Transitions in Agbiotech: Economics of Strategy and Policy

EDITED BY
William H. Lesser

Proceedings of NE-165 Conference
June 24-25, 1999
Washington, D.C.

Including papers presented at the:

International Consortium on Agricultural Biotechnology
Research Conference
June 17-19, 1999
Rome Tor Vergata, Italy

PART SIX: Public/Private Sector Relationships

29. Public Universities and Hard White Wheat Variety Releases

M. A. Boland

Food Marketing Policy Center
Department of Agricultural and Resource Economics
University of Connecticut
and
Department of Resource Economics
University of Massachusetts, Amherst

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M. A. Boland

Department of Agricultural Economics
Kansas State University

Chapter 29

Public Universities and Hard White Wheat Variety Releases

M. A. Boland[1]

Introduction

Coordination of supply channels is an important component of a successful competitive strategy by food and agribusiness firms. One current policy issue is the role of United States (U.S.) land grant university Agricultural Experiment Stations in wheat supply channels.[2] Public scientists and economists have long made important contributions to agricultural supply channels. For example, measurement of quality attributes in crops and animals, coupled with value-based marketing programs, have been the focus of much research and education. Likewise, public breeding programs have been instrumental in improving productivity and quality traits in agricultural commodities.

Public breeding programs have historically developed the majority of wheat varieties grown in the U.S. while biotechnology advancements have been instrumental in the development of effective wheat hybrids in recent years. Hard white wheat varieties are new to much of the U.S. Thus, alternative release procedures and the potential effect on wheat supply channels have been considered by Agricultural Experiment Stations. Recently, University of Idaho and Montana State University provided restricted release of varieties to a producer-owned cooperative and several private firms. The development of these varieties is funded through taxpayer and producer wheat checkoff funds.

The objective is to provide an overview of release procedures for hard white wheat varieties in various states. First, biotechnology issues in wheat and an overview of wheat breeding programs is discussed. Then a summary of recent developments in release procedures is presented followed by a general discussion.

Background Information

> "Private breeding programs along with public breeding programs in Nebraska, Montana, South Dakota, and Washington are committing 20 to 40% of their efforts (on white wheat).... Kansas State University is committing 75% of their breeding efforts and investment.... Colorado and Oregon State Universities trail with a 50% commitment." *Successful Farming* (December 1998).

> "Because (variety) 377s is unique with a potentially higher demand than commodity wheat, the university (Idaho) decided against releasing it as a public variety. Rather, they wanted to license it to an identity-preserved

program.... the best way to accomplish this was through a farmer cooperative." *Successful Farming* (October 1997).

"When it comes to hard white wheats (produced at Montana State University), exclusive licensing is necessary to give companies an incentive for handling the new class of wheat." *AGWEEK* (April 1999).

"Producers form closed cooperative (AGvantage IP) to market Kansas State University hard white wheats." *Kansas Farmer* (1999).

"Monsanto succeeds in developing a chemical hybridizing agent for wheat...promise of wheat hybrids is a reality...white wheat hybrids in 2003." *The Furrow, High Plains Journal, Farm Journal* (November 1996, August 1997, March 1999).

Publicly funded breeding programs account for the majority of wheat varieties grown in the U.S. For example in 1998, almost 75 percent of all wheat varieties grown in Texas, Oklahoma, Kansas, Nebraska, Colorado, Montana, Idaho, North Dakota, and South Dakota were developed by Agricultural Experiment Stations. Private firms have largely developed crop varieties such as corn because these are hybrids. That is, producers purchase hybrid seed because hybrids cannot self-pollinate. Thus, seed companies have economic incentives to conduct research on new hybrid varieties because producers must purchase hybrid seed each year.

However, there is little hybrid wheat planted in the U.S. Rather, producers plant varieties and have the option of holding back seed, which is then conditioned and planted next spring, or buying certified seed each year. With firmer regulations in place with regard to Plant Variety Protection, non-hybrid crops such as soybeans which have the Roundup® herbicide tolerant gene in them, cannot be held back as seed.

Recent announcements by Monsanto which owns two of the largest private wheat breeding firms, AgriPro and HybriTech, suggests that Roundup Ready® wheat will be available in 2002. A contracting program with Farmland Industries has been introduced in Kansas this year for AgriPro's hard red hybrid wheat variety, which has higher yields (8 to 10 bushels) in certain areas relative to public varieties. If these varieties reduce input costs, producers may switch from public to private wheat varieties. What does biotechnology mean for public wheat breeding programs?

