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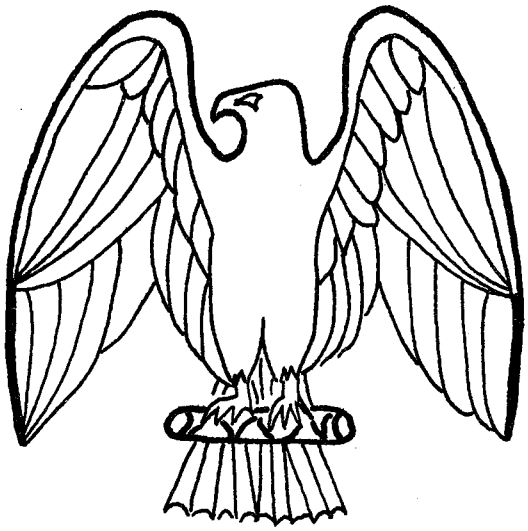
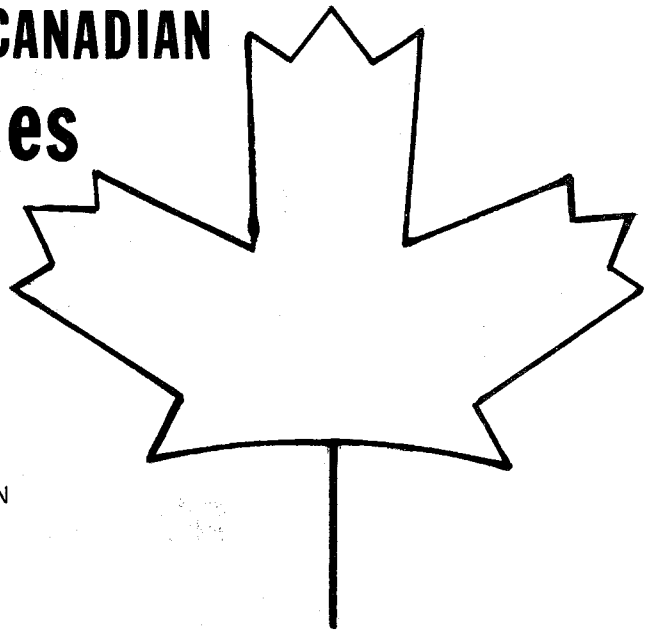


Comparative Analysis of UNITED STATES AND CANADIAN Wheat Grades



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FOREWORD

This report represents a continuation in the study of market development for hard red spring and durum wheat. A comparative analysis of United States and Canadian wheat grade standards was made to alert North Dakota wheat producers to recent changes in Canadian wheat grades and standards and to show how they compare with existing United States grades and standards.

The authors wish to extend their appreciation to members of the foreign and domestic grain trade for their valuable suggestions on wheat grade standards. Special appreciation is extended to Mr. Melvin G. Maier who provided advice on organization and conducted a survey of import buyers in selected international markets.

The authors gratefully acknowledge the manuscript review and valuable suggestions contributed by Dr. Hugh J. McDonald, Mr. Leonard B. Sibbitt, Mr. Donald M. Senechal, and Dr. Gordon W. Erlandson.

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Highlights

The recent fluctuations in wheat prices due to record commercial export sales dramatize the increasing importance of the export market as an outlet for North Dakota's wheat production. The quality of wheat that is available to foreign buyers is of major significance to them. Consequently, grain standards must be relied upon by both producers and foreign buyers as the measure of wheat quality.

Canada has in recent years undertaken a complete review of its competitive position in world markets and has made a substantial effort to capture a larger share of the world market for high-protein wheat. A major undertaking has been the adoption of a new grain grading system designed to provide customers with a wider choice of quality and greater uniformity with respect to protein content.

This study identified the changes in Canadian wheat grades and compared them with existing United States grades.

Effective August 1, 1971, the Canadian grades No. 1 Manitoba Northern and No. 2 Manitoba Northern were combined to form a new grade--No. 1 Canada Western Red Spring Wheat. Effective August 1, 1972, No. 3 Manitoba Northern and half of the No. 4 Manitoba Northern grades were combined to form a new grade--No. 2 Canada Western Red Spring Wheat. The remaining half of No. 4 Manitoba Northern will be combined with No. 5 wheat to form the grade No. 3 Canada Western Red Spring Wheat.

Analysis indicated that No. 1 Canada Western Red Spring more closely parallels No. 2 Manitoba Northern than No. 1 Manitoba Northern. This was a logical step, however, because a large amount of the wheat grown in and exported from Canada prior to the change was the grade No. 2 Manitoba Northern. The grade No. 1 Canada Western Red Spring was an improvement over the grades No. 1 and No. 2 Manitoba not only because it allows for protein segregation, but also it does not contain as many relative terms in its grade factors as did No. 1 and No. 2 Manitoba Northern.

In terms of quality specification, No. 1 Canada Western Red Spring falls between the United States grades No. 1 Dark Northern Spring and No. 2 Dark Northern Spring, but is somewhat closer to No. 1 than No. 2 Dark Northern Spring. The change in Canadian wheat standards brought them into a more parallel position with United States wheat standards, especially with respect to the marketing of wheat with guaranteed protein contents.

