NORTHWEST CROPS & SOILS PROGRAM

# 2022 Spring Wheat Crosses Trial

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THE UNIVERSITY OF VERMONT EXTENSION

**2022 SPRING WHEAT CROSSES TRIAL**

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The goal of this project is to develop spring wheat varieties that are suited for organic management in Northeast soils and climatic conditions. Most commercially available varieties are developed in regions with climates, soils and management techniques that are very different from northern New England. These modern varieties are also genetically homogenous and inbred for uniformity, sometimes resulting in rapid breakdown of genetic resistance to local diseases.

Ten crosses were developed by Dr. Stephen Jones of Washington State University, including crosses of two varieties bred by famed Vermont botanist and wheat breeder, Cyrus Pringle. These crosses were grown on 4 farms in the Northeast and further selection was done by farmers. These selections are being continued by University collaborators to further refine and evaluate these spring wheat crosses.

## MATERIALS AND METHODS

The top performing spring wheat crosses have been grown out at four locations across New England and New York state. Seed was collected and trialed at Borderview Research Farm in Alburgh, Vermont. The crosses evaluated include Adirondack Kelse/AC Walton, Adirondack Kelse/Helios, Butterworks Kelse/AC Walton, Essex Kelse/AC Walton, Essex Kelse/Helios, Essex Kingsey/Tigre, Glenn, Grange Corner Faller/Tigre, Grange Corner Kelse/AC, and Tom. Parents of the crosses are listed in Table 1.

**Table 1. Cultivars used as parents in spring wheat breeding project.**

| Variety | Market class | Year | Place of Origin | Pedigree |
|---|---|---|---|---|
| AC Walton | HRSW | 1995 | Prince Edward Island | Nobeoka Bozu/2/Kolibri/Janus/3/Opal/Glenlea |
| Faller | HRSW | 2007 | North Dakota | Amidon/Stoa/Kitt/Sumai3 |
| Helios | HRSW | 2006 | Saskatchewan | BW674/AC Cadillac/AC Barrie |
| Kelse | HRSW | 2008 | Washington | Westbred 906R / PI520542 // Scholar |
| Kingsey | HRSW | 2011 | Quebec | |
| Surprise | SWSW | 1875 | Vermont | Chile Club/Michigan Club |
| Tigre | HW facultative | 2015 | France | |

The seedbeds were prepared by conventional tillage methods (Table 2). Plots were planted with a six-inch Great Plains cone-seeder on 18-Apr. The spring wheat crosses were planted at 125 lbs $ac^{-1}$.

**Table 2. General plot management, 2022.**

| Trial information | Alburgh, VT<br>Borderview Research Farm |
|---|---|
| **Soil type** | Benson rocky silt loam |
| **Previous crop** | Corn |
| **Seeding Rate (lbs ac$^{-1}$)** | 125 |
| **Row spacing (in)** | 6 |
| **Replicates** | 4 |
| **Planting date** | 18-Apr |
| **Harvest date** | 3-Aug |
| **Harvest area (ft)** | 5 x 20 |
| **Tillage operations** | Pottinger TerraDisc |

Heights and lodging were determined prior to harvest on 3-Aug. For determining heights, three plant heights per plot were measured for each plot, excluding awns. Lodging was assessed visually as percent lodged, with 0% indicating no lodging and 100% indicating the entire plot was lodged. Wheat was harvested with an Almaco SPC50 small plot combine on 3-Aug. Grain moisture, test weight and yield were determined with a Dickey-John mini-GAC meter and pound scale. The grain was cleaned with a Clipper M2B cleaner and dried at 40$^{o}$ C until grain moisture was below 14%. Samples were ground into flour using a Perten LM3100 Laboratory Mill. Grains were analyzed for protein content using the Perten Inframatic 8600 Flour Analyzer. Grain protein affects gluten strength and loaf volume. Most commercial mills target 12-15% protein. Protein was calculated on a 12% moisture basis. Falling number was measured on the Perten FN 1500 Falling Number Machine. The falling number is related to the level of sprout damage that has occurred in the grain. It is measured by the time it takes, in seconds, for a stirrer to fall through a slurry of flour and water to the bottom of the tube. Falling numbers greater than 350 indicate low enzymatic activity and sound quality wheat. A falling number lower than 200 indicates high enzymatic activity and poor quality wheat. Deoxynivalenol (DON) was analyzed using Veratox DON 2/3 Quantitative test from the NEOGEN Corp. This test has a detection range of 0.5 to 5 ppm. Samples with DON values greater than 1 ppm are considered unsuitable for human consumption.

