NebGuide

University of Nebraska–Lincoln Extension, Institute of Agriculture and Natural Resources

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G2206

Selecting Winter Wheat Cultivars for Organic Production

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Organic Farming and Related NebGuides for Nebraska

This publication is part of a NebGuide series on organic farming being developed by University of Nebraska–Lincoln Extension. As the publications are completed, they will be available on the UNL Extension Publications website. Go to *extension.unl.edu/publications* and enter the title into the search box, or contact your local extension office.

- University of Nebraska–Lincoln Organic Farming Research
- Transitioning to Organic Farming
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A guide to selecting winter wheat cultivars for organic production, including selection criteria, cultivar recommendations, and how to supplement with organic and conventional online data.

This guide provides farmers, seedsmen, educators, and consultants cultivar recommendations and explains how to use them and online data to select winter wheat cultivars for organic production.

Organic and conventional criteria are compared to enable organic producers to supplement with information from conventional variety trials when applicable.

Significant Traits

Traits of Equal Importance to Organic and Conventional Systems

See **Chart of Wheat Variety Trait Scores** (*cropwatch.unl.edu/web/wheat/organic*) to compare varieties.

Stem rust resistance — To avoid epidemics like those observed in the early twentieth century, all released cultivars are selected for resistance to predominant races of stem rust.

Leaf-spotting disease resistance — In minimum tillage fields, spores from Septoria and tan spot on plant residues will infect the new crop.

Wheat streak mosaic virus (WSMV) and Triticum mosaic virus (TrMV) resistance — Volunteer wheat that survives between summer harvest and fall planting serves as a "green bridge" for wheat curl mites, which transmit WSMV and TrMV to newly emerging wheat. This is especially important for western Nebraska because of volunteer wheat that grows after hail events.

Winter hardiness — Greater hardiness is required if protective residue is lacking or when planting late. To avoid damage from late spring freezes, choose day-length sensitive cultivars such as those developed in Nebraska and South Dakota. Cultivars developed south of Nebraska are more likely to break dormancy based on heat rather than day length. In general, cultivars that head later are more likely to be sensitive to day length, and thus are more winter hardy.

Leaf rust and stripe rust resistance — Rust diseases are favored by moist conditions when, and if, spores are blown in

Table I. Steps for Selecting Wheat Cultivars Suited to Your Organic Farm

Information Source	*How to Use the Information*
This NebGuide	1. Determine your wheat market (see Selecting Cultivars for Premium Markets section). 2. Determine which traits fit your farming system (see Significant Traits section). 3. Choose cultivars from *Table II* (details found in Summary of Organic Variety Trial Results and Selecting Cultivars for Low-Nitrogen Systems sections).
Chart of Wheat Variety Trait Scores (*cropwatch.unl.edu/web/wheat/organic*) **Organic Winter Wheat Data Summary:** (*cropwatch.unl.edu/web/wheat/organic*) **Western semi-arid** **Eastern sub-humid**	1. Download the Chart of Wheat Variety Trait Scores and find cultivars that match your priorities. This chart provides scores for traits not listed in *Table II*. 2. Download the appropriate Organic Winter Wheat Data Summary (western semi-arid or eastern sub-humid). Different cultivars were tested in western Nebraska than in eastern Nebraska. Cultivars are grouped by yield based on standardized z-scores for each year. Choose cultivars in the highest yielding group that fit your priorities.
Winter Wheat Variety Test Results online (*cropwatch.unl.edu/web/varietytest/wheat*) or in **Seed Guide**, EC103 (*www.ianrpubs.unl.edu/sendIt/ec103.pdf*) (updated annually in August)	1. Find the results for the most recent organic trial in your region. Eliminate the lowest yielding cultivars. Compare yields using the value for least significant difference (LSD). If the difference is less than the LSD, the yields are equal. 2. Narrow your list by using data from conventional trials in your region. Choose cultivars that rank high for yields at all locations within your region. (See Using and Interpreting Conventional Trial Data section for an explanation.)

from southern locations and the cultivar is susceptible. These diseases are not normally important in western Nebraska.

Wheat soilborne mosaic virus resistance — This disease is vectored by a soil fungus and causes stunting, yellowing, and yield reduction. It is moving northward and is now found in southeast Nebraska.

Traits of Greater Importance to Organic Systems Than Conventional Systems (*Table II*)

Acceptable/enhanced end-use quality — Described in the next section, Selecting Cultivars for Premium Markets.

Coleoptile length — A longer coleoptile is needed when planting deep to reach moisture, as is often the case on western Nebraska dryland farms.

Fusarium head blight (FHB) resistance — This fungal disease is favored by moist, moderate to warm conditions before and during the flowering stage. Infection produces shriveled kernels and vomitoxin (also called DON, short for deoxynivalenol). Because of difficulty in controlling the testing environment, multiple years of data are necessary to confirm FHB resistance. Genetic resistance is important, even more so in organic systems, because it cannot be supplemented by fungicides. Usually, this is critical only in eastern Nebraska.