COMPARATIVE ANALYSIS OF UNITED STATES AND CANADIAN WHEAT GRADES

by
Timothy A. Petry and Donald E. Anderson[1]

North Dakota has long been known for its wheat production, particularly hard red spring and durum wheats. For many years North Dakota has been first in hard red spring production in the United States and second in total production of all wheat. Hard red spring wheat possesses characteristics desired for high-quality bread products.

In 1971 per capita consumption in the United States of wheat in food products amounted to 113 pounds, equal to 496 million bushels of wheat utilized per year.[2] With an annual production of approximately one and a half billion bushels, it can readily be seen that the export market is an important outlet for wheat producers.[3] Both production and exports of hard red spring wheat in the United States have been rising in the past five years (Table 1). With production increasing, the export market offers the greatest potential for market expansion. Even though the United States population is increasing, per capita consumption of wheat products is declining. Hard red spring wheat is graded and marketed overseas as subclasses Dark Northern Spring (DNS) and Northern Spring (NS). Very little, if any, Red Spring (RS)--the third subclass of hard red spring--is exported.

TABLE 1. THE UNITED STATES HARD RED SPRING WHEAT PRODUCTION, DOMESTIC USE, CARRYOVER, AND EXPORTS (FOR YEARS BEGINNING JULY 1) (MILLION BUSHELS)

Year	Production	Domestic Use	Carryover	Exports
1968-69	239	132	143	77
1969-70	190	136	210	89
1970-71	198	118	178	113
1971-72	366	134	146	104
1972-73	276	181	275	198
1973-74	331	208	173	228

Source: United States Department of Agriculture, Economic Research Service, Wheat Situation, February, 1974.

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[1]Petry is an Assistant Professor and Anderson is a Professor of Agricultural Economics, North Dakota State University, Fargo.

[2]United States Department of Agriculture, Agricultural Statistics, 1972, United States Government Printing Office, Washington, D.C., 1972, pp. 60-61.

[3]Ibid., p. 3.

Wheat is the largest single source of farm income in North Dakota, accounting for $347,857,000 (or 35 percent) of the total farm income in 1971.[4] Production was estimated at 291,574,000 bushels--which includes 207,711,000 bushels of hard red spring wheat; 82,063,000 bushels of durum; and 1,800,000 bushels of winter wheat.[5]

The major international competitor for Dark Northern Spring Wheat markets, Canada, recently initiated a major change in its wheat grades and standards in an attempt to become more competitive in the world wheat market.

Traditional Canadian Wheat Standards

Prior to August 1, 1971, the "Statutory Grades" of Canadian hard red spring wheat consisted of No. 1 Manitoba Hard; Nos. 1, 2, 3, and 4 Manitoba Northern; and No. 4 Special. These grades were called statutory grades because they had been defined by Parliament and were listed in the Canada Grain Act.[6] Commercial grades (No. 5 wheat, No. 6 wheat, and feed wheat) were determined each season by the Committee on Western Grain Standards when conditions necessitated, in accordance with provisions of the Grain Act. The most commonly used commercial grades were No. 5 and No. 6 wheats. The committee also agreed on standard samples made to conform to several statutory and commercial grade specifications.

Standards were spelled out for statutory grades according to test weight, variety of wheat, percentage of hard vitreous kernels, degree of soundness, and maximum limits of foreign material. Standards for commercial grades included the same factors except for percentage of hard vitreous kernels[7] (see Table 2).

The standard sample of the statutory grades represented the minimum quality acceptable in any particular grade prior to or on receipt of grain into licensed terminal elevators. Wheat was initially graded by the country elevators. The grading of wheat as it moved out of country elevators to terminals was officially handled by the Board of Grain Commissioners (now the Canadian Grain Commission) grain inspection branch

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[4]Price, J. R., and F. R. Taylor, North Dakota Crop and Livestock Statistics--Annual Summary for 1972, Revisions for 1971, Agricultural Statistics No. 29, United States Department of Agriculture, Statistical Reporting Service, and North Dakota State University, Department of Agricultural Economics, cooperating, Fargo, North Dakota, May, 1973, p. 62.

[5]Ibid., p. 63.

[6]The Canada Grain Act, Ottawa, Ontario, Canada, 1952, Chapter 25.

[7]Bellingham, Andrew B., Contrasts in Marketing in Major Wheat Exporting Nations, Foreign Agricultural Service, United States Department of Agriculture, August, 1971, p. 9.