Data were analyzed using a general linear model procedure of SAS (SAS Institute, 1999). Replications were treated as random effects, and treatments were treated as fixed. Mean comparisons were made using the Least Significant Difference (LSD) procedure where the F-test was considered significant, at $p<0.10$. Variations in genetics, soil, weather, and other growing conditions can result in variations in yield and quality. Statistical analysis makes it possible to determine whether a difference between treatments is significant or whether it is due to natural variations in the plant or field. At the bottom of each table, a LSD value is presented for each variable (i.e. yield). Least Significant Differences (LSDs) at the 0.10 level of significance are shown. This means that when the difference between two treatments within a column is equal to or greater to the LSD value for the column, there is a real difference between the treatments 90% of the time. Treatments that were not significantly lower in performance than the highest value in a particular column are indicated with an asterisk. 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). Least Significant Differences 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 accompanying 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.

| Variety | Yield |
|---|---|
| A | 3161 |
| B | 3886* |
| C | **4615*** |
| **LSD** | **889** |

# RESULTS AND DISCUSSION

Seasonal precipitation and temperature recorded at a weather station at Borderview Research Farm are shown in Table 3. April, June, and July were all colder than normal. April and June had higher precipitation than the 30-year average, while May and July had less than average precipitation. Overall, May was hotter and drier than the 30-year average. From April through July, there was an accumulation of 3510 Growing Degree Days (GDDs), 36 GDDs below the 30-year average.

**Table 3. Temperature and precipitation summary for Alburgh, VT, 2022.**

| **Alburgh, VT** | April | May | June | July |
|---|---|---|---|---|
| Average temperature (°F) | 44.8 | 60.5 | 65.3 | 71.9 |
| Departure from normal | -0.81 | 2.09 | -2.18 | -0.54 |
| | | | | |
| Precipitation (inches) | 5.57 | 3.36 | 8.19 | 3.00 |
| Departure from normal | 2.50 | -0.40 | 3.93 | -1.06 |
| | | | | |
| Growing Degree Days (32-95°F) | 391 | 883 | 1000 | 1236 |
| Departure from normal | -20 | 65 | -64 | -17 |

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 (1981-2010) for Burlington, VT.

Essex Kelse/AC Walton was the tallest variety at 106 cm, with 98.7 cm as the trial mean for heights. However, there were no significant differences between the varieties for heights. Butterworks Kelse/AC Walton and Essex Kelse/AC Walton had the lowest occurrence of lodging at 1.25%, with a trial mean of 3.00% lodging. No significant differences were detected between the varieties for lodging.

Moisture content below 14% is desirable for long term storage. No varieties were at or below 14% moisture content. Essex Kelse/Helios had the lowest harvest moisture at 17.7% and was statistically similar to Adirondack Kelse/AC Walton, Adirondack Kelse/Helios, Glenn, and Tom. All varieties had to be dried down for long term storage (Table 4).

Test weight is the measure of grain density and is determined by weighing a known volume of grain. Generally, the heavier the wheat is per bushel, the higher baking quality. None of the crosses met the desired standard of 60 lbs $bu^{-1}$. The cross with the highest test weight was Adirondack Kelse/Helios (56.8 lbs $bu^{-1}$) and was statistically similar to Adirondack Kelse/AC Walton, Essex Kelse/Helios, and Glenn.

