Plains Grains Inc. (PGI), a nonprofit, private quality-based marketing initiative, was formed in 2004 through the Oklahoma Wheat Commission, Oklahoma Department of Agriculture, Food and Forestry and Oklahoma State University Division of Agricultural Sciences and Natural Resources.

PGI was designed to bridge the gap between wheat producers, grain companies and foreign and domestic flour millers to benefit all segments of the wheat industry.

PGI facilitates the appropriate wheat-quality tracking needed to provide millers with the quality information they need to purchase U.S. wheat. While state data is important, it is critical to PGI’s marketing goals to have quality data for the entire Hard Red Winter (HRW) wheat production area. Each state may be able to produce the quality needed by foreign buyers, but it will take multiple states to achieve the critical mass needed to meet the quantity needs. By working together as a region we can meet both quality and quantity demands.

In 2004, PGI’s crop quality survey included the Oklahoma HRW wheat crop. Designed as a regional marketing entity, PGI then brought five other HRW wheat-producing states on board for the crop quality survey in 2005. Due to the welcome reception and success of PGI in the foreign marketplace, the entire Great Plains HRW wheat production region now subscribes to the PGI crop quality survey.

Visit our website at plainsgrains.org for up-to-date information, interactive maps and more!
Wheat is one of the oldest and most widely used food crops in the nation and it supplies approximately 20% of food calories for the world’s population. Whole grains contain protective antioxidants in amounts near or exceeding those in fruits and vegetables.

Wheat is the United States’ leading export crop and the fourth-leading field crop. The most common class produced in the United States is Hard Red Winter (HRW) wheat. The class a variety fits into is determined by its hardness, the kernels’ color and planting time. Other classes are Durum, Hard Red Spring, Soft Red Winter, Hard White and Soft White.

Almost 50% of the wheat produced in the U.S. is exported. Approximately one-third of the HRW produced is exported. Nigeria is the No. 1 importer of U.S. HRW, with a little more than 75% of its total imports coming from the U.S.

Wheat flour is the major ingredient in many favorite foods found across the globe. More foods are made from wheat than any other cereal grain. Wheat has the ability to produce a widely diverse range of end-use products because each class of wheat has distinct characteristics that create unique functionality.

HRW wheat is versatile with excellent milling and baking characteristics for pan breads. Principally used to make bread flour, HRW is also a choice wheat for Asian noodles, hard rolls, flat breads and improving blending.

HRW wheat accounts for about 40% of total U.S. wheat production and is grown primarily in the Great Plains states of Colorado, Kansas, Montana, Nebraska, North Dakota, Oklahoma, South Dakota, Texas, Wyoming, and the Pacific Northwest.
National Wheat Overview

Wheat Major Classes

The six major classes of U.S. wheat are Hard Red Winter (HRW), Hard Red Spring, Soft Red Winter, Soft White, Hard White (HW) and Durum. Each class has a somewhat different end use and production tends to be region-specific. This region is mostly limited to production of (HRW) and Hard White wheat classes, therefore the data in this publication will focus on the quality of those classes for the current crop year.

**HRW** wheat accounts for about 40% of total U.S. wheat production, dominates the U.S. wheat export market and is grown primarily in the Great Plains, stretching from the Mississippi River to the Pacific Ocean and from Canada to Mexico.

**Hard Red Winter wheat accounts for about 40% of total U.S. wheat production.**

This fall-seeded wheat is versatile with moderately high protein content and excellent milling and baking characteristics. Principally used to make bread flour, HRW is also a choice wheat for Asian noodles, hard rolls, flat breads and is commonly used as an improver for blending.

**HW** is the newest class of wheat, used for the same basic products as HRW wheat, can provide higher milling extraction and requires less sweetener in whole-wheat products due to its milder, sweeter flavor.

HW, which is closely related to Red wheats, receives enthusiastic reviews when used for Asian noodles, hard rolls, bulgar, tortillas, whole wheat or high-extraction applications, pan breads or flatbreads.
Overview

The 2020 hard red winter (HRW) wheat crop was unique in several respects. This crop does hold value for about every customer. Overall, the crop had very few insect or disease issues throughout the entire growing season.

Most kernel characteristics are similar or equal better than last year. However, average test weight and thousand kernel weight exceeded the 5-year averages. Similarly, most flour, dough and bake data were equal to or better than last year, but again there were several exceptions that exceeded the 5-year averages. Those included the W-values, farinograph peak time, farinograph stability time, bake absorption and loaf volume.

Overall, the 2020 crop has good milling and processing characteristics and should provide customers with an exceptionally good range of quality and value.