Preharvest sprouting tolerance — Sprouting affects end-use quality and is favored by rain at harvest time if the cultivar is susceptible. Since sprouting is more of a concern for white wheat, data for red wheat usually are not available. Susceptible cultivars are not recommended in southeastern Nebraska.

Traits Specific to Organic Systems (*Table II*)

Seedborne diseases affect grain quality by imparting a fishy odor or by discoloring the flour. Since fungicide seed treatments are not allowed in organic systems, genetic resistance to seedborne diseases is very important. Important seedborne diseases found in Nebraska include:

- Common bunt or stinking smut (symptoms of gray puffy seeds from infection with *Tilletia* species), and
- Black point (symptoms include discoloration of the embryo end of the grain from infection with *Alternaria*, *Helminthosporium*, or *Fusarium* species).

Common bunt spore balls rupture at or after harvest. Since spores on untreated seed germinate between 40 and 60°F and can only infect small seedlings, bunt infection is favored in cold soils of late-planted wheat, as when planting wheat after soybean harvest. Breeding for common bunt resistance was discontinued with the advent of fungicidal seed treatments. *Table II* shows bunt presence in grain harvested from organic plots at UNL South Central Agricultural Laboratory in 2012.

Selecting Cultivars for Premium Markets

Grain qualities sought by organic grain buyers depend on the end use and are affected by both genetics and environment.

Bread and breakfast cereal are the prevailing premium markets for organic wheat. Protein content and protein quality are important for the bread market. A few cultivars ('Karl 92,' 'Lyman,' and 'NE08457') are consistently high in protein content. Protein content usually decreases with higher yields. Breeding programs compensate for lower protein content in higher yielding cultivars by improving the protein quality, as reflected in baking tests. Preharvest sprouting tolerance is also important for the bread market because gluten is weakened when grain is sprouted in the head before harvest, causing poor bread texture. The breakfast cereal market does not require high protein content or strong gluten, but is more concerned with the whole grain content of antioxidants and dietary fiber in the bran layer. Buyers for whole-wheat markets, including breakfast cereal, will not tolerate wheat that is contaminated with vomitoxin, because this toxin is highly concentrated in the bran layer. Scores for quality-related traits are in *Table II*.

Table II. Criteria for Selecting Among Promising Wheat Cultivars for Organic Production and Markets

Major Selection Criteria	*High Yield Organic Test Locations (HPAL = west; SCAL, HAL and ARDC = East and Central)*	*Years Tested Organic*	*Cultivar[W]*	*Coleoptile length*	*Mixing and baking at 12.0% grain protein content in 2010*	*Bread Quality 2008-2010*	*Anti-oxidant Content 2009- 2011*	*Common bunt 2012*	*Black Point 2012*	*Preharvest Sprout Susceptibility†*	*FHB Susceptibility**
				Inches		Score of 1-9, 1 is best (years tested)					
Bread and Yield	All locations	5	Camelot	3.4	Good	4	6	2	1	1 (5)	6
Bread and Yield	All locations	3	NW07505(W)	3.3	Very Good	1	1	1	8	5 (3)	4
Bread[¥] and Yield	All locations	5	Wahoo	3.5	Good	5 ¥	7	3	4		5
Bread[¥] and Yield	All locations	5	McGill	3.0	Fair	6 ¥	1	2	9	5 (5)	4
Bread and Yield	East and Central	3	NE07444	3.5	Very Good	2		3	9	3 (1)	5
Bread and Yield	East and Central	3	NE02558	3.0	Very Good	3		2	4		4
Bread and Yield	East and Central	3	Expedition	3.4	Very Good	3		1	1	2 (5)	4
Bread and Yield	East and Central	3	NE06607	3.3	Very Good	4		1	4	1 (1)	3
Bread and Yield	West	5	NW03681(W)	3.1	Good	3		9	2	3 (3)	5
Bread and Yield	West	5	Hatcher	3.0	Good	4	8				6
Bread	None	4	Karl 92	3.0	Very Good	1		9	3		5
Bread	None	4	NE05425	3.0	Very Good	1		9	3		6
Bread[¥]	None	5	Alice (W)	2.8	Good	5 ¥	3			3 (5)	7
Bread[¥]	None	5	Pronghorn	3.8	Fair	5 ¥	7	3	2	7 (5)	5
Bread[¥]	None	5	Buckskin	4.0	Poor	6 ¥	9				6
Yield	All locations	5	Goodstreak	4.3	Fair	8					3
Yield	All locations	5	Overland	3.1	Very Poor	9	3	5	4	4 (5)	4
Yield	East and Central	3	NW03666(W)	3.0	Good	5		1	2	5 (3)	5
Yield	East and Central	4	Danby (W)	3.3	Poor	7				3 (3)	7
		2	Lyman	3.5				1	4		2

¥Historical expectations for good bread quality were not confirmed for grain from organic trials.
(W) Hard white winter wheat. Others are all hard red winter wheat.
†Preharvest sprout scores (except 'Alice' and 'Expedition' scores from South Dakota State University (SDSU) data) are from Bob Graybosch, USDA-ARS, Lincoln, Neb., using wheat head samples collected near Mead, Neb. Scores for entries tested only one or two years may change with further testing.
*FHB scores are standardized averages of 2001-2005 SDSU data and 2007-2011 UNL data. FHB values for 'Danby' and 'Karl 92' were obtained from (2008) Kansas State University Agriculture Experiment Station Publication MF-991.

