

Production of Specialty Small Grains in Ohio



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In Ohio, soft red winter wheat is the predominantly produced small grain, with 530,000 acres planted in fall 2024 (USDA-NASS, 2024). Soft red winter wheat is commonly used for sponge cakes, cookies, crackers, and other confectionary products (U.S. Wheat Associates, 2023). Although soft red winter wheat is commonly produced by farmers in Ohio, interest in other classes of wheat or other small grains is due to local demand and niche markets (Table 1).

Table 1. Small grains, primary production areas within the U.S., and common end uses.

Small Grain	Primary Production Area	End-Use
U.S. Wheat Classes		
Soft red winter wheat	Eastern portion of the U.S., including Ohio	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, 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



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In the U.S., wheat is divided into six classes based on bran color (red or white), protein content (hard = high protein, soft = low protein), and growth habit (winter or spring), which influence end-use (Table 1). Ancient wheats, such as spelt, einkorn, and emmer, have been minimally changed by breeding efforts and are marketed by health food industries. Ancient wheat yields are often lower than modern wheat varieties, and grain often requires dehulling after harvest (Thapa et al., 2023); however, low fertilizer requirements and high consumer demand may offset challenges associated with ancient wheat production (Cadeddu et al., 2021). Other small grains, such as barley, oat, rye, and triticale, are commonly used as a forage or cover crop, but grain can be used as animal feed or within food or drink products.

A three-year experiment (2020-2021, 2021-2022, 2022-2023) was established at the Northwest Agricultural Research Station in Wood County, Ohio, to compare soft red winter wheat yield to specialty small grains. Winter small grains were planted within 2 to 11 days of the county Hessian fly-free date of September 23 and harvested in July (Table 2). Spring small grains were planted in April and harvested in late July or early August. For all years, soybean was the previous crop and small grains were planted in 7.5-inch row width. The seeding rate varied by small grain type. Soft red winter wheat, soft white winter wheat, hard red winter wheat, hard white winter wheat, hard red spring wheat, and durum were seeded at 1.75 million seeds/acre. Spelt, winter and spring barley, triticale, and oat were seeded at 1.5 million seeds/acre. Winter rye for feed, einkorn, and emmer were seeded at 1.0 million seeds/acre while hybrid winter rye was seeded at 0.8 million seeds/acre. The entire field area received minimum tillage each fall prior to planting. Nitrogen fertilizer, ranging from 27 to 33 lb N/acre, was applied to the entire field area in the fall. Each spring, an additional 90 lb N/acre was applied to the winter small grains (late March to mid-April) and spring small grains (mid-May to early June). The entire field area had lime, phosphorus, and potassium applied as needed to maintain soil test levels appropriate for winter wheat production.

Table 2. Planting and harvesting dates for winter and spring small grains planted at the Northwest Agricultural Research Station in Wood County, Ohio.

Year	Winter Small Grains		Spring Small Grains	
	Planting Date	Harvesting Date	Planting Date	Harvesting Date
1	Sept 25, 2020	July 22, 2021	April 5, 2021	July 22, 2021
2	Oct 2, 2021	July 11, 2021	April 20, 2021	Aug 4, 2021
3	Oct 4, 2022	July 10, 2023	April 13, 2023	Aug 2, 2023

Winter Small Grains. Across the three years, the standard small grain for Ohio, soft red winter wheat, yielded the greatest, averaging 93 bu/acre (Figure 1). Soft white winter wheat, hard red winter wheat, and hard white winter wheat grain yield was slightly lower, averaging 87, 81, and 85 bu/acre, respectively. The fall-planted ancient wheat, spelt, yielded an average of 47 bu/acre. Winter malting barley had an average yield of 82 bu/acre and triticale had an average yield of 80 bu/acre. Hybrid winter rye yielded an average of 71 bu/acre while winter rye for feed yielded 59 bu/acre. Yield of winter small grains by variety is shown in Table 3.

Spring Small Grains. Hard red spring wheat and durum wheat yielded much lower than fall-planted wheat, averaging 39 and 35 bu/acre, respectively (Figure 1). The two spring-planted ancient wheats, einkorn and emmer, yielded even lower at 13 and 17 bu/acre, respectively. Spring barley for feed yielded an average of 51 bu/acre, and spring barley for malt yielded an average of 60 bu/acre. Of the spring small grains, oat yielded the greatest at an average of 73 bu/acre; however, yields were extremely variable depending on the year and variety (Table 4).

