

Hard White Wheat



Producing North Dakota's Next Market Opportunity

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Market Opportunities

- Participate in expanding whole-wheat and whole-grain product demand in the U.S.
- Increase U.S. share of Asian noodle market
- Provide North Dakota producers with another premium wheat option

What is hard white wheat?

Hard white wheat is the newest class of wheat marketed in the U.S., but it is not new to the rest of the world. Wheat in this class has a hard endosperm and white bran (Figure 1). Except for the absence in color in the outer seed coat and being typically more prone to weathering, hard white wheat is identical to hard red wheat. The white bran color does not alter the starch characteristics or protein functionality of the kernel.

Hard white wheat is used in whole-wheat and high-extraction flour applications, such as pan breads, flatbreads and specialty noodles. Within the hard white wheat quality class, the U.S. Department of Agriculture makes no distinction between winter and spring types.

Production of hard white wheat in the U.S. is on less than 2 million acres, but it expanded significantly from 2002 to 2005 with the aid of an incentive program the USDA funded. Kansas and Colorado, the largest hard white producing states, grow winter types. Much of the wheat grown in China and South Asia, and virtually all of the wheat in Australia, is hard white wheat. Canadian producers recently

increased production of hard white wheat, which is being marketed as two classes: Canadian Prairie Spring White, (targets the flatbread market) and Canadian Western Hard White (targets the noodle and leavened bread markets).



Figure 1. Kernels of Alsen hard red spring wheat (left) and Lolo hard white spring wheat (right).

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Why does the U.S. need to expand hard white wheat production?

Demand for hard white wheat exists in both the domestic and export markets. Millers are capable of extracting more flour of the color and ash content they desire from the white grain.

Whole-wheat products made from white wheat have a favorable appearance, compared with similar products made from red wheat, since they have less pigmentation (Figure 2).

In addition, with fewer phenolic compounds and tannins in the bran, white wheat imparts a less bitter taste to the final product. Because of the interest in increasing the intake of fiber through whole-grain consumption in the U.S., white wheat is being used as a way of producing whole-wheat bread with much of the same appearance and taste as traditional white bread made from refined red wheat flour. White wheat also is preferred for use in high-protein Asian noodle and bread products.

Due partly to its proximity to the market, Australia supplies much of the hard white wheat to the Asian markets. Increased production of hard white spring wheat in the U.S. could allow U.S. producers to compete for a greater share of this market.

What quality characteristics of hard white wheat do end users require?

The quality characteristics required of hard white wheat vary depending on the intended end use. White wheat for making leavened breads requires high protein and strong gluten strength. Unleavened flatbreads require low to moderate levels of protein (10 percent to 12 percent), and pan breads require moderate to high protein levels (12 percent to 14 percent). While many Asian noodle manufacturers require white wheat with moderate protein levels, some require white wheat with high protein (Figure 3).

A positive for our region is the fact that millers around the world are very interested in obtaining hard white wheat with the same quality characteristics (e.g., protein content of approximately 14 percent or greater and strong gluten) of the hard red spring wheat they purchase for top-quality products. Customers in Asia speak of their desire for a “white DNS,” referring to Dark Northern Spring, the highest (premium) quality subclass of hard red spring wheat.