Weather and Harvest

The 2020 HRW planted area was again near historic 100-year lows, continuing the trend of recent years, HRW production is estimated at 18.9 MMT (695 mil bu), a 3.8 MMT decrease from 2019. Moisture (or lack of) and below freezing temperatures during the later stages of crop development defined the 2020 crop in the central and southern Great Plains. Eastern areas of that region experienced favorable growing conditions and subsequently realized near record yields (per unit area), particularly good kernel characteristics, but lower protein. At the same time western areas of the central and southern Great Plains experienced drought and freeze events during the later stages of crop development that adversely affected the crop resulting in lower yields and smaller kernels, but higher protein. With very few exceptions disease and insects were not a major issue for the 2020 HRW crop.

The northern Great Plains and Pacific Northwest (PNW) faced variable growing conditions as well. Washington, Montana, Idaho and South Dakota all harvested a crop that was at record or near record yields (per unit area) with generally particularly good kernel characteristics and protein. At the same time Oregon experienced a significant reduction in yield due to unseasonably dry weather.

Wheat and Grade Data

Overall 92% of Composite, 90% of Gulf Tributary and 96% of PNW Tributary samples graded U.S. No. 2 or better. Average test weight of 61.4 lb/bu (80.8 kg/hl) is above the 2019 average of 60.6 lb/bu (79.6 kg/hl) and above the 5-year average of 60.4 lb/bu (79.4 kg/hl). Average dockage (0.5%), total defects (1.4%) and foreign material (0.1%) are all equal to or like 2019 and the 5-year averages. Average shrunken and broken is (1.1%), above 2019 (0.8%) and above the 5-year average (1.0%). Average thousand kernel weight of 31.2g while less than 2019 (32.7g), is like the 5-year average (31.1g). Protein is (11.9%), above last year (11.4%) and slightly lower than the 5-year average (12.1%). The average wheat falling number is 369 sec, indicative of sound wheat.
Flour and Baking Data

The Buhler laboratory mill flour yield average is 73.5%, slightly lower than the 2019 average (74.5%) and the 5-year average (75.4%). The 2020 flour ash of 0.49% (14% mb) is comparable to last year’s 0.48%, but lower than the 5-year average of 0.54%. The alveograph W value of 261(10^-4 J) is significantly higher than last year and the 5-year averages (223 and 232 10^-4 J) respectively.

Farinograph peak time (5.3 minutes) is higher than in 2019 and 5-year respectfully (3.3 and 4.6) minutes. Stability time (10.3 minutes) is significantly higher than last year and the 5-year average of (7.3 minutes and 8.1 minutes) respectively. Average bake absorption is 63.1%, above the 62.7% value for 2019 and the 5-year average of 62.9%. Overall loaf volume averaged 859 cc and is comparable to last year’s 863 cc and to the 5-year average of 853 cc.
## Hard Red Winter Production (1,000 Bushels)

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**Some data derived from Crop Production report issued by USDA NASS updated September 30, 2018.**

## Hard Red Winter Harvested Acres (1,000 Acres)

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## Hard Red Winter Yield (bu/ac)

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### Metric Units

#### Hard Red Winter Yield (tons/ha)

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**Some data derived from Crop Production report issued by USDA NASS updated September 30, 2018.**
Plains Grains Inc. (PGI) is an Oklahoma-based, regional wheat marketing entity that has designed a wheat quality survey to provide end-use quality information to the U.S. wheat buyer. PGI facilitates collection and testing of wheat samples at harvest in order to provide data that specifically describes the quality of U.S. wheat.

PGI facilitates quality testing on a “grainshed” basis. Grainsheds are defined by identifying key loading facilities and outlining the production region which contributes to that facility’s grain supply. By defining the production areas in this manner, PGI’s survey is able to more accurately represent and determine the quality of wheat that will come from a specific regional terminal, thereby giving buyers a truer picture of the product available to compose a shipment of Hard Red Winter (HRW) wheat.

The quality of wheat originating from a grainshed is determined by pulling samples from country and terminal elevators located within each defined grainshed. These samples are then immediately sent to the USDA ARS Hard Winter Wheat Quality Lab in Manhattan, Kansas, where they are analyzed and tested for more than 25 quality parameters. Official grade is determined at the Federal Grain Inspection Service office in Enid, Oklahoma.
The Federal Grain Inspection Service (FGIS) of the USDA Grain Inspection, Packers and Stockyards Administration (GIPSA) sets the standard for U.S. grain grades and grade requirements. U.S. grain grades are reflective of the general quality and condition of a representative sample of U.S. wheat. These grades are based on characteristics such as test weight and include limits on damaged kernels, foreign material, shrunken and broken kernels, and wheat of contrasting classes. Each determination is made on the basis of the grain free of dockage. Grades issued under U.S. standards represent a sum of these factors.

