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Hard White Wheat at a Crossroads

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Abstract

Hard white wheat (HWW), which has a white-flour look and whole-wheat nutrition, has milling and baking qualities that make it particularly suited for certain products. These include not only whole-wheat products, but pan breads, tortillas, and certain kinds of oriental noodles. In 2003, HWW plantings accounted for 2.3 percent of all wheat grown in major HWW-producing States. This represented an acceleration, occurring in part because of a government incentive program. Up to now, HWW sales have been largely confined to the domestic market because production is not large enough to sustain steady exports. In addition, strong foreign competition makes it unlikely that the international marketplace will generate any significant price premiums for HWW. Continuing expansion of HWW production would depend on the development of new, higher-yielding varieties that are more tolerant to sprout damage—a major problem in 2004—and continuation of the government incentive program.

Keywords: wheat, hard white wheat, oriental noodles, identity preservation, niche commodities, farm policy, incentive payments

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Introduction

U.S. wheat breeders are making a concerted effort to develop new varieties of hard white wheat (HWW), which at present accounts for a very small proportion of U.S. wheat acreage. HWW plays a strategic role in several State breeding programs because of its end-use characteristics and its potential to increase demand, farm income, and the U.S. competitive position on the world market. Kansas State University (KSU), for example, has devoted about 75 percent of its wheat breeding program (in terms of the percentage of crosses between varieties) to white wheat since the late-1990s, up from 10 to 25 percent in the 1980s (Madl). Other States, including Idaho, Washington, Oregon, Colorado, Montana, Nebraska, North Dakota, and Oklahoma, have followed suit by devoting 20-40 percent of their breeding programs to HWW (Oades).

According to extensive university and industry studies, HWW—hard-endosperm wheat with white bran—has the potential for yielding 1 to 3 percent more flour per bushel of grain than other wheats, when milled to standards for flour color.[1] Higher flour extraction rates are possible because HWW's white bran means that more bran can be included in the flour, resulting in higher fiber content than that of other wheats. In addition, HWW has a less bitter aftertaste when used in whole wheat products, and its color qualities are preferred by some consumers. These superior milling characteristics appeal to both domestic and foreign wheat buyers, providing potential alternative markets to hard red winter (HRW) and hard red spring (HRS) wheats.

The expansion of HWW production, however, may be constrained by an agronomic factor—its susceptibility to sprout damage which lowers falling number (FN) and test weight of the wheat crop.[2] With precipitation at harvest, sprouting occurs much more rapidly and extensively in white than in red wheats. Therefore, it is important that HWW be grown in areas normally dry at harvest time. Sprout damage has been a major problem for HWW, as evidenced by sprouting in the 1999 and 2004 Kansas crops. Conditions that favor widespread sprouting of white wheats are estimated to occur 1 in every 5 years in eastern Kansas, but less than 1 in every 20 years in western Kansas (Kansas Wheat Commission and the Kansas Association of Wheat Growers). Thus from an agronomic standpoint, HWW has brighter prospects in western Kansas. However, new cultivars in the research pipeline, which are still about 2-3 years away from commercialization, hold promise for sprout tolerance. Sprout damage is less an issue in the Pacific Northwest (PNW), where risk of rainfall at harvest is low—which helps explain why (soft) white wheats are the chief class there.

Sprouted wheat results in dough stickiness or bread loaves with gummy insides and large voids, leading to difficulty in slicing loaves and lower consumer appeal (Wheat Marketing Center, Inc.). Millers do not accept wheat with more than minimal sprout damage in U.S. wheat grades and standards. If the damage is more than minimal, elevators treat the wheat as feed quality and apply discounts of $1 - $1.50 per bushel.

[1]HWW is milled to an ash standard, which is used by the U.S. flour milling industry as a proxy to measure flour color. Ash—the metal and mineral residue after a test sample of flour has been incinerated in a very hot oven to burn off all organic material—is present mainly in the bran layer. Thus, ash content measures how much bran is milled into the flour, which in turn determines the color. All products made from HWW in General Mills (except frozen dough) have higher extraction rates because they are milled to higher ash standards than HRW products (Olsen). Higher extraction rates of HWW can be realized if bakers are willing to accept higher ash content. These higher extraction rates are achieved in overseas markets, particularly Asia, where a color standard applies to noodle products for which HWW is especially suited.

[2]FN measures the length of time (in seconds) that it takes a plunger to fall from top to bottom through a small mixture of milled wheat and water. If wheat is sound (no sprout), the starch will be thick and the falling number will be high—above 300 seconds for bread baking. In contrast, sprouting can create extra alpha-amylase, resulting in low FN. Flour made from wheat with a low FN holds less water when mixed and the dough absorbs less water during baking. As a result, bakers must use more flour to make the same number of loaves, which raises their costs. Test weight is weight per unit volume as measured in pounds per Winchester bushel as defined in the United States, determined by weighing the quantity of grain required to fill a 1-quart container. The international equivalent measure is kilograms per hectoliter.