TABLE 2. STATUTORY GRADES OF WESTERN CANADIAN GRAIN, RED SPRING WHEAT

Grade Name	Standard of Quality: Minimum Weight Per Measured Bushel in Pounds[a]	Standard of Quality: Variety	Standard of Quality: Minimum Percentage by Weight of Hard Vitreous Kernels	Standard of Quality: Degree of Soundness	Maximum Limits of Foreign Material: Foreign Material Other Than Wheat: Matter Other Than Cereal Grains	Maximum Limits of Foreign Material: Foreign Material Other Than Wheat: Total Including Cereal Grains Other Than Wheat	Maximum Limits of Foreign Material: Wheats of Other Classes or Varieties: Durum	Maximum Limits of Foreign Material: Wheats of Other Classes or Varieties: Total Including Durum
No. 1 Manitoba, Hard	62 (60.07)	Marquis or any variety equal to Marquis.	80	Sound and well matured . . .	Free	Free	Free	Free
No. 1 Manitoba, Northern	60 (58.14)	Marquis or any variety equal to Marquis.	65	Well matured, practically free from damaged kernels.	Practically free	Practically free	Practically free	About 1%
No. 2 Manitoba, Northern	58 (56.20)	Marquis or any variety equal to Marquis.	50	Reasonably well matured, reasonably free from damaged kernels.	Practically free	About 1%	About 1%	3%
No. 3 Manitoba, Northern	57 (55.23)	Any variety of red spring wheat of fair milling quality excluding Garnet.	35	Excluded from higher grades on account of lightly frosted, immature, or other light damage; reasonably well matured.	Reasonably free	About 2%	3%	10%
No. 4 Manitoba, Northern	56 (54.26)	Any variety of red spring wheat excluding Garnet.	--	Excluded from higher grades on account of frosted, immature, or other damage; reasonably well matured.	Reasonably free	About 2½%	4%	10%
No. 4 Special	53 (51.38)	Any variety of red spring wheat.	--	Rusted or shrunken, but otherwise reasonably sound; reasonably well matured.	Reasonably free	About 2½%	4%	--

[a]Imperial bushel measure. Winchester bushel weight in parentheses.

Source: The Canada Grain Act, Ottawa, Ontario, Canada, 1952, Chapter 25, p. 61.

as the wheat moved through inspection points, such as Winnipeg, Edmonton, or Calgary. The wheat was rechecked at the terminals where it was cleaned before it moved into the export market.

As soon as possible after August 1, the Board collected samples of the new crop and from these prepared tentative standard samples of the statutory grades and other commercial grades as required. After reports on the milling and baking qualities had been obtained, the Grain Standards Committee met and determined what standard samples and standard export samples would serve as the minimum for each of the first nine statutory grades and all of the commercial grades considered advisable.[8] These standard samples served as a guide for grading the statutory and commercial grades of wheat moving in trade channels.

The grades No. 1 Manitoba Hard to No. 4 Special, inclusive, were established to segregate ranges of quality of hard red spring wheat for milling and baking purposes. All of these grades have been exported to some extent in the past. In recent years, No. 1 Manitoba Hard was used very little because of the exceptionally high visual quality demanded for this grade. For years Canada exported only No. 1, No. 2, and No. 3 Manitoba Northern with No. 2 accounting for most of Canada's wheat exports. Wheat falling short of these grades were used for domestic use only.

As an example, the composition of the 1968-69 standard export sample for No. 2 Manitoba Northern Wheat was: 61.78 pounds test weight (Imperial bushel); total foreign material, including other cereal grains, 0.4 percent, including 0.16 percent other seeds; and wheat of other classes and varieties not equal to Marquis 1.5 percent, including 0.2 percent contrasting classes.[9]

The statutory grade standards for No. 2 Manitoba Northern Wheat were as follows: minimum 58 pounds test weight (Imperial bushel), Marquis or any variety equal to Marquis, minimum 50 percent hard vitreous kernels, reasonably well matured and reasonably free from damaged kernels, practically free from foreign materials other than cereal grains, about 1 percent total foreign material including cereal grains other than wheat, about 1 percent durum and 3 percent total wheat of other classes or varieties including durum.

Test weight[10] per bushel is an important index of the pounds of flour that may be milled from a bushel of wheat--the largest flour yields generally being obtained from wheat of a high test weight per bushel and relatively low yields of flour from wheat of relatively low test weight per bushel.

Any variety must possess milling and baking qualities at least equal to those of the standard variety, Marquis. Even though Marquis is the standard,

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[8]The Winnipeg Grain Exchange, Marketing Western Canada's Grain, Winnipeg, Canada, 1967, p. 61.

[9]Bellingham, op. cit., p. 10.

[10]Test weight is measured by the Imperial bushel, which is 1.032 times larger than the Winchester bushel used in the United States.

only a very small percentage of the acreage seeded to hard red spring wheat is seeded to Marquis.[11]

Texture in wheat refers to the hardness or softness of the kernels, which qualities, in turn, are indications of the glutenous or starchy character of the kernels. Hard, vitreous kernels refer to kernels that are not starchy (soft), not severely damaged in any way, but which have the natural reddish coloring which indicates glassiness of texture.[12]

Reasonably well matured means that the wheat was harvested when ripe and that there is no evidence of green and bronzy discoloration on the kernels. Reasonably free from damaged kernels indicates that there are few pieces of the wheat kernels broken during harvesting and handling and few immature whole kernels in which the endosperm did not fully develop before growth stopped. Most of these damaged kernels are screened and sold as feed.

Foreign material other than cereal grains includes all of the wild weed seeds and domestic crops, such as beans, corn, and buckwheat, that may be found in harvested wheat seed. Cereal grains other than wheat include the cereal crops (i.e., barley, oats, rye, etc.) that are not readily removable from the wheat.

Therefore, it can be said that dockage is material that can be removed from wheat, and foreign material is the unwanted matter that remains after cleaning.

Present Canadian Wheat Standards

In 1970 the Canada Grain Act was revised to provide a wider range of choice and a greater uniformity in quality specifications of hard red spring wheat moving into the export market.

Effective August 1, 1971, the grades No. 1 Manitoba Northern and No. 2 Manitoba Northern were combined to provide a new grade--No. 1 Canada Western Red Spring Wheat. Wheat meeting the requirements of this grade will be segregated by protein content when it reaches the terminal elevators. The eastern terminal elevators will provide minimum protein content levels of 12 percent, 13 percent, 14 percent, and 15 percent when sufficient quantities are available; and the western terminal elevators will offer minimum protein levels of 12.5 percent, 13.5 percent, and 14.5 percent.

