



2019 CROP QUALITY REPORT



U.S. WHEAT ASSOCIATES



FROM THE PRESIDENT



USW staff, U.S. wheat farmers, state wheat commission staff and industry guests at the 2019 USW World Staff Conference.

Dear Friends:

I am very happy to introduce the 2019 U.S. Wheat Associates (USW) Crop Quality Report. This analysis of the grade, flour and end-product performance of all six U.S. wheat classes remains one of the largest and most useful projects our organization conducts on behalf of U.S. wheat farmers. We sincerely hope that you will find the information here useful in your work helping to feed the people of the world.

While the commitment from U.S. farm families to produce the highest quality wheat endures, every new year presents different challenges. Our primary responsibility in producing this report is to provide you with a full and honest assessment of the new crop. Our task is then to offer the assistance and support necessary to help your business get the most functionality and profitability from U.S. wheat.

For hard red winter (HRW), hard red spring (HRS) and soft red winter (SRW) production in 2018/19, the challenges were persistent cool temperatures in the spring and too much rain at harvest time. The results of those conditions are somewhat evident in these crops, especially in the HRS crop that suffered from persistent rain on mature wheat. The effort by public and private wheat breeders to constantly improve quality outcomes is helping to maintain acceptable performance. It was also wetter than normal in the Pacific Northwest, but the 2018/19 soft white (SW) crop still graded as U.S. #1 SW with very good test weights and end use performance as indicated by solvent retention capacity analysis.

We recommend using the new data here – and past performance data – as a baseline to which you may compare your own results, which are also determined in part by the commitment to service from your local USW marketing and technical representatives.

This report would not be possible without our state wheat commission members and many public and private service providers who collect and analyze the samples and tabulate results. We also appreciate the sustained support of our respected partners at the USDA Foreign Agricultural Service.

Sincerely,

Vince Peterson, USW President

***“And to the world’s wheat buyers,
millers, bakers and wheat food
processors, thank you again
for choosing U.S. wheat.
We wish you all a very successful
and profitable year ahead.”***

TABLE OF CONTENTS

2 2019 CROP QUALITY REPORT OVERVIEW

4 ANALYSIS METHODS



10 HARD RED WINTER

18 HARD RED SPRING



26 HARD WHITE

32 SOFT WHITE



38 SOFT RED WINTER

44 DURUM

49 WHEAT GRADES AND GRADE REQUIREMENTS

U.S. Wheat Associates is funded by the U.S. Department of Agriculture's Foreign Agricultural Service, and by wheat producers through the following member organizations:

Arizona Grain Research and Promotion Council

California Wheat Commission

Colorado Wheat Administrative Committee

Idaho Wheat Commission

Kansas Wheat Commission

Maryland Grain Producers Utilization Board

Minnesota Wheat Research and Promotion Council

Montana Wheat & Barley Committee

Nebraska Wheat Board

North Dakota Wheat Commission

Ohio Small Grains Marketing Program

Oklahoma Wheat Commission

Oregon Wheat Commission

South Dakota Wheat Commission

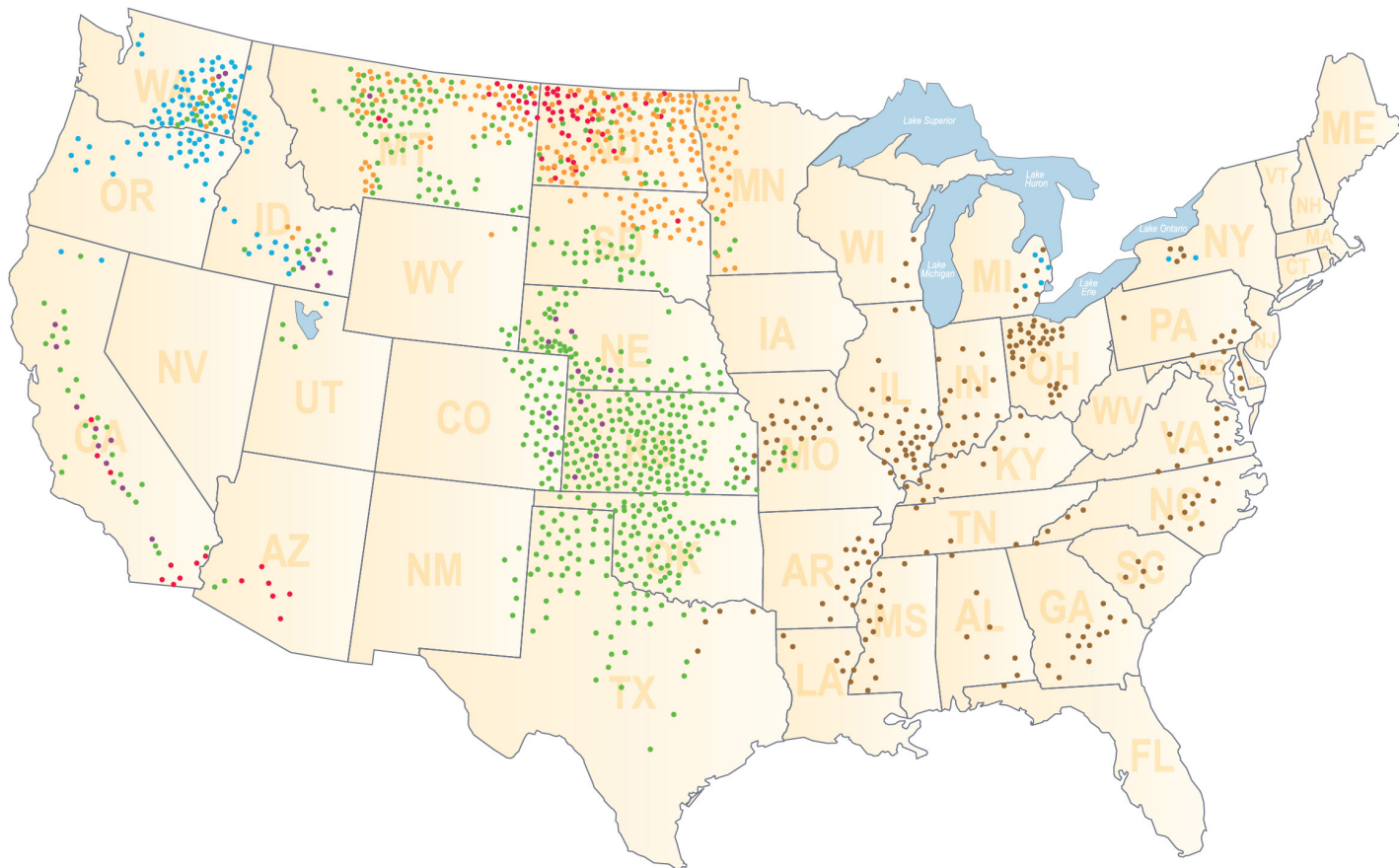
Texas Wheat Producers Board

Washington Grain Commission

Wyoming Wheat Marketing Commission



2019 CROP QUALITY OVERVIEW



HARD RED WINTER

HARD RED SPRING

HARD WHITE

SOFT WHITE

SOFT RED WINTER

DURUM

PLANTING AND HARVEST DATES

Wheat		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HRW	Planting	█											
	Harvest					█	█	█	█	█	█	█	█
HRS	Planting				█	█	█	█	█	█	█	█	█
	Harvest												
HW	Planting			█	█	█	█	█	█	█	█	█	█
	Harvest												
Durum	Planting	█											
	Harvest					█	█	█	█	█	█	█	█
SW	Planting			█	█	█	█	█	█	█	█	█	█
	Harvest												
SRW	Planting												
	Harvest					█	█	█	█	█	█	█	█