Will HWW, which was established as a new class of wheat in May 1990 by USDA's Federal Grain Inspection Service (now the Grain Inspection, Packers and Stockyards Administration) remain a niche product or will it become a major class of wheat? The answer clearly depends on whether HWW will bring in higher net returns than competing classes of wheat, such as HRW and HRS in the Great Plains or soft white wheat (SWW) in the PNW. This, in turn, will hinge on HWW's marketability, the likelihood of sprout damage, and yield performance in actual commercial production. For farmers, the critical questions are how HWW yields, how frequently sprout damage might strike, and whether HWW's traits translate into a price premium relative to competing classes of wheat.

Trial yields for Trego, the most popular HWW variety, were comparable to Jagger, the most common HRW wheat variety, in 2003 winter wheat performance tests in western Kansas.[3] Other things being equal, this competitive yield would encourage wider adoption of the new HWW varieties over those released in the early 1990s, which were lower yielding than then-existing HRW varieties. Results from actual farm experience and a longer time series will be needed to verify the yield advantages recorded at experiment stations.

[3]The 2003 trial yields found that Trego had average yields in the range of 51-61 bu/ac in southwest and northwest dryland regions, compared with 52-62 bushels in trial yields for Jagger (Kansas State University). In fact, some less commonly planted HWW varieties outyielded both Trego and Jagger.

Hard White Wheat Plantings Approached 1 Million Acres in 2003

During 1998-2002, HWW plantings nearly tripled as market demand increased. Partly as a result of a government incentive program authorized in the 2002 Farm Act, plantings of HWW in 2003 nearly tripled again in just 1 year, approaching 1 million acres. Changes in contract provisions by major grain companies between 2003 and 2004 and price discounts charged by some local elevators to HWW, however, put a damper on producers' interest in growing HWW for the 2004 crop.

The 1998-2002 Expansion

The number of acres planted to HWW is subject to some uncertainty (table 1). Based on a compilation by USDA's Economic Research Service, U.S. farmers' HWW plantings totaled between 263,000 and 354,000 acres for harvest in 2002, up from 100,000-140,000 acres in 1998 (table 1). Nearly three-fourths of HWW plantings in 2002 were winter wheat, which requires cold temperatures for proper growth (vernalization) and thus is typically planted in fall and harvested the following summer. The rest of HWW acreage was spring wheat, which has no vernalization requirement and is planted in spring and harvested in summer. In 2002, HWW accounted for less than 1 percent of all wheat grown in all the HWW-producing States.

In 2002, Kansas, Colorado, Montana, Idaho, and California were the top five producing States, accounting for over 90 percent of U.S. HWW acreage. In Kansas and Colorado, producers planted winter varieties, while producers in Idaho and Montana planted both spring and winter varieties. White wheat grown in California is genetically a spring variety, but was adapted and planted as a winter variety.

Of the major producing States, Kansas and California showed steady increases in HWW plantings from 1998, reaching 1 percent and nearly 4 percent, respectively, of all wheat grown in these two States in 2002. Yields of the newly released HWW varieties were competitive with popular HRW varieties, and in some cases outperformed them. In addition, millers were offering price premiums to farmers to grow HWW.

Planting patterns in other major producing States were mixed. In Montana and Colorado, HWW plantings went down from 1998 to 2000, but then expanded sharply. The release of higher yielding HWW varieties boosted their adoption by producers. In contrast, HWW plantings in Idaho expanded in 2000, but contracted in 2002 with the exit of a large farmer cooperative that dealt with the contract and seed supply of HWW. Production/marketing contracts, discussed later, are common in private HWW plantings.

Table 1—Major producing States for hard white wheat in the period 1998-2004

State	HWW planted acres for harvest (1,000) 1998	2000	2002	2004	Variety	Percent of State wheat acreage in 2004	Source of data
Montana	40.5	17.4	37-75	35.5-45.4	Nufrontier, Nuwest Golden 66 & 86*	0.76	Montana Agri. Stat. Service; Montana Wheat Commission; Pro/Mar Select Wheat, Inc.; NE Wheat Board
Colorado	20-50	13.3	56-75	105.0-170.0	Trego, Platte Solomon	5.95	Rollin Sears; AgriPro, Inc; CO Ag. Stat. Service; NE Wheat Board
Kansas	10-20	25-35	100-125	386.5-485.1	Trego, NuFrontier Lakin, NuHorizon Platte, Arlin, Oro Blanco, Rio Blanco, KS196	4.40	Rollin Sears; Farmer Direct Foods; Kansas Wheat Commission; Nebraska Wheat Board
Idaho	15	69	22.5-29.0	37.0-45.0	Klasic, ID377S* NuHorizon, NuFrontier	3.39	Pro/Mar Select Wheat, Inc.; Idaho Agri. Stat. Serv.; NE Wheat Board
California	12	12.6	23.7	41.0-75.0	Blanca Grande Klasic, Plata	8.66	California Wheat Commission; Nebraska Wheat Board
Oregon	<2	<2	0.24	0.93	ID377S*	0.09	OR Agri. Stat. Service; NE Wheat Board
Washington	0.05	24.3	16.0-16.1	42.6-57.0	ID377S* Winsome	2.11	Wash. Agri. Stat. Service; NE Wheat Board
Nebraska	0.58	15	3.3-6.0	25.8-33.2	Platte, NuFrontier	1.51	General Mills; NE Agri. Stat.Serv.; NE Wheat Board
Others**	0.12	0.12	4.2	53.6		0.25	State Agri. Stat. Services; NE Wheat Board
Top 5 States	97-137	150.7-160.7	239.2-327.7	612.1-832.1		4.69	
All HWW States***	99.8-139.8	178.7-188.7	262.9-354.2	727.0-964.3		1.71	

