120622NO | 13-Jun | 103 | 91.3 |
| SD120624NO | 13-Jun | 101 | 75.0 |
| SD160149NO | 11-Jun | 103 | 63.8 |
| SD160816NO | 13-Jun | 106 | 73.8 |
| SD171242NO | 20-Jun | 108* | 95.0 |
| Shelly | 21-Jun | 102 | 78.8 |
| Streaker | 12-Jun | 102 | 91.3 |
| Terra Hulless | 12-Jun | 100 | 82.5 |
| LSD (0.10) | - | 9.50 | 28.9 |
| Trial mean | - | 103 | 56.0 |

† No optimal value or range has been determined for heading date.
‡Lodging with 0% indicates no lodging and a rating of 100% indicates that the entire plot was lodged.
**§**Treatments with an asterisk (*) are not statistically different from the top performer, shown in **bold**.

Significant differences were observed across all metrics for harvest and quality measurement amongst the hulless oat varieties (Table 5). OA1456-2N was the highest yielding variety within the trial at 2736 lbs $ac^{-1}$ and was statistically similar to Casino, Fuego, Navaro, Nitro, Paul, SD120582NO, SD120601NO, SD120624NO, and SD160149NO. Overall, yields were fairly low when compared to major grain growing regions with a trial average of 2070 lbs $ac^{-1}$ (where yields may average ~4000 lbs $ac^{-1}$ with test weights reaching 38 lbs $bu^{-1}$). However, grain test weights were comparable with a trial average of 36.2. Highest test weight was observed in Fuego at 40.3 lbs $bu^{-1}$ with 16 of the other varieties having statistically similar test weights. OA1456-2N had the lowest overall moisture at 13.5% with the highest observed value seen in Shelly at 21.8%. Fuego and SD120624NO were the only other varieties that remained below the standard for storage moisture of 14.0%, however 19 of the varieties were statistically similar in harvest moisture. The majority of these varieties would require further dry-down to ensure proper, safe storage of these grains. The average crude protein within the trial was 11.3% (similar to the 2022 trial average of 11.6%) with the highest standalone crude protein observed in ND040341 at 12.9%. This variety yielded just over 2000 lbs $ac^{-1}$ of grain, whereas other higher yielding varieties such as OA1456-2N (10.5% crude protein) had comparably lower protein concentrations (Figure 1). Starch content was fairly consistent across varieties of hulless oats with 17 varieties having similar concentrations to the top performer SD120601NO at 55.9% with a trial average of 51.1 lbs $bu^{-1}$.

**Table 5. Hulless oat harvest and seed quality, Alburgh VT, 2023.**

| Variety | Yield @13.5% moisture | Test weight | Moisture | Crude protein @ 12% moisture | Starch @ 12% moisture |
|---|---|---|---|---|---|
| | lbs $ac^{-1}$ | lbs $bu^{-1}$ | % | % | % |
| AC Gehl | 1421 | 38.7* | 19.8 | 11.7 | 51.4* |
| Buff | 2059 | 36.1* | 14.6* | 10.6 | 53.4* |
| Buff Sylvia | 1869 | 34.8* | 16.4* | 11.1 | 53.3* |
| Casino | 2118*‡ | 39.7* | 16.2* | 11.8 | 52.2* |
| Fuego | 2412* | **40.3** | 13.8* | 11.7 | 49.6 |
| Navaro | 2254* | 38.9* | 16.2* | 11.3 | 52.9* |
| ND040341 | 2015 | 39.7* | 15.8* | **12.9** | 46.5 |
| Nitro | 2370* | 32.9 | 16.1* | 12.3 | 47.4 |
| Nusso | 1487 | 39.1* | 14.9* | 12.2 | 50.8* |
| OA1456-2N | **2736** | 40.1* | **13.5** | 10.5 | 53.3* |
| Paul | 2121* | 37.9* | 16.5* | 11.3 | 49.7 |
| Pennuda | 1805 | 35.2* | 16.3* | 11.8 | 52.6* |
| SD110853NO | 1844 | 36.5* | 15.1* | 10.6 | 51.0* |
| SD111540NO | 1774 | 36.4* | 17.5* | 10.3 | 44.2 |
| SD120582NO | 2615* | 37.9* | 14.2* | 11.0 | 50.9* |
| SD120601NO | 2403* | 34.1 | 15.5* | 10.8 | **55.9** |
| SD120622NO | 2044 | 37.3* | 18.5* | 11.1 | 51.6* |
| SD120624NO | 2613* | 32.2 | 13.9* | 11.4 | 50.9* |
| SD160149NO | 2512* | 34.9* | 14.5* | 10.9 | 52.1* |
| SD160816NO | 1985 | 31.4 | 16.5* | 10.6 | 51.4* |
| SD171242NO | 2063 | 34.4 | 18.0* | 10.9 | 50.8* |
| Shelly | 1804 | 33.9 | 21.8 | 11.6 | 50.4 |
| Streaker | 1880 | 35.6* | 14.9* | 11.0 | 51.3* |
| Terra Hulless | 1479 | 30.0 | 18.3 | 10.8 | 51.8* |
| LSD (0.10) | 661.6 | 5.56 | 4.21 | 0.493 | 5.36 |

| | | | | | |
|---|---|---|---|---|---|
| Trial mean | 2070 | 36.2 | 16.2 | 11.3 | 51.1 |

