CIS 972

Identity Preserved Shipment Alternatives for Marketing Pacific Northwest TCK-free Wheat to China

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Wheat shipments from the Pacific Northwest are barred by China because of the wheat pathogen *Tilletia controversa Kühn* (TCK), a fungus that infests wheat seed and causes dwarf bunt disease. China's authorities imposed a zero tolerance quarantine against importing wheat infested with TCK in 1973 to prevent possible introduction of the fungus and damage to its domestic wheat production. China's Plant and Quarantine Department's consistent refusal or docking of wheat shipments originating from the Pacific Northwest for nearly two decades has stimulated an extensive research effort to improve TCK resistance, identification, and chemical control.

Dwarf bunt, commonly called TCK smut in the Pacific Northwest, is a fungal disease that sporadically affects wheat in the northern United States, especially in the Pacific Northwest. While it affects only a small percentage of U.S. wheat production, TCK spores are easily dispersed during harvest, transport, and storage. Through transport and blending, the spores can potentially contaminate all wheat shipped through Pacific Northwest ports. Thus, TCK presents a marketing barrier that goes beyond the local wheat production region. Additionally, TCK is not easily identified and can be confused with other fungi that infest wheat, such as *Tilletia caries* that causes common bunt in wheat, and *Tilletia fusca*, a grass pathogen.

China will need to import at least 10 million metric tons of wheat annually throughout the 1990s. If wheat consumption in China increases modestly, its imports could exceed 30 million metric tons by the end of the century. The potential market share for Pacific Northwest wheat could be substantial without the TCK quarantine. Opening wheat trade with China could increase wheat demand and have a positive effect on the supply and demand situation that dictates soft white wheat prices in the Pacific Northwest. Wheat shipped to China from Portland would have lower transportation costs than wheat currently shipped to Bangladesh, Pakistan, Iran, and Egypt. Lower transportation costs from the Pacific Northwest could reduce costs to the Chinese and give that market access to white wheat with characteristics superior to other classes and varieties of wheat that they import.

Controlling TCK smut is difficult for several reasons. Chemical fungicides are ineffective or presently unavailable. New virulent TCK races can arise very quickly. Disease resistance in host plants is only partially understood, and agronomic practices yield only partial control.

Agronomic, distribution, and inspection procedures and standards from fields to end users may need to be changed in order to meet the zero tolerance standard for dwarf bunt. In the field, harvest operations generate TCK spore clouds, which are wind-borne and widely distributed. The spore-infested wheat is loaded onto trucks and delivered to country elevators or on-farm storage, contaminating those sites. The zero tolerance does not differentiate viable spores from dead spores. At this time, the People's Republic of China will not accept a United States' certificate of TCK smut cleanliness or non-viability. Wheat shipments originating in the Pacific Northwest are subject to mandatory testing by the Plant Quarantine Department of the People's Republic of China.

Economic Analysis

An economic analysis of marketing TCK-free wheat from Montana to China in the 1970s found the cost to be prohibitive. The Montana study assumed TCK-free areas could be located and isolated and that wheat from those areas would be delivered to regional, TCK-free elevators. This study extends the Montana cost analysis and con-

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siders a number of additional intermodal, identity preserved transportation, distribution, and agronomic alternatives to remove the TCK market barrier, to deliver TCK-free wheat, or both. Fig. 1 shows the estimated costs of the alternative procedures. A dockage risk factor is estimated for all alternatives except the base model and 4C to allow for possible rejection of the shipment meeting zero tolerance standards.