█ CALIFORNIA-ARIZONA PLANTING

█ CALIFORNIA-ARIZONA HARVEST

█ OTHER STATES PLANTING

█ OTHER STATES HARVEST

U.S. PRODUCTION BY CLASS

CROP YEAR (BEGINNING JUNE 1) (MILLION METRIC TONS)

	2019	2018	2017	2016	2015
Hard Red Winter	22.7	18.0	20.4	29.5	22.6
Hard Red Spring	15.2	16.0	10.5	13.4	15.4
Hard White	0.9	0.9	0.9	0.9	0.6
Durum	1.6	2.1	1.5	2.8	2.3
Soft White	6.6	6.5	6.2	6.9	5.4
Soft Red Winter	6.5	7.8	7.9	9.4	9.8
Total	53.4	51.3	47.4	62.9	56.1

Based on USDA crop estimates as of September 30, 2019.

SUMMARY OF CLASSES

	Hard Red Winter ²		Hard Red Spring		Soft White		Soft Red Winter		Northern Durum ³		Desert Durum ³	
	2019	5-Year Avg	2019	5-Year Avg	2019	5-Year Avg	2019	5-Year Avg	2019	5-Year Avg	2019	5-Year Avg
Test Weight (lbs/bu)	60.6	60.3	60.7	61.7	61.6	60.7	58.1	58.1	61.1	60.5	63.0	62.7
(kg/hl)	79.6	79.4	79.8	81.2	81.0	79.8	76.5	76.5	79.6	78.8	82.0	81.8
Grade	1 HRW	1 HRW	1 NS	1 NS	1 SW	1 SW	2 SRW	2 SRW	2 AD	1HAD	1 HAD	1 HAD
Dockage (%)	0.5	0.6	0.6	0.5	0.4	0.5	0.4	0.5	1.3	0.7	0.3	0.4
Wheat Moisture (%)	11.5	11.3	12.7	12.1	9.9	9.1	13.7	12.9	12.2	11.5	6.6	6.8
Wheat Protein (%) ⁴	11.4	12.2	14.4	14.2	10.0	10.1	9.5	9.7	13.9	13.9	13.8	13.6
Wheat Ash (%) ⁴	1.50	1.51	1.55	1.51	1.35	1.35	1.37	1.46	1.51	1.57	1.70	1.71
1000 Kernel Weight (g)	32.7	30.7	31.0	31.2	36.4	34.2	31.8	31.9	44.2	39.2	47.8	49.1
Wheat Falling Number (sec)	376	384	339	374	317	335	288	309	345	384	699	582
Flour/Semolina Extraction (%) ³	74.5	75.5	68.4	67.9	72.1	73.9	67.5	69.5	57.5	67.1	71.7	65.6
Flour/Semolina Ash (%) ³	0.48	0.55	0.54	0.51	0.45	0.45	0.44	0.45	0.60	0.70	0.90	n/a
Wet Gluten (%)	24.3	27.9	34.0	34.2	24.5	24.5	20.5	22.2	33.1	34.3	34.7	33.3
Farinograph:												
Peak Time (min)	3.3	4.9	8.0	7.4	1.7	2.7	1.1	1.3	n/a	n/a	n/a	n/a
Stability (min)	7.3	8.2	10.1	10.8	2.6	2.8	1.7	2.3	n/a	n/a	n/a	n/a
Absorption (%)	57.8	59.6	62.8	62.9	52.2	53.4	52.5	52.6	n/a	n/a	n/a	n/a
Alveograph W (10 ⁻⁴ J)	223	234	342	375	85	96	80	81	255	211	212	239
Loaf Volume (cm ³)	863	851	1026	969	n/a	n/a	711	720	n/a	n/a	n/a	n/a
Production (MMT)	22.7	22.6	15.2	13.6	6.6	6.3	6.5	11.0	1.4	1.6	0.2	0.4

Page 10

Page 18

Page 32

Page 38

Page 44

Page 44

¹HW data is not included.

²HRW data does not include California.

³Durum extraction and ash values are for semolina.

⁴Protein - 12% moisture basis; ash - 14% moisture basis.

U.S. SUPPLY AND DEMAND

ESTIMATED FOR 2019/20 (YEAR BEGINNING JUNE 1)

	HRW	HRS	White	SRW	Durum	TOTAL
Beginning stocks	14.0	7.2	2.4	4.3	1.5	29.4
Production	22.7	15.2	7.4	6.5	1.6	53.4
Imports	0.1	1.5	0.1	0.1	1.4	3.2
Total supply	36.8	23.9	9.9	10.9	4.5	86.0
Domestic use	13.1	8.5	2.5	5.2	2.4	31.8
Exports	10.3	6.9	5.2	2.7	0.7	25.9
Total demand	23.4	15.4	7.7	7.9	3.1	57.7
Ending stocks	13.4	8.4	2.3	3.0	1.3	28.4
Stocks 5-year average	13.2	6.4	2.3	4.8	1.0	27.7

Based on USDA Supply/Demand estimates as of October 10, 2019.



ANALYSIS METHODS

WHEAT GRADE FACTORS

The U.S. grade of a sample is a numeric value from 1 to 5 or the designation "Sample Grade" which reflects the physical condition of a sample and thus may indicate its general suitability for milling. All numeric factors other than test weight are reported as a percentage by weight of the sample. (See table on page 3.) Grade determining factors include:

TEST WEIGHT is a measure of density in pounds per bushel (lb/bu) or kilograms per hectoliter (kg/hl). Test weight may be an indicator of potential milling yield and the general condition of the sample. Problems during growing season or at harvest often reduce test weight.

DAMAGED KERNELS show signs of disease, insect activity, frost or sprouting and may adversely affect milling or flour quality.

FOREIGN MATERIAL is any material other than wheat that remains after dockage is removed. Because foreign material is not easily removed, it may have an adverse effect on milling and flour quality.

SHRUNKEN AND BROKEN kernels have a shrunken or shriveled appearance or were broken in handling and may reduce milling yield.