### Official U.S. Grades and Grade Requirements

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Note: U.S. Sample grade is wheat that:
(a) Does not meet the requirements for U.S. Nos. 1, 2, 3, 4, or 5; or
(b) Has a musty, sour, or commercially objectionable foreign odor (except smut or garlic); or
(c) Is heating or of distinctly low quality.

*Includes damaged kernels (total), foreign materials, and shrunken and broken kernels.
**Unclassed wheat of any grade may contain not more than 10.0% of wheat of other classes.
***Includes contrasting classes.
****Includes any combination of animal filth, castor beans, crotalaria seeds, glass, stones, or unknown foreign substance.
Each determination of heat-damaged kernels, damaged kernels, foreign material, wheat of other classes, contrasting classes and subclasses is made on the basis of the grain when free from dockage and shrunken and broken kernels.

**Defects** are damaged kernels, foreign materials and shrunken and broken kernels. The sum of these three factors may not exceed the limit for the factor defects for each numerical grade.

**Foreign material** is all matter other than wheat that remains in the sample after the removal of dockage and shrunken and broken kernels.

**Shrunken and broken kernels** are all matter that passes through a 0.064 x 3/8-inch oblong-hole sieve after sieving according to procedures prescribed in the FGIS instructions.

**Damaged kernels** are kernels, pieces of wheat kernels and other grains that are badly ground-damaged, badly weather damaged, diseased, frost-damaged, germ damaged, heat-damaged, insect-bored, mold-damaged, sprout-damaged or otherwise materially damaged.

**Test Weight** is a measure of the density of the sample and may be an indicator of milling yield and the general condition of the sample, as problems that occur during the growing season or at harvest often reduce test weight.
## Wheat Grading Data

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# Kernel Quality Data

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In addition to the U.S. grade factors, there are other characteristics at work to determine the value of the wheat. Examples include dockage, wheat moisture, wheat protein content, thousand-kernel weight (TKW) and falling number.

**Moisture content** is an indicator of grain condition and storability. Wheat or flour with low moisture content is more stable during storage. Moisture content is often standardized (12% or 14% moisture basis) for other tests that are affected by moisture content.

**Protein content** relates to many important processing properties, such as water absorption and gluten strength, and finished product attributes such as texture and appearance. Higher-protein dough usually absorbs more water and takes longer to mix. Hard Red Winter (HRW) wheat generally has a medium-to high-protein content, making it most suitable for all-purpose flour and chewy-texture breads.

**Ash content** also indicates milling performance and how well the flour separates from the bran. Millers need to know the overall mineral content of the wheat to achieve desired or specified ash levels in flour. Ash content can affect flour color. White flour has low ash content, which is often a high priority among millers.

**Thousand-kernel weight** and kernel diameter provide measurements of kernel size and density important for milling quality. Simply put, it measures the mass of the wheat kernel. Millers tend to prefer larger berries or at least berries with a consistent size. Wheat with a higher TKW can be expected to have a greater potential flour extraction.

**Falling number** is an index of enzyme activity in wheat or flour and is expressed in seconds. Falling numbers above 300 are desirable, as they indicate little enzyme activity and a sound, quality product. Falling numbers below 300 are indicative of more substantial enzyme activity and sprout damage.

**Dockage** is all matter other than wheat that can be removed from the original sample by use of an approved device according to procedures prescribed in FGIS instructions.

**Kernel size** is a measure of the percentage by weight of large, medium and small kernels in a sample. Large kernels or more uniform kernel size may help improve milling yield.

**Single Kernel Characterization System (SKCS)** measures 300 individual kernels from a sample for size (diameter), weight, hardness (based on the force needed to crush) and moisture.
## Other Wheat Characteristics

*non-grade data*

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2020 Hard Red Winter Wheat Regional Quality Survey
Flour Characteristics

Flour is analyzed for indicators of milling efficiency and functionality properties. These include: flour yield, ash content, falling number and flour protein.

**Flour yield** is expressed as a percentage and represents the portion of the wheat kernel that can be milled into flour, which is a significant indicator of milling profitability. Millers need to know the mineral content in wheat to achieve the desired ash levels in flour.

**Ash content** is an indication of how well flour separates from the bran. Flour ash is expressed as a percentage of the initial sample weight and is usually expressed on a 14% moisture basis.

**Flour falling number** is an index of undesirable enzyme activity that normally occurs when the kernel sprouts or germinates. A high falling number indicates minimal activity, whereas a low falling number indicates more substantial enzyme activity. Too much activity means that too much sugar and too little starch are present in the flour. Starch provides the supporting structure of bread, so high activity results in sticky dough and poor texture in the finished product.

**Wet Gluten Index** is a measurement that indicates whether the gluten is weak, normal or strong. A weak gluten would be represented by a gluten index of 0 and the strongest gluten index is 100.