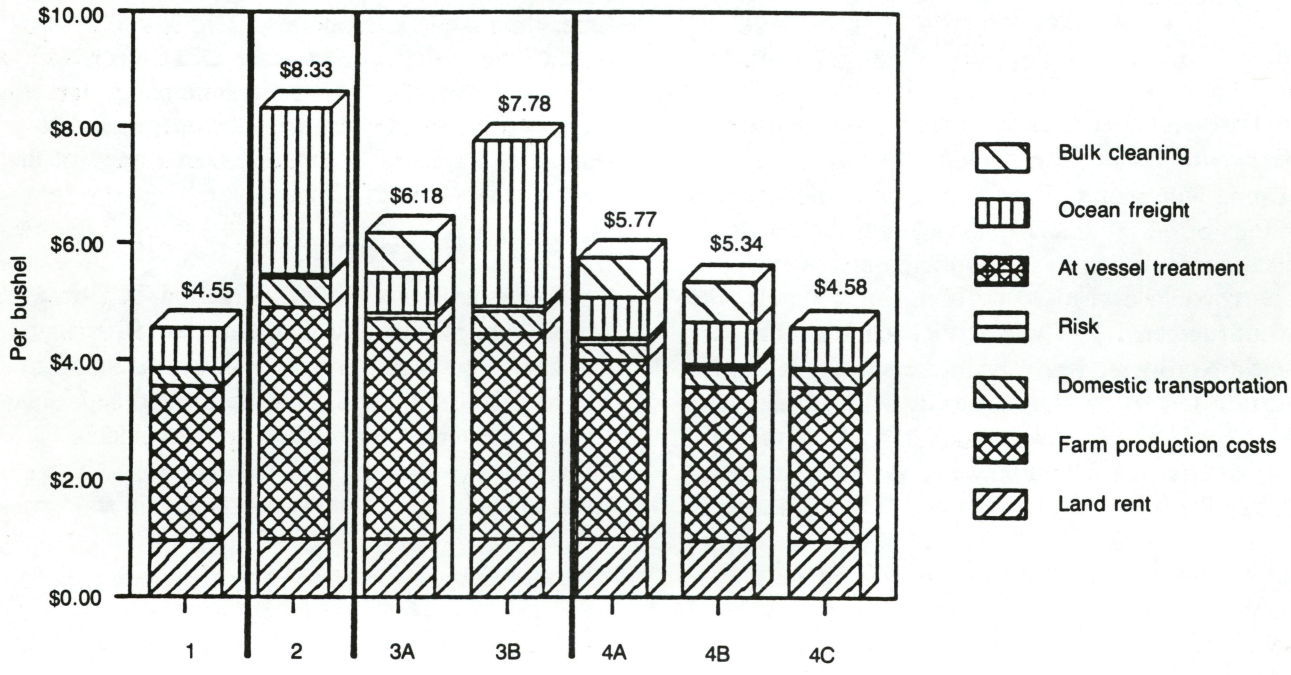
Alternative 1: Current bulk production, transport, and marketing. For this alternative, costs were estimated for conventional winter wheat production and marketing. It was assumed that wheat was seeded in the fall and either stored on farm or delivered by truck to a country elevator after harvest. The grain was shipped in bulk both inland and during the overseas carriage. Bulk distribution and handling costs were low because of efficiencies of scale. The baseline delivered cost to China via Portland, Oregon, for bulk wheat was estimated at $4.55 per bushel based upon 1989 cost of production estimates for the Palouse (fig. 1).

Alternative 2: Isolation — Identity preserved, containerized, intermodal shipments. This alternative assumed wheat was produced in selected, TCK-free locations and transported through channels isolated from other contaminated grain. For this scenario, fungicide treatment of seed and soil and use of TCK-resistant varieties were assumed. Harvesting, transportation, and elevator equipment were cleaned and disinfected before handling TCK-free wheat to avoid introducing TCK spores remaining from handling other contaminated grain.

The cost of shipping wheat from the production site, identity preserved with intermodal containers (Alternative 2), was estimated at $8.33 per bushel (fig. 1), 83 percent more than shipping bulk wheat to China (Alternative 1). Farm production costs increased 37 percent while post-farm grain handling cost escalated 253 percent over the bulk system. The cost of shipping containers on ocean vessels was $2.54 per bushel, compared to the current bulk ocean freight of $0.68 per bushel. While containerized domestic transportation costs were expensive, ocean container freight costs were the primary constraining factor.

Alternative 3: Isolation — Identity preserved and delivery through TCK-free elevator. In this alternative, wheat was produced as described in Alternative 2 but delivered through dedicated TCK-free elevators. It was assumed that a dedicated, TCK-free export facility supported by hinterland TCK-free elevators was available. Two alternatives were examined.

Alternative 3A: Identity preserved and bulk delivery through dedicated hinterland and export elevator. With dedicated, TCK-free elevators in the hinterland and at Portland available to receive TCK-free wheat, the one-time cleaning of dedicated hinterland and export elevators were assumed to be



1, Current bulk; 2, identity preserved container; 3, identity preserved dedicated elevator; 4, at vessel treatment.

Fig. 1. Costs to deliver wheat to China from northern Idaho.

assumed to be insignificant when considered as a long-term cost. Thus, the expense for facility cleaning was not explicitly added to costs. Since TCK spores can remain in grain dust, it was assumed bulk vessel holds were cleaned and disinfested before loading TCK-free wheat. The total estimated delivered cost to China was $6.18 per bushel (fig. 1), 36 percent higher than the conventional bulk system. The increased expense to transport wheat from the production site to dedicated, hinterland elevators, cleaning of harvest and transportation equipment, and applying seed and soil treatments caused farm production costs to increase 24 percent. Post-farm activity costs were 75 percent higher than the current bulk system chiefly due to bulk vessel cleaning costs.

Alternative 3B: Identity preserved and containerized delivery through dedicated hinterland and export elevator. In this scenario, dedicated TCK-free elevators were assumed to be available in the hinterlands but not at Portland. The remaining assumptions were the same as in alternative 3A, except that transportation was by container from the hinterlands to circumvent export elevators. Estimated delivered cost to China was $7.78 per bushel (fig. 1), a 71 percent increase above the current bulk system. Most of the increase resulted from ocean container freight rates.