The inclusion of protein segregation within the new grades will allow foreign millers to purchase wheat with protein content necessary for blending with their domestic wheat. It is obvious that the quality of the foreign country's domestic wheat will change from year to year, necessitating different

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[11]The Canadian Wheat Board, Breeding and Testing New Varieties, Bulletin No. 1, Winnipeg, Manitoba, Canada, November, 1961, p. 11.

[12]Watanabe, Shin, Grain Standards in the World Wheat Market, Unpublished M.S. Thesis, Department of Agricultural Economics, North Dakota State University, Fargo, 1969, p. 27.

protein levels of imported wheat for blending purposes. As the foreign millers become more and more sophisticated in their baking processes, the closer will be the quality tolerances that are demanded.

Effective August 1, 1972, No. 3 Manitoba Northern and half of the No. 4 Manitoba Northern grades were combined to form a new grade--No. 2 Canada Western Red Spring Wheat. This grade will also be segregated at protein levels of 12 percent, 13 percent, 14 percent, and 15 percent. The remaining half of No. 4 Manitoba Northern will be combined with No. 5 wheat to form the grade No. 3 Canada Western Red Spring Wheat, which will not include protein segregation.

Besides these three grades of Canada Western Red Spring Wheat, grades of wheat called Utility will be provided for wheat used for nonmilling commercial uses, as well as for livestock feeding purposes. If the necessary supply exists, there will be three grades of Utility Wheat--No. 1, No. 2, and No. 3.

No. 1 Canada Western Red Spring Wheat (which replaced the grades of No. 1 and No. 2 Manitoba Northern) has the following definition of minimum quality (see Table 3): minimum 59 pounds test weight (Imperial bushel); Marquis or any variety equal to Marquis; minimum 65 percent hard, vitreous kernels; reasonably well matured and reasonably free from damaged kernels; practically free from foreign materials other than cereal grains; about 0.75 percent total foreign material including cereal grains other than wheat; and about 1 percent durum and 3 percent total wheat of other classes or varieties including durum.

The minimum specifications for each grade are governed by the grade definitions set forth in the Canada Grain Act and can be changed only by statutory amendments.

The average quality specifications of export grades are governed by export standards, which are higher than the minimum grade definitions embodied in the Canada Grain Act. Specifications for export standards are made each year and depend upon the character of the particular crop harvested and the quality of the carryover from previous years' crops.

As an example, the specifications for the export standard of No. 1 Canada Western Red Spring Wheat for 1971 were as follows: test weight of 61.78 pounds per bushel (Imperial bushel); total foreign material, including other cereal grains 0.4 percent, including 0.15 percent other seeds; and wheats of other classes and varieties not equal to Marquis 1.5 percent, including 0.2 percent contrasting classes.[13]

A certificate final is issued by the Canadian Grain Commission as a guarantee of quality of each particular shipment that it covers. This certificate guarantees that when a ship is loaded, the shipment represents the grade specified and that it is equal to the current Standard Export Sample of that grade. Under this sytem, the buyer has no legal recourse if he is dissatisfied with the shipment, although he may refer the matter back to the

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[13]Board of Grain Commissioners for Canada, Canada's New Grades of Red Spring Wheat, Information Bulletin, March, 1971, p. 2.

TABLE 3. CANADIAN GRADES OF WESTERN RED SPRING WHEAT

Grade Name	Standard of Quality				Maximum Limits of:			
					Foreign Material Other Than Wheat		Wheats of Other Classes or Varieties	
	Minimum Test Weight Per Measured Bushel	Variety	Minimum Percentage of Hard Vitreous Kernels	Degree of Soundness	Other Than Cereal Grains	Total Including Other Cereal Grains	Contrasting Classes	Total
No. 1 Canada Western Red Spring	59	Equal to Marquis.	65	Reasonably well matured, reasonably free from damaged kernels.	Practically free	About 0.75%	About 1%	About 3%
No. 2 Canada Western Red Spring	57	Equal to Marquis.	50	Fairly well matured, may be moderately bleached or frost damaged, but reasonably free from severely weather-damaged kernels.	Reasonably free	About 1.5%	About 3%	6%
No. 3 Canada Western Red Spring	54	Any variety of fair milling quality.	--	Excluded from higher grades on account of frosted, immature, or other damage.	Reasonably free	About 3.5%	About 5%	10%
No. 1 Feed Wheat	51	Any class or variety of wheat.	--	Excluded from higher grades on account of severe damage. May contain 8% heat-damaged kernels, but free from foreign or un-natural odors.	About 3% large seeds, wild oats, wheat heads, singly or in combination.	10%	--	--
No. 2 Feed Wheat	--	Any class or variety of wheat.	--	Excluded from higher grades on account of light weight. May contain 15% heat-damaged kernels, but free from foreign or unnatural odors.	About 3% large seeds, wild oats, wheat heads, singly or in combination.	15%	--	--

Protein Segregation: No. 1 Canada Western Wheat shall be segregated on receipt at terminal elevators to provide for 13.0, 14.0, and 15.0% protein levels. Protein levels of 12 and 16.0% may be provided for in years when sufficient quantities of wheat at these levels are available. Levels of protein other than those specified can be blended within the terminal on request of the Canadian Wheat Board, but under supervision of the Board of Grain Commissioners.