TOTAL DEFECTS is the sum of damaged kernels, foreign material and shrunken and broken kernels.

VITREOUS KERNELS in hard red spring wheat are uniformly dark and have no spots that appear chalky or soft. In durum, vitreous kernels have a glassy and translucent appearance without any spots that appear chalky.

WHEAT NON-GRADE FACTORS

DOCKAGE is the percentage by weight of material removed from a sample by the Carter Dockage Tester. Being easy to remove, dockage should not affect milling quality but may have other economic effects for buyers. Grade factors are determined after dockage is removed.

MOISTURE content is the percentage of water by weight of a sample and is an important indicator of profitability in milling. Flour millers add water to adjust wheat moisture to a standard level before milling. Lower wheat moisture allows more water to be added, increasing the weight of grain to be milled at virtually no cost. Moisture content is also an indicator of grain storability as wheat and flour with low moisture are more stable during storage. Because moisture can be readily added to or removed from a sample, other analysis results are often mathematically converted to a standard moisture basis (mb), such as 14%, 12% or dry matter, so results can be compared.

PROTEIN content is the percentage of protein by weight in a sample. Because

there is no rapid method for determining wheat protein quality, protein quantity is used as an indicator in trade and by millers of the suitability of wheat or flour for various products and is an important factor in determining the value of wheat. High protein is usually desired for products such as pan breads, pasta, buns and frozen yeast-raised products.

Low protein is usually desired for products such as snacks or cakes.

ASH content is the percentage of minerals by weight in wheat or flour. In wheat, ash is primarily concentrated in the bran and is an indication of the flour yield that can be expected during milling. In flour, ash content indicates milling performance by



PHOTO TAKEN AT THE FEDERAL GRAIN INSPECTION SERVICE

indirectly revealing the amount of bran contamination in flour. Ash in flour can impart a darker color to finished products. Products requiring white flour call for low ash content, while whole wheat flour has higher ash content.

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

1000 KERNEL WEIGHT is the weight in grams of 1,000 kernels of wheat and may indicate grain size and expected milling yield.

SINGLE KERNEL CHARACTERIZATION

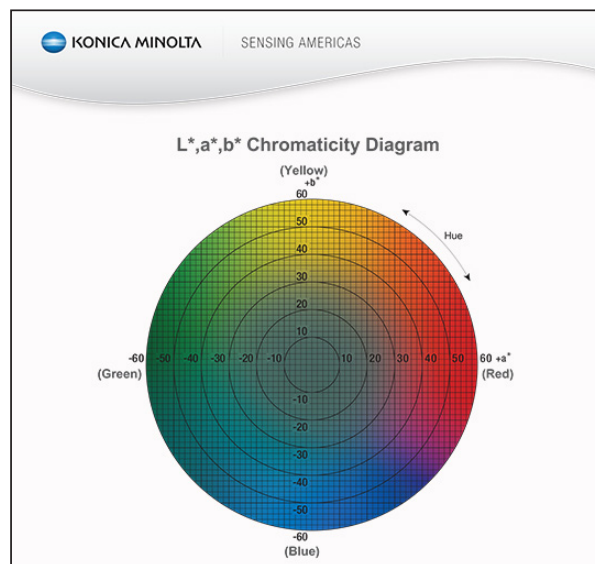
SYSTEM (SKCS) measures 300 individual kernels from a sample for size (diameter), weight, hardness (based on the force needed to crush) and moisture. Detailed SKCS results (not reported in this booklet) include the distribution of these factors, which may be an indicator of the uniformity of the sample and help millers experienced with the system to optimize flour milling yields. Kernel characteristics may help millers optimize tempering or adjust roll gap settings.

SEDIMENTATION value is a measure of the volume of sediment that results when

lactic acid is added to a sifted, ground wheat sample. High sedimentation volume indicates strong gluten while low sedimentation volume indicates weaker gluten.

FALLING NUMBER is the time required for a plunger to fall through a heated mixture of flour and water and is a measure of enzyme activity. Sprouted wheat forms alpha-amylase which breaks down starch into sugars. High falling number values indicate low alpha-amylase activity. Some alpha-amylase is required for certain products such as yeast-raised bread. However, excessive alpha-amylase in wheat cannot be removed and is difficult to reduce by blending. Flour with excessive amylase activity produces a sticky dough that can cause processing problems and products with poor color and weak texture. Falling number usually correlates closely with amylograph results.

DON (DEOXYNIVALENOL), produced by *Fusarium* fungi, is the most common mycotoxin in wheat.



COLOR measures a sample's lightness (L^*) on a scale of 0 to 100 and "chromaticity" or hue on two scales from -60 to +60 for green to red (a^*) and blue to yellow (b^*). High L^* values indicate a bright color, and higher b^* values indicate more yellow. Flour color is influenced by endosperm color, particle size and ash content and often affects the color of the finished product. Durum semolina color is heavily influenced by particle size.

FLOUR DATA

EXTRACTION is the percentage by weight of flour obtained from a wheat sample. The extraction rate is critically important to a commercial mill's profitability. In a laboratory, milling with the Buhler laboratory mill is done mainly to obtain flour for other tests. The Buhler laboratory mill extraction rate is always significantly lower than the rate that can be obtained on a commercial mill.

WET GLUTEN is a measure of the quantity of gluten in wheat or flour samples as determined using the Glutomatic System. Gluten forms when water is added to the protein in wheat and is responsible for the elasticity and extensibility characteristics of flour dough.

GLUTEN INDEX is also determined by the Glutomatic System and is a measure of gluten strength regardless of the quantity of gluten present. Gluten index is used commercially to select durum samples

with strong gluten characteristics. In bread (hard) wheat, a variety of factors other than gluten quality can affect the results, though very low gluten index may be an indication of protein damage from insect or disease activity.

AMYLOGRAPH measures flour starch pasting properties that are important to products such as sheeted Asian noodles. Amylograph also measures enzyme (alpha-amylase) activity which usually is from sprout damage. Amylograph results usually correlate closely with falling number results.

STARCH DAMAGE, the percentage by weight of damaged starch in a flour sample, is a measure of the physical damage done to starch granules during milling. Bread wheat flour typically has higher starch damage than soft wheat flour. Highly damaged starch readily absorbs more water, which affects dough mixing and other processing properties.

Because starch damage depends on how the sample was milled, starch damage is important for interpreting other results reported.

SOLVENT RETENTION CAPACITY (SRC) is the weight, expressed as percentages, of four solvents held by flour after centrifugation to the original flour weight on a 14% mb. The solvents, distilled water, sucrose (measuring pentosans), lactic acid (measuring glutenins) and sodium carbonate (measuring starch damage), indicate the ability of flour to absorb water during mixing and release water during baking. Specific ranges of lower SRC values are desirable for specific soft wheat products while higher SRC values are desirable for bread products. Gluten performance index (GPI), a calculation of three SRC values – lactic acid/(sodium carbonate + sucrose) – is a good predictor of overall performance of flour glutenins, especially for bread wheat flour.