For all Asian noodle products, low ash (1.3 percent

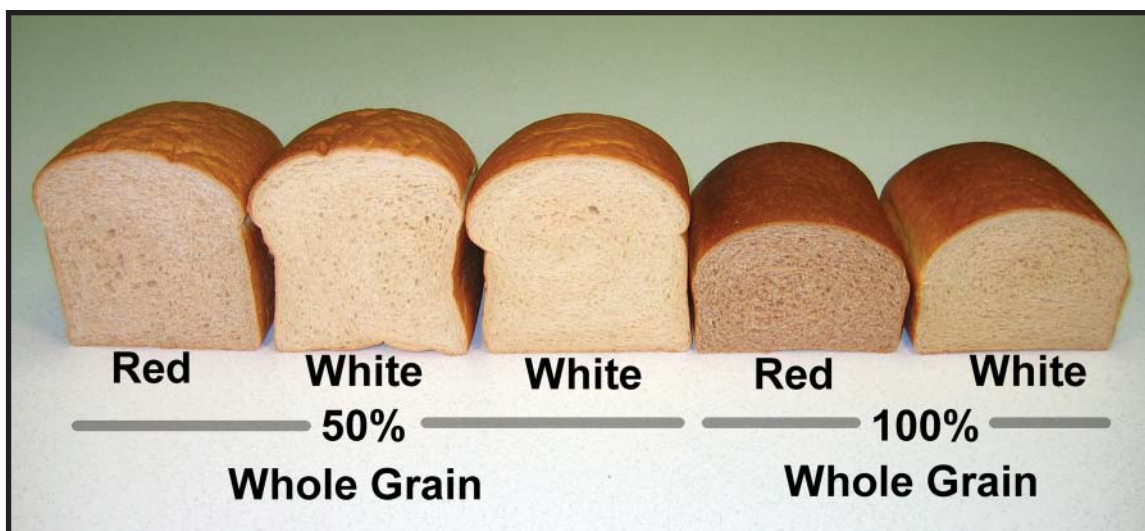


Figure 2. Loaves made of whole grains from white wheat show a distinct color difference from that of red wheat and taste more like the traditional white bread consumers prefer.



Figure 3. Unlike pasta products, which are extruded, Asian noodles are cut from sheets of dough.

to 1.4 percent) and low polyphenol oxidase (PPO) activity are necessary. Polyphenol oxidase is an enzyme that breaks down the polyphenols present in wheat food products when exposed to oxygen (Figures 4 and 5). Many Asian noodles sold as fresh or refrigerated products and made with flour high in PPO activity take on a grayish color, which is unacceptable to consumers. Some Asian buyers also prefer wheat varieties that exhibit a softer, spongy “mouth feel” when eaten. This smoother noodle texture is gained from varieties that have a partial “waxy” or lower amylose starch endosperm.

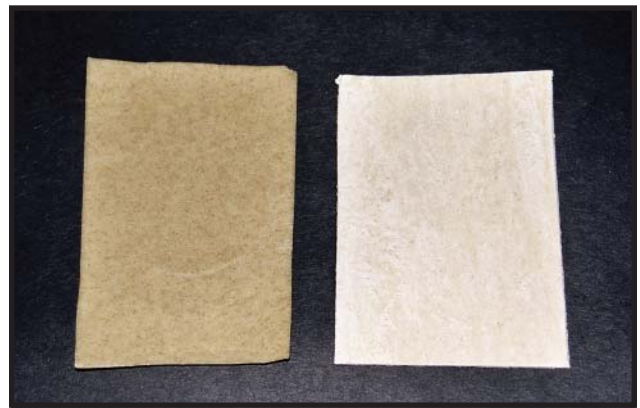


Figure 4. The tendency to turn gray is noticeable in the dough sheet on the left, which was made from flour with high PPO activity. The sheet on the right was made from flour with low PPO activity.

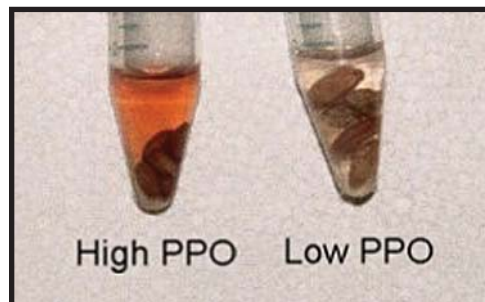


Figure 5. Seed analyses in a buffer solution of varieties with high and low PPO activity.

What varieties of hard white wheat are available for production in North Dakota?

Several variety candidates are available for the production of hard white wheat in North Dakota; however, most are not well-adapted to the region. Producers can expect lower grain yields and test weights, compared with hard red spring wheat varieties, because many existing hard white wheat varieties are susceptible to the diseases common in North Dakota. NDSU and private companies are focusing on developing adapted, disease-resistant, high-yielding hard white spring wheat varieties with good milling and baking characteristics and low PPO.

The following varieties have been tested in North Dakota, and have been compared to hard red spring wheat varieties for their agronomic performance (see Table 1 for the results from 2005):

Spring Wheat Varieties

AC Snowbird

- Developed by Agriculture and Agri-Food Canada and released in 2004
- Possesses high protein quality and targets the Asian noodle and leavened bread markets
- In limited testing in North Dakota in 2005, exhibited average to slightly below-average performance for grain yield when treated with fungicides, and it exhibited susceptibility to leaf diseases and fusarium head blight in the absence of fungicides
- Approved variety for the Canadian Western Hard White class in Canada