Source: The Canada Grain Act, Ottawa, Ontario, Canada, 1971.

Canadian Grain Commission. They, in turn, can make whatever settlement they deem necessary.

United States Standards

The United States Grain Standards Act was passed in 1916 to provide for the establishment of official grain standards, the federal licensing and supervision of the work of grain inspectors, and the entertaining of appeals from the grades assigned by the licensed inspectors.

Federal standards under this act are now in effect for wheat, corn, barley, oats, rye, sorghum, flaxseed, soybeans, and mixed grain. These standards are based on quality characteristics that are desired by the grain trade, including plumpness of kernel, soundness, cleanliness, dryness, purity of type, and the general condition of the grain. To reflect the characteristics which comprise the set of criteria for assigning grades to wheat, the official grades require determination of the following quality factors: test weight per bushel, percent of damaged kernels, percent of foreign material, percent of shrunken and broken kernels, and percent of wheat of other classes.

As provided for in the United States Grain Standards, United States Dark Northern Spring Wheat has three subclasses which depend upon the percent of dark, hard, and vitreous kernels. For these subclasses, grades exist with limits for test weight, heat-damaged kernels, total damaged kernels, shrunken and broken kernels, total defects, contrasting classes, and total wheat of other classes. Special grades exist with limits on moisture, smut, garlic, weevils, ergot, treated, and heavy wheat. Any wheat with moisture content exceeding 13.5 percent receives the special grade designation "tough." Special grade designations are used to denote wheat that contains specific measurable amounts of objectionable foreign material, such as garlic, weevils, treated grain, etc. Another special grade designation "heavy" is applied if the test weight of wheat grading No. 1, No. 2, or No. 3 is at least 60 pounds per bushel. Wheat in lower grades cannot be graded "heavy" regardless of its test weight. Grades exist from United States' Nos. 1 to 5 and lastly a sample grade. These grades and the maximum and minimum limits for each factor remain unchanged from year to year.[14]

The present official grade standards for hard red spring wheat are shown in Table 4.

United States Hard Red Spring Wheat is marketed overseas as United States Dark Northern Spring. Generally, United States Dark Northern Spring is considered to be equal to Canadian Western Red Spring of similar protein content in milling and baking properties. Official standards of the United States No. 2 Dark Northern Spring Wheat are: 57 pounds test weight; 75-100 percent dark, hard, vitreous kernels; maximums of 0.2 percent heat damage; 4 percent total damage; 1 percent foreign material; 5 percent shrunken and

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[14]United States Department of Agriculture, Official Grain Standards of the United States, Washington, D.C., 1964.

TABLE 4. NUMERICAL GRADES AND GRADE REQUIREMENTS OF HARD RED SPRING AND DURUM WHEAT (EFFECTIVE AS OF JANUARY 1, 1969)

Grade	Minimum Test Weight, lb./bu.		Percent Maximum Limits of:						
			Defects					Wheat of Other Classes	
	Hard Red Spring Wheat	Durum Wheat	Heat-Damaged Kernels	Total Damaged Kernels	Damaged Material	Shrunken and Broken Kernels	Total Defects	Contrasting Classes	Total
U.S. No. 1	58.0	60.0	0.1	2.0	0.5	3.0	3.0	1.0	3.0
U.S. No. 2	57.0	58.0	0.2	4.0	1.0	5.0	5.0	2.0	5.0
U.S. No. 3	55.0	56.0	0.5	7.0	2.0	8.0	8.0	3.0	10.0
U.S. No. 4	53.0	54.0	1.0	10.0	3.0	12.0	12.0	10.0	10.0
U.S. No. 5	50.0	51.0	3.0	15.0	5.0	20.0	20.0	10.0	10.0

Dockage: When equal to 0.5 percent or more, shall be stated as in the following examples: Dockage ranging from 0.5 to 0.9 percent shall be expressed as 0.5 percent, from 1.0 to 1.4 percent as 1.0 percent, from 1.5 to 1.9 percent as 1.5 percent.

Heavy Wheat: Shall be hard red spring wheat of grades Nos. 1, 2, and 3 which has a test weight per bushel of 60 pounds or more or any other class of wheat of grades Nos. 1, 2, and 3 which has a test weight per bushel of 62 pounds or more.

Hard Red Spring Wheat: This class shall include all varieties of hard red spring wheat and may include not more than 10.0 percent of wheats of other classes. This class shall be divided into the following three subclasses:

1. Dark Northern Spring Wheat: This subclass shall be hard red spring wheat with 75 percent or more of dark, hard, and vitreous kernels.
2. Northern Spring Wheat: This subclass shall be hard red spring wheat with 25 percent or more, but less than 75 percent of dark, hard, and vitreous kernels.
3. Red Spring Wheat: This subclass shall be hard red spring wheat with less than 25 percent of dark, hard, and vitreous kernels.

Source: Official Grain Standards of the United States, Revised 1970 Edition, SRA-AMS-177, Grain Division, Agricultural Marketing Service, United States Department of Agriculture, 1970, p. 17.

broken kernels; 5 percent total defects; 2 percent wheat of contrasting classes; and 5 percent total of wheat of other classes.

