

Winter Rye Variety Trial 2017 Results

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Winter rye has long been an important cover crop species in Maine, with “Aroostook” as the standard variety. New markets for rye have developed in the region, including seed, flour, and beverage markets. Variety selection is a critical management decision and will depend on what growing conditions, uses, and markets farmers are targeting (see Table 2). Eight winter rye varieties, described in Table 1, were evaluated under drilled and broadcast seeding for their suitability for different uses and markets.

Table 1. Winter rye varieties, types, characteristics, and suppliers for the 2017 trial.

Variety	Type	Characteristics	Seed source
Aroostook	cover crop	Released in 1981 by Cornell and the Maine Department of Agriculture. Cold tolerant with good late fall and early spring growth.	USDA-NRCS Big Flats Plant Material Center
Guardian	cover crop	Selected for winter hardiness, early vigor and early spring green up.	LaCrosse Seed Co., La Crosse, WI
Oklon	cover crop & forage	Released in 1993 by the Nobel Foundation and Oklahoma Agriculture Experiment Station.	Oklahoma Foundation Seed
Winter Grazer 70	forage	Forage type with good early vigor.	Pennington Seed Co., Madison, GA
Brasetto	grain	Hybrid variety developed in Germany. Short plant heights and milling characteristics.	Seedway, Hall, NY
Danko	grain	Selected for high yields, kernel size, test weight, and lodging resistance. Developed by the Polish Plant Breeding Institute, Poznan Poland. Introduced to North America in 1985.	Seedway, Hall, NY
AC Hazlet	grain	Selected for larger kernels, better floret fertility, and shorter plant heights. Released in 2006 and developed by Agriculture and Agri-Food Canada at the Semiarid Prairie Research Center, Swift Current, SK.	Elk Mound Seed, Elk Mound, WI
Midsummer (aka Svedjerug)	heirloom grain	Heirloom variety from Scandinavia. Small kernel size and tall plants. Excellent flavor.	University of Maine

Table 2: Winter rye variety characteristics of potential importance for different markets.

Winter Rye Characteristics	Use or Market		
	Cover Crop	Seed Market	Food & Beverage
Establishes well with broadcast seeding	X		
Fall % ground cover	X		
Winter survival	?	X	X
Biomass in early spring, late spring, and/or at flowering	X		
Early flowering, for roller-crimper system	X		
Rapid grain dry down		X	X
Grain yield		X	X
Grain quality (test wt., % plump, ...)		X	X

METHODS

The trial was conducted at the University of Maine Rogers Research Farm, in Old Town. The eight varieties were planted using three different treatments: drilled at 1 million seeds per acre with a small plot drill on 6.5" spacing, broadcast at 1 million live seeds per acre, and broadcast at 2 million live seeds per acre. The broadcast treatments were spread by hand followed by shallow rototilling and packing because the soil was extremely dry. These and other agronomic practices are described in Table 3.

Table 3. Agronomic practices in Old Town, Maine in 2017.

Old Town	
Previous Crop	Buckwheat cover crop
Soil Type	Nichoville very fine sandy loam
Fertility	20 tons/acre solid dairy manure
Planting Date	September 28
Planting Methods and Rates	Drilled at 1 million live seeds/acre Broadcast at 1 million live seeds/acre Broadcast at 2 million live seeds/acre
Varieties	See Table 1.
Harvest Date	August 2, 2017

RESULTS

Seeding Method

Table 4 shows the results of early spring measurements, including plant stands, tiller density, and biomass. In all cases, the performance of the varieties was not influenced by how they were seeded. Therefore, the results for the different varieties are averaged over the seeding methods, and the results for the different seeding methods are averaged over the varieties.

Both the drill seeding and low rate broadcast seeding produced stands close to the target plant density, which was 23 plants per square foot (1 million plants/acre). The target rate for the high rate broadcast

treatment was 46 plants per square foot (2 million plants/acre) but only 34 plants per square foot was achieved. We have observed in prior studies that seedling establishment decreases with high seeding rates. Seeding method had no effect on above-ground biomass but interestingly, the broadcast seeded plots produced higher root biomass than drill seeded plots. The only other seeding method effect we saw was higher lodging in the high rate broadcast plots as compared with the low rate plots (Table 5), which presumably was due to the significantly higher tiller density (Table 4).

Table 4. Early spring performance of different winter rye varieties and seeding methods: plant density, tiller density, biomass sampled on May 11, and flowering date in Old Town, Maine.