Biotechnology and Wheat

Wheat has lagged with respect to biotechnology. For example, wheat ranks 11th in the number of USDA-Animal and Plant Health Inspection Service (1999) permits with 70 approved permits. Wheat is more complex to breed than oilseeds or corn but the primary reason that genetically modified wheat is not yet available is the small wheat

seed market. Many producers save and condition their own seed rather than purchase seed each year.

The overwhelming majority of field tests for genetically modified wheats are being done by one firm, Monsanto, which had obtained (as of May 1999) 46 of the 70 approved field test permits (Figure 1). Agricultural Experiment Stations accounted for 15 (ten by University of Idaho and five by Montana State University) while USDA-ARS and Novartis had four apiece. The remaining permit was held by AgrEvo (owned by Hoechst and Schering).

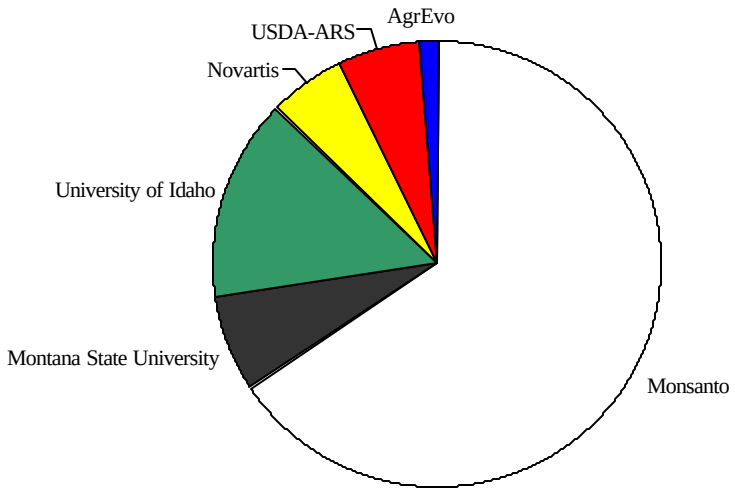

FIGURE 1 Field Test Permits for Genetically Modified Wheat, by Institution for 1994 to May 1999

These permits are classified into eight categories: 1) agronomic properties such as yield enhancing, drought resistance, etc., 2) bacterial resistance, 3) fungal resistance, 4) herbicide tolerant, 5) marker gene, 6) nematode resistance, 7) insect resistance, and 8) other. Thus far, permits for wheat exist in the first five categories only (Figure 2). There are some striking results. Product quality has four permits; all granted to USDA-ARS for wheat seed storage attributes. Agronomic property permits been given to Monsanto (nine permits for drought tolerance or yield enhancing properties) and Montana State University (four permits for drought tolerance).

The largest number of permits has been in the herbicide tolerant (twenty by Monsanto and one by AgrEvo) and viral resistance categories (six by Monsanto, one by Montana State University, and ten by University of Idaho). Fungal resistance has fifteen permits (eleven by Monsanto and four by Novartis) and Monsanto has five gene marker permits.

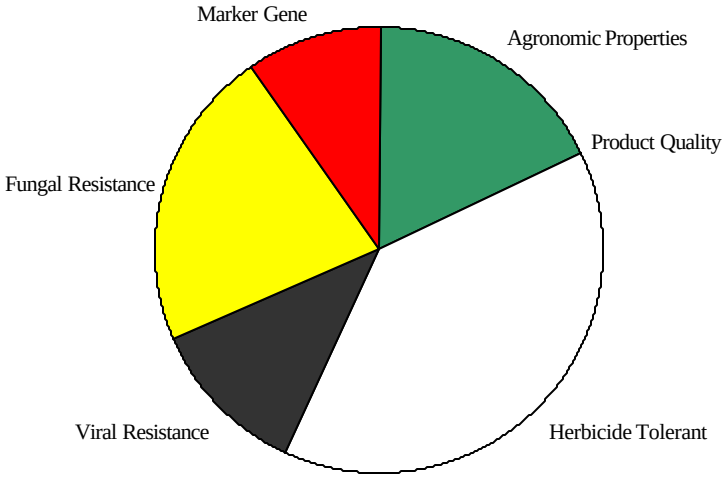

FIGURE 2 Field Test Permits for Genetically Modified Wheat, by Class for 1994 to May 1999

Thus, biotechnology research in flour or noodle quality is relatively insignificant. This suggests that transformations in wheat kernels such as the crease, which is the physical characteristic that largely determines flour, yield (and hence, increases revenue) or reduction of the bran layer (i.e., decreases costs) have high research and investment costs. However, methods of reducing producer input costs (i.e., less herbicides) or increasing revenues (i.e., hybrid yields) have a higher payoff to firms conducting biotechnology research in wheat. It is likely that other biotechnology research will focus on increased seed dormancy to reduce pre-harvest sprouting and fungal resistance (scab, leaf rust, etc.). Private firms are doing much of the research.