Test weight per bushel of wheat in the United States is expressed in terms of pounds per measured Winchester bushel, which has a 2,150.42 cubic inch capacity. The bushel is commonly regarded as a volume measure, but today's marketing of wheat by weight rather than volume has become so universal that the wheat bushel has been defined as a 60-pound unit.[15] Millers prefer wheat of a high test weight per bushel because test weight is usually directly correlated to flour yield.

Dark, hard, and vitreous kernels of Dark Northern Spring Wheat refer to kernel hardness or softness, which are indicators of the glutenous or starchy condition of the kernel.

The different kinds of damaged wheat kernels affect the milling and baking quality of the flour in different ways.[16]

Frosted wheat, when the entire seed coat is badly affected, produces a flour of poor dough quality and is unsatisfactory in producing good bread.

Heat damage in wheat is perhaps more objectionable than any other, because wheat so injured produces a flour poor in color and of unsatisfactory bread-making properties. Bread from such flour is small in volume, the crumb discolored, of very poor texture, and results in bread that has an offensive odor and usually tastes bad.

Moldy wheat is often caused by the improper storage of damp or "tough" wheat. Such wheat usually develops a musty odor that will ultimately be transmitted to the flour and to the end products made from the flour.

All unwanted matter that cannot be removed from wheat as dockage is called "foreign material." It consists of inseparable weeds, seeds, inert matter, and other grain (i.e., rye) that cannot be readily removed. Foreign material is objectionable because it must be sold as wheat, while dockage can be removed in the initial cleaning process.

Shrunken and broken kernels are wheat kernels that were not mature when harvested or were cracked and broken during the harvesting and handling process. Kernels of this type that will pass through a sieve with slotted perforations 0.064 inch wide by 0.375 inch long are called "shrunken and broken kernels." These kernels are not wanted by the millers because they seriously affect the flour yield.

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[15]Hyslop, John D., Price-Quality Relationships in Spring Wheat, Technical Bulletin 267, University of Minnesota Agricultural Experiment Station, St. Paul, Minnesota, 1970, p. 5.

[16]The following descriptions are taken largely from the Grain Grading Primer, Miscellaneous Publication No. 740, United States Department of Agriculture, Washington, D.C., September, 1957, pp. 1-50.

Wheat of other classes is an objectionable factor because each class of wheat has its own distinct use; and the mixing of classes, therefore, would limit the efficiency of the particular class use.

The determination of dockage, moisture, temperature, odor, garlic, and insects is based on the wheat as a lot. All other determinations are based on dockage-free wheat.

All percentage figures are based on weight. Percentages, except for dockage, are expressed in whole and tenth percents to the nearest tenth of a percent. The percentage of dockage is reported in one-half percent intervals.

Although protein content in wheat is not included as a specific grade factor in the United States wheat grades, it is, nevertheless, an inherent quality factor in the production, marketing, and milling of wheat.

Because protein content is positively correlated with baking quality, premiums usually are paid by the milling industry for wheat with a high protein content. For this reason, wheat is segregated by protein content at local elevators. Producers, in turn, are paid premiums by the local elevator for high-protein content wheat in an amount depending on the current distribution of protein in the available supply of wheat and the market demand for protein.

Even though protein content in wheat is not a specific grade factor, the United States has had a system of marketing on protein specifications since 1928.[17]

A nationwide network of state and private inspection points is maintained in the United States and are licensed by the Consumer and Marketing Service of the United States Department of Agriculture. Under this system, wheat is sampled and officially graded either at the country elevator or terminal market, depending on which method of marketing is used.

Comparison and Analysis

Comparisons of the grade factors of Manitoba No. 1 (1 Man.),[18] Manitoba No. 2 (2 Man.), Canadian Western Red Spring No. 1 (1 CWRS), Dark Northern Spring No. 1 (1 DNS), and Dark Northern Spring No. 2 (2 DNS) are shown in Table 5. The grade factors are not identical between the United States and Canadian system, but they are close enough to allow viable comparisons of the different grades.

Test weight per bushel is measured in terms of the Imperial bushel in Canada and the Winchester bushel in the United States. When the minimum test

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[17]Gustafson, Jim, "Battle of Tin Cans Leads to Establishing Protein Premiums," Farmers Union Herald, Volume 47, No. 16, St. Paul, Minnesota, August 20, 1973, p. 9.

[18]The abbreviations in parentheses will be used in place of the full grade designation throughout the remainder of this study.

TABLE 5. COMPARISON OF UNITED STATES AND CANADIAN GRADES OF WHEAT

Grade Factor \ Wheat Grade	1 Man.[a]	2 Man.[a]	1 CWRS[a]	U.S. No. 1	U.S. No. 2
Minimum test weight per bushel	60 lbs. Imperial	58 lbs. Imperial	59 lbs. Imperial	58 lbs. Winchester 59.76 lbs. Imperial	57 lbs. Winchester 58.82 lbs. Imperial
Percent dark, hard, vitreous kernels	80%	65%	65%	DNS - 75-100%[b] NS - 25-75% RS - <25%	DNS - 75-100%[b] NS - 25-74% RS - <25%
Heat damage	NA[c]	NA	NA	0.1%	0.2%
Total damage	Practically free	Reasonably free	Reasonably free	2%	4%
Variety	Marquis or equal	Marquis or equal	Marquis or equal	NA	NA
Wheat of contrasting classes	Practically free	1%	1%	1%	2%
Wheat of other classes total	1%	3%	3%	3%	5%
Percent shrunken and broken kernels	NA	NA	NA	3%	5%
Foreign material other than cereal grains	Practically free	Practically free	Practically free	0.5%	1%
Total foreign material other than wheat, including cereal grains other than wheat	Practically free	1%	0.75%	NA	NA
Percent total defects	NA	NA	NA	3%	5%
Protein content[d]	Not segregated	Not segregated	Segregated	Segregated	Segregated

[a]Effective August 1, 1971, the grades Manitoba No. 1 and No. 2 were combined to form Canadian Western Red Spring No. 1.