ANALYSIS METHODS

DOUGH PROPERTIES



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FARINOGRAPH generates a curve that indicates the power used over time as flour and water are mixed into dough. The results describe the mixing properties of the dough and include:

- **PEAK 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.
- **STABILITY** is the interval between the point where the top of the curve first intersects the 500-BU line (called the "arrival time") and the point where the top of the curve departs the 500-BU line ("departure time"). Long stability times also indicate strong gluten and dough properties, useful in products such as yeast-raised breads, while short stability times indicate weaker gluten useful in many confectionary products.
- **ABSORPTION** is the amount of water (as a percent by weight on a 14% mb) required to center the curve peak on the 500-BU line. High water absorption provides economic advantages for producing more dough pieces than flour with lower water absorption.



PHOTO COURTESY OF WHEAT MARKETING CENTER

ALVEOGRAPH generates a curve indicating the air pressure necessary to inflate a piece of dough like a bubble to the point of rupture and indicates the gluten strength and extensibility of dough. Values reported include:

- **P** ("overpressure" or resistance), measured in millimeters to the maximum height of the curve, reflects the maximum pressure while blowing the bubble of dough and indicates dough resistance to extension.
- **L** (length), the length of the curve measured in millimeters, reflects the size of the bubble and indicates dough extensibility.
- **W** (the area under the curve) reflects the amount of energy needed to inflate the dough to the point of rupture and indicates dough strength.

The alveograph is well suited for measuring the dough characteristics of weaker gluten wheat and, with adapted hydration and mix time, of stronger wheats including durum. Requirements differ depending on intended flour use. Low P values (indicating weak gluten) and long L values (high extensibility) are preferred for cakes and confectionery products; P/L close to 1 and high W values (strong gluten) are preferred for pan breads; and P/L values close to 0.75 are favored for durum for pasta semolina.

MIXOGRAPH generates a graph that records the force needed to mix flour or semolina and water into dough. The mixograph is similar to the farinograph but is quicker and uses a pin mixer and a smaller flour sample. Peak height and peak time are common mixing parameters that are determined by the mixograph.

- **CLASSIFICATION** indicates dough characteristics for durum milled fractions on a scale of 1 to 8 with higher values indicating stronger dough properties.
- **PEAK TIME** is the interval from the first addition of water to when the curve peaks and is considered an indicator of both the rate of dough development and hydration rate. Short peak time indicates a quick hydration rate and long peak time a slow hydration rate.
- **PEAK HEIGHT** is the height of the curve at peak time measured from the bottom of the mixogram paper to the middle of the band width at the curve peak. Peak height is primarily a function of protein content but is affected by water absorption and dough strength. Peak height increases with protein content and dough strength, decreases with water absorption and is measured in "mixogram units (MU)". An MU is one rectangle on the mixogram.

EXTENSOGGRAPH generates a force-time curve for a piece of dough that is stretched until it breaks. Results include:

- **RESISTANCE**, measured at the maximum curve height in Brabender Units (BU), reflects the maximum force applied and indicates the resistance of the dough to extension.
- **EXTENSIBILITY**, measured as the total length of the curve at the base line in centimeters, reflects how far the dough was stretched.
- **AREA** is the area under the curve reported in square centimeters.

These factors help describe the gluten strength and dough extensibility characteristics of flour for a wide range of end products. The extensograph can also evaluate the effects of fermentation time and additives on dough performance.

EVALUATION OF END-PRODUCTS

BAKING ABSORPTION is the water required for optimum dough mixing performance, expressed as a percent of flour weight on a 14% mb.

CRUMB GRAIN AND TEXTURE is determined on a scale of 1 to 10 by visual comparison to a standard using a constant illumination source. Higher scores are preferred.

LOAF VOLUME is the volume of a test loaf after baking. Higher loaf volumes

indicate better baking performance for pan breads.

SPECKS are visually counted in a semolina sample and reported as the number in 10 square inches. These small particles of bran or other material that escaped the wheat cleaning and semolina purifying process reflect the milling process and the characteristics of the durum and can detract from pasta appearance and desirability.

SUGAR SNAP COOKIE, SPONGE CAKE, CHINESE SOUTHERN-TYPE STEAMED BREAD, SPAGHETTI AND HARD WHITE NOODLE AND STEAMED BREAD tests all use standardized methods to evaluate the suitability of the sample for that product or similar products.

THE HARVEST AND CARGO SAMPLES FOR EACH CLASS ARE EVALUATED USING THE FOLLOWING METHODS. FLOUR OR SEMOLINA PRODUCED AS DESCRIBED IN “LABORATORY MILLING EXTRACTION” IS ANALYZED TO PROVIDE FLOUR, SEMOLINA AND END-USE PRODUCT DATA.

WHEAT AND GRADE DATA

GRADE: Official U.S. Standards for Grain.

DOCKAGE: Official USDA procedure using the Carter Dockage Tester.

MOISTURE: HRW, HRS, SW, HW – Official USDA Conductance method; Durum – AACCI 44-11.01 (Motomco Moisture Meter) and AACCI 44-15.02 (air oven method); SRW – AACCI 44-15.02.

TEST WEIGHT: AACCI 55-10.01; test weight is converted to hectoliter weight: for durum – $\text{kg/hl} = \text{lb/bu} \times 1.292 + 0.630$, for other classes – $\text{kg/hl} = \text{lb/bu} \times 1.292 + 1.419$.

PROTEIN: HRW, HRS, SW, HW – AACCI 39-25.01 (NIR method); all other classes – AACCI 46-30.01 (Dumas combustion nitrogen analysis or CNA method).

SINGLE KERNEL CHARACTERIZATION: AACCI 54-31.01 using Perten SKCS 4100.

SEDIMENTATION: HRS, HRW (Midwestern), SRW, SW, HW – AACCI 56-61.02; Durum – AACCI 56-70.01; HRW California (CA) – AACCI 56-63.01.

1000 KERNEL WEIGHT: HRS, Durum, SRW – based on a 10 gram (g) clean wheat sample counted by an electronic counter; SW, HW – based on the average weight of three 100-kernel samples expressed on a 14% moisture basis (mb); HRW – average of SKCS kernel weight times 1,000.

ASH: AACCI 08-01.01 expressed on a 14% mb.

FALLING NUMBER: AACCI 56-81.03; average value is a simple mean of sample results.

DON: All analysis is on ground wheat. HRS, Durum – gas chromatograph with electron capture detector as described in the Journal of AOAC International 79,472

(1996). SRW, HRW (CA) – Neogen ELISA; HRW (Midwestern) – Charm ROSA DonQ2 Quantitative Test.

