Dennis Shields

Hard White Wheat: Changing The Color of U.S. Wheat?

Many U.S. wheat breeders are now making a concerted effort to develop hard white wheat (HWW) varieties, which account for less than 1 percent of U.S. wheat acreage. Kansas State University (KSU), for instance, is devoting about 75 percent of its wheat breeding program to white wheat, up from 10-25 percent in the 1980's. This fall, KSU is planting foundation seed of two new varieties for possible release next year (the release was originally scheduled for this fall). Other States, such as Idaho, Washington, Colorado, Montana, and Nebraska, are devoting at least 20-40 percent of their breeding programs to HWW as well.

HWW plays a strategic role in these State breeding programs because of its end-use characteristics. According to extensive university and industry studies, HWW is regarded to have superior milling and breadbaking characteristics to hard red winter wheat (HRW) because of HWW's higher milling extraction rates (i.e., more flour per bushel of grain milled to the same color standards), less bitter aftertaste for whole-wheat bread, and color qualities preferred by some consumers. These end-use features appeal to both domestic and foreign wheat buyers, providing potential markets for wheat farmers growing HRW.

The development of promising varieties has raised speculation about whether wheat growers in Kansas and elsewhere in the Great Plains might make a dramatic switch from hard red to hard white and the consequences for the U.S. wheat industry. Some breeders expect HWW acreage to expand rapidly because of its higher milling extraction rates and better quality characteristics. Nonetheless, there are both agronomic and economic questions that will determine the speed and extent of its adoption.

Will HWW remain a niche product or will it become a major new class of wheat? For farmers, the most critical questions are how it yields and what are the price premiums relative to competing classes of wheat. Trial yield tests indicate that the two new KSU HWW varieties produce 3-4 bushels more per acre than the State average. The trial yield is comparable to trial yields of some of the State's most popular HRW varieties. This yield advantage should encourage a wider adoption of these new HWW varieties than those released in the early 1990's, which did not yield as high as then-existing HRW varieties. Results from actual farm experience will be needed to verify yield advantages achieved at the experiment stations.

U.S. farmers will adopt any new product if it increases net returns or proves to have other advantages. This is amply demonstrated in the cases of Roundup Ready soybeans and Bt corn. HWW adoption promises to be slower because it must establish its advantages with users as well as growers and provide economic incentives across the board.

Acreage of genetically modified crops has soared in the first 3 years of adoption.
Special Article, page 21

To avoid price discounts assessed to "mixed" wheat, the HWW would have to be kept separate from other classes because mixing would (1) eliminate the extraction rate advantage, and (2) possibly lower the grade if the level of "contrasting classes of wheat" exceeds the limit. Segregation may be costly initially, but it would be less so as elevators handle larger volumes of HWW. For example, farmers and elevators in barley areas routinely separate feed barley from malting barley.

Another question revolves around end-users' willingness to pay more for the wheat. While there are potential niche uses for HWW, prices will be shaped by the market and be influenced by other classes of wheat. If HWW expands beyond the specialty level, costs will be drawn down by larger volumes and economies of scale.

Current Status: Production Contracts Preserve HWW Identity

Based on a compilation by USDA's Economic Research Service, U.S. farmers have increased HWW plantings to 100,000-140,000 acres for harvest in 1998. About half is winter wheat (planted in fall, harvested the following summer) and the rest is spring (planted in spring, harvested in summer). This accounts for only 2-3 percent of U.S. white wheat acreage—just 0.2 percent of all U.S. wheat acreage. (For the top five producing States, HWW accounts for 0.6-0.9 percent of total wheat acreage.) The remaining white wheat is "soft," which lacks the elastic properties necessary for baking pan bread (i.e., loafs) and instead is used

for products such as cakes, cookies, flat breads, and some noodles.

Montana, Colorado, Kansas, Idaho, and California account for over 95 percent of total HWW acreage. In Kansas, Colorado, and California, producers plant primarily winter varieties, while producers in Idaho and Montana plant mostly spring varieties.

Behind much of this year's increase in HWW is a cooperative, Pro/Mar Select Wheat, Inc. In an effort to expand its business, it contracted with members to plant 40,000 acres of HWW (Idaho 337S variety—a spring variety) in Montana in 1998.

In Idaho, HWW acreage is estimated to have expanded from 8,000 acres in 1997 to 15,000 acres this year in response to increased market demand. In Colorado, HWW acreage totaled only 7,000 acres in 1996, but expanded to at least 20,000 acres in 1998 as domestic millers contracted with growers at premiums over HRW, reportedly ranging from 25 to 35 cents per bushel.