*Spring variety (others are winter varieties). **Includes Oklahoma (30,000 acres), Texas (15,300 acres), North Dakota (5,900 acres), South Dakota (1,000 acres), Utah (1,000 acres), and Wyoming (373 acres) for the 2004 crop. *** HWW accounted for 2.31 percent of 2004 wheat acreage planted in major HWW-producing States (excluding North Dakota, South Dakota, Utah, Oregon, and Wyoming). Compiled by Economic Research Service, USDA.

The 2003 HWW Incentive Program

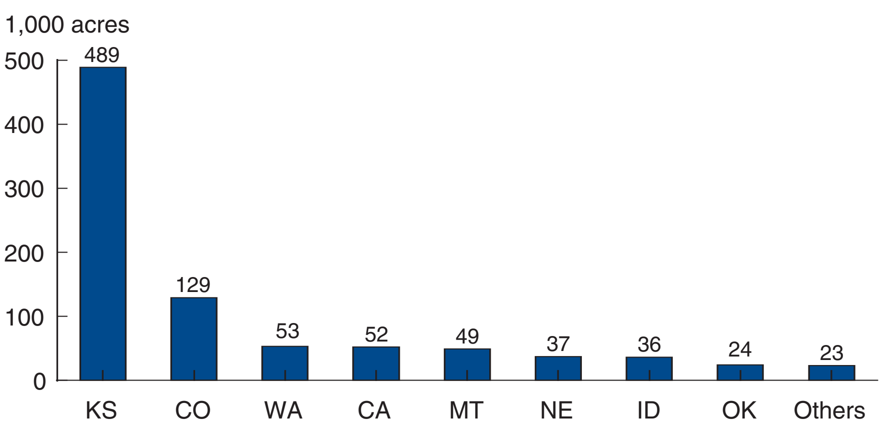
HWW plantings in 2003 accelerated in part because of government interest. The 2002 Farm Act contains a 3-year HWW incentive program aimed at stimulating the supply of HWW for domestic milling and exports for crop years 2003 through 2005. Eligible producers receive production incentive payments of $0.20 per bushel for U.S. No. 2-or-better HWW, up to a maximum of 60 bushels per planted acre. An additional incentive of $2 per acre is provided for each acre planted with certified registered or foundation seed. The program is funded by the 2002 Farm Act at $20 million. These incentive payments amounted to a potential increase of about 10 percent, on average, of the expected farm price for 2003 HWW, contributing to an expansion of HWW planted acreage.

HWW plantings for harvest in 2003 are estimated to have been about 900,000 acres, accounting for 2.3 percent of all wheat grown in major HWW-producing States. Kansas had more than half of U.S. HWW-planted acreage in 2003 (fig. 1). Compared with the previous year, HWW plantings in the United States expanded by nearly 600,000 acres, an increase of about 190 percent. The expansion occurred across the board, with the largest increase in Kansas (fig. 2). HWW grown in Kansas accounted for about 5 percent of all wheat seeded in 2003, more than three times higher than the 2002 level. Trego, a KSU-developed public HWW variety, accounted for more than half of HWW acreage in Kansas (Kansas Wheat Commission). Among the major producing States, Colorado, Washington, Nebraska, California, and Oklahoma showed visible increases in 2003 HWW plantings. HWW plantings in Idaho in 2003 were above the 2002 level, but below that of 2000. Plantings of HWW in Montana in 2003 showed a slight decline (based on the mid-point of the range in 2002) due to the exit of a large farm cooperative offering the production/marketing contract and seed supply of HWW.

While the government incentive program was a significant factor in the dramatic expansion in 2003 HWW plantings, other factors also played an important role. Superior yield performance of HWW varieties in western

Figure 1

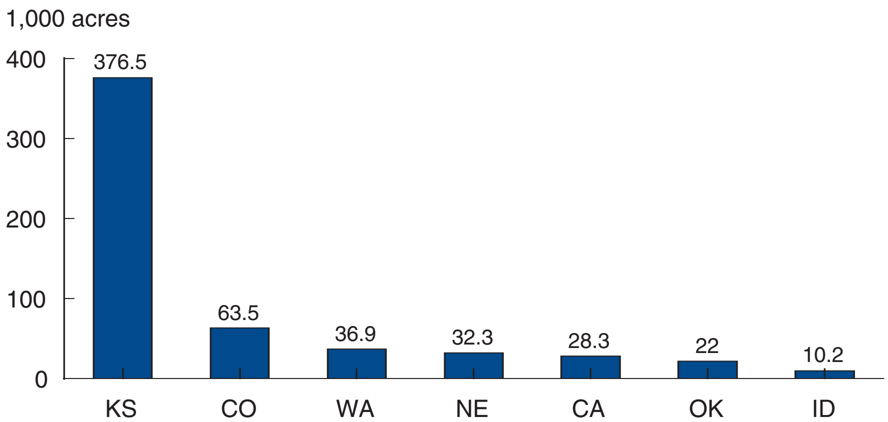
Kansas had more than half of U.S. HWW acreage in 2003[1]



[1]Includes all HWW acreage enrolled under the incentive program.