VITREOUS KERNELS: HRS and Durum – percentage by vitreous kernels weight handpicked from a 15 g clean wheat sample.

KERNEL SIZE DISTRIBUTION: HRS, Durum (Northern) – Cereal Foods World (Cereal Science Today) 5:(3), 71 (1960). HRW (Midwestern), SW, HW, SRW – Wheat is sifted with a RoTap sifter using Tyler No. 7 (2.82 mm) and No. 9 (2.00 mm) screens. HRW (CA), Durum (Pacific Southwest) – uses U.S. Standard Sieves No. 7 (2.80 mm) and No. 10 (2.00 mm). Kernels remaining on the No. 7 screen are “Large,” passing through the No. 7 screen but not the No. 9 or No. 10 (HRW (CA), Pacific Southwest Durum) are “Medium,” and passing through the No. 9 or No. 10 screen are “Small.”

ANALYSIS METHODS

FLOUR DATA

LABORATORY MILLING EXTRACTION:

Samples are cleaned and tempered according to AACCI 26-10.02. All samples other than HRW (CA) are milled with standardized mill settings on a Buhler laboratory mill using these methods: SW – AACCI 26-31.01; HRW (Midwestern), SRW, HRS and HW – AACCI 26-21.02. SRW – uses a 183 micron sieve. HRW (CA) is milled on a Brabender® Quadrumat Senior Mill using the Brabender® procedure. All extraction rates are calculated against total products on an “as is” mb.

ASH: AACCI 08-01.01, reported on 14% mb.

COLOR: HRW (Midwestern) – Minolta method using Minolta Chroma Meter CR-110 with Granular-Materials Attachment; HRW (CA) – CR-210; HRS, SW, SRW, HW – CR-410 with Granular-Materials Attachment CR-A50. CIE 1976 L*a*b* color system: L* indicates white-black, a* – red-green and b* – yellow-blue.

PROTEIN: HRW, HRS – AACCI 39-10.01 (NIR method); all other classes – AACCI 46-30.01 (Dumas CNA method).

WET GLUTEN AND GLUTEN INDEX: HRW, HRS, SRW, HW – AACCI 38-12.02; SW – AACCI 38-12.02 (water reduced from 4.8 to 4.2 ml).

FALLING NUMBER: AACCI 56-81.04; average value is a simple mean of sample results.

FARINOGRAPH: AACCI 54-21.02 (Constant Flour Method) with 50 g bowl. Absorption is reported on 14% mb.

ALVEOGRAPH: AACCI 54-30.02. SW, HW, HRS, Durum – Alveolab.

AMYLOGRAPH: AACCI 22-10.01 modified to use 65 g flour (14% mb) and 450 ml distilled water with paddle (HRS) or pins (other classes).

EXTENSOGRAPH: AACCI 54-10.01, modified 45 and 135 min rest for HRS, HRW and HW; 45 min rest for SW and SRW.

STARCH DAMAGE: SRW – AACCI 76-30.02; all other classes – AACCI 76-33.01 (SDmatic method).



PHOTO TAKEN AT THE FEDERAL GRAIN INSPECTION SERVICE

SOLVENT RETENTION CAPACITY (SRC): SW, HW – SRC machine (Chopin); all other classes – AACCI 56-11.02.

SEMOLINA DATA

LABORATORY MILLING EXTRACTION:

Samples are milled using a Brabender® Quadrumatic Junior Semolina Mill. Grain is tempered to 15.5% moisture one day before milling. Semolina extraction rates are calculated against total products on an “as is” mb. Pacific Southwest samples are milled on a Modified Chopin CD2 Mill. Extraction rates are calculated against total products on an “as is” mb.

ASH: AACCI 08-01.01 on 14% mb.

COLOR: Minolta Method using Minolta Chroma Meter CR-410 (Northern) or CR-210 (Pacific Southwest) with Granular-Materials Attachment. CIE 1976 L*, a*, b* color space.

PROTEIN: AACCI 46-30.01 (Dumas CNA method).

WET GLUTEN AND GLUTEN INDEX: AACCI 38-12.02 (Glutomatic procedure).

SPECKS: Sample is pressed under a 3 x 4 inch glass plate and the specks within a one-inch square marked on the plate are counted. Average of three determinations is expressed as specks per 10 square inches.

MIXOGRAPH: Northern – 10 g of semolina are mixed in a 10 g bowl with 5.8 ml of distilled water to give maximum dough consistency. Pacific Southwest – 35 g of semolina are mixed in a 35 g bowl with optimum water absorption using the formula $y = 1.5 \cdot X + 43.6$; X = semolina protein (14% mb). The spring setting is 8 (Northern) and 10 (Pacific Southwest). A classification incorporating peak height and general curve characteristics is assigned based on comparison with eight reference mixograms; the higher the classification number, the stronger the curve type.



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END-USE PRODUCT DATA

MIDWESTERN HRW: AACCI 10-10.03 ("pup loaf" method). 100 g flour at 14% mb with optimized water absorption is mixed to optimum development with other ingredients (6% sugar, 3% shortening, 1.5% salt, 1.0% instant dry yeast, 50 ppm ascorbic acid and 0.25% malted barley flour) in a 100 g pin mixer with head speed of 100 to 125 rpm. The dough is fermented for 60 min with two punches, then molded, panned and proofed for 60 min before baking at 220° C (425° F) for 18 min. Loaf volume is measured immediately after baking by rapeseed displacement. Crumb grain and texture are evaluated on a 0 to 6 scale, which for this booklet is converted to a 1 to 10 scale.

CA HRW: AACCI 10-10.03 producing two loaves per batch using 6% sugar, 3% shortening, 1.5% salt, 1.5% active dry yeast, 50 ppm ascorbic acid, 0.10% malted barley flour in a 200 g Swanson pin mixer with head speed of 100 to 120 rpm and 120 min fermentation. Loaf volume is measured 1 hour after baking. Grain and texture are scored on a scale of 1 to 10 with higher numbers indicating preferred quality.

SRW: AACCI 10-10.03 producing two loaves per batch using dry yeast and ascorbic acid. After mixing, the dough is divided into two equal portions, fermented for 160 min, molded and panned in pup loaf pans before proofing and baking. Loaf volume is measured immediately after baking by rapeseed displacement. SRW cookie spread ratio – AACCI 10-50.05.

HRS: AACCI 10-09.01 (long fermentation method) modified: 15 SKB units fungal amylase/100 g flour; 1% instant dry yeast; 10 ppm ammonium phosphate; 2% added shortening. Dough is mechanically punched, molded and baked in "Shogren-type" pans. Scoring is based on a 1 to 10 scale with higher numbers indicating preferred quality attributes.