Most HWW is grown through production contracts and marketed under identity-preserved programs because elevators and millers would discount prices if HWW were mixed with other classes of wheat. For example, Pro/Mar obtained an exclusive right to contract the HWW variety (Idaho 377S) with producers in Idaho when the University of Idaho released it last year. Initially, Pro/Mar restricted production contracts to its member-producers in Idaho. Now it has extended contracts to growers in other States. Pro/Mar has total control over the distribution of Idaho 377S seeds to member-producers, and the purchasing contracts bar farmers from retaining seed for planting the next season (i.e., all HWW harvested must be sold back to Pro/Mar).

Since Idaho 377S must not be contaminated with other varieties at harvest, harvesting equipment must be thoroughly cleaned. HWW must also be segregated from other varieties during handling, storage, and transportation until it reaches the final end-user.

In Kansas, the American White Wheat Producers Association (AWWPA)—a farmer cooperative chartered in 1988 to market HWW—enters into contracts with its members to grow the association's HWW varieties. Growers must purchase certified seed from an AWWPA-certified seed dealer and take measures to ensure wheat quality, such as treatment of disease and insect infestation and growing HWW on summer-fallow land so that it will not be mixed with other classes of wheat. They are also encouraged to grow wheat only in drier areas to avoid sprout damage because HWW is predisposed to preharvest sprouting if too much rain occurs near harvest time and delays harvest. In addition, all fields are inspected by AWWPA and producers are required to submit a 35-pound grain sample from each field after harvest.

In return, producers receive prices above the base price of HRW in Hutchinson, Kansas, depending on the premiums that end-users are willing to pay. In the mid-1990's, the premium was set by the AWWPA at 15 cents per bushel; however, market forces have determined the premium in recent years. Producers are required to sell all HWW production to AWWPA and deliver their wheat crops to a designated receiving point—usually an elevator, but sometimes a flour mill. AWWPA can arrange for hauling the grain, with shipping costs deducted from producer returns.

AWWPA owns no elevators, trucks, flour mills, or baking facilities. Instead, it contracts with flour mills for the milling and packaging of whole white wheat flour and other HWW-based food ingredients (e.g., patent flours, brans, and white wheat bulgar). Total contracted production is 20,000 acres in 1998, which is greater than in previous years. The AWWPA plans to expand contract acreage soon with release of the new KSU varieties.

Montana Is Top Hard White Wheat Producer in 1998

State	Planted acres	Variety	Percent of total wheat area	Data sources
Montana	40,500	Idaho 377S*, Golden 66*, Nuwest	0.71	Pro/Mar Select Wheat, Inc.; Western Plant Breeders; Wheat Montana Farm
Colorado	20,000-50,000	Platte, Solomon	0.67-1.66	Rollin Sears, Kansas State University; AgriPro, Inc.
Kansas	10,000-20,000	Arlin, Oro Blanco, Rio Blanco, KS196, Snow White, Platte	0.01-0.02	Rollin Sears, KSU; American White Wheat Producers Association
Idaho	15,000	Idaho 377S*	1.05	Pro/Mar Select Wheat, Inc.
California	12,000	Klasic	1.82	California Wheat Commission
Oregon	< 2,000	Idaho 377S*	< 0.14	Oregon Agricultural Statistics Service
Others**	750	Winter varieties	< 0.05	State ag statistics services
Top 5 States	97,000-137,000		0.6-0.9	

*Spring variety (others are winter varieties). **Includes Nebraska (579 acres), Oklahoma (100 acres), Washington (50 acres), Wyoming, and Texas.

Economic Research Service, USDA

Like Pro/Mar, AgriPro in Colorado contracts with producers to grow two HWW varieties (Platte and Solomon). HWW wheat produced under the contract is then sold to ConAgra and shipped to its mill in Denver. Premiums in the range of 25-35 cents per bushel are offered to producers in exchange for their efforts to preserve grain identity.

Behind Demand For Hard White Wheat

There are several potential reasons for favoring hard white wheat over hard red wheat. For millers, the white wheat has a flour extraction rate 1-2 percentage points higher than red wheat when both are milled to similar color standards. For consumers, whole-wheat products made from hard white wheat may be more appealing to those favoring whiteness. White bran is less obvious than red bran in flour and food products. In addition, bran from white wheat is used in breakfast and snack-type foods and commands a higher price than bran from red wheat.

U.S. millers can use hard white wheat for most of the same uses as hard red wheat. However, there appear to be three specialty products for which hard white wheat's end-use characteristics are well suited: whole-wheat breads, tortillas, and oriental noodles.