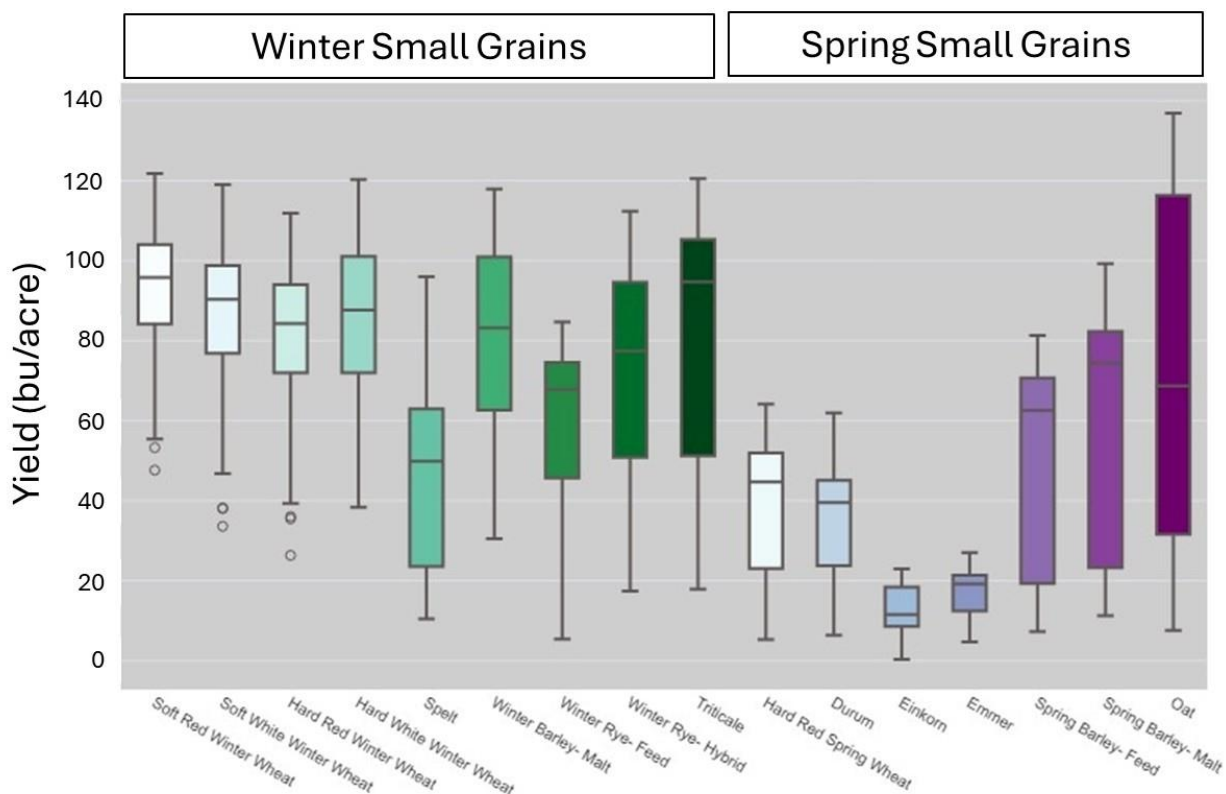


Figure 1. Grain yield of winter and spring small grains. The shaded box shows the inter-quartile range, representing the middle 50% of the value. The solid line within each shaded box represents the median value. The upper and lower whiskers represent the maximum and minimum value, respectively.

Overall, spring small grains tended to yield lower than the winter small grains. This is likely due to the shorter grain fill period associated with spring small grains compared to winter small grains. Furthermore, spring-planted small grains are extremely sensitive to planting date. Spring-planted small grains yielded greatest in 2021 and 2023 when they were planted on April 5 and April 13, respectively. In 2022, the spring small grains were planted on April 20 due to wet weather, which resulted in lower grain yields (Table 5).

Other Considerations. Although grain yield is an important parameter, there are several other important factors that need to be considered before producing specialty small grains.