Variety	Plant density (num./ft ²)	Tiller [†] density (num./ft ²)	Above-ground (shoot) dry matter (lbs/ac)	Below-ground (root) dry matter (lbs/ac)	Average flowering date
Aroostook	26 a	70 ab	2967 a	775 c	June 6
Guardian	20 a	68 ab	2277 b	932 bc	June 8
Oklon	26 a	72 ab	2339 ab	858 bc	June 7
Winter Grazer	29 a	66 b	2669 ab	804 c	June 6
Brasetto	27 a	81 a	2758 ab	1361 a	June 7
Danko	28 a	71 ab	2508 ab	1226 ab	June 8
AC Hazlet	24 a	54 b	2405 ab	1015 abc	June 9
Midsummer§	25 -	87 -	1605 -	591 -	June 12
Seeding Method					
Drill	20 B	66 B	2411 A	830 B	June 8
Broadcast, low	23 B	64 B	2563 A	1072 A	June 9
Broadcast, high	34 A	77 A	2706 A	1081 A	June 9

[†]“Tillers” was counted as any stem with three or more leaves and includes the main stem, tillers, and side tillers

§ The Midsummer variety was evaluated only with the drill seeding method and so was not included in this statistical analysis.

Variety Performance as a Cover Crop

All varieties provided good stands and similar ground cover in the fall after seeding (data not shown). Winter survival also was good for all of the varieties tested. There were no significant differences among the varieties in terms of spring plant stands. However, some varieties differed in how many tillers they produced. Midsummer and Brasetto produced significantly more tillers than AC Hazlet and Winter Grazer. Note that in this report “tillers” refers to any stem that has three or more leaves. “Tillers” includes the main stem, tillers, and side tillers.

The varieties produced from 1600 to almost 3000 pounds of above-ground biomass by May 11th, when, depending on the year, field preparation for spring crops might begin (Table 4). For the most part, above-ground (or “shoot”) biomass production at this stage was similar among the varieties. The only statistically significant differences were that Aroostook produced substantially higher shoot biomass than Guardian and, in a separate analysis of just the drill seeded treatments, shoot biomass for Aroostook and Brasetto was significantly higher than that for Midsummer.

Root biomass differed more among the varieties than shoot biomass. Aroostook and Winter Grazer, which had relatively high shoot biomass, had among the lowest root biomass. Brasetto, Danko, and AC Hazlet had among the highest root biomass at this stage of growth.

Above-ground biomass is presented again in Figure 1, with two additional dates to show biomass accumulation over time. Although there appear to be differences among the varieties at the May 22 sampling date, we were unable to detect any statistically significant differences due to high variability among the plots. Varieties produced between about 3,000 and 5,000 pounds of above-ground biomass by this date, which is when terminating for summer crops might begin.

Farmers planning to use a roller-crimper to create a dead rye mulch for no-till seeding must wait until the plants are in full flower and shedding pollen to avoid substantial regrowth of the rye. In our trial, Aroostook and Winter Grazer were the earliest to flower, starting on June 6, and Midsummer was the latest, starting on June 12 (Table 4). At this stage, Aroostook and Oklon produced significantly more above-ground biomass than AC Hazlet and Guardian. Other differences among the varieties were insignificant. However, all varieties produced over 6,000-8,000 pounds per acre of above-ground biomass, which is considered the minimum needed to achieve adequate weed suppression in a rye-mulch no-till system (see References).