HWW is used to make increasingly popular whole-wheat breads. Bread made from whole HWW flour is lighter colored and less bitter than bread made from red wheat. The bran of white wheat contains less of the phenolic compounds that give whole red wheat bread a stronger, bitter flavor. Thus, less sugar is needed for making whole white wheat bread. Besides the ingredient cost savings, lower sugar content appeals to nutrition-conscious shoppers.

Tortillas are a traditional Mexican flat bread made from either corn or wheat. Corn tortillas predominate in Mexico, while consumption of wheat tortillas exceeds corn tortillas by 2 to 1 in the U.S. Reportedly, U.S. consumers generally prefer bright white tortillas, which may give HWW an advantage over HRW wheat.

Tortillas made from wheat are used increasingly in the U.S. as so-called wraps for a variety of non-Mexican cuisine. This practice began in the mid-1990's in California and has been taken up by the Nation's fast-food industry. This innovative use of tortillas is helping to boost consumer demand for wheat in the U.S., which bodes well for white wheat demand.

Makers of noodle flour in East and Southeast Asia tend to favor white wheat for making certain oriental noodles. U.S. soft white wheat is well suited for making some of these noodles. However, other types require a hard white wheat (with low-level protein, sometimes referred to as "semi-hard" in Asia), of which the U.S. now produces little. Australia wins out because it can supply large quantities of high-quality hard white wheat.

Most Asian noodle manufacturers use a flour made from a blend of wheats based on relative prices and desired end-use characteristics. Color and texture characteristics imparted by Australian white wheats are particularly suited to these blends. Australia currently supplies half of the wheat (including Australian Standard White) for noodle demand in Asia, according to reports from noodle manufacturers in South Korea, China, Hong Kong, Philippines, Taiwan, Singapore, Malaysia, Thailand, and Indonesia.

Noodles made from Australian wheats are renowned for a stable white or yellow color—essential for producing a desirable noodle. Compared with wheats from Australia, U.S. red wheats tend to contain high levels of an enzyme, polyphenol oxidase (PPO), that U.S. researchers found to be responsible for noodle discoloration. Raw noodles (which, along with partially boiled noodles, are preferred by many Asian consumers) made from U.S. red wheats may discolor to green, dark brown, or black within 24 hours of manufacture. The rate of darkening of fresh noodles is important because they might not be consumed for 1 or more days after manufacturing.

The new KSU HWW varieties are expected to compete with mid-protein Australian wheat offerings (Hard, Premium, and Noodle) in international markets. They will have lower protein levels than Australian Prime Hard, but greater than Australian Standard White. According to the foreign offices of the U.S. Wheat Associates, Asia imports more than 400 million bushels of wheat (including Australian Standard White) for making noodles, which accounts for one-half of total wheat imports into Asia. (Asia, including China, accounts for about one-third of world wheat imports.) One of the two varieties of KSU HWW still lacks color stability. U.S. researchers are working on improvements in order to match the quality of Australian wheat for making oriental noodles. For the last several years, Canada has also been working on developing white wheats for the Asian market.

Will HWW Yields Outweigh Higher Marketing Costs?

Expanded HWW production depends upon the economics of adopting new HWW varieties, which, in turn, is driven by market demands for this new class of wheat. The economic forces include yield potential of the new HWW varieties, the price premium offered by the market, and any differences in the costs of production and marketing between HWW and competing classes of wheat. Differences in net producer returns of HWW and the competing class depend primarily on yields and prices, since the costs of production may not be much higher than for HRW on a per-bushel basis.

In Kansas, for example, the new KSU varieties have a yield advantage of 3-4 bushels (per acre) over the average of current HRW varieties based on 1997 trial yield test results. However, it still would take 2-3 years to reach commercial production stage in Kansas when farmers sell grain to be milled. Thus, it will take some time before they can be widely grown to determine farmer acceptance and observe if yield gains on the farm match those in the trials.

It is unlikely that producers will receive more than modest premiums due to marketing expenses associated with keeping white wheat segregated in the HRW-dominated areas. For example, flour millers would have to make some adjustments to their operations—such as separate storage and processing of the grain, and separate milling specification for the higher extraction rate—in order to accommodate a new class of wheat.

Higher flour extraction rates are another driving force for a possible expansion of HWW acreage. The higher flour extraction rates would entice flour millers to accept HWW as a new class of wheat in their milling operation.

Marketing System Must Adapt To Preserve HWW Quality

For HWW production to expand widely, the marketing system will need to preserve the identity of HWW to avoid discounts by buyers. Presently, identity is preserved by controlling plantings—only specific seeds certified by seed companies or farmer cooperatives are permitted for plantings. Producers are not permitted to keep HWW seeds for next season's plantings. As acreage expands, identity preservation (IP) could extend to IP marketing by class, instead of just by variety, so long as the HWW quality characteristics are maintained.

