2016

Barley Weed Control Trial

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NORTHWEST CROPS & SOILS PROGRAM

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UNIVERSITY OF VERMONT EXTENSION
CULTIVATING HEALTHY COMMUNITIES

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Demand for local, organic grains has been increasing in recent years as businesses such as flour mills, malt houses, and bakeries have grown and developed business models to include a higher proportion of local ingredients in their products. While acreage has increased in recent years, the organic grains industry requires the use of innovative strategies to control weeds and address disease issues to grow grains in the most efficient manner. In 2016, the University of Vermont Extension Northwest Crops and Soils Program evaluated barley grown in with different row spacing combined with cultivation to assess the weed control potential of these new seeding strategies.

MATERIALS AND METHODS

The soil type at the Alburgh location was a Covington silty clay loam (Table 1). The plots were 10' x 40' with variable row spacing and cultivation (Table 2). Barley was seeded on 28-Apr at a rate of 158 lbs ac^{-1}. Surrogate mustard was hand broadcasted on 28-Apr at a rate of 3.75 lbs ac^{-1} to ensure weed presence in the trial. Barley was harvested on 3-Aug. The previous crops were a corn and cover cropping trial.

Table 1. Barley weed control trial specifications, Alburgh, VT, 2016.

	Borderview Research Farm Alburgh, VT
Soil type	Covington silty clay loam, 0-3% slope
Previous crops	Corn and fall seeded cover crops
Plot size (feet)	10 x 40
Tillage type	Spring plow, disk, and spike tooth harrow
Barley planting date	28-Apr
Barley seeding rate (lbs ac^{-1})	158
Mustard planting date	28-Apr
Mustard seeding rate (lbs ac^{-1})	3.75
Barley harvest date	3-Aug

Four planting strategies were used in this experiment: band sowing, band sowing with cultivation, narrow rows, standard width rows, and wide rows with cultivation. The band seeding treatment had a five-inch-wide seeded area with 6-inch row spacing. The band sowing treatment was planted with a custom made air seeder, mounted with precision Dutch openers, (Gandy Company, Owatonna, MN). The narrow, standard, and wide had a one-inch-wide seeded area with 4.5-inch, 6.5-inch, and 9.1-inch row spacing, respectively. The narrow and wide seeded treatments were seeded with a Kverneland grain drill (Kverneland Group, Klepp stasjon, Norway), and the standard seeded treatments were seeded with a Sunflower 9412 grain drill (Sunflower Manufacturing, Beloit, KS).

Table 2. Barley seeding methods, Alburgh, VT, 2016.

Treatment	Row Spacing	Planter
Band	6”	Gandy air seeder
Band with cultivation	6”	Gandy air seeder
Narrow	4.5”	Kverneland grain drill
Standard	6.5”	Sunflower grain drill
Wide with cultivation	9.1”	Kverneland grain drill

Three metal pigtails were placed in the ground in each plot to ensure measurements were taken from the same locations through the season. On 27-Jul, biomass was sampled from three locations in each plot using a 2.69 ft^2 quadrat. The biomass was sorted into three categories: barley, mustard, and other weeds. Biomass is presented on a per-acre-dry-matter basis. Heights were taken on 27-Jul in each of the plots; ten measurements were taken for each barley and mustard.

On 3-Aug, the barley was harvested using an Almaco SPC50 small plot combine. Seed was cleaned with a small Clipper M2B cleaner (A.T. Ferrell, Bluffton, IN). They were then weighed for plot yield, tested for harvest moisture using a DICKEY-John M20P moisture meter, and evaluated for test weight using a Berckes Test Weight Scale. Once test weight was determined, the samples were then ground into flour using the Perten LM3100 Laboratory Mill, and were evaluated for crude protein content using the Perten Inframatic 8600 Flour Analyzer. In addition, falling number for the barley was determined using the AACC Method 56-81B, AACC Intl., 2000, on a 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 sample. A falling number lower than 200 indicated high enzymatic activity and poor quality. Deoxynivalenol (DON) analysis was analyzed using Veratox DON 5/5 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. Percent germination was determined by incubating 100 seeds in 4.0 mL of water for 72 hours and counting the number of seeds that did not germinate. Each plot was done in duplicate. Grain assortment, or plumpness was determined using the Pfeuffer Sortimat using 100g of clean seed, and was determined by combining the amount of seed remaining on the 2.78 mm and 2.38 mm sieves (Kitzingen, Germany). Barley yields are presented at 13.5% moisture on a per acre basis. Yields were analyzed using the GLM procedure in SAS and brew values were analyzed using the PROC MIXED procedure in SAS with the Tukey-Kramer adjustment, which means that each cultivar was analyzed with a pairwise comparison. Relationships between variables were analyzed using the GLM procedure.

Hybrid	Yield
A	6.0
B	7.5*
C	**9.0***
LSD	2.0

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 hybrids 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 (i.e. yield). Least Significant Differences (LSDs) at the 0.10 level of significance are shown. Where the difference between two hybrids within a column is equal to or greater than the LSD value at the bottom of the column, you can be sure that for 9

out of 10 times, there is a real difference between the two hybrids. In this example, hybrid C is significantly different from hybrid A but not from hybrid B. The difference between C and B is equal to 1.5, which is less than the LSD value of 2.0. This means that these hybrids did not differ in yield. The difference between C and A is equal to 3.0, which is greater than the LSD value of 2.0. This means that the yields of these hybrids were significantly different from one another.