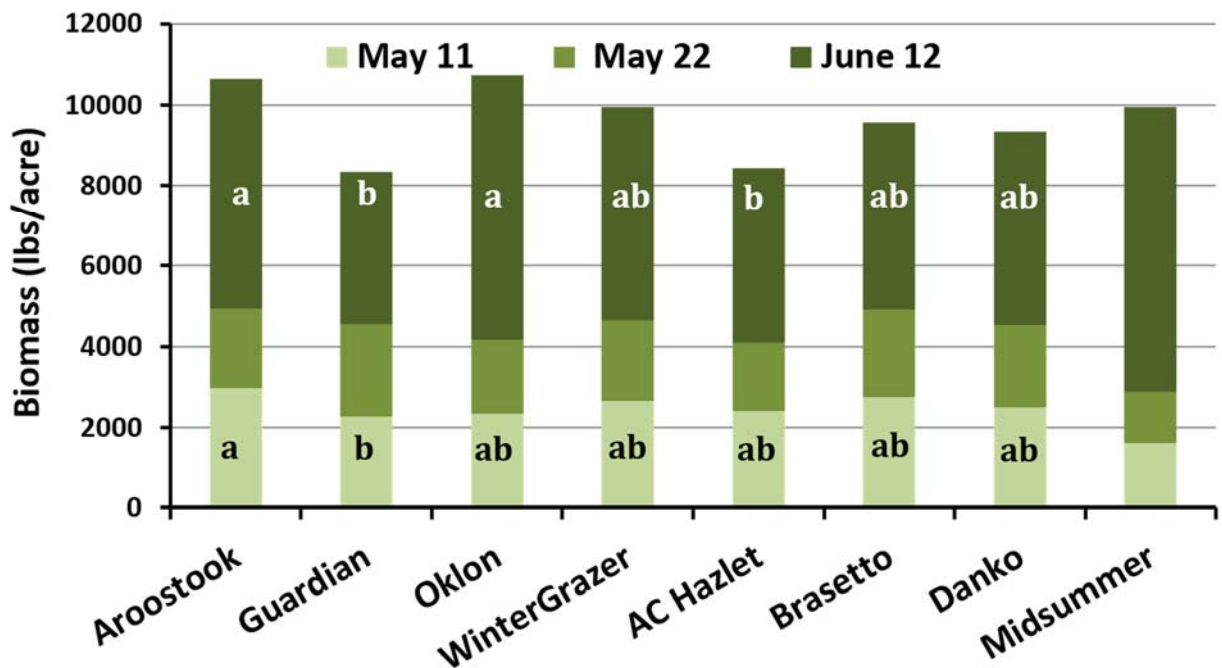


Figure 1. Winter rye above-ground (shoot) biomass at three dates, averaged over the three planting methods. Bars are cumulative; the top of the lightly shaded bar represents biomass on May 11, the top of the medium shaded bar represents biomass on May 22, and the top of the darkly shaded bar represents biomass on June 12. Varieties that share any letters in common within a bar color (i.e., sampling date) are not significantly different from one another at that sampling date. The May 22 date does not have any letters because there were no significant differences among varieties. Midsummer does not have letters because it was only evaluated under drill seeding and so could not be included in the statistical analysis.

Variety Performance as a Grain or Seed Crop

As expected, the cover crop and forage type varieties (Aroostook, Guardian, Midsummer, Oklon and Winter Grazer) were the tallest, whereas the grain types (Brasetto, Danko, Hazlet) had the highest grain yields (Table 5). The hybrid Brasetto out yielded all of the others. Aroostook was at the low end for yield and had substantially higher lodging and lower test weights than any of the other varieties.

Table 5. Height, lodging, and grain yield and quality measures of different winter rye varieties and seeding methods grown in Old Town, Maine in 2017.

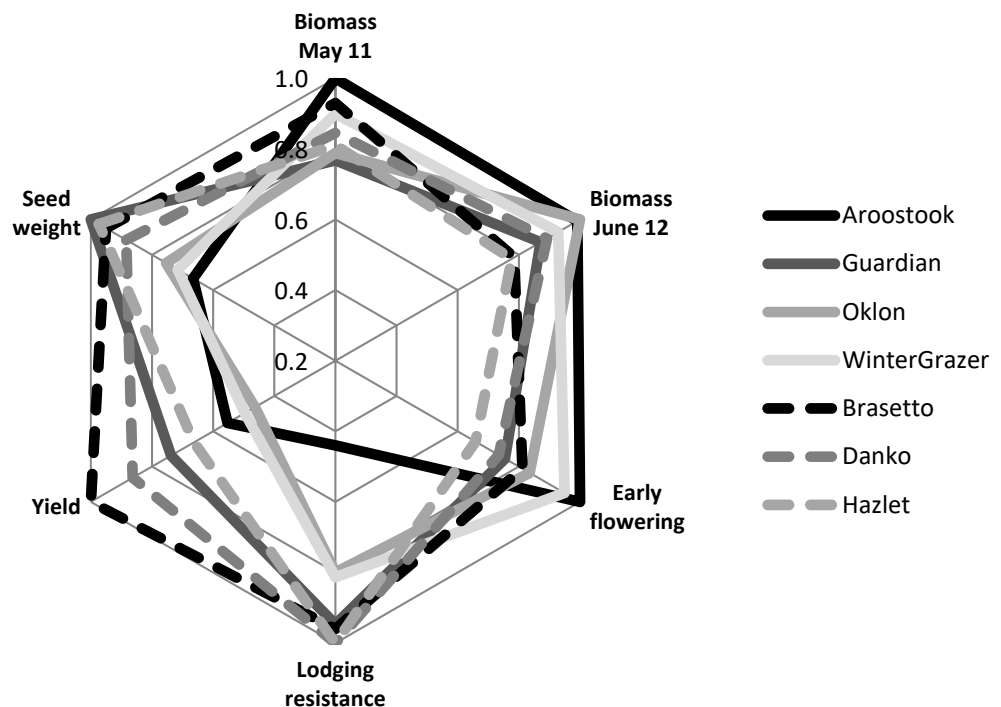
Variety	Height (feet)	Lodging (1-9) [†]	Yield [‡] (lbs/acre)	Grain moisture (%)	Test weight (lbs/bu)	Thousand seed weight (g)
Aroostook	6.9	5.7 a	2832 de	12.2 b	54.2 c	24.0 d
Guardian	5.2	1.9 b	3779 bc	13.7 a	56.8 a	36.0 a
Oklon	6.0	3.0 b	2373 e	12.5 b	55.7 b	27.1 c
Winter Grazer	5.8	2.9 b	2543 e	12.4 b	55.4 b	25.8 cd
Brasetto	4.3	1.8 b	5124 a	12.9 ab	56.5 a	34.2 ab
Danko	4.9	1.5 b	4424 b	12.9 ab	56.9 a	31.8 b
AC Hazlet	4.7	1.5 b	3397 cd	13.4 a	56.8 a	35.1 ab
Midsummer [§]	5.6	3.3 -	2564 -	12.2 -	53.4 -	19.8 -
Seeding Method						
Drill	5.4	2.1 B	3474 A	12.9 A	55.7 A	29.4 A
Broadcast, low	5.3	2.3 B	3357 A	12.8 A	56.1 A	30.7 A
Broadcast, high	5.2	3.5 A	3527 A	12.9 A	55.8 A	30.2 A