SW: Cookie diameter – AACCI 10-52.02. Sponge cake volume* and score – Japanese standard method described by Nagao in *Cereal Chemistry* 53:977-988, 1976. Sponge

cake control flour is "western white." SW High Protein – AACCI 10-10.03 with 180 min fermentation for bread.*

DURUM: Pasta is made using the laboratory procedure described by Walsh, Ebeling and Dick, *Cereal Foods World*: 16: (11) 385 (1971). Water (Pacific Southwest – adjusted to optimum hydration based on P-value from alveograph test; Northern – 32%) is added to semolina and mixed in a Hobart mixing bowl for 5 min. Semolina-water mixture is extruded using a DeMaco laboratory pasta extruder. Spaghetti is dried using modified Buhler low-temperature drying cycle as described by P. Yue, P. Rayas-Duarte, and E. Elias, *Cereal Chemistry* 76(4):541–547. Color scores are determined by the procedure described by Walsh, *Macaroni Journal* 52: (4) 20 (1970), using a Minolta Color Difference Meter (Northern CR-410, Pacific Southwest CR-210). Higher values (scale 1 to 12) are preferred. Cooked weight, cooking loss and firmness are determined by AACCI 16-50.01.

HW BAKING: AACCI 10-10.03 with 180 min fermentation.*

HW NOODLE: Two noodle types are prepared from each HW flour: Chinese raw noodles and Chinese wet noodles. Raw noodle formula: flour 100%, salt 1.2% and distilled water 28%; wet noodle formula: flour 100%, salt 2%, K₂CO₃ 0.45%, Na₂CO₃ 0.45% and distilled water 32%. Noodle sheet color is measured twice on each side of a dough sheet that is resting atop a two other dough sheets to ensure color consistency. This is done for two dough sheets (eight readings total) using a Minolta CR-410 Chroma Meter; the mean value is reported.

For wet noodles, noodle sheet color is measured on both uncooked and parboiled (for 1.5 min) sheets. Cooking yield is percent of weight gain after cooking for 5 min for raw noodles and 1.5 min for wet noodles, rinsing in 26° to 27° C (79° to 81° F) water and draining. Sensory noodle color stability score

is a total score of noodle color rated at 2 and 24 hours against a control sample (an assigned score of 7) and is reported based on a 1 to 10 scale; higher scores indicate better color stability. Noodle texture is determined on five strands of cooked noodles with a strand cross-cut dimension of 2.5 x 1.2 mm for raw noodles, W x T; 1.7 x 1.6 mm for wet noodles, W x T using a Stable Micro Systems TA.XT2 Texture Analyzer. Firmness indicates noodle bite; springiness indicates the degree of recovery after first bite; cohesiveness is a measure of noodle structure disruption during first bite; and chewiness is a product of firmness, cohesiveness and springiness (firmness x cohesiveness x springiness) and thus is a single parameter that incorporates the three textural parameters. Higher textural parameter values are generally more desirable for Chinese-style noodles.

CHINESE STEAMED BREAD: Two types of steamed breads are prepared: Chinese southern-type steamed breads from each of the SW and white club (WC) flours; and Asian-type steamed breads from each of the HW flours. Chinese southern-type formula: flour 100%, sugar 15%, shortening 4%, baking powder 1.2%, instant yeast 0.8%, nonfat dry milk powder 3% and water 39 to 43%; Asian-type formula: flour 100%, instant yeast 1.5%, sugar 12%, shortening 2% and water 42.5 to 45.0%. Yeast is dissolved in water before use. All steamed breads are prepared using no-time dough methods (Wheat Marketing Center protocols). The total product score comprises volume*, external characteristics, internal characteristics, eating quality and flavor. Each property is rated compared with a control sample. The control flour is scored 70.

**Finished Product Volume for SW bread, sponge cake and steamed bread and HW bread and steamed bread: Laser light using a Tex Vol Instrument (BVM-L370).*



HARD RED WINTER

Versatile, with excellent milling and baking characteristics for wheat foods like hearth breads, hard rolls, croissants and flat breads. HRW is also an ideal wheat choice for some types of Asian noodles, general purpose flour and as an improver for blending.



GULF AND PNW

494

Samples collected from grain elevators in 40 reporting areas when at least 30% of the local harvest was complete.

Official grade and non-grade factors were determined on each sample. Functionality tests were conducted on 90 composite samples categorized by growing region and protein ranges of <11.5%, 11.5 to 12.5% and >12.5%. Production weighted results are presented as Composite, Gulf-Tributary and PNW-Tributary averages. Gulf-Tributary states, PNW-Tributary states and California are highlighted on the map below. The methods are described in the Analysis Methods section of this booklet.



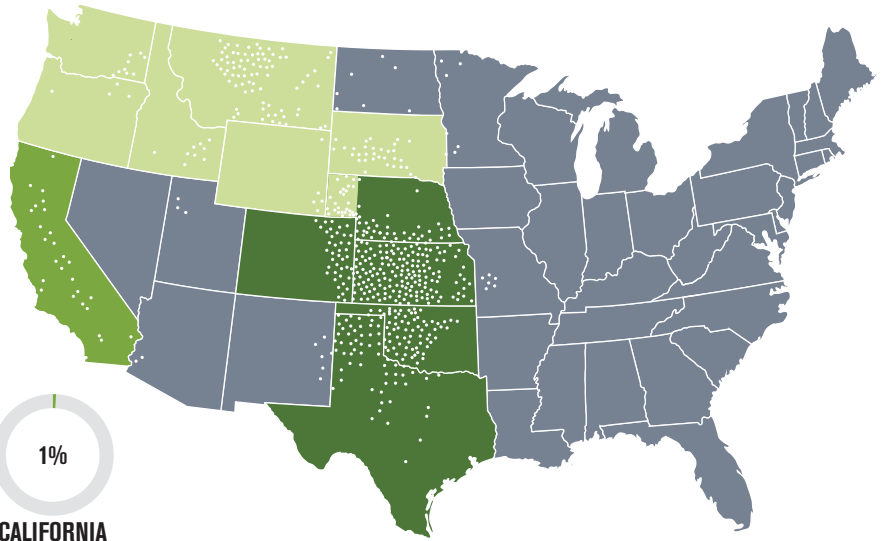
USDA/ARS Hard Winter Wheat Quality Lab, Manhattan, KS, and Plains Grains, Inc., collected samples and conducted quality analyses.

12

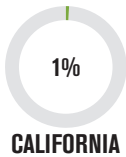
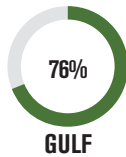
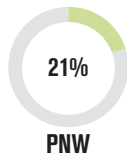
STATES SURVEYED

98%

OF TOTAL HRW PRODUCTION REPRESENTED



PERCENTAGE OF TOTAL U.S. HRW PRODUCTION BY EXPORT TRIBUTARY



CALIFORNIA

162

Samples collected from grain elevators during local harvest.