Large-scale segregation would be required from production points, storage, transportation, all the way through end-users. Limited onfarm storage space might present more of a challenge for Kansas than for the Northern Plains, where there is typically more storage capacity. Also, as production expands, segregating HWW from other classes of wheat may initially call for hauling the wheat crop to more distant elevators, which increases marketing costs. However, as HWW acreage substitutes for red wheat, storage space may be less of an issue. Elevator space will increasingly become available to handle white wheat. Elevators will likely adapt by handling different classes of wheat, or by specializing in HWW. Currently, some seed companies or farmer cooperatives contract with selected elevators to handle just HWW.

While IP is a deviation from the current norm, there are indications that other field crops are also likely to require segregation in the near future. New varieties (e.g., high-oil corn and high-oleic soybeans) with special traits aimed at enhancing various uses are already hitting the market.

An expansion of HWW production and subsequent potential for export has implications for grain grades and standards. Current U.S. wheat standards allow a 2-percent limit on contrasting classes of wheat and a 5-percent limit on total wheat of other classes for U.S. No. 2 wheat (the base grade of exported wheat). For price-sensitive buyers, such as those in the Middle East and Indian Subcontinent (where HWW could be used for making some flat breads such as pita because of its higher extraction rate and lighter color), the standards might be accepted without requiring a tighter limit in contract specification. (Semi-hard wheat is preferred by flour millers in these regions for making certain flat breads.)

However, tighter limits than U.S. wheat standards allow may be specified in the contract to reflect needs of quality-sensitive buyers. Those buyers who are especially sensitive to purity could contract directly with U.S. producers under an identity preservation program.

How to measure the wheat color would remain an issue to be addressed in determining the level of contrasting classes of wheat. The technology to distinguish white from red wheat is available. The single-kernel hardness tester, although extremely accurate, reportedly costs as much as $90,000 per unit, which may not be affordable to many elevators. Visual inspection is the traditional, less expensive option, but it may not be very accurate.

HWW: Niche or Mainstream?

The prospects of HWW acreage expansion will depend on how much end-users value this class of wheat. Over the next 3 to 4 years, HWW sales will be mainly to domestic markets. Exports are expected to remain minimal until sales are sufficient to provide a consistent supply. Small shipments using containers would likely be uncompetitive with Australian wheat, although shipments can be separated in a wheat cargo to reduce transport costs. Exports could go to Mexico for making tortillas and pan bread, to Asia for making oriental noodles, and to the Middle East and Indian Subcontinent for flat bread.

The rate of expansion in HWW acreage will initially be limited by the availability of certified seed. Approximately 1,000 bushels of combined foundation seeds for the two new KSU varieties will be planted in the fall of 1998. In subsequent years, the supply of certified seed will be limited by sales of HWW to domestic flour millers (instead of retained for seed) to demonstrate to farmers that there is a market outlet. Based on KSU's current distribution plan, nearly 2 million bushels of certified HWW seed is targeted for harvest in Kansas in 2000. In addition, according to KSU, marketing plans submitted by bidders to receive the foundation seeds indicated that one-half to three-quarters of this certified seed may be sold to farmers for seedings in fall 2000 and the remainder sold to flour millers and for market development trials. HWW area would then equal 8-12 percent of Kansas wheat acreage harvested in 2001.

Assuming traditional adoption rates for popular HRW varieties would apply to the new HWW varieties because of yield advantages, HWW acreage would expand further to nearly 15 percent of Kansas wheat acreage harvested in 2002. However, this comparison is not completely valid because previous varieties involved no changes in marketing or storage and had established market outlets. Also, concern about sprout damage will dampen optimism about a fast adoption of HWW. Thus, considering all the factors together, HWW acreage will not likely expand beyond 10-15 percent of Kansas wheat area in 2002, unless it is proven to producers that HWW offers higher revenues.

Without significant price premiums, the primary adoption driver would have to be the yield advantages. If trial yield gains are achieved by farmers, it would be similar to a popular HRW variety—Jagger—which was introduced in 1994. But it was not until 1998 that Jagger reached 20 percent of seeded acreage in Kansas. The amount of foundation seed for the two HWW varieties (1,000 bushels) is smaller than for Jagger when it was released (3,000 bushels). These comparisons suggest that the area planted to the two new varieties in Kansas will be less than 15 percent by the year 2002, especially if the yield improvements for these varieties are not as great as breeders expect.

William Lin (202) 694-5303 and Gary Vocke (202) 694-5241
wwlin@econ.ag.gov
gvocke@econ.ag.gov AO