The average yield for the trial was 2564 lbs $ac^{-1}$. Adirondack Kelse/AC Walton was the highest yielding variety at 2812 lbs $ac^{-1}$, however, was not statistically different than the other varieties.

**Table 4. Harvest data of Spring Wheat Crosses, Alburgh, VT, 2022.**

| **Variety** | **Height** | **Lodging** | **Harvest moisture** | **Test weight** | **Yield @ 13.5% moisture** |
|---|---|---|---|---|---|
| | cm | % | % | lbs $bu^{-1}$ | lbs $ac^{-1}$ |
| Adirondack Kelse/AC Walton | 98.7 | 2.50 | 18.2*† | 54.0* | **2812** |
| Adirondack Kelse/Helios | 92.3 | 3.75 | 19.3* | **56.8*** | 2686 |

| | | | | | |
|---|---|---|---|---|---|
| Butterworks Kelse/AC Walton | 96.8 | **1.25** | 23.2 | 48.8 | 2296 |
| Essex Kelse/AC Walton | **105.5** | **1.25** | 21.9 | 51.9 | 2470 |
| Essex Kelse/Helios | 96.8 | 3.75 | **17.7*** | 53.8* | 2426 |
| Essex Kingsey/Tigre | 100.4 | 2.50 | 22.3 | 50.6 | 2776 |
| Glenn | 99.6 | 3.75 | 18.8* | 54.8* | 2447 |
| Grange Corner Faller/Tigre | 99.7 | 3.75 | 21.1 | 52.2 | 2629 |
| Grange Corner Kelse/AC Walton | 99.4 | 5.00 | 23.5 | 49.0 | 2342 |
| Tom | 97.8 | 2.50 | 18.9* | 51.6 | 2761 |
| LSD (p=0.10) | NS | NS | 2.19 | 4.31 | NS |
| Trial mean | 98.7 | 3.00 | 20.5 | 52.3 | 2564 |

†In the column, treatments followed by an * are not significantly different from one another at the p=0.10 level.
Top performing treatments are shown in **bold**.
NS, no significant difference.

**Table 5. Quality data of Spring Wheat Crosses, Alburgh, VT, 2022.**

| Variety | Crude Protein @ 12% moisture | Starch | Falling number | DON |
|---|---|---|---|---|
| | % | % | seconds | ppm |
| Adirondack Kelse/AC Walton | 10.7 | 61.0*† | 275 | 1.45 |
| Adirondack Kelse/Helios | **12.2** | 60.8* | 349* | 1.08* |
| Butterworks Kelse/AC Walton | 12.0 | 59.9 | 307 | 1.45 |
| Essex Kelse/AC Walton | 11.4 | 60.3* | 314 | **0.875*** |
| Essex Kelse/Helios | 11.7 | 60.8* | 325 | 1.90 |
| Essex Kingsey/Tigre | 11.9 | 60.7* | 237 | 1.50 |
| Glenn | 11.6 | 60.8* | 380* | 1.45 |
| Grange Corner Faller/Tigre | 11.5 | 60.4* | 302 | 1.43 |
| Grange Corner Kelse/AC Walton | **12.2** | 59.3 | 283 | 2.08 |
| Tom | 11.4 | **61.1*** | **380*** | 1.19* |
| LSD (p=0.10) | NS | 0.77 | 41.2 | 0.33 |
| Trial mean | 11.7 | 60.5 | 315 | 1.44 |

†In the column, treatments followed by an * are not significantly different from on another at the p=0.10 level.
Top performing treatments are shown in **bold**.
NS, no significant difference.

None of the crosses had crude protein levels above the desired industry minimum of 14%. Adirondack Kelse/Helios and Grange Corner K/A had the highest crude protein levels of 12.2% (Table 5, Figure 1). Tom had the highest starch content of 61.1% and was statistically similar to all but two varieties (Butterworks Kelse/AC Walton and Grange Corner K/A). Falling numbers for all crosses were above 200 seconds, indicating sound quality wheat. Tom had the highest falling number at 380 seconds and was statistically similar to Adirondack Kelse/Helios and Glenn.