Official grade and non-grade factors and functionality tests were determined on each sample. Results are weighted averages. The methods are described in the Analysis Methods section of this booklet.



California Wheat Commission Laboratory and Federal Grain Inspection Service (FGIS) conducted tests and analyses.

GULF AND PNW HARVEST SURVEY

OVERVIEW: The 2019 hard red winter (HRW) wheat crop received abundant moisture during the planting and growing season throughout the Great Plains, while swings in temperature and severe weather occurred in the Pacific Northwest (PNW) and Montana. Unexpectedly high yields resulted in lower wheat and flour protein, but the crop exhibits good milling and end-product characteristics. Even though mixing times and tolerances are shorter than the 5-year averages, the loaf volumes achieved indicate there is adequate protein quality to make quality bread. This crop meets or exceeds typical HRW contract specifications and should provide value to the customer. The 2019 HRW crop can be characterized as clean and sound with good milling properties and end-product qualities but with below average protein.

WEATHER AND HARVEST: The 2019 HRW planted area is near historic 100-year lows, continuing the trend of recent years. Despite stagnant planted area, HRW production is estimated at 22.9 MMT (840 mil bu), a 27% increase over 2018. USDA estimates the HRW supply (excluding imports) is the third highest in the last 20 years.

Various climatic conditions challenged this crop. However, moisture remained adequate, or even excessive, in the

central and southern production areas and resulted in better than expected yields, lower than average protein, but otherwise good milling and processing characteristics. The U.S. Southern, Central and Northern Plains experienced an unusually wet spring, slowing crop maturity and uniformly delaying the beginning of harvest two weeks or more. At the same time, the PNW and Montana experienced abnormal swings in temperature and severe storms. Despite intense and prolonged moisture during later stages of crop development, disease and insect pressure in most production areas was unusually low. Once harvest began, it progressed normally in most production areas.

WHEAT AND GRADE DATA: Despite challenging growing conditions in many areas, the 2019 crop has generally good kernel characteristics. Overall 93% of Composite, 91% of Gulf-Tributary and 97% of PNW-Tributary samples graded U.S. No. 2 or better. Average test weight of 60.6 lb/bu (79.6 kg/hl) is below 2018 but above the 5-year average. Average dockage (0.5%), total defects (1.3%), foreign material (0.2%) and shrunken and broken (0.8%) are all equal to or better than 2018 and the 5-year averages. Average thousand kernel weight of 32.7 g exceeds last year

and the 5-year average (both 30.7 g). Kernel characteristics, including test weight, thousand kernel weight and kernel diameter are good and consistent with favorable growing conditions. However, growing conditions favoring kernel size and test weight are not conducive to accumulating protein, which is below last year and the 5-year averages. The average wheat falling number is 378 sec, indicative of sound wheat.

FLOUR AND BAKING DATA: The Buhler laboratory mill flour yield average is 74.0%, comparable to the 2018 average of 75.1% and the 5-year average of 75.5%. The 2019 flour ash of 0.48% (14% mb) is comparable to last year's 0.44% but lower than the 5-year average of 0.55% due to milling adjustments made in 2018. The alveograph W value of 223 10^{-4} J is significantly lower than last year but comparable to the 5-year average of 234 10^{-4} J. Farinograph peak and stability times, 3.3 and 7.3 min, respectively, are lower than last year's 5.2 and 12.2 min. Average bake absorption is 62.7%, below the 63.7% value for 2018 but comparable to the 5-year average. Overall loaf volume averaged 863 cc, well below last year's 901 cc, but comparable to the 5-year average of 851 cc.

CALIFORNIA HARVEST SURVEY

OVERVIEW: California's wheat growing regions are defined by climate, value of alternative crops and distinct differences in variety selection. Most California hard wheat is planted from October to January and harvested in June and July. With the strong demand for new crop wheat in the domestic marketplace, importers are encouraged to express their interest in purchasing California wheat in early spring.

WEATHER AND HARVEST: California had a very wet winter in 2018/19 with rainfall

totals well above average. This included an unusually heavy rainfall event in mid-May as most crops were maturing. Disease incidence was above average, with stripe rust observed throughout the state and Septoria noted in the Sacramento Valley. Relatively cool temperatures during the grain filling period contributed to slightly higher than average yields.

SUMMARY: California hard wheat varieties are known for their low moisture and large and uniform kernel

size. Because wheat is predominantly grown under irrigation, growers achieve high yields and consistent quality. Overall, the majority of the 2019 crop has medium protein. Consistent with other years, the 2019 crop has low moisture, high flour extraction and strong baking performance – all of which make California wheat suitable for blending.