Source: USDA farm program data, Farm Service Agency, USDA.

Figure 2
Kansas had the largest increase in 2003 HWW planted acreage



Source: USDA farm program data, Farm Service Agency, USDA.

Kansas (compared with HRW varieties) and above-average quality attributes, together with attractive contract programs offered by major grain companies, were at least as important in the expansion. In the southwest Kansas dryland region, for example, Trego's average yield and test weight were 2 bu/ac and 2 lb/bu higher than the average, respectively (Kansas State University). Attractive contract programs offered to producers by major grain companies were also an important factor. Some companies offered producers an input subsidy for seeds by charging seeds at bulk wheat prices, which could cut per acre seed costs by as much as half (Gilpin). Others offered price premiums for HWW, ranging from 7 to 10 cents per bushel, with incremental increases in the premium for higher test weight and protein content.

The 2004 HWW Sprout Damage

HWW plantings for harvest in 2004 totaled around 846,000 acres (based on the mid-point of the range), down 6 percent from 2003. In Kansas, HWW plantings declined to about 436,000 acres for the 2004 crop, down from nearly 500,000 acres. Among other major producing States, Colorado, Idaho, and California showed modest increases in 2004 HWW plantings, and Montana showed a decline.

There were a few key reasons for the overall decline in 2004 HWW plantings. First, changes in contract provisions by major grain companies between 2003 and 2004 discouraged producers from growing HWW (Stoddard). One grain company, for example, backed out of contracts with producers growing HWW on dryland to promote that company's own HWW variety, which performs well on irrigated acreage. In contrast, another grain company discontinued contracts on irrigated acreage and switched to dryland contracts to increase HWW's protein content. Further, a grain company reportedly discontinued the price premium it had offered to producers in the past, believing that the government incentive payments would be enough to entice producers to grow HWW. In some localities, HWW was blended with HRW by elevators to avoid the costs of segregation. Further, a few local elevators charged discounts to HWW in order to make up the high costs of segregation associated with the small-scale HWW volume (Stoddard).

The 2004 HWW crop suffered widespread sprout damage that cut across Kansas, Nebraska, Colorado, and even the PNW region. The HWW harvest was delayed by unusually heavy rain in western Kansas, western Nebraska, and eastern Colorado. This had adverse consequences for the quality of the crop, with extensive sprout damage, as indicated by low falling numbers and low test weight. Sprout damage was particularly severe in Kansas, impacting 40 to 50 percent of the HWW crop, while it affected 15 to 20 percent of the crop in Nebraska and Colorado (Stoddard).

Producers who suffered sprout damage in 2004 would likely be ineligible for an incentive payment, which requires that the wheat be graded as U.S. No. 2 or better. The grade standards for U.S. No. 2 HWW specify a maximum total of 4-percent damaged kernels, which include sprouted kernels, and 5-percent total defects (including damaged kernels, foreign material, and shrunken and broken kernels). If total damaged kernels exceeded 4 percent and total defects exceeded 5 percent, but were less than the maximum allowed for a grade of U.S. No. 4—which is 10 percent for total damaged kernels and 12 percent for total defects—the wheat would also not qualify for indemnity payments under crop insurance policies for coverage of quality loss. To trigger compensation under this provision, the sprout-damaged HWW must be graded as U.S. No. 5 or worse (that is, sample grade).

Behind the Demand for Hard White Wheat

Flour millers may favor HWW over HRW and HRS because of HWW’s potentially higher extraction rate and unique end-use characteristics. Soft white wheat is not generally substitutable for HWW because most varieties of SWW lack the gluten properties necessary for baking pan bread (i.e., loaves) and are used for products such as cakes, cookies, flat breads, steam buns, and some noodles.

U.S. millers may prefer HWW because it has a flour extraction rate 1-3 percent higher than red wheat when both are milled to similar color standards, since more bran can be included in the HWW flour without darkening it. Millers can use HWW for most of the same uses as HRW. The higher extraction rate for HWW amounts to about an additional pound of flour per bushel of wheat, assuming a 74-percent extraction rate for each bushel. At the flour price of $10.25 per hundredweight in Kansas City quoted as of August 27, 2004, this extra pound of flour would carry a market value of about 10 cents. Whole wheat products made from HWW may be more appealing to consumers who favor whiteness along with higher fiber and mineral contents, because 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. However, to induce the use of HWW in flour milling, its advantages to flour millers would have to exceed the price premium they pay for it.

HWW's end-use characteristics are particularly well suited for whole-wheat products, pan breads, tortillas, and certain kinds of oriental noodles. HWW is used to make increasingly popular whole-wheat breads. Bread made from whole HWW flour is not only lighter colored but also less bitter than bread made from red wheat; white wheat bran contains less of the phenolic compounds that give whole red wheat bread a stronger flavor. Thus, less sugar is needed, which is appealing to nutrition-conscious shoppers.