- **Contracts or Other Agreements.** Specialty small grains are not sold through traditional grain elevators like corn, soybean, and wheat, so a contract or other agreement should be in place before planting.
- **Grain Quality Parameters.** Depending on the end-use, certain grain quality parameters may need to be met. For example, hard red winter wheat should have a medium to high protein content of 10.0% to 13.0% (U.S. Wheat Associates, 2024). However, in an Ohio environment, protein content may be lower. In addition to protein, other quality parameters of test weight, grain plumpness, germination, and deoxynivalenol concentration may be important depending on end-use.
- **Agronomic Best Management Practices.** In Ohio, most small grain agronomic best management practices are based on soft red winter wheat. There are guidelines for producing winter malting barley in Ohio (Lindsey et al., 2020), but limited guidelines for other specialty small grains. Agronomic management of specialty small grains in Ohio is an area of research that needs to be further explored.

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

Type	Brand	Variety	2021 Yield	2022 Yield	2023 Yield
-----bushels per acre-----					
Soft Red Winter Wheat	Pioneer	25R74	103.4 AB	71.0 A	101.1 A
	Dyna-Gro	DY 9862	94.7 DC	71.2 A	102.1 A
	FS Wheat	FS 603	92.3 DC	66.0 A	108.0 A
	MI Crop Imp. Assoc.	Harpoon	91.1 D	69.3 A	103.0 A
	Jung	Jung 5195	97.3 BCD	80.4 A	106.7 A
	Jung	Jung 5888	96.4 DC	77.4 A	107.2 A
	Legacy	LW 2023	104.7 A	75.4 A	108.2 A
	AgriPro	SY Viper	98.9 ABC	61.2 A	109.6 A
Soft White Winter Wheat	Dyna-Gro	9242W	96.3 A	60.4 A	102.1 A
	MI Crop Imp. Assoc	Jupiter	94.7 A	40.6 A	101.1 BC
	KWS	KWS 317	95.6 A	73.1 A	114.0 A
	MI Crop Imp. Assoc	MI 14W019	88.9 AB	71.7 A	not tested
	MI Crop Imp. Assoc	MI 16W013	not tested	not tested	97.9 BC
	MI Crop Imp. Assoc	MI 16W052	93.5 A	73.6 A	95.9 BC
	MI Crop Imp. Assoc	Moonlight	81.7 B	68.4 A	100.2 BC
	MI Crop Imp. Assoc	Whitetail	88.8 AB	63.4 A	93.8 BC
Hard Red Winter Wheat	OK Foundation Seed	Bakers Anne	78.9 E	46.7 BC	94.9 BCD
	OK Foundation Seed	Double Stop CL Plus	79.0 E	58.0 ABC	95.7 BC
	SD Ag. Exp. Station	Expedition	86.1 B	71.9 A	91.9 BCD
	OK Foundation Seed	Green Hammer	79.4 ED	48.8 BC	90.7 CD
	OK Foundation Seed	Showdown	97.8 A	69.7 A	109.5 A
	OK Foundation Seed	Skydance	84.3 CD	43.1 C	87.9 D
	OK Foundation Seed	Smiths Gold	not tested	60.8 AB	96.4 BC
	AgriPro	SY Wolf	90.0 B	58.5 AB	98.4 B
Hard White Winter Wheat	Colorado State	Breck	86.4 BC	62.2 A	101.9 A
	KS Wheat Assoc/Kansas State	Joe	86.0 BC	68.8 A	104.8 A
	KS Wheat Assoc/Kansas State	KS Silverado	86.8 BC	55.5 A	106.0 A
	Colorado State	Monarch	83.5 C	64.9 A	103.2 A
	OK Foundation Seed	OCW04S71T-6W	90.7 AB	69.0 A	102.4 A
	OK Foundation Seed	OK 12716W	90.3 AB	66.6 A	98.3 A
	Colorado State	Snowmass 2.0	95.3 A	73.2 A	102.3 A
	Colorado State	Thunder CL	73.2 D	54.3 A	102.4 A
Spelt	Ohio Seed Imp. Assoc.	Comet	32.3 A	38.0 A	68.6 A
	Ohio Seed Imp. Assoc.	Sabre	22.7 A	47.1 A	70.1 A
	Ohio Seed Imp. Assoc.	Sungold	25.7 A	54.2 A	81.4 A
Winter Malting Barley	Virginia Tech	Avalon	99.9 AB	50.1 A	75.1 BC
	Ackermann	Flavia	108.8 A	not tested	not tested
	Ackermann	Hirondella	105.2 A	67.2 A	99.6 A
	Ackermann	Marouetta	not tested	47.3 A	92.7 AB
	Virginia Tech	Thoroughbred	90.5 B	58.7 A	68.2 C