[†]1 = no lodging, 9 = severe lodging

[‡]Yield at 13.5% moisture

[§] The Midsummer variety was evaluated only with the drill seeding method and so was not included in this statistical analysis.

Figure 1. Star diagram of the relative performance of winter rye varieties for characteristics important for use as a cover crop or a grain crop. Results are scaled so that, for each characteristic, the highest value is 1.0 and other values are expressed as the fraction of that highest value.



The “star diagram” in Figure 1 summarizes the winter rye variety performance results for three characteristics important for cover crop use (spring biomass, early summer biomass, and flowering date) and three characteristics important for grain production (resistance to lodging, yield, and seed weight). Results are scaled to show the relative performance of the varieties for each characteristic such that the highest value for each measure is expressed as 1.0 and other values are expressed as the fraction of that highest value.

Aroostook, the standard winter rye variety being used in Maine as a cover crop, performed well for the cover crop characteristics but poorly as a grain crop, having the lowest lodging resistance and among the lowest yield and seed weight. These results emphasize the importance for cover crop seed producers to find alternative varieties that perform well for grain production, as well as for use as a cover crop. Guardian, Danko, and Brasetto performed relatively well in all of the measures in Figure 1. Note however that Brasetto is not suitable as a cover crop due to high seed cost.

CONCLUSIONS

- Varieties did not differ in how they performed with drill vs broadcast seeding. However, note that the broadcast seeding method included a light rototilling and packing.
- All varieties produced over 8,000 pounds per acre of above-ground biomass by flowering time, which is considered adequate for weed suppression in no-till roller-crimper systems. However, the later flowering for AC Hazlet and Midsummer make them less suitable for this system.
- Aroostook rye performed well for all cover crop measures but lodged easily and yielded relatively poorly making it a poor choice for grain production. The Aroostook seed for this trial was sourced from a seedbank, while most farmers grow farm-saved seed, but we doubt farm-saved seed would have performed better.
- Brasetto was the top yielding variety, with low lodging, average grain moisture, and good seed and test weight. As a hybrid variety with seed costs 2-3 times greater than standard varieties, it is not well suited for cover crop use but is a good choice for higher-value human-grade grain markets.
- Guardian and Danko were the most “well rounded” of the varieties, performing relatively well for both cover crop and grain characteristics.
- Keep in mind that these are results from just one trial in one year. Seek out additional information before deciding which varieties are best for your farm.

References:

Curren, W., D. Lingenfelter, M. Ryan, D. Sandy, M. Dempsey, and B. Crockett. 2015. Weed Management. In: Penn State Organic Crop Production Guide. pp. 121-150. The Pennsylvania State University, State College, PA.

<http://agsci.psu.edu/organic/resources/organic-crop-production-guide>

Smith, A.N., S.C. Reberg-Horton, G.T. Place, A.D. Meijer, C. Arellano, J.P. Mueller. 2011. Weed Science Vol. 59, Issue 2, pg(s) 224- 231. <https://doi.org/10.1614/WS-D-10-00112.1>

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