

Production of Specialty Small Grains in Wisconsin

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Short and S-Wheat

- Diverse small grain species can be produced in Wisconsin.
- The lack of specialized management recommendations and markets may be a hindrance to growers choosing to pursue specialty grains.

Introduction

Small grain production in Wisconsin is largely made up of soft red winter wheat and rye, with 265,000 (~80% grain acres) and 260,000 (~12% grain acres) acres planted in 2024, respectively (NASS, 2024). Soft red winter wheat is a class of wheat that is used for a variety of food products, such as cookies and crackers (U.S. Wheat Associates, 2024). Other commonly grown small grains in the state include oat, with 140,000 acres planted in 2024, and barley, with 15,000 acres planted in 2024 (NASS, 2024). However, there is an increase in interest for locally produced food ingredients, which may drive interest in specialty small grains (Table 1).

The six U.S. wheat classes are determined by their red or white bran color, hard/high or soft/low protein content, and winter or spring growth habit (Table 1). Some species, like spelt, einkorn, and emmer, considered “ancient wheats”, may have lower yields due to minimal genetic improvement and require post-harvest processing to de-hull the grain (Thapa et al., 2023). These challenges may be countered by lower fertilizer requirements and higher consumer demands (Cadeddu et al., 2021). Barley, oat, rye, triticale, and other small grains are commonly grown as a forage or cover crop, but they can also be utilized as food ingredients for both humans and livestock.

Materials & Methods

An experiment was established at the Arlington Agricultural Research Station in Columbia County, Wisconsin to compare the grain yields of different small grain species. The trial was established across three growing seasons (2020-2021, 2021-2022, 2022-2023). Planting and harvest dates, along with spring fertilizer rate and application dates can be found in Table 2. The previous crop was soybean in all years and small grains were direct seeded into 7.5” rows. The seeding rate varied by small grain type. Wheat (soft red winter, soft white winter, hard red winter, hard white winter, hard red spring, and durum) was seeded at a rate of 1.75 million seeds per acre. Spelt, triticale, oat, and barley (winter malting, spring malting, spring non-malting) were seeded at a rate of 1.5 million seeds per acre. Non-hybrid winter rye, einkorn, and emmer were seeded at a rate of 1.0 million seeds/acre and hybrid winter rye was seeded at a rate of 800,000 seeds per acre. Management decisions were based on state recommendations for wheat. All fall planted treatments received 55 lb. N per acre at green-up (~Feekes 3-4) and all spring planted treatments received 20 lb. N per acre at or shortly after planting.

Table 1. Small grains by primary U.S. production areas and common end-uses.

Small Grains	Primary Production Area	End-Use
U.S. Wheat Classes		
Soft red winter wheat	Eastern portion of the US	Sponge cakes, cookies, crackers, and other confectionary products
Soft white wheat	Pacific Northwest with small acreage in Michigan	Sponge cakes and Asian noodles
Hard red winter wheat	Great Plains, Pacific Northwest, and California	Pan breads, hard rolls, croissants, and flat breads
Hard white wheat	Central Plains (Nebraska, Kansas, Colorado) and California	Asian noodles, pan breads, and flat breads
Hard red spring wheat	North Central Region (North Dakota, South Dakota, Montana)	Bagels, artisan breads, pizza crust, and other strong dough products
Durum	North Dakota with smaller acreage in Montana and California	Pasta, couscous, and some Mediterranean breads
Ancient Wheats		
Spelt, Einkorn, and Emmer	Scattered production in North Central Region and Eastern U.S.	Flour, health food products
Other Small Grains		
Barley	Central Plains and Pacific Northwest	Animal feed, malt products, cereals, soups
Triticale	Scattered production in Pacific Northwest, Midwest, and South	Animal feed, health food market
Rye	Oklahoma, Pennsylvania, Wisconsin, North Dakota	Animal feed, flour, alcoholic products
Oat	Central Plains, North Central Region (North Dakota, South Dakota), Texas, and Wisconsin	Animal feed, rolled oats, oat flour

Table adapted from (Lindsey, 2024).

Table 2. Planting, spring fertilizer application, and harvest dates for the experiment planted at the Arlington Agricultural Research Station in Columbia County, Wisconsin in 2021-2023.