Wheat Breeding Research Funding

USDA reported that public expenditures on wheat research were almost 85 percent of total wheat research expenditures (Fuglie at al. 1996). Wheat seed had the lowest growth in seed price between 1975 and 1992 (.97 percent per year) relative to hybrid corn (4.75 percent), hybrid sorghum (5.08 percent), and non-hybrid soybeans (1.92 percent). Seed companies were able to obtain 35 (sorghum) to 48 (corn) percent of the improved hybrid seed value compared to 24 percent for wheat. This resulted in private firms investing over ten percent of seed sales in hybrid seed research compared to only five percent on wheat. Public wheat variety research has resulted in increased yields averaging one-half bushel annually in the Great Plains over the past two decades (Epplin 1997).

Private firm wheat research expenditures had atrophied due to limited success with hybrid wheats in the 1970s and 1980s. However, the 1994 amendments to the Plant

Variety Protection Act coupled with the use of reliable genetic transformation methods for wheat, have increased private sector expenditures (Blechl 1998). Private firm varieties will need to reduce input costs to producers or outperform public variety yields for producer adoption.

In addition to taxpayer funds, producers contribute breeding research funds through a wheat checkoff program. These funds are then used by producer associations to invest in wheat research, promotion, and education. In many states, these investments can be substantial. For example in Kansas, producers have contributed almost $4 million to the white wheat breeding program over the past ten years while taxpayers have contributed another $11 million. Due to such investment, there is some sentiment that benefits to any breeding improvements that might have economic incentives (i.e., hard white wheat) should accrue to producers rather than others in wheat supply channels. Hard white wheat is increasingly becoming more important in public and private breeding programs (Boland and Howe 1999).

Recent Developments in White Wheat Variety Releases

The introduction of white wheat into U.S. presents several problems for wheat supply channels. First, white wheat must be kept separate from red wheat or it will be severely discounted. Second, because white wheat varieties are developed for specific end uses such as noodles or crackers, the wheat must be marketed through an identity-preserved supply channel that allows end-users to purchase wheat from suppliers. Finally due to a small supply (less than 200,000 acres of hard white wheat at the present time), increased marketing investments in identity-preserved supply channels are needed to locate end-users.

These reasons have led Agricultural Experiment Stations to consider alternatives to a public release of hard white wheat varieties. A traditional release process involves Agricultural Experiment Stations turning wheat seed over to crop improvement or seed associations who, in turn, increase seed production so that all producers may have an opportunity to purchase the variety (Schumacher et al. 1999).

The motivations for considering alternatives include: 1) protecting research investment of taxpayers, wheat producers, and crop improvement associations; 2) maximizing seed increase while assuring varietal integrity; 3) developing markets with maximum value for white wheat to match production growth; 4) providing an orderly transition from predominately red to predominately white wheat; and 5) maximizing the number of grower participants. A summary of hard white wheat identity-preserved supply channels in various states (listed alphabetically) is described below.

Colorado

Hard white wheat acres in Colorado have increased from 7,000 acres (1996) to over 20,000 (1998). Monsanto's AgriPro contracted hard white wheat varieties (Solomon and Platte) with a leading miller (Con Agra) and Colorado producers. The premiums paid to producers averaged $.25 to $.35 per bushel in 1998. The majority of the premium is for end-use properties such as protein and other characteristics; the white color is worth only a few cents. Goertzen Seed Research (owned by Cargill) has contracted a hard white wheat variety, Snow White, with producers for use in Cargill's mills with $.05 to $.10 premiums.

Idaho

Idaho Agricultural Experiment Station and USDA-ARS used a restricted release to license a hard white wheat variety, Idaho 377s, to Pro-Mar Select of Idaho, Inc. in 1996. The license fee is $.02 per bushel of seed for first 2.5 million bushels, $.015 for the next 2.5 million, and $.01 per bushel for anything over five million bushels. Idaho 377s was developed for export noodle markets but is now used in domestic and export markets. Pro-Mar Select of Idaho is a producer-owned cooperative with 130 members who are wheat growers. The cooperative has had mixed success but increased acreage from 8,000 (1997) to 60,000 (1999). Pro-Mar Select sub-licensed Idaho 377s to General Mills in Montana. Over 100,000 acres in Montana were contracted in 1999 and premiums have averaged $.05 to $.10 per bushel. A soft white wheat variety, Whitebird, was released publicly but the seed was sold to several private firms who agreed to increase seed production through Idaho Crop Improvement Association's Identity Preservation Program. Two other public soft white wheat varieties (Brundage, Treasure) are produced and marketed by private firms such as General Mills through identity-preserved wheat supply channels.