AC Vista

- Developed and released by Agriculture and Agri-Food Canada in 1996
- Possesses intermediate grain protein level
- In 2005 North Dakota tests, where fungicide was applied for disease control, and in regional experimental tests in prior years, AC Vista generally exhibited the highest yield potential of all of the white wheat varieties tested
- Approved variety for the Canadian Prairie Spring White class in Canada

Argent

- The first hard white wheat variety developed by NDSU, released in 1998
- Essentially a white version of Grandin, exhibiting high test weight and average protein with good milling and baking qualities
- Kernel color tends to be darker than other hard white wheat varieties, which can present problems in its acceptance as white wheat by some end users

Explorer

- Developed by Montana State University and released in 2001
- Best adapted to the western regions of North Dakota and portions of Montana
- Possesses relatively high grain protein levels, good milling and baking qualities
- Not suitable for noodle end uses due to its high PPO activity

Lolo

- Released by the University of Idaho in 1997
- Exhibits low to moderate grain protein content and high yield potential
- Susceptible to leaf rust and other foliar diseases
- Possesses a partial waxy mutation and low PPO activity, characteristics that make it well suited for the Asian noodle market

Pristine

- Developed by WestBred and released in 2001
- Exhibits good grain protein content
- In limited testing, has average to poor yield potential in North Dakota.
- Early maturing and can be very susceptible to fusarium head blight if conditions are optimal for disease development during its early flowering period

WinterWheat Variety

Wendy

- Developed and released by South Dakota State University in 2004; is a hard white winter wheat with a moderate level of winter hardiness
- Has good yield potential in environments with limited disease pressure
- Has moderate grain protein
- Susceptible to leaf diseases and fusarium head blight, and for this reason performed poorly in state trials in North Dakota in 2005

Information on other hard white wheat varieties will be posted on the NDSU Specialty Wheat Web site as it becomes available.



Table 1. Grain yield and test weight performance of representative commercial hard white spring wheat varieties in 2005, average of six North Dakota and Montana locations, including one irrigated and one dryland Sidney, Mont., location.*

Cultivar	Grain color	Grain yield (bu/A)	Test weight (lbs/bu)
AC Snowbird	White	50.6	58.2
AC Vista	White	57.9	56.8
Argent	White	47.7	58.9
Explorer	White	46.8	56.9
Golden 86	White	42.0	57.8
IDO377S	White	50.5	57.2
Lolo	White	48.4	57.7
MT9420	White	44.2	55.8
Pristine	White	34.3	58.1
Winsome	White	49.9	55.8
Alsen	Red	54.0	59.9
Parshall	Red	52.4	59.6
Reeder	Red	54.4	58.4
Mean		48.7	57.7

*Data from North Dakota locations are from experiments grown at the Agronomy Seed Farm at Casselton and at the NDSU Research Extension Centers at Carrington, Minot, Hettinger and Williston. All entries at the Casselton, Carrington and Minot locations were treated twice with foliar fungicides.

Where can producers obtain seed of hard white wheat varieties?

Knowing where you will market your wheat before planting is important, since white wheat varieties vary considerably in their end-use qualities. Seed of Argent and Lolo is available from certified seed growers in North Dakota. Check a current North Dakota Field Inspected Seed Bulletin for information on seed producers with seed of these white wheat varieties. Private companies such as WestBred and Agripro will have information on seed availability of white wheat varieties they have developed or are developing. Information on the availability of white wheat varieties developed in Canada can be obtained from Quality Assured Seeds at (306) 791-0500. Wendy is available from the South Dakota Crop Improvement Association. For a listing of current growers, see <http://plantsci.sdstate.edu/seedcert/Growerdir.htm>.

What special management practices do producers need to grow hard white wheat?

Production

Management practices that optimize hard white wheat production are basically identical to those used for hard red wheat. Although end users require a range in protein content for their products made from hard white wheat, in most cases high-protein white wheat will be in highest demand. Nitrogen management and variety choice should focus on producing a crop with high grain protein. Most of the available hard white wheat varieties were developed by breeding programs outside of North Dakota, and generally lack the level of disease resistance needed, particularly for the eastern part of the state. Fungicide applications for foliar diseases and/or scab may be required in the more disease-prone regions and in seasons with high disease pressure to obtain reasonable yields with these varieties.

Harvesting

White wheat varieties are more prone to preharvest sprouting than their red wheat counterparts. Rain, high humidity and cool temperatures after the grain has matured can induce sprouting in the spike. Hard white wheat should be harvested in a timely manner to reduce preharvesting sprouting. Harvesting white wheat before hard red spring wheat varieties is one way of reducing the chance of unnecessary exposure to conditions that may induce preharvest sprouting.