Fall Planted Treatments			
	2021	2022	2023
Planting Date	09/25/20	09/29/21	09/23/22
Fertilizer Date (55 lbs N/a)	03/29/21	04/11/22	04/10/23
Harvest Date	07/21/21	07/29/22	07/25/23
Spring Planted Treatments			
	2021	2022	2023
Planting Date	03/31/21	04/12/22	04/10/23

Fertilizer Date (20 lbs N/a)	04/06/21	04/12/22	04/10/23
Harvest Date	07/26/21	08/11/22	08/02/23

Results

Winter Small Grains. Hybrid winter rye averaged the highest grain yield across the three years, at 121 bu/acre. Soft red and soft white winter wheat were the next highest, at 98 bu/acre. This was followed by hard white winter wheat, winter malting barley, and non-hybrid winter rye at 90, 88, and 85 bu/acre, respectively. Hard red winter wheat and triticale had average yields of 81 and 78 bu/ac, respectively. Spelt averaged the lowest yields, at an average of 63 bu/acre. The yield of the winter small grains, separated by variety, can be found in Table 3.

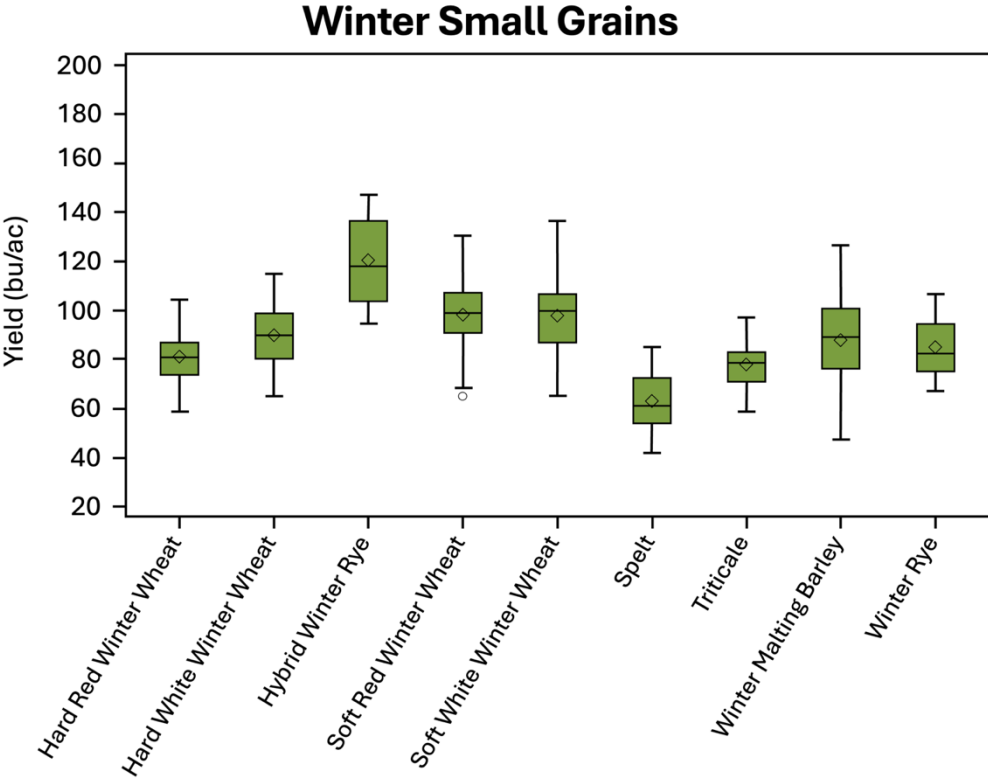


Figure 1. Grain yield of winter small grains. The box shows the inter-quartile range, representing the middle 50% of the value. The solid line within each shaded box represents the median value and diamond shows the mean value. The upper and lower whiskers represent the maximum and minimum value, respectively. Open circles show potential outliers.

Spring Small Grains. While oat yielded the highest average across the three years, at 112 bu/acre, yields were incredibly variable across years. Spring malting barley and non-malting barley averaged yields of 82 and 72 bu/ac, respectively. The two spring wheats, hard red spring and durum wheat, yielded much lower on average than the winter wheats, at 61 and 60 bu/ac, respectively. The spring planted ancient wheats consistently yielded the lowest, at 54 and 52 bu/ac, respectively. Overall, spring planted treatments were more variable between years compared to fall planted treatments. The yield of the spring small grains by variety are found in Table 4.