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. April through August experienced 6.36 fewer inches of precipitation than the average. Despite the lack of rain, June and July were close to the average temperatures. Temperatures in April were almost 5 degrees lower than the 30-year average, while May and August were above the 30-year average. Overall, there were an accumulated 4536 Growing Degree Days (GDDs) this season, approximately 43 more than the historical 30-year average.

Table 3. 2016 weather data for Alburgh, VT.

Alburgh, VT	April	May	June	July	August
Average temperature (°F)	39.8	58.1	65.8	70.7	71.6
Departure from normal	-4.90	1.80	0.00	0.10	2.90
Precipitation (inches)	0.00	1.50	2.80	1.80	3.00
Departure from normal	-0.26	-1.92	-0.88	-2.37	-0.93
Growing Degree Days (32°F-95°F)	291	803	1017	1201	1224
Departure from normal	-98	50	3	4	84

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.

Prior to harvest, the barley and surrogate mustard was measured for heights (Table 4). The average barley height was 48.7 cm and the average mustard height was 48.2 cm. The band seeded treatment that was not cultivated had the tallest barley, but was not statistically significant from the cultivated band treatment or the wide seeded treatment. The narrow seeded barley had the shortest mustard at 44.7 cm tall, but was not significantly significant from three other treatments.

Table 4: Barley and mustard heights pre-harvest, Alburgh, VT, 2016.

Treatment	Barley height cm	Mustard height cm
Band	**53.0***	54.6
Band with Cultivation	48.7*	48.3*
Narrow	46.1	**44.7***
Standard	46.3	44.8*
Wide	49.7*	48.7*
Trial mean	48.7	48.2
LSD (0.10)	6.40	9.47

*Treatments with an asterisk are not significantly different than the top performer in **bold**.
LSD – Least significant difference.

Biomass was sampled and separated between barley, mustard, and other weeds within each treatment (Table 5). The average barley biomass was 18,188 lbs ac^{-1}; the wide seeded treatment provided the most biomass with 20,349 lbs ac^{-1}. The cultivated band, narrow, and standard width treatments were not statistically significant from the wide seeded treatment. There were no significant differences in mustard biomass between treatments; the trial average was 3328 lbs ac^{-1}. Weed biomass was lowest in the narrow treatment but not significantly different from the wide and standard treatments.

Table 5: Biomass of barley, mustard, and other weeds, Alburgh, VT, 2016.

Treatment	Barley biomass lbs ac^{-1}	Mustard biomass lbs ac^{-1}	Other weed biomass lbs ac^{-1}
Band	16339	3724	1538
Band with Cultivation	18786*	3360	1417
Narrow	17778*	2631	**567***
Standard	17687*	3846	1012*
Wide	**20349***	3077	972*
Trial mean	18188	3328	1101
LSD (0.10)	3700	NS	453

*Treatments with an asterisk are not significantly different than the top performer in **bold**.
LSD – Least significant difference.
NS – No significant difference between treatments.

After harvest, barley was assessed for harvest moisture, test weight, and yield (Table 6). The average harvest moisture was 12.3%. Three treatments were not statistically significant from the band sown barley without cultivation. None of the treatments reached the ideal test weight of 48 lbs per bushel; there were no significant differences between treatments. The average trial yield was 1492 lbs ac^{-1}; there were no significant differences between treatments.

Table 6: Harvest measures of barley seeding treatments, Alburgh, VT, 2016.

Treatment	Harvest moisture	Test weight	Yield
	%	lbs bu^{-1}	lbs ac^{-1}
Band	**13.9***	40.4	1512
Band with Cultivated	12.2*	41.5	1469
Narrow	10.9	39.9	1557
Standard	11.7*	42.1	1433
Wide	12.6*	38.9	1491
Trial mean	12.3	40.6	1492
LSD (0.10)	2.66	NS	NS

*Treatments with an asterisk are not significantly different than the top performer in **bold**.
LSD – Least significant difference.
NS – No significant difference between treatments.

Barley from the five different treatments was tested for quality (Table 7). There were no significant differences between treatments regarding germination, protein, or DON. The trial averaged 94.6% germination, 10.4% crude protein, and 0.515 ppm of DON. The band sowing treatment with cultivation had the highest thousand kernel weight, but was not statistically different from the band sowing treatment that was not cultivated. The band sowing treatment that was not cultivated had the plumpest kernels, but was not statistically significant from the cultivated band sowing treatment or the standard seeded treatment.

Table 7: Barley quality assessments, Alburgh, VT, 2016.

Treatment	Germination	Crude protein @ 12% moisture	DON	Thousand kernel weight	Plumpness (>2.38 mm)
	%	%	ppm	g	%
Band	96.8	10.4	0.575	48.1*	**95.2***
Band with Cultivation	90.0	10.7	0.375	**48.5***	94.2*
Narrow	96.5	10.1	0.525	43.4	91.2
Standard	96.3	10.5	0.625	45.3	94.1*
Wide	93.5	10.5	0.475	46.3	92.8
Trial mean	94.6	10.4	0.515	46.3	93.5
LSD (0.10)	NS	NS	NS	1.91	2.28

*Treatments with an asterisk are not significantly different than the top performer in **bold**.
LSD – Least significant difference.
NS – No significant difference between treatments.

DISCUSSION

It is important to remember that the results only represent one year of data. Overall, it appeared that the band and wide sown treatments were successful in decreasing weed presence without sacrificing barley quality. Although the reduced weed pressure from cultivated treatments did not provide a yield or quality advantage in this dry year. Further research on barley sowing methods will be required to determine the most effective method. This trial will be evaluated again 2017.

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