In December 1998, Idaho Agricultural Experiment Station entered into a one year, renewable agreement with Nabisco regarding soft white wheat varieties. Nabisco will fund seed increases for the most promising breeding lines, test baking qualities in their California baking laboratory using solvent-retention capacity, and provide funding for equipment and staff at the Aberdeen Experiment Station. However, Nabisco will not own the publicly funded varieties or any information obtained from the testing but can apply for exclusive rights to any variety.

Kansas

Kansas Agricultural Experiment Station, in conjunction with AgriPro, licensed hard white wheat varieties to a producer-owned cooperative (American White Wheat Producers Association) in 1988 (Bequette and Herrman 1994). The varieties included AgriPro's Rio-Blanco, and Agricultural Experiment Station's KS84HW196 and Arlin. The decision to release these varieties to a producer-owned cooperative was due to

concerns that a general release could disrupt wheat supply channels due to potential mixing with red wheat because there was no hard white wheat class until 1990. Price premiums were as high as $.15 per bushel in the mid-1990's with 20,000 acres of production until the cooperative declared bankruptcy.

In 1998, Kansas Agricultural Experiment Station announced plans to release two hard white wheat varieties (Betty and Heyne) and another eight to ten over the next three to five years. Alternative release procedures, which potentially could involve a restricted release, were analyzed (Schumacher et al. 1999). American White Wheat Producers Association, Farmland Industries, Cargill, and a new producer cooperative composed of Kansas Crop Improvement Association members (called AGvantage IP) submitted proposals for the white wheat varieties. After a great deal of discussion, Kansas Agricultural Experiment Station decided to release the hard white wheats using the general release procedures. At the present time, producers who are members of AGvantage IP and who grow Betty or Heyne can contract with Farmland Industries for a $.10 per bushel premium. A third variety, Trego, will be released in 2000.

Montana

Montana Agricultural Experiment Station has also used a restricted release for hard white wheat varieties. General Mills has exclusive rights to Nuwest, which was developed for noodles and breads. Heartland Seed Co. (private seed company) licensed MTHW 9420 from Montana Agricultural Experiment Station in April 1999 and will contract with millers for use in noodles. Future hard white wheat varieties may be licensed to single firms. Wheat Montana, a private milling and baking firm, also contracts a hard white wheat variety called Golden 86.

Montana Agricultural Experiment Station and Idaho Experiment Station, in conjunction with wheat processing and marketing firms (Great Harvest Bread Co., Fisher Flour Mills, Pendleton Flour Mills, Pro-Mar Select Wheat of Idaho), wheat breeding and quality testing firms (Western Plant Breeders, Montana Cereal Quality Laboratory, Aberdeen Wheat Quality Laboratory), and technical assistance (U.S. Wheat Associates), are involved in a major project to further develop identity-preserved supply channels for future white wheat varieties under an $800,000 USDA grant.

Nebraska

Nebraska has several non-red wheats including purple and blue, and white wheat is under development at the present time. The first hard white wheat variety, NuPlains, is scheduled for release in 1999 or 2000. Baenziger, Shelton, and Baltensperger (1998) report that “as state experiment stations expand their focus on regional efforts...different marketing mechanisms for hard white wheat may need to be investigated for Nebraska white wheat varieties.” However, a general public release will be used for NuPlains.

Discussion

Clearly, Agricultural Experiment Stations are guided by well-meaning intentions in analyzing alternative release procedures for hard white wheat. And, it is too early to tell whether these intentions will be successful. It is important to note that there are differences between states, which may influence the Agricultural Experiment Station's decision-making process.