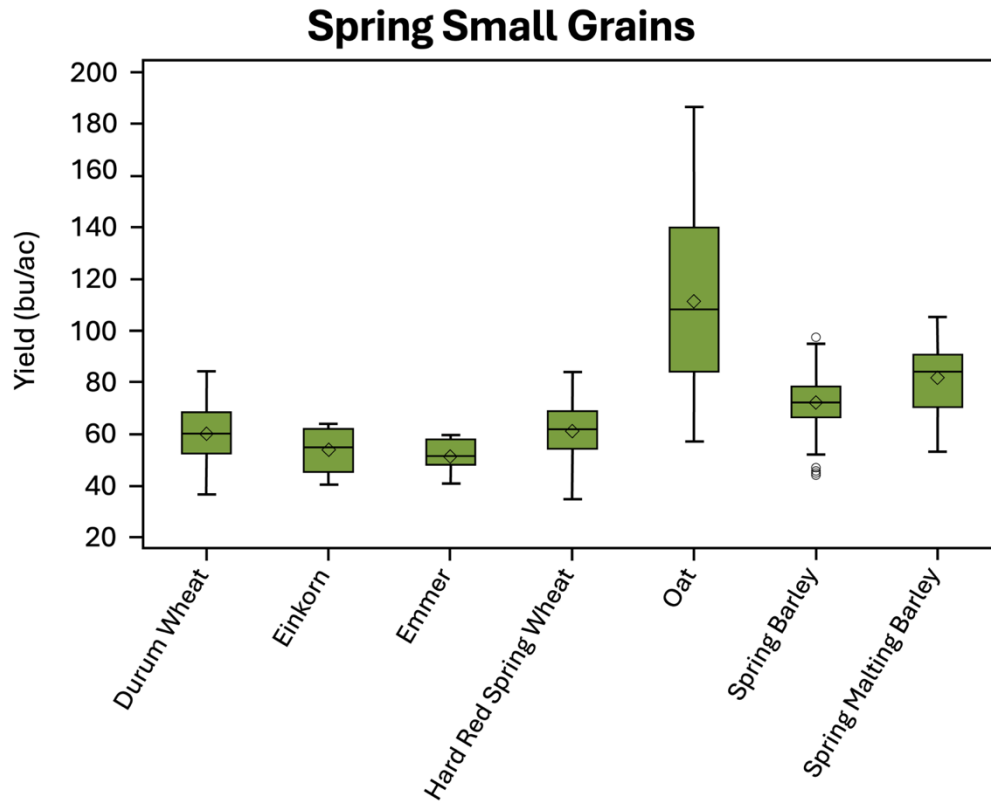


Figure 2. Grain yield of spring small grains. The box shows the inter-quartile range, representing the middle 50% of the value. The solid line within each shaded box represents the median value and diamond shows the mean value. The upper and lower whiskers represent the maximum and minimum value, respectively. Open circles show potential outliers.

Conclusions & Considerations

Across the three years, fall-planted small grains had higher average yields than the spring-planted grains. This could be attributed to the shorter growing season, making it more susceptible to issues due to weather and pests. Fall planted treatments yielded the highest in 2021 and the lowest in 2023. Spring planted treatments yielded the highest in 2021, which also corresponded to the earliest planting date.

Yield is important to consider when deciding species and varieties to plant, but there are other factors to consider. Most traditional grain elevators will not buy specialty grains, so be sure to have a contract and logistical plan in place before moving forward. There are also quality parameters to consider, based on the end-use of the selected grain. Measures of quality such as protein, test weight, grain plumpness, etc. may be important points to consider depending on the market you intend to sell to.

Table 3. Grain yield of winter small grains. Different letters within a small grain type and year indicate a statistically significant difference in grain yield at 95% confidence.

Type	Variety	2021	2022	2023
		-----Yield (bu/ac)-----		
Hard Red Winter Wheat	Bakers Ann	80 A	89 AB	81 A
	Double Stop CL Plus	78 A	76 BC	77 AB
	Expedition	79 A	83 AB	83 A
	Green Hammer	88 A	66 C	66 B
	SY Wolf	80 A	83 AB	78 AB
	Showdown	93 A	94 A	81 A
	Skydance	92 A	78 BC	74 A
	Smiths Gold	86 A	84 AB	82 A
Hard White Winter Wheat	Breck	82 AB	93 AB	89 AB
	Joe	97 AB	94 AB	87 AB
	KS Silverado	91 AB	83 AB	82 AB
	Monarch	97 AB	93 AB	87 AB
	OCW04S717T-6W	96 AB	87 AB	81 AB
	OK 12716W	106 A	97 A	90 AB
	Snowmass 2.0	92 AB	100 A	98 A
	Thunder CL	82 B	77 B	77 B
Hybrid Winter Rye	KWS Bono	127 A	126 A	108 A
	KWS Daniello	124 A	130 A	100 A
	KWS Propower	135 A	137 A	98 A
Soft Red Winter Wheat	25R74	104 A	98 A	97 A
	D511W	98 A	88 A	99 A
	DY 9862	101 A	95 A	102 A
	FS 623	104 A	92 A	89 A
	Harpoon	97 A	100 A	94 A
	Jung 5888	109 A	88 A	88 A
	LW 2023	110 A	100 A	108 A
	SY Viper	98 A	95 A	102 A
Soft White Winter Wheat	Dyna-Gro 9242W	99 AB	101 A	88 AB
	Jupiter	107 AB	103 A	94 AB
	KWS 317	116 A	107 A	106 A
	MI14W0190	102 AB	98 A	81 B
	MI16W0133	100 AB	99 A	84 B
	MI16W0528	105 AB	105 A	91 AB
	Moonlight	95 B	96 A	84 B
	Whitetail	106 AB	99 A	81 B
Spelt	Comet	77 A	61 AB	54 AB
	Sabre	62 B	57 B	48 B
	Sungold	77 A	70 A	60 A
Triticale	Gainer 154	78 A	83 A	75 A
	Trical 815	85 A	Not tested	Not tested
	Trical exp 917 "Ace"	Not tested	72 A	74 A
Winter Malting Barley	Avalon	90 A	69 B	54 B
	Flavia	101 A	Not tested	Not tested
	Hirondella	96 A	97 A	86 A
	Marouetta	Not tested	83 AB	95 A
	Thoroughbred	103 A	83 AB	96 A
Winter Rye	Danko	93 A	92 A	83 A
	Hazlet	86 AB	99 A	83 A
	Spooner	80 B	76 B	73 A