Tortillas are a traditional Mexican flat bread made from either corn or wheat. Corn tortillas predominate in Mexico, while wheat tortillas are preferred 2 to 1 over corn tortillas in the United States. U.S. consumers reportedly prefer bright white tortillas, which may give HWW an advantage over HRW (Wheat Marketing Center, Inc.).

Tortillas made from wheat are used increasingly in the United States as "wraps" for a variety of non-Mexican foods. This practice began in the mid-1990s in California and has been taken up by the Nation's fast-food industry. While this innovative use of tortillas bodes well for white wheat demand in the United States, its impact on total wheat demand might be limited because it substitutes for other wheat products.

Makers of noodle flour and the flour millers in Asia tend to favor white wheat for noodles. While U.S. soft white wheat is suitable for some of these noodles, many types require the use of HWW (with low- to medium-level protein, sometimes referred to as "semi-hard" in Asia), with its superior dough color and color stability. The United States has struggled with "bread" quality vs. "Asian noodle" quality in the HWW breeding programs, but is increasingly developing varieties with good crossover capability. Light dough color, color stability, and appropriate textual characteristics are keys to successfully serving Asian markets. Australia provides a large supply of this kind of HWW because it has a variety-release system that caters to the export marketing of white wheats tailored to Asian markets, produced under identity preservation (IP) systems.[4] Australian breeding programs employ these quality objectives in their selection process.

[4]IP, for purposes of this study, is broadly defined as a production-handling-distribution process in which crops are required to be kept separate to avoid commingling during planting, harvesting, loading and unloading, storage, and transportation, so as to preserve the identity of the crops and ensure their end-use quality.

Most Asian noodle manufacturers use flour made from a blend of wheats based on relative prices and the end-use characteristics desired. Color and texture imparted by Australian white wheats are particularly suited to these blends. About half of wheat imported into Asia, primarily supplied by Australia, is used for noodle production, according to reports from Asian noodle manufacturers (Oades). The market potential of Asian noodle demand is considerable. On average, 40 to 50 percent of the total wheat supply is consumed in the form of noodles and steamed breads in Japan, South Korea, Taiwan, Indonesia, Thailand, Malaysia, the Philippines, Vietnam, Hong Kong, and Singapore. China mills over 85 percent of its domestic and imported wheat for the production of noodles, steamed breads, dumplings, and Chinese pastry products.

Noodles from Australian wheats are known for a stable white or yellow color, essential for 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 have found to be responsible for noodle discoloration. Raw noodles, along with partially boiled noodles, are preferred by many Asian consumers, and those made from some red wheats may discolor to green, brown, or gray 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 HWW varieties recently released by Kansas State University, together with those released by other States or private entities, are expected not only to enhance the supply of HWW for the domestic market in the short run, but also to compete with mid-protein Australian wheat in international markets. According to the foreign offices of U.S. Wheat Associates, Asia imports more than 400 million bushels of wheat for making noodles, with that use accounting for half of total wheat imports into Asia. (Asia, including China, accounts for about a third of world wheat imports.)[5]

[5]According to John Oades of U.S. Wheat Associates, Asia is the fastest growing wheat market in the world, and noodles are its fastest growing segment.

Not all HWW varieties have acceptable noodle-making quality. To meet the minimum requirements of good noodle wheat, the variety must impart good color stability and noodle texture. Color stability depends largely on low levels of PPO. In addition, unlike wheat used for bread, which requires high protein and high gluten, wheat with a low- to mid-protein range and less gluten strength is desired for most types of noodles. Over the last decade, U.S. researchers have been making dramatic improvements in the quality of HWW in order to surpass the quality of Australian wheat for oriental noodles. According to the Wheat Marketing Center in Portland, Oregon, flour made from some U.S. HWW varieties performs better than, or equals, the Australian control flour (Hou).

Over the last several years, Canada has also made inroads in developing white wheats for the Asian market. In 2003, Canada produced 185,000 tons of HWW, enough for sales to key markets, particularly to Asia. With a second HWW variety being commercialized, Canada is expected to boost its production to approximately 550,000 tons in 2004. Feedback from customers on the quality of Canadian HWW has been positive, noting its ability to produce bright, clean noodles that are free of specks and have good texture, as well as to produce bread with a bright crumb color.

Marketing System Must Adapt to Preserve HWW Identity

To avoid the loss of price premiums typically stipulated in the contract, HWW must be kept separate from other classes because mixing (1) eliminates the extraction rate advantage, and (2) possibly lowers the grade if the level of "contrasting classes of wheat" (e.g., soft white vs. hard white) or of "wheat of other classes" exceeds the grade limit. Private HWW varieties are mostly grown under contracts with specifications that lower the risk of commingling with other classes of wheat. Public varieties, such as Trego, are generally grown with or without contracts. In either case, segregation of HWW from other classes through the supply chain to end users is needed for preserving its identity. However, segregation involves costs above those for mainstream marketing of bulk wheat.