Selecting Cultivars for Low-Nitrogen Systems

Organic farming systems typically have less nitrogen available to the crop compared to conventional systems. Likewise, wheat produced in organic systems typically has lower protein content than wheat produced in conventional systems.

Cultivars with High Quality Protein

A promising strategy to compensate for low nitrogen availability in organic soils is to grow cultivars that will bake well at low protein content. Cultivars with good baking quality at 12.0 percent grain protein are good candidates for producing high quality grain in low nitrogen organic soils. In *Table II*, baking performance is shown for grain blended from two locations to 12.0 percent protein. Preliminary studies indicate that 'NW07505,' 'NE02558,' and 'NE06607' bake well at grain protein content as low as 10.5 percent.

Cultivars Suitable for Top-Dressing

Nitrogen supplementation (or other strategies to improve soil nitrogen availability) may be necessary for cultivars that require high protein content to achieve good bread quality. Of 36 lines in the 2010 variety trial at the UNL Haskell Agricultural Lab, only 'Anton' and 'Karl 92' had greater than 12.0 percent grain protein without top-dressing. In two out of three years, top-dressing at boot stage with an OMRI-approved liquid product at 20 pounds N/acre improved protein content on average from 10.5 to 11.2 percent. This increase came at the expense of lower yields for most cultivars in 2010. Five lines ('Clarks Cream,' 'Camelot,' 'Arrowsmith,' 'NW03681,' and 'NE05425'), improved to greater than 12.0 percent protein content after top-dressing. Only four cultivars ('Arrowsmith,' 'Danby,' 'McGill,' and 'Goodstreak'), showed positive responses for both protein content and yield. Therefore, these four are the only cultivars recommended for top-dressing for the sake of improving protein content.

Interpreting Variety Trial Data

Summary of Organic Variety Trial Results (*Table II* and Organic Winter Wheat Data Summary, *cropwatch.unl.edu/web/wheat/organic*)

From 2008 through 2011, 55 experimental lines and wheat cultivars, including popular older cultivars such as 'Clark's Cream' and 'Buckskin' (both released in 1973) were evaluated on organic plots at four research centers across Nebraska. In 2012, the trials were limited to South Central Agricultural Laboratory (SCAL) near Clay Center and the UNL High Plains Agricultural Lab (HPAL) at Sidney. In 2013, the trial was planted only at SCAL.

Three hard red winter wheat lines with high yields during five years of testing, and with a coleoptile of at least 3.4 inches long, are recommended for organic production for all of Nebraska: 'Camelot' is recommended for the bread market, and 'Goodstreak' and 'Wahoo' for other markets. 'McGill' and 'Overland' are recommended where long coleoptiles are not required, with the following exceptions: 'Overland' should be avoided if intended for the bread market. 'McGill' requires high nitrogen availability to meet the protein goal for the bread market.

Other promising winter wheat lines for organic production are listed in *Table II*. No recommendations for the breakfast cereal market are provided since important traits for this market (flaking, viscosity, and dietary fiber) have not been evaluated. 'NW03681' and 'Karl 92' have excellent bread quality but are both low yielding lines and were found to be highly susceptible to common bunt in 2012. 'NE08457' has a long coleoptile and high protein content but requires more yield evaluations to qualify as a promising line. 'Lyman' is more tolerant to Fusarium head blight than any other hard winter wheat cultivar tested in the northern Plains. 'Buckskin' is known to have a niche of adaptation at the Nebraska and Wyoming border, despite its poor yield performance at HPAL.

Using and Interpreting Conventional Variety Trial Data (Seed Guide, EC103 (*ianrpubs.unl.edu/sendIt/ec103.pdf*) and Organic Winter Wheat Data Summary, (*cropwatch.unl.edu/web/wheat/organic*)

If a few guidelines are followed, conventional trial data can aid in choosing cultivars for organic production. Data from outside of one's region (western semi-arid or eastern sub-humid) should be ignored. Choose from cultivars that rank high for yield at *all* locations in your region. If the rank is high for all locations, the cultivar will likely rank high elsewhere, including organic environments. However, be aware that conventional trials do not reflect the impact of seedborne diseases. Some other differences in performance cannot be predicted, such as the surprisingly better grain fill of 'Wahoo' in organic wheat plots during dry years compared to nearby conventional fields.

A Note on Seed Availability

Seed for most of the cultivars tested in organic trials is available from conventional sources, yet only a few cultivars are available from organic seed suppliers. If organic seed of your desired cultivar is unavailable, the National Organic Program allows the use of conventional seed, unless treated with prohibited pesticides. Experimental lines may be available from UNL Foundation Seed in small quantities. A Nebraska organic cooperative is increasing 'NW03666,' 'NE07444,' and 'NE02558' for possible licensing. Three other lines, 'NW07505,' 'NE06607,' and 'NE08457,' may become available through the university system soon.

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