Alternative 4: At vessel disinfestation. Alternative 4 couples traditional handling and bulk shipment of wheat with disinfestation treatment at the export elevator. Live TCK spores could be killed by treating wheat with sodium hypochlorite, irradiation, or oxidizing vapors.

Alternative 4A: At vessel sodium hypochlorite treatment. It was assumed wheat was sprayed with a light mist of 1.5 to 2.0 percent sodium hypochlorite before loading into the vessel. This alternative assumes the bulk grain vessel was cleaned.

When treatments to disinfest wheat occur at the export elevator, the costs were substantially reduced from identity preserved alternatives 2 and 3 because existing wheat marketing channels could be used. Treating at the export elevator eliminates the need to clean harvest and transportation equipment and storage facilities, to apply soil treatment and to use expensive identity preserved techniques discussed in alternatives 2 and 3. Post-farm activity costs were higher than the base model due largely to bulk vessel cleaning costs. Overall, Alternative 4A delivered TCK-free wheat to China for an estimated $5.77 per bushel, 27 percent higher than the base (Alternative 1).

Alternative 4B: At vessel treatment, new seed treatment technology. Alternative 4B differed from 4A in the seed treatment used. This scenario illustrated that research on control of dwarf bunt has offered potential for cost-cutting technology. During the last 3 years, an experimental seed treatment has been 100 percent effective in controlling TCK smut in test plots. Alternative 4B assumed the availability of that seed treatment as a replacement for existing seed treatments. Since TCK-free wheat can be contaminated with air-borne and residual spores remaining in harvesting, transportation, and elevator equipment, vessel treatment with sodium hypochlorite was maintained. Because zero tolerance was assumed, the dockage risk factor and cleaning of bulk vessel holds were included in the costs to meet the standard.

The use of the breakthrough seed treatment reduced estimated farm production costs to the same level as Alternative 1. The estimated delivered cost to the People's Republic of China was $5.34 per bushel for this alternative. Overall, alternative 4B was 17 percent higher than Alternative 1.

Alternative 4C: At vessel treatment, tolerance level accepted. Alternative 4C differs from Alternative 4B by allowing a low TCK tolerance level but it still assumed at-vessel treatment to kill dwarf bunt spores that may be contained in the grain. It was assumed a tolerance level at the vessel loading point is negotiated with the Chinese and that the dockage risk factor and the bulk vessel hold cleaning costs were eliminated.

Farm production costs were as described in Alternative 1. However, post-farm activity costs increased 3 percent due to the $0.03 per bushel sodium hypochlorite treatment at the export elevator loading site. The estimated delivered cost to the People's Republic of China was $4.58 per bushel. Assuming the zero tolerance to TCK required by the Chinese could be modified to allow shipments under these conditions, the estimated delivered cost to China would be 0.7 percent more than current bulk production and transportation methods. This last alternative is economically more viable if U.S. research results can convince China's authorities that the risk of TCK contamination is eliminated. The assurance process needs to stop with the at-vessel treatment. Further viability testing after treatment will only eventually lead to identifying a viable spore at some time. In the same way that treatment with pesticides is assumed 100 percent effective when applied, treatment of TCK-infested wheat must also be assumed 100 percent effective.

Although containerized, or otherwise identity preserved, shipments may provide technically feasible means of guaranteeing TCK-free wheat, the costs to chemically treat seed and soil, and to clean harvest and transportation equipment, storage facilities, and transport containers are prohibitive. Domestic costs, however, are not the largest obstacle to transporting TCK-free wheat to China in intermodal containers. The ocean freight rate is 319 percent greater to ship wheat in containers than in bulk ($2.85 versus $0.63 per bushel).

While TCK smut affects only a small percentage of wheat production in the Pacific Northwest, the intrusion of TCK spores into harvesting and transportation equipment and storage facilities creates a problem that far overshadows the significance of TCK smut as a production problem. There exists little present assurance that TCK smut can be economically eradicated with current technology or isolated by identity preserved transportation and distribution systems. Further advances in technology could conceivably break through the economic barrier of eliminating or isolating dwarf bunt.

Conclusion

The People's Republic of China's zero tolerance against TCK smut has excluded wheat exports from the Pacific Northwest ports. This exclusion can result in increased transportation costs to deliver wheat from other ports and the loss of access to a potentially large wheat export market for Pacific Northwest wheat producers. Continued lack of access to the People's Republic of China wheat market for the Pacific Northwest is inevitable unless realistic tolerance levels for TCK smut are negotiated with China's phytosanitary authorities, or economical means of delivering TCK-free wheat are found. While increased emphasis is being placed on post-harvest sanitation efforts, this study concludes that research efforts should be concentrated at the export elevator discharge system.

For further details see: Patricia Carlson, et al., 1992. A Technology-Cost Assessment of Alternatives for Shipping Dwarf Bunt (TCK) Free Wheat to China from the Pacific Northwest, University of Idaho Agricultural Experiment Station Research Bulletin No. 154.

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