[b]NDS - Dark Northern Spring }
NS - Northern Spring } Subclasses of Hard Red Spring Wheat
RS - Red Spring }

[c]NA - Not defined.

[d]Not a specific grade factor, included only for comparison purposes.

weight per bushel of 1 DNS is converted from Winchester bushel measure to Imperial bushel measure, the minimum standard becomes 59.76 (58 X 1.032 = 59.756) pounds per bushel. This is slightly less than the 60-pound requirement for 1 Man., but higher than the 59 pounds required for the new 1 CWRS. Likewise, converting the 57-pound minimum for 2 DNS to Imperial measure (57 X 1.032 = 58.824), results show that the minimum is higher than the 58 pounds required for 2 Man., but less than the 59-pound minimum requirement for 1 CWRS.

From this evidence it can be inferred that the grades 1 Man., and 2 Man. versus 1 DNS and 2 DNS, respectively, nearly equalled each other with respect to the minimum test weight per bushel requirement. The change in the Canadian standards (1 Man. and 2 Man. combined to form 1 CWRS) in effect lowered the minimum requirements for test weight per bushel of Canadian wheat to a point between the United States grades--1 DNS and 2 DNS.

The minimum percentage by weight of hard, vitreous kernels for 1 CWRS is 65 percent, which is the same as was the minimum requirement for 2 Man. The minimum percentage for United States No. 1 is broken down by subclasses as follows: Dark Northern Spring (which moves in largest volume in international trade)--75 percent, Northern Spring--25 to 75 percent, and Red Spring--less than 25 percent. The minimum requirement for 2 DNS is the same as 1 DNS. In comparison, the Canadian grades 1 Man. and 2 Man. had, and 1 CWRS has, a specific minimum percentage requirement; while the United States divides wheat under each grade into subgroups for the different levels of hard, vitreous kernels. Under this system, Canada's method maintains more stringent requirements, but is somewhat arbitrary when compared to the United States method which offers a wider range of choice under each grade to the potential customer.

The Canadian wheat grading system does not set specific limits for heat damage. United States standards do, however, set a maximum limit of 0.1 percent heat-damaged kernels for 1 DNS and 0.2 percent for 2 DNS.

Canada does not have a specific maximum of total damaged kernels that may be present in any certain grade. Their standards merely state than 1 Man. was to be "practically free," 2 Man. "reasonably free," and now 1 CWRS is to be "reasonably free" of total damaged kernels. Limits, such as these, are dependent largely upon the discretion of the graders who, though well trained, may understandably deviate somewhat in interpreting whether a sample is or is not "reasonably free" of damaged kernels. The United States standards specify maximum limits of total damaged kernels that may be present within each grade--2 percent for 1 DNS and 4 percent for 2 DNS.

Canadian standards state that for a variety to be graded 1 CWRS, it must be of equal or better quality than Marquis. The United States does not have a specific variety as the minimum for any grade. However, certain varieties that have poor milling qualities may be discounted at the marketplace. But this distinction is not easy to make, especially in the export market. Consequently, wheats with lower milling qualities in many cases may not be discounted at all.

The maximum limits for wheat of contrasting classes are set at 1 percent for both 1 CWRS and 1 DNS. Previously, 1 Man. had a "practically free" limitation and 2 Man. a 1 percent maximum limitation for wheat of contrasting classes. Wheat of contrasting classes is typified by occurrences, such as durum kernels, interspersed in a sample or lot of hard red spring wheat. The 1 percent maximum

limitation of this grade factor is present because amounts exceeding this would adversely affect the quality of the final product for which the lot was intended.

Likewise, total wheat of other classes cannot exceed 3 percent in lots of either 1 DNS or 1 CWRS.

Canadian standards do not specify a limit on shrunken and broken kernels, but United States wheat standards allow no more than 3 percent shrunken and broken kernels in 1 DNS and 5 percent in 2 DNS.

Both 1 Man. and 2 Man. had, and 1 CWRS has, the stipulation that lots of these grades of wheat be "practically free" of foreign material other than cereal grains. Again, this is a relative term not as exact as the 0.5 percent maximum set for 1 DNS and the 1.0 percent maximum foreign material, other than cereal grains, set for 2 DNS. However, 1 CWRS does have the stipulation that it cannot contain more than 0.75 percent total foreign material, including cereal grains other than wheat. United States wheat standards do not have this particular grade factor included in the provisions.

United States wheat standards also have a final provision that 1 DNS cannot contain more than a maximum of 3 percent and 2 DNS a maximum of 5 percent total defects.