Regional Differences

USDA's Census of Agriculture (1997) notes the following numbers of wheat producers with $100,000 or more in sales (50 percent or more of total farm sales): Idaho: 2,849; Kansas: 10,871; and Montana: 3,634. Kansas has 3.5 times the number of producers as Montana or Idaho. In addition, Kansas has more acres (10.9 million) planted to wheat relative to Montana (5.8 million) and Idaho (1.4 million). Yields per acre on non-irrigated land are also much higher in Kansas. Finally, Kansas's producers plant only hard red (99 percent) and soft red wheats (one percent) while Montana producer's plant hard red winter and spring (99 percent) and white wheats (one percent). Idaho producers plant a greater variety of wheats (25 percent hard red winter or spring; 75 percent soft or hard white wheats).

Kansas has 2.5 (5) times greater wheat checkoff funds relative to Montana (Idaho) due to higher production. Some of these funds are used to help support public wheat breeding programs. However Idaho, and to a lesser extent Montana, have greater identity-preservation possibilities due to increased storage, elevator segregation ability, and producer experience with different wheat classes. Much of the wheat grown in these two states is exported to Far East Asian countries or used in regional mills for bread, noodles, and cookies. Kansas has greater numbers of grain handling firms relative to Idaho and Montana.

Factors for Success

Several factors are needed to ensure the success of a hard white wheat variety that is released to an identity-preserved supply channel. First, producers cannot be allowed to keep any of the wheat for seed or the exclusive licensing will not work. Second, a clear end-user must be identified. Due, in part to lack of marketing expertise, American White Wheat Producers Association and Pro-Mar Select have had difficulty linking large volumes of wheat with end-users. Third, the capability to segregate and keep the wheat separate from other varieties during storage, handling, and transportation until the final end-user must exist. Fourth, economic incentives are needed for all participants across the supply channel (producers, merchandisers, end-users). The positive reaction and competition for exclusive rights to the varieties from millers and other end-users suggests that these economic incentives exist for hard white wheat. It is important to note that

many of these economic incentives are related to various milling and baking attributes and not just bran color.

Finally, any restricted release must have clear and positive net returns to taxpayer and producer investments in the breeding program. These returns may be royalties through licensing arrangements, which are used to reinvest in research and development of new varieties, or through maximum participation of producers in the system (i.e., opportunities to invest in a cooperative or unlimited access to the seed varieties). One criticism of hard white wheat restricted release procedures is the fear that seed producers will premium price the certified seed relative to close substitutes such as certified hard red wheat seed. For example, Betty and Heyne certified wheat seed is expected to be $1 to $2 a bag higher initially than certified hard red seed, which results in almost $.05 per bushel cost to a producer. If premiums are only a few cents per bushel with no yield increases, there may not be enough economic incentives to increase producer adoption.

In the short-run, there will be economic incentives to those organizations (producer-owned cooperatives, private firms, etc.) if transaction costs for segregating the wheat and matching end-users with supply are less than the cost of purchasing and milling red wheat. These economic incentives are likely to come from increased milling extraction rates, (i.e., higher flour yields if U.S. millers grind further), protein content, and other quality factors. In the long run, there may be emerging export or niche domestic markets, especially if segregation costs are reduced as producers and grain merchandising firms learn to manage two classes of wheat, and biotechnology reduces input costs. Furthermore, given significant investment by firms and Agricultural Experiment Stations, there will be a greater hard white wheat supply.

Conclusion

Do public universities have a role in modifying agricultural supply channels? Clearly for the introduction of hard white wheat, Agricultural Experiment Stations require input from producers, agribusiness firms, and others in the wheat supply channel. The role of the Agricultural Experiment Station is to provide research and education. Disruption of hard red wheat supplies channels by haphazardly releasing white wheat varieties would not result in the greatest return to taxpayer and producer wheat checkoff fund investments. If handled correctly, a restricted release is one option that may provide increased returns to taxpayer and producer checkoff fund investments until enough supply is available. However, regional differences in the structure of the wheat industry may lead to a restricted release (Idaho, Montana) to producers in an identity-preserved supply channel or a general release (Kansas) to the market. Given differences in the structure of wheat supply channels in these states, it is not surprising that alternative release procedures are considered for use by Agricultural Experiment Stations.

Endnotes

[1]The author is an assistant professor of agricultural economics at Kansas State University. This project was funded, in part, under USDA-RBS cooperative agreement number 99-15. Interviews with breeders, merchandisers, Agricultural Experiment Station staff, seed producers, wheat producers, and trade association staff were used in preparing this report. Contribution No. 99-480-A of the Kansas Agricultural Experiment Station.

[2]The term 'Agricultural Experiment Stations' is used throughout the paper mainly for historical reasons but it is important to recognize that Cooperative Extension Service has made important contributions in research and education. In reality, land grant universities typically use foundations to license intellectual property rights, etc.

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