Production/Marketing Contracts Are Common in Private HWW Variety Plantings

Identity preservation of HWW begins at the farm level. To ensure the delivery of the identity specified by end users, most private HWW varieties are grown under production/marketing contracts—also called "delivery agreements" by the industry. In Kansas, about 80-85 percent of the HWW crop is grown under contracts (Madl). Alternatively, testing for the presence of a contrasting class or wheat of other classes is used in some regions, such as California, in lieu of contracting.

Production/marketing contracts for HWW commonly specify the following safeguards:

- Restricting the HWW varieties that producers are allowed to grow
- Growing HWW only on summer-fallow land to avoid commingling with volunteer wheat of other classes
- Cleaning farm equipment (e.g., planters and combines) and handling facilities (e.g., storage bins)
- Scouting the fields and treating the crop for any diseases and insect infestations
- Submitting a grain sample from each field after harvest for quality check (e.g., protein content)
- Delivering HWW to a designated receiving point (usually an elevator, but sometimes a flour mill)
- Barring farmers from retaining seeds for planting in the next season

Segregation Throughout the Supply Chain Raises Costs

From seed plantings to end users, the identity of HWW can only be preserved through segregation. However, segregation activities at each stage of the supply chain add extra costs. Some of these are out-of-pocket expenses, while others are opportunity costs, that is, foregone revenues resulting from segregation activities.

Some out-of-pocket costs that producers, grain handlers, and flour millers incur in segregating HWW from other classes of wheat, including restrictions on management practices, are for:

- Cleaning farm equipment and grain handling and processing facilities throughout the supply chain
- Greater input costs, including annual seed purchases, and grain quality sampling and testing
- Hauling grain a greater distance for delivery at a receiving point
- Additional expenses for handling a smaller volume of HWW than of bulk wheat
- Additional expenses for recruiting farmers to grow HWW and administering the contracting program
- Contracting for a greater volume of HWW than needed to protect against potential crop failure due to unfavorable weather
- Planting HWW on summer-fallow land to avoid commingling from volunteer wheat

In addition, identity preservation of HWW incurs opportunity costs. Due to its small volume, producers, grain handlers, and processors may not be able to fully utilize their handling and storage facilities. This is a hidden cost, which increases the overhead cost per unit of throughput due to lost handling and storage revenues. Further, segregation restricts the extent of blending to meet the requirements of contract specification, which is an important source of the grain handler's gross margin. Finally, there are hidden costs associated with the loss of flexibility throughout the supply chain (e.g., farmers can only plant HWW on summer-fallow land in the Great Plains). However, segregation can be managed at the elevators by dedication of single-dump pit elevators to either HRW or HWW. Multiple-dump pit facilities can substantially reduce the costs of segregation if they designate a dump pit to HRW or HWW; however, an opportunity cost still exists.

Marketing Will Need to Adapt if HWW Production Becomes Large-scale

Segregation may be costly initially, but it would become less so if HWW plantings increased and elevators handled larger volumes. For example, farmers and elevators in barley areas routinely separate feed barley from malting barley, and at relatively low cost; also, producers in the northern-tier States (e.g., North Dakota and Montana) segregate HRS from durum wheat.

In the PNW, producers and handlers also segregate HRW, HRS, and soft white wheat.

For production to expand widely, the marketing system will need to preserve the identity of HWW so that the price premium offered to producers can be sustained. At present, the identity is preserved largely through segregation by variety, as stipulated in many contract programs. IP by variety reflects the fact that HWW varieties differ in their end-use characteristics, and only some varieties are well suited for specific products. For example, HWW used for oriental noodles requires low- to mid-range protein content and less gluten strength than HWW for bread. If acreage expands, HWW could be marketed through IP by class (i.e., a class of wheat with hard endosperm and white bran) instead of variety, as long as the HWW quality characteristics for specific end products are maintained.

Segregation requires that specific HWW varieties be kept separate from other classes of wheat and other HWW varieties throughout the supply chain, from production point, handling, storage, and transportation all the way to end users. Limited onfarm storage space might present more of a challenge in Kansas as handling volume expands than in the Northern Plains, where there is typically more farm storage capacity. Also, if production expands, segregating HWW from other classes of wheat may initially call for hauling the crop to more distant elevators, which increases marketing costs. However, if HWW increasingly substitutes for red wheat, nearby storage space may be less of an issue, as was the case with the spike in 2003 crop production: Elevator space became increasingly available to handle a larger volume of white wheat. If production expands, grain companies can more readily designate elevators to handle only HWW, reducing the costs of segregation. Currently, some seed companies or farmer cooperatives in Kansas contract with selected elevators owned by major grain companies to handle just HWW.

While IP is a deviation from the current norm, some other field crops with specific attributes are produced, handled, and marketed to preserve the purity of their characteristics. For example, IP corn crops that have already been commercialized include corn marketed as non-biotech, high oil corn, hard endosperm or food-grade corn, white corn, waxy corn, nutritionally enhanced corn, high amylase corn, high lysine corn, seed corn, and organic corn. However, market viability of HWW is not guaranteed even if the crop is grown under IP programs, as evidenced by financial difficulties encountered by some suppliers.