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

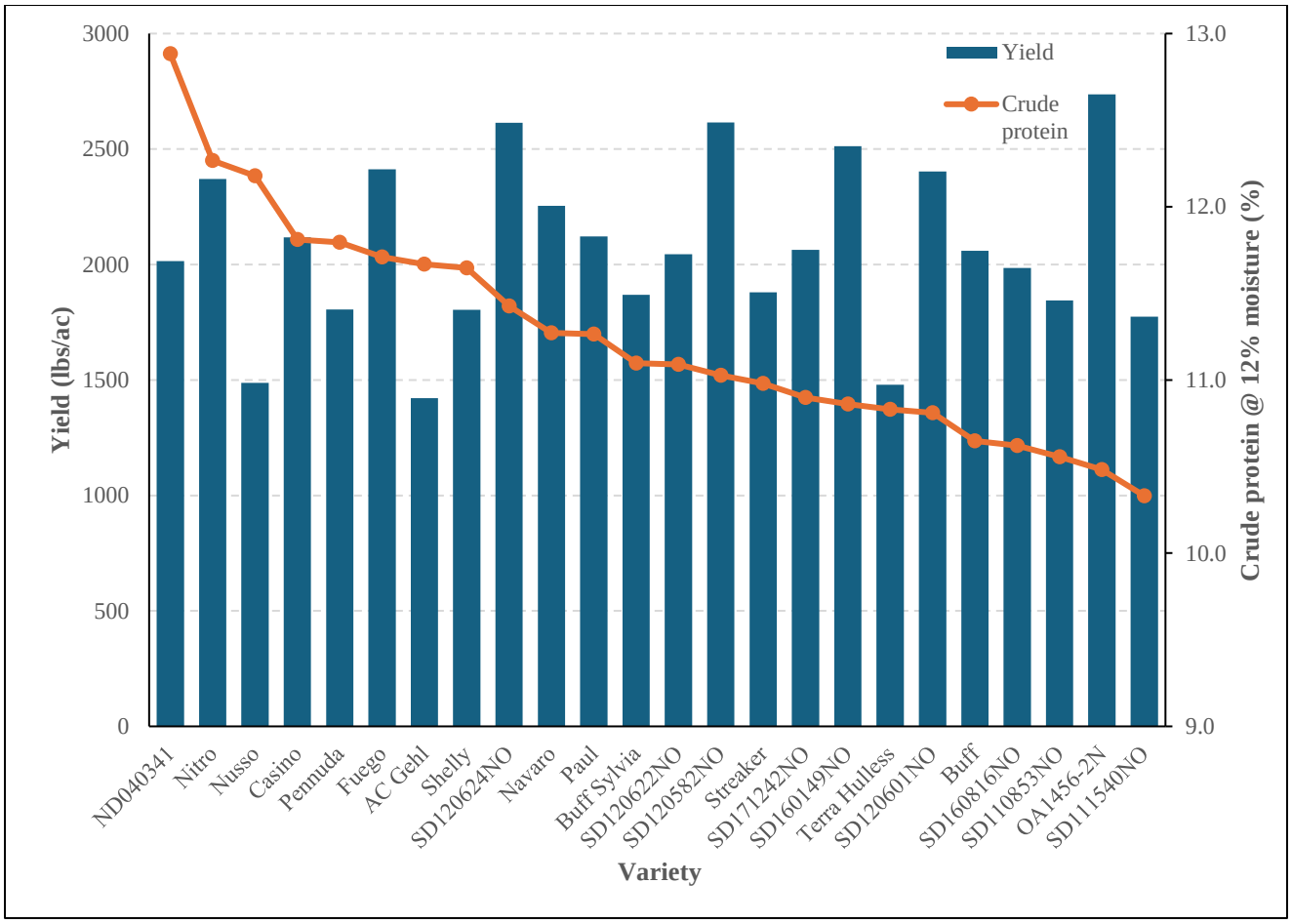


**Figure 1. Yield and crude protein of hulless oat varieties evaluated in Alburgh, VT, 2023.**

## DISCUSSION

The 2023 growing season showed temperatures below average and significantly higher precipitation coming in major rain events that severely impacted a vast number of crops. Years such as this highlight the importance of standability, especially for grain crops, which have a greater potential to be impacted by weather events leading up to harvest. Average yields for the trial were lower than in past years likely as a result of these weather events. Average trial yields in 2022 were 2733 lbs $ac^{-1}$ with the same varieties trialed across these two past years showing a decrease in the 2023 growing season. When looking at grain quality it is also important to keep in mind grain quality as well as yields. While a certain variety may be highest yielding, the quality may be less desirable; as such, it might be necessary to compromise one parameter over the other depending on desired outcomes. While not presented in this data set, DON levels were evaluated for the first replication of this trial. For every variety within the trial values for DON remained well below the 1.0ppm threshold indicating that all of them would be safe for human consumption.

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