Table 4. Grain yield of spring-planted small grains. Different letters within a small grain type and year indicate a statistically significant difference in grain yield at 95% confidence.

Type	Variety	2021	2022	2023
-----Yield (bu/ac) -----				
Durum Wheat	Alzada	56.6 BC	46.0 B	55.3 B
	Divide	52.3 C	49.9 B	58.9 AB
	Joppa	70.6 A	62.7 A	59.3 AB
	Lustre	67.0 AB	51.0 B	61.8 AB
	ND Gano	70.2 A	56.6 AB	68.3 A
	ND Riveland	66.7 AB	53.1 AB	69.0 A
	TCG-Bright	68.0 AB	51.4 AB	69.4 A
Einkorn	Azure	60.0	44.2	57.3
Emmer	Lucille 1 (hull on)	48.5 A	47.1	58.6
	Lucille Unhulled	51.2 A	Not tested	Not tested
Hard Red Spring Wheat	CP 3530	63.6 ABC	58.6 A	66.0 AB
	Dagmar	64.1 ABC	47.2 BC	66.1 AB
	MN-Torgy	72.8 A	51.2 BC	65.5 AB
	ND Frohberg	58.3 BC	51.1 BC	62.3 AB
	ND VitPro	56.4 C	45.8 B	59.6 B
	SY Valda	69.7 AB	59.1 A	74.7 A
	Vida	60.7 ABC	48.8 BC	70.2 AB
	WB 9590	68.1 ABC	55.6 BC	74.0 A
Oat	Antigo	153.1 A	98.2 AB	68.7 A
	Badger	135.3 A	96.1 B	72.5 A
	BetaGene	151.4 A	Not tested	Not tested
	Esker	134.7 A	106.0 AB	85.1 A
	Esker 2020	159.5 A	111.3 AB	83.9 A
	ForagePlus	152.9 A	122.8 A	91.0 A
	Laker	135.3 A	109.3 AB	83.0 A
	WIX10305-4	Not tested	121.9 AB	69.6 A
Spring Barley	Kewaunee	76.0 A	65.0 A	75.0 A
	Quest	83.5 A	62.5 A	76.7 A
	Robust	81.5 A	58.3 A	71.9 A
Spring Malting Barley	Fantex	92.1 A	64.9 A	91.9 A
	ND Genesis	89.3 A	78.1 A	87.2 A
	Tradition	87.2 A	69.1 A	77.9 A

Acknowledgements

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References

Cadeddu, F., Motzo, R., Mureddu, F., and Giunta, F. (2021). Ancient wheat species are suitable to grain-only and grain plus herbage utilisations in marginal Mediterranean environments. *Agronomy for Sustainable Development*, 41, 15.

Lindsey, L. (2024). Production of Specialty Small Grains in Ohio. Ohio State University Extension. <https://ohioline.osu.edu/factsheet/anr-0154>

USDA National Agricultural Statistics Service (NASS). (30 Sept. 2024). Wisconsin Ag News – Small Grain Summary. United States Department of Agriculture. https://www.nass.usda.gov/Statistics_by_State/Wisconsin/Publications/Crops/2024/WI-Small-Grains-09-24.pdf

Thapa, R.K., Eberle, C., and Youngquist, C. (2023). Ancient spring wheat production in Wyoming. *Crop, Forage & Turfgrass Management*, 9, e20237.

U.S. Wheat Associates. (2024). Soft Red Winter. <https://www.uswheat.org/crop-quality/soft-red-winter/>