An expansion of HWW production, with the subsequent potential for export, has implications for contract specifications. Up to this point, sales of HWW have been largely limited to domestic flour milling. However, there were cargo shipments during marketing year 2003/04 to Morocco (about 66,400 metric tons), Egypt (37,400 metric tons), South Africa (36,000 metric tons), Lebanon (25,000 metric tons), and other destinations (including Taiwan, Thailand, Venezuela, Mexico, and the Philippines), according to GIPSA grain inspection data (USDA). The volume of HWW exported during the 2003/04 marketing year reached 195,000 metric tons, accounting for about 20 percent of HWW production, up from 19,400 tons a year earlier. 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 would be used for making flat breads such as pita because of its higher extraction rate and lighter color), the standards might be accepted without requiring tighter contract specifications. However, tighter limits may be specified in contracts for some quality-sensitive buyers, such as those in Japan. Buyers who are especially sensitive to purity could contract directly with U.S. producers under an IP program, even though this kind of contractual arrangement does not exist at present.

How to measure wheat color remains an issue in determining the level of contrasting classes of wheat. However, the technology to distinguish hard from soft wheat is available. The single-kernel hardness tester, although extremely accurate, reportedly costs $50,000 per unit. From the elevator perspective, whether the cost is affordable depends on the annualized cost over the unit's lifetime expectancy and the cost per tested bushel, based on throughput. In contrast, technology for detecting the color of HWW is still in development. At present, visual inspection is the traditional, less expensive option, but this is becoming more challenging as kernel characteristics become less standard. For example, some HWW varieties grown in Kansas in 2001 had the appearance of red wheat, which was mostly attributed to environmental factors. However, these varieties had all the end-use characteristics of HWW. This technical difficulty was resolved only after a "waiver" of grain-grading rules was granted through aggressive lobbying by the Kansas Wheat Commission (i.e., a suspension of color inspection—a policy that remains in effect). A near-infrared reflectance (NIR) instrument, which can be used to detect the color of HWW, will not be commercially available for a few years.

Will HWW Returns Outweigh Higher Marketing Costs?

Expanded HWW production in the future will depend upon adoption of new HWW varieties, driven by market demands for this class of wheat. Important factors include the yield potential of new HWW varieties, the likelihood of sprout damage, the price offered by the market, and any differences in the costs of production and marketing between HWW and competing classes of wheat. Differences in producer net returns of HWW and the competing class depend primarily on yields and prices, since the costs of HWW production are similar to those of HRW on a per bushel basis (Sears).

At present, popular HWW varieties (e.g., Trego, a KSU public variety) have trial yields comparable with those of HRW (e.g, Jagger) in the Central Plains. Varieties of HWW recently released by major grain companies and farmers' cooperatives in the private sector (such as GM10005 in northwest Kansas and Nufrontier in southwest Kansas) were also comparable to Jagger in the 2003 yield trials. Adoption of these yield-improved varieties is promising. However, it will take time to determine farmer acceptance and to observe if yield gains in actual farm situations match those in experimental trials.

Another question revolves around end users' willingness to pay more for HWW. While there are niche uses in the U.S. for HWW, prices will be shaped by the market and influenced by competition from other classes of wheat. The improved extraction rate and favorable color and taste attributes for specialty products have led buyers to pay price premiums for HWW in the domestic market. In most cases, price premiums for HWW offered to producers through contract programs are around 10 cents per bushel throughout the Great Plains (Taylor).

The expansion of HWW acreage critically depends on whether the increase in revenues through yield enhancement and price premiums can outweigh additional marketing costs. A 1999 economic engineering study at KSU found that in Kansas the cost of segregating wheat into two or three quality categories ranged from 5.6 cents/bu to 6.5 cents/bu for many country elevators equipped with one drive, one bucket elevator, and two pits (Herrman, Boland, and Heishman). The cost of segregation was lower for country elevators equipped with two drives, two bucket elevators, and three pits, ranging from 2.3 cents/bu to 2.9 cents/bu. If HWW expands beyond the specialty level, costs will drop with larger volumes and economies of scale.

HWW: Niche or Mainstream?

In the long run, market forces will drive plantings of HWW. The current incentive program is an important factor, which contributed to a spike in HWW adoption in 2003 and will have an effect on HWW plantings for 2004-05. Beyond this time, the expansion of HWW plantings can only be sustained if domestic market forces continue their momentum and export markets continue to grow.

In addition to market access, farmers will favor HWW plantings if they receive higher price premiums, which depend on growth in market demand. Farmers would also favor plantings if HWW has demonstrated yield advantage over HRW varieties, particularly those new HWW varieties recently released or waiting to be released by private entities. The strategy of devoting more resources in State breeding programs to HWW in the Plains and PNW would continue to boost HWW yields relative to HRW varieties. However, the sprout damage that occurred to the 2004 crop will most likely put a damper on producers' interest in growing HWW for harvest in 2005.[6] This adverse effect could last for more than just a year or two if producers believe that sprout damage could recur, instead of being a one-time phenomenon. End-use characteristics of whole wheat products made from HWW, such as less bitter aftertaste and less sugar (and hence fewer calories), white color, and associated higher fiber content, may appeal to many customers. Moreover, milling HWW to color standards instead of ash standards would help sustain price premiums that flour millers are willing to pay HWW producers due to the resulting higher extraction rate. However, due to strong competition from Australia—with similar competition developing from Canada—export markets are not likely to be a major source of price premiums for HWW in the future.