**Minolta Color** results are reported with the values L*, a* and b*. L* ranges from 100 (white) to 0 (black) a* ranges from +60 (red) to -60 (green) b* ranges from +60 (yellow) to -60 (blue).
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2020 Hard Red Winter Wheat Regional Quality Survey
Dough Characteristics

The strength and mixing properties of dough help the baker determine the value of the flour they purchase. Flour specifications often require specialized testing to determine how flour will perform during processing.

**Farinograph** testing is one of the most common flour quality tests in the world. Farinograph results are used to determine dough strength and processing requirements.

**Absorption** is a measurement of the amount of water required for the flour to be optimally processed into the finished product. Peak time indicates the time it takes for the dough to develop from the moment the water is added until maximum consistency is achieved. This measurement is expressed in minutes.

**Stability** is an indication of dough strength as it is a measurement of how long the dough maintains maximum consistency. Stability is also expressed in minutes. Weak gluten flour has a lower water absorption and shorter stability time than strong gluten flour.

**Peak time** represents dough development time by measuring the length of time from the moment water is added until the dough reaches maximum consistency. This measurement indicates optimum mixing time for the dough under standardized conditions.

**Mixing Tolerance Index** is the resistance of the dough to breakdown during continued mixing. It is the difference in Brabender Unit (BU) value at the top of the curve at peak time and the value at the top of the curve five minutes after the peak. This indicates tolerance to over-mixing and is expressed as a numerical score based on comparison to a control.

**Alveograph** testing determines the gluten strength of dough by measuring the force required to blow and break a bubble of dough. The results of the test are used by millers to ensure a more consistent product. “P” relates to the force required to blow the bubble of dough; “L” relates to the extensibility of the dough; “W” is a combination of dough strength and extensibility. Weak gluten flour with low P value and long L value is preferred for cakes, where as strong gluten flour used for breads will have a higher P value.

**Development time** is the time interval from the first addition of water to the maximum consistency immediately prior to the first indication of weakening. Long peak times indicate strong gluten and dough properties while short peak times may indicate weak gluten.
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Baking tests are the final laboratory testing method in the evaluation of wheat quality. Generally, the amount and type of protein present determines baking performance, though starch quality can also have an influence.

Technicians evaluate loaves for their volume, or size, and the interior appearance of the loaf such as crumb grain and crumb color. Other performance factors include dough absorption, or bake absorption, and the optimum mixing time of the dough.

**Baking absorption** is the amount of water added to achieve properly hydrated dough. It is expressed as a percentage, with higher values being better.

**Crumb grain and texture** measures the cell size and shape. It is rated on a scale of one to 10 and higher numbers are preferred.

**Bake mix time** represents mixing time when all normal ingredients are added for producing an end product (in addition to water and flour) prior to baking.
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The harvest samples were evaluated using these methods:

**Grade:** Official U.S. Standards for Grain.

**Dockage:** Official USDA procedure using the Carter Dockage Tester.

**Test Weight:** AACC Method 55-10; the weight Per Winchester Bushel (2150.42 in³) as determined using an approved device, USDA approved. The test weight is mathematically converted to hectoliter weight: kg/hl = lb/bu x 1.292 + 1.419.

**Moisture:** DJ Gac 2100.

**Protein:** NIRT method.

**Ash:** AACC Method 08-01 expressed on a 14% moisture basis.

**Falling Number:** AACC Method 56-81B. An average value is a simple mean of sample results.

**Kernel Size Distribution:** Cereal Foods World (Cereal Science Today) 5:71-71, 75 (1960). Wheat is sifted with a RoTap sifter using a Tyler No. 7 screen (2.82 mm) and a Tyler No. 9 Screen (2.00 mm). Kernels retained on the No. 7 screen are classified as “Large.” Kernels passing through the No. 7 screen and retained on the No. 9 screen are “Medium.” Kernels passing through the No. 9 screen are “Small”.

**Single Kernel Characterization:** AACC Method 55-31 using SKCS Model 4100.

**Extraction:** Samples cleaned and tempered according to AACC Method 26-10A. All were milled with identical mill settings on a Buhler laboratory mill as follows: AACC Method 26-21A.

**Moisture:** NIR Protein: NIR Ash: AACC Method 08-01 expressed on a 14% moisture basis.

**Falling Number:** AACC Method 56-81B.

**Wet Gluten & Gluten Index:** AACC Method 38-12

**Farinograph:** AACC Method 54-21 with 50-gram bowl.

**Absorption** is reported on 14% moisture basis.

**Alveograph:** AACC Method 54-30A.

**Loaf Volume:** AACC Method 10-10B producing 2 loaves per batch using wet compressed yeast and ascorbic acid. After mixing, dough is divided into two equal portions, fermented for 160 minutes, proofed and baked in “pup loaf” pans. Loaf volume is measured immediately after baking by rapeseed displacement.