Protein content is not a specific grade factor in either United States or Canadian wheat standards; but, nevertheless, it is an important quality characteristic, especially for end users of wheat. For this reason, it was included for comparison in Table 5. There was no system of protein segregation for spring wheat in Canada prior to the change in Canadian wheat standards and the addition of protein segregation effective August 1, 1971. So, grades of 1 Man. and 2 Man. were not segregated for protein levels before being sold. 1 CWRS is segregated on receipt at terminal elevators, as are the United States grades of 1 DNS and 2 DNS. The United States has been marketing wheat on a protein segregation basis for nearly half a century; so in order for Canada to remain competitive, it was necessary that they initiate a program of wheat protein content segregation among their new grades.

Now that the specific grade factors of each grade have been compared, a brief comparison of the grades shown in Table 5 will follow.

Effective August 1, 1971, the grades 1 Man. and 2 Man. were combined to form 1 CWRS. As was shown by the above comparisons and by consulting Table 5, it can be inferred that 1 CWRS more closely parallels 2 Man. than 1 Man. This was a logical step, however, because a large amount of the wheat grown in and exported from Canada prior to the change was the grade 2 Man.[19] The grade 1 CWRS was an improvement over the grades 1 Man. and 2 Man. not only because it allows for protein segregation, but also because it does not contain as many relative terms in its grade factors as do 1 Man. and 2 Man. (i.e., designations practically free, reasonably free, etc.).

In terms of quality specifications, 1 CWRS falls between the United States grades 1 DNS and 2 DNS, but is somewhat closer to 1 DNS than 2 DNS.

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[19]Bellingham, op. cit., p. 10.

In conclusion, it can be said that the change in Canadian wheat standards in effect brought them into a more parallel position with United States wheat standards, especially with respect to protein segregation and marketing with guaranteed protein contents.

Each year the Canadian Grain Commission establishes an export standard of 1 CWRS and other grades offered in the export market. This export standard is the average quality that can be expected for each grade. It is dependent on the quality of wheat for the current year, as well as on the quality of any carryover from previous years.

A comparison between Number 1 United States Dark Northern Spring (1 DNS), Number 1 Canadian Western Red Spring (1 CWRS), and the 1971 Export Sample of Number 1 Canadian Western Red Spring (1E CWRS) is illustrated in Table 6. A comparison of 1 DNS with 1 CWRS was discussed previously, so only the factors of 1E CWRS that are different from 1 CWRS will be discussed. The following comparison is based on data illustrated in Table 6.

Test weight per bushel for 1E CWRS (1971) was set at 63.4 pounds Avery bushel measure. This is equal to 59.8 pounds by the United States Winchester bushel measure, which is higher than the 58-pound minimum requirement for 1 DNS. However, consideration must be given to the fact that the grade factor for 1E CWRS is the average quality that can be expected for that year, while the factors for 1 DNS and 1 CWRS are the minimum requirements for that grade.

The average wheat of contrasting classes found in 1E CWRS is 0.2 percent compared to a maximum limit of 1 percent allowed in 1 CWRS and 1 DNS. This shows that the Canadian farmers and grain handlers are more effective in avoiding the mixing of contrasting classes of wheat in production and marketing.

The total wheat of other classes allowable for both 1 CWRS and 1 DNS is 3 percent compared to the average for 1E CWRS of 1.5 percent. Total foreign material, other than wheat including cereal grains other than wheat allowable, is 0.75 percent for 1 CWRS compared to the average stated for 1E CWRS of 0.4 percent. Both of these factors have a percentage content present that is about half of the maximum allowable. A percentage this small would have to be considered desirable to overseas customers.

It was previously shown that 1 DNS has somewhat higher standards than 1 CWRS. The 1 CWRS Export Sample for 1971 has higher factors than the minimum required for both 1 CWRS and 1 DNS. A complete comparison of 1E CWRS with the grades 1 DNS and 1 CWRS is difficult because the grade factors of 1E CWRS are only the average for a particular year and the grade factors for 1 CWRS and 1 DNS are set by law as minimum requirements for that grade. The IE CWRS grade is important to overseas customers because it gives them an idea of the quality that can be expected when the grade is purchased. The United States does not include an export sample type grade in its grading system.

TABLE 6. COMPARISON OF UNITED STATES AND CANADIAN NUMBER 1 DOMESTIC AND EXPORT GRADES OF WHEAT

Grade Factor \ Wheat Grade	U.S. No. 1	1 CWRS Export Sample 1971	1 CWRS
Minimum test weight per bushel	58 lbs. Winchester	59.8 lbs. Winchester 63.4 lbs. Avery	57.2 lbs. Winchester 59 lbs. Imperial
Percent dark, hard, vitreous kernels	DNS - 75% NS - 25.75% RS - 25%	65%	65%
Heat damage	0.1%	NA	NA
Total damage	2%	Reasonably free	Reasonably free
Variety	NA	Marquis	Marquis
Wheat of contrasting classes	1%	0.2%	1%
Wheat of other classes total	3%	1.5%	3%
Percent shrunken and broken kernels	3%	NA	NA
Foreign material other than cereal grains	0.5%	Practically free	Practically free
Percent total defects	3%	NA	NA
Total foreign material other than wheat, including cereal grains other than wheat	NA	0.4%	0.75%
Protein content[a]	Segregated	Segregated	Segregated

[a]Not a specific grade factor, included only for comparison purposes.

Source: Table 5 and Board of Grain Commissioners for Canada, Canada's New Grades of Red Spring Wheat, Information Bulletin, March, 1971, p. 2.