[6]Due to seed shortages, some winter wheat producers in Kansas decided to plant their cropland to HWW for the 2005 crop. A longstanding drought, coupled with rains during harvest time that caused widespread sprout damage to the 2004 winter wheat crop, reduced winter wheat seed production in some areas of Kansas. Certified seed growers in these areas reportedly harvested about 30 percent of the normal production. In contrast, no seed shortages were reported for HWW. It is less certain, however, whether the seed shortages for winter wheat varieties would translate into an increase in HWW plantings for harvest in 2005.

Over the next several years, HWW production will be at a crossroads. A pessimistic view is that plantings of HWW will cease to expand, or will even decline, if many producers view the recurrence of sprout damage within a relatively short time as inevitable. These producers can point to sprout damage that occurred to the 1999 and 2004 HWW crops in Kansas. However, a more likely scenario is that despite the decline in HWW plantings for the 2004 crop, the acreage will continue to expand, but at a slower rate. Many HWW producers will probably view the likelihood of sprout damage recurring soon as slim. In addition, sprout damage-tolerant varieties could be commercialized in 2-3 years, and this characteristic is an explicit goal in KSU's HWW breeding program (Madl).

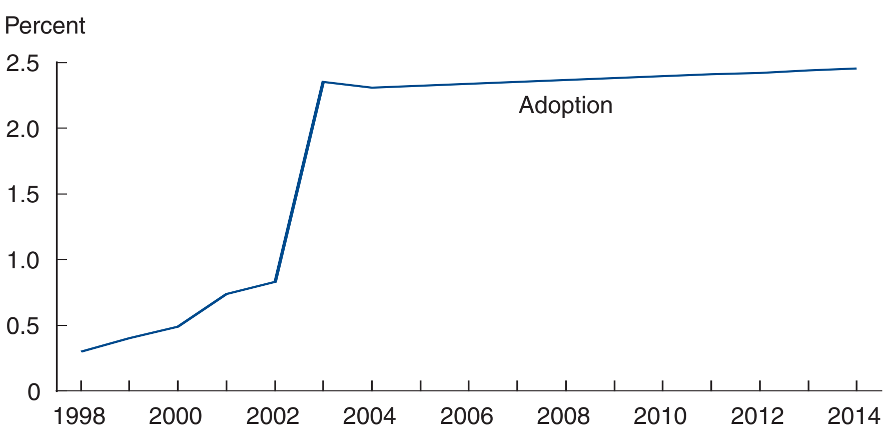
Ideally, the prospects of HWW plantings over the next decade could be determined by modeling acreage response to changes in producers' expected net returns for HWW and competing crops, and to the implementation of the government incentive program. However, a lack of sufficiently long time series of HWW data (like that already collected and published by USDA's National Agricultural Statistics Service for other classes of wheat on acreage, yield, costs of production, and farm price) makes this modeling effort practically impossible. As a result, a logistic growth curve, which was used to measure the growth in the adoption of hybrid corn in the late fifties, is used in this study to project the trends in HWW adoption in the United States (Maddala). The base scenario of the logistic growth curve assumes that in the long run, producers in major HWW producing States as a whole will reach an adoption rate of 5 percent—the level achieved in Kansas for the 2003 crop.

Results of the logistic growth curve suggest that in the absence of the government incentive program, HWW would likely account for about 2.5 percent of all wheat grown in major HWW-producing States over the next decade, up from the current 2.3 percent (fig. 3). The adoption rates of HWW prior to 2005 are actual data, while those in 2005 and after are trend projections.

In addition, the projection for 2005 does not reflect any potential impacts from sprout damage that occurred to the 2004 crop in the Central Plains States. Instead, it is part of the logistic growth trend. As indicated earlier, the government incentive program played an important role in the spike of the 2003 HWW planted acreage because it offered producers payments that amounted to a 10-percent increase, on average, in the expected farm price. Projected adoption rates over the next decade suggest an annual growth rate of less than 1 percent for HWW, or close to 1 million acres by 2015. At this level of production, the volume of HWW for cargo shipments to overseas markets would still be somewhat limited.

On the other hand, if demand for HWW grows more rapidly than in the previous several years and is reflected in market premiums, the prospects of HWW plantings would be brighter than those in the above scenario. Exports could go to Mexico for making tortillas and pan breads, to Asia and Latin America for oriental noodles, and to the Middle East and Indian Subcontinent for flat breads. The sustainability of HWW would be enhanced under this more optimistic scenario in that the adoption rate of HWW in major producing States is likely to considerably exceed that actually achieved (about 5 percent) in Kansas in recent years. Needless to say, the expansion of HWW production would be further accelerated if the government incentive program continues in the future.

Figure 3
Logistic growth curve of HWW adoption: 1998-2014



Source: USDA farm program data, Farm Service Agency, USDA.

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