Table 3. Grain yield of winter small grains. Different letters within a small grain type and year indicated a statistically significant difference in grain yield at 95% confidence. **CONTINUED FROM PREVIOUS PAGE**

Type	Brand	Variety	2021 Yield	2022 Yield	2023 Yield
-----bushels per acre-----					
Winter Rye	Albert Lea	Danko	75.1 BC	53.7 A	70.7 B
	Albert Lea	Hazlet	77.4 BC	43.7 AB	74.0 B
	WI Crop Imp. Assoc.	Spooner	69.7 C	14.7 C	48.8 C
	KWS	Bono (hybrid)	98.3 A	64.5 A	98.1 A
	KWS	Propower (hybrid)	78.2 BC	57.3 A	88.2 A
	KWS	Serafino (hybrid)	83.5 B	29.0 BC	39.6 C
	Albert Lea	Danko	75.1 BC	53.7 A	70.7 B
	Albert Lea	Hazlet	77.4 BC	43.7 AB	74.0 B
Tritcale	TriCal	Gainer 15	100.0 A	46.9 A	105.9 A
	TriCal	Ace	94.0 B	not tested	not tested

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

Type	Brand	Variety	2021 Yield	2022 Yield	2023 Yield
-----bushels per acre-----					
Hard Red Spring Wheat	CROPLAN	CP3530	55.4 A	21.7 A	55.1 A
	Montana State	Dagmar	40.7 B	10.8 A	40.8 EF
	Univ of Minnesota	MN Torgy	52.8 A	22.3 A	47.5 DC
	North Dakota St Univ	ND Frohberg	55.9 A	19.5 A	50.2 BC
	North Dakota St Univ	ND VitPRO	51.9 A	16.0 A	45.1 DE
	Syngenta	SY Valda	54.4 A	15.1 A	50.6 BC
	Montana State	Vida	51.5 A	22.6 A	40.7 F
	WestBred	WB 9590	Not tested	Not tested	52.0 AB
Durum	WestBred	Alzada	23.8 D	15.6 A	36.4 C
	ND State Univ.	Divide	43.9 C	23.1 A	43.4 AB
	ND State Univ.	Joppa	46.6 BC	21.5 A	39.9 BC
	Montana State	Lustre	52.3 AB	24.7 A	39.3 BC
	ND Ag Exp Station	ND Gano	47.4 ABC	14.4 A	43.4 AB
	ND Ag Exp Station	ND Riveland	54.4 A	21.5 A	45.0 A
	TCG	TCG Bright	45.1 BC	16.0 A	42.0 AB
Einkorn	Azure Standard	Azure	Not tested	10.1	15.1
Emmer	Albert Lea	Lucille	20.2	7.4	21.3
Spring Barley-Feed	WI Foundation Seeds	Kewaunee	65.6 A	18.4 A	66.0 A
	Albert Lea	Quest	65.6 A	14.7 A	71.7 A
	Albert Lea	Robust	66.3 A	14.7 A	72.0 A
Spring Barley-Malt	Albert Lea	Fantex	61.1 B	12.1 B	73.0 A
	Albert Lea	ND Genesis	87.1 A	20.7 A	85.0 A
	ND Crop Impr. Assoc.	Tradition	79.9 A	20.4 A	81.9 A

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Type	Brand	Variety	2021 Yield	2022 Yield	2023 Yield
-----bushels per acre-----					
Oat	WI Foundation Seeds	Antigo	Not tested	35.4 A	96.7 C
	WI Foundation Seeds	Badger	Not tested	43.6 A	113.8 B
	WI Foundation Seeds	BetaGene	Not tested	26.8 A	95.2 C
	WI Foundation Seeds	Esker	Not tested	36.2 A	120.5 AB
	WI Foundation Seeds	Forage Plus	Not tested	20.1 A	130.5 A
	WI Foundation Seeds	Laker	Not tested	30.6 A	124.2 AB
	WI Foundation Seeds	Antigo	Not tested	35.4 A	96.7 C
	WI Foundation Seeds	Badger	Not tested	43.6 A	113.8 B