Storage

Segregating white wheat from red wheat is important during production, storage and marketing, as wheat classes with more than 1 percent admixture of a contrasting class will result in a grade reduction. Mixing white wheat that has more desirable traits for noodles with our premium red wheat could have an adverse effect on our traditional leavened bread market.

Equipment used in planting and harvesting, and storage facilities, should be cleaned when going from one class to another. Use certified seed and avoid planting white wheat for at least two years after a wheat crop of a different class to reduce unwanted red wheat volunteers. Maintaining a bin that will be used only for white wheat can help reduce the chance of mixtures after harvest. Notify your elevator when delivering wheat so its staff is able to segregate the white wheat from other classes. As white wheat develops as a class in North Dakota, identity-preserved programs with producer contracts still might be the norm.

Where can I sell white wheat?

Although interest in hard white wheat has grown considerably, opportunities for selling white wheat locally still are limited. Until the supply and demand for white wheat becomes well established in North Dakota, producers should not produce white wheat without a contract. Check with local elevators for opportunities for contracting white wheat. The North Dakota Mill is purchasing hard white wheat from producers in the Dakota Pride Cooperative. When we identify additional opportunities for contracting white wheat in North Dakota, they will be posted on the NDSU Specialty Wheat Web site at <http://specialtywheat.ndsu.nodak.edu>.

What things should I consider before growing hard white wheat?

You should consider the following question before producing white wheat:

- Have I secured a buyer for the white wheat I intend to produce?
- Do I have access to seed of the variety, and how will it yield relative to hard red spring varieties?
- Have at least two years gone by since I have grown other classes of wheat in the field where I plan to grow white wheat?
- Do I have the facilities to segregate white wheat from other classes of wheat until it is marketed?
- If segregation is required, does the premium offered for white wheat pay the extra cost of segregation (e.g., cost for cleaning equipment, trucks and storage facilities)?
- Will I be able to harvest the white wheat in a timely manner if conditions are conducive to sprouting when the crop is ripe?
- If I plan to grow a hard white winter wheat, does it have the winter hardiness required for reliable production?

What is the future of hard white wheat?

Recent research indicates the potential for developing white wheat that resists preharvest sprouting at levels comparable to that of red wheat. Developing white wheat varieties with sprouting resistance will be important for their ultimate success in North Dakota. New varieties and production practices will focus on high protein and strong gluten characteristics to make them viable for production of leavened breads and as high-quality wheat flours. Midprotein hard white winter wheat likely will adequately supply the market for flatbreads and even some types of Asian noodles.

A price incentive likely will be needed to stimulate hard white wheat production in the short term and to cover the added costs associated with segregation, and agronomic and harvest risk. Since North Dakota hard red spring wheat is a premium class in both the U.S. and globally, this incentive would have to be above that already paid. As white wheat assumes a more prominent place in spring wheat production and various end-use markets, it likely will develop into a more actively traded wheat class at local elevators, similar to hard red spring and durum.

Hard white wheat has the potential to gain additional markets. Australian hard white wheat is the dominant wheat class for the lower protein noodle markets of many Asian countries; however, hard red spring wheat still is used in these countries for making leavened breads and mixing with the Australian wheat to improve the “bite” characteristic of higher protein noodle products. Hard white spring wheat with similar protein content and gluten strength as hard red could rapidly replace more of the Australian wheat in Asian noodles.

Where can I find additional information on hard white wheat production and marketing?

You can find additional information about hard white wheat at the following Web sites:

NDSU Specialty Wheat

<http://specialtywheat.ndsu.nodak.edu/>

General information about white wheat, other specialty wheats and hard white wheat specific to North Dakota.

Economic Analysis of Producing White Wheat – North Dakota

www.ext.nodak.edu/~aedept/

See publication 454. A pdf titled “White Wheat Market and Strategy Analysis for North Dakota,” which discusses the economics of producing hard white wheat in North Dakota.

Producing Hard White Wheat

www.hardwhitewheat.unl.edu

General information about producing and marketing hard white winter wheat and information about varieties and practices specific to Nebraska.

Hard White Winter Wheat for Kansas

www.oznet.ksu.edu/library/crpsl2/samplers/srl120.asp

A publication developed by the Kansas State University Experiment Station and Extension Service in 1998 with background information on the development and use of hard white winter wheat in Kansas.

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