Each of the ten spring wheat crosses were tested for deoxynivalenol (DON) vomitoxin, nine of which exceeded the FDA threshold for DON levels considered safe for human consumption (1 ppm) (Table 5). Grange Corner Kelse/AC Walton had the highest DON levels at 2.08 ppm. Essex Kelse/Helios was the only spring wheat cross that was below the FDA threshold at 0.875 ppm and was statistically similar to Adirondack Kelse/Helios and Tom. Contamination of wheat with DON is directly related to the incidence of Fusarium head blight and strongly associated with relative moisture and timing of rainfall at flowering.

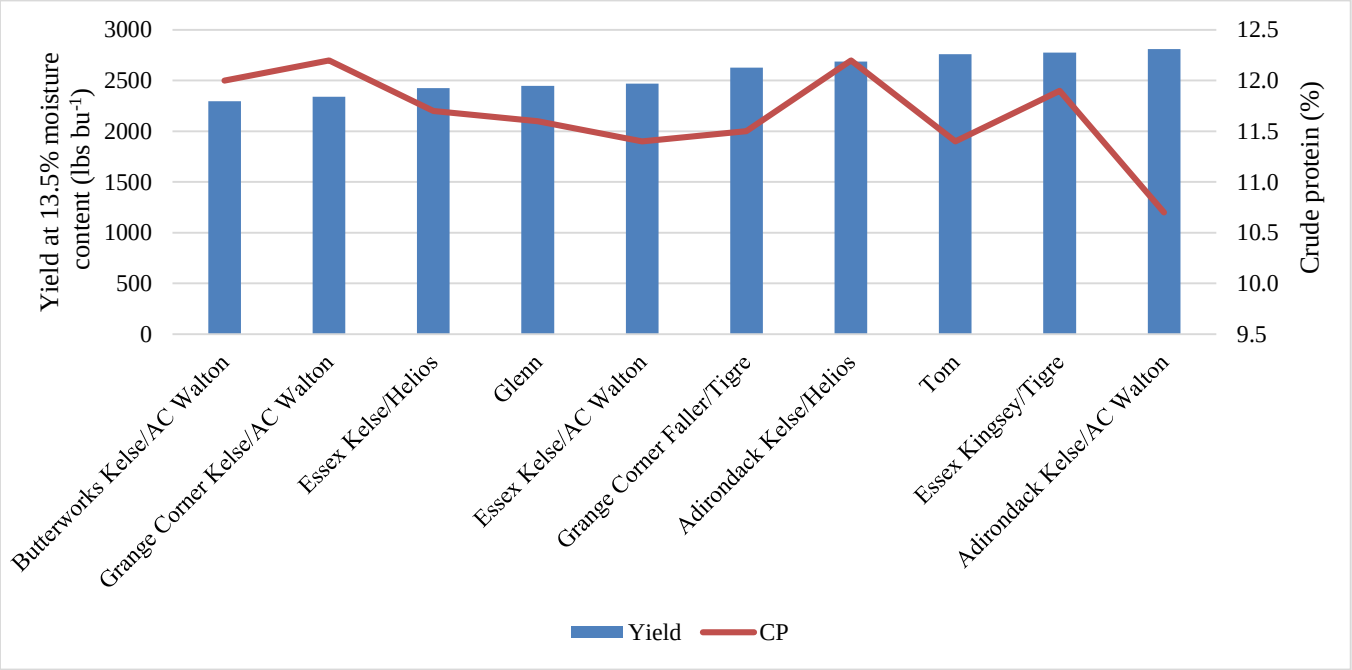


**Figure 1. Yield and protein of spring wheat crosses, Alburgh, VT, 2022.**

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