HARD RED WINTER



HARVEST DATA

COMPOSITE AVERAGE

	COMPOSITE AVERAGE					
	2019 BY PROTEIN ¹			2018	5-YEAR	
	Low	Med	High	Overall	OVERALL	AVERAGE
WHEAT GRADE DATA:						
Test Weight (lb/bu)	60.9	60.2	60.0	60.6	60.9	60.3
(kg/hl)	80.1	79.2	78.5	79.6	80.2	79.4
Damaged Kernels (%)	0.3	0.4	0.5	0.3	0.1	0.3
Foreign Material (%)	0.1	0.2	0.2	0.2	0.2	0.2
Shrunken and Broken (%)	0.8	0.8	0.8	0.8	1.1	1.0
Total Defects (%)	1.2	1.5	1.5	1.3	1.4	1.4
Grade	1 HRW	1 HRW	1 HRW	1 HRW	1 HRW	1 HRW
WHEAT NON-GRADE DATA:						
Dockage (%)	0.5	0.5	0.6	0.5	0.5	0.6
Moisture (%)	11.4	11.6	11.5	11.5	10.9	11.3
Protein (%) 12%/0% moisture basis	10.8/12.3	11.9/13.5	12.8/14.6	11.4/12.9	12.4/14.1	12.2/13.9
Ash (%) 14%/0% moisture basis	1.49/1.73	1.51/1.76	1.56/1.82	1.50/1.75	1.49/1.74	1.51/1.76
1000 Kernel Weight (g)	33.2	32.4	32.0	32.7	30.7	30.7
Kernel Size (%) lg/md/sm	72/27/1	70/29/1	69/30/1	71/28/1	61/38/2	64/35/1
Single Kernel: Hardness	57.0	60.4	59.6	58.1	65.8	62.0
Weight (mg)	33.2	32.4	32.0	32.7	30.7	30.7
Diameter (mm)	2.67	2.65	2.63	2.66	2.60	2.61
Sedimentation (cc)	43.6	47.0	54.3	45.9	54.2	49.6
Falling Number (sec)	376	374	374	376	374	384
DON (ppm)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
FLOUR DATA:						
Lab Mill Extraction (%)	74.4	74.8	73.8	74.5	75.1	75.5
Color: L*	91.4	91.1	91.0	91.3	91.6	90.1
a*	-1.7	-1.6	-1.6	-1.7	-1.7	-1.4
b*	10.1	10.1	9.7	10.0	10.2	10.1
Protein (%) 14%/0% moisture basis	9.5/11.1	10.5/12.2	11.6/13.4	10.0/11.8	11.2/13.0	11.2/13.0
Ash (%) 14%/0% moisture basis	0.48/0.53	0.48/0.56	0.50/0.59	0.48/0.56	0.44/0.52	0.55/0.65
Wet Gluten (%)	22.1	26.9	29.6	24.3	28.1	27.9
Gluten Index	99	97	96	98	98	94
Falling Number (sec)	389	399	385	393	413	384
Amylograph Viscosity: 65g (BU)	583	570	552	580	664	507
Starch Damage (%)	6.6	6.6	6.7	6.6	6.3	6.5
SRC: GPI	0.73	0.72	0.77	0.73	0.75	
Water / 50% Sucrose	61/102	66/109	65/115	63/106	64/108	
5% Lactic Acid / 5% Na ₂ CO ₃	132/80	141/88	154/86	138/83	145/85	
DOUGH PROPERTIES:						
Farinograph: Peak Time (min)	2.4	4.3	5.0	3.3	5.2	4.9
Stability (min)	6.6	7.8	9.1	7.3	12.2	8.2
Absorption (%)	57.2	58.5	59.6	57.8	58.4	59.6
Alveograph: P (mm)	79	78	83	78	83	83
L (mm)	72	88	107	81	92	87
P/L Ratio	1.10	0.89	0.78	0.97	0.90	0.95
W (10 ⁻⁴ J)	210	231	286	223	280	234
Extensograph: Resistance (BU)	488/808	453/781	496/806	476/798	570/771	439/685
(45/135 min) Extensibility (cm)	13.8/11.2	14.4/12.8	15.3/13.6	14.2/12.0	14.3/11.8	14.3/13.3
Area (cm ²)	88/109	85/123	100/133	88/116	107/145	83/113
BAKING EVALUATION:						
Pan Bread: Bake Absorption (%)	62.2	62.9	64.8	62.7	63.7	63.0
Crumb Grain and Texture (1-10)	5.8	6.2	6.6	6.1	6.6	6.3
Loaf Volume (cc)	829	895	938	863	901	851
PRODUCTION OF 11 STATES (%):						

¹Protein Range: Low, <11.5%; Med, 11.5 - 12.5%; High, >12.5%.

GULF EXPORTABLE AVERAGE

PNW EXPORTABLE AVERAGE

2019 BY PROTEIN ¹						2019 BY PROTEIN ¹					
Low	Med	High	Overall	2018 OVERALL	5-YEAR AVERAGE	Low	Med	High	Overall	2018 OVERALL	5-YEAR AVERAGE
60.6	59.8	59.7	60.3	60.4	60.0	62.1	61.8	61.1	61.7	62.4	61.4
79.7	78.6	78.5	79.3	79.5	79.0	81.6	81.3	78.3	80.4	82.0	80.6
0.3	0.5	0.6	0.4	0.1	0.3	0.1	0.2	0.2	0.2	0.1	0.2
0.1	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1
0.9	0.9	0.9	0.9	1.3	1.1	0.6	0.6	0.7	0.6	0.6	0.8
1.3	1.6	1.7	1.4	1.6	1.5	0.8	0.9	1.0	0.9	0.8	1.1
1 HRW	2 HRW	2 HRW	1 HRW	1 HRW	1 HRW	1 HRW	1 HRW	1 HRW	1 HRW	1 HRW	1 HRW
0.5	0.5	0.6	0.5	0.5	0.6	0.5	0.5	0.7	0.5	0.4	0.5
11.6	11.8	11.6	11.6	11.4	11.6	10.7	10.7	11.1	10.8	9.6	10.3
10.8/12.3	11.9/13.5	12.8/14.6	11.2/12.7	12.7/14.4	12.3/14.0	10.6/12.1	12.0/13.6	13.0/14.8	11.9/13.5	11.7/13.3	11.9/13.6
1.52/1.76	1.53/1.78	1.58/1.84	1.52/1.77	1.51/1.76	1.52/1.77	1.40/1.63	1.43/1.67	1.49/1.73	1.44/1.68	1.44/1.67	1.48/1.71
32.5	31.7	31.8	32.3	29.4	30.1	35.5	34.7	32.9	34.3	34.4	32.5
72/27/1	69/30/1	68/31/1	71/28/1	55/43/2	62/37/1	74/25/1	73/26/1	71/28/1	73/26/1	77/22/1	69/30/1
56.2	58.3	59.3	57.0	65.0	61.3	59.5	67.8	60.4	62.1	67.7	64.3
32.5	31.7	31.8	32.3	29.4	30.1	35.5	34.7	32.9	34.3	33.6	32.5
2.64	2.62	2.61	2.63	2.53	2.58	2.80	2.76	2.69	2.75	2.74	2.68
42.5	45.5	53.1	44.0	53.8	48.6	47.5	52.1	58.4	52.8	55.4	53.3
383	379	377	382	375	385	352	356	365	356	370	378
<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
74.4	74.8	73.6	74.5	75.0	75.7	74.4	74.8	74.3	74.5	75.3	74.9
91.3	91.0	90.9	91.2	91.5	90.0	91.6	91.4	91.3	91.4	91.8	90.4
-1.7	-1.6	-1.6	-1.7	-1.7	-1.4	-1.7	-1.7	-1.5	-1.6	-1.7	-1.4
10.1	10.1	9.8	10.1	10.3	10.1	9.8	10.1	9.4	9.8	10.1	9.9
9.5/11.0	10.4/12.1	11.5/13.3	9.8/11.5	11.4/13.3	11.3/13.2	9.7/11.3	10.9/12.6	11.9/13.8	10.9/12.7	10.6/12.3	10.9/12.8
0.48/0.56	0.49/0.57	0.51/0.60	0.49/0.57	0.45/0.53	0.57/0.66	0.46/0.54	0.46/0.54	0.46/0.54	0.46/0.54	0.43/0.50	0.51/0.60
21.8	27.1	29.4	23.7	28.6	28.5	23.4	26.1	30.3	26.7	26.7	26.6
99	96	97	98	98	93	98	98	94	97	98	96
396	395	387	396	412	384	364	413	376	386	416	378
581	560	531	572	705	509	592	605	628	609	548	500
6.6	6.5	6.8	6.6	6.1	6.5	7.0	6.8	6.5	6.8	6.9	6.7
0.73	0.70	0.75	0.72	0.76		0.69	0.77	0.80	0.75	0.73	
60/101	66/110	67/117	63/106	63/108		63/105	68/107	60/106	64/106	68/107	
133/80	137/86	156/89	137/83	145/83		128/82	154/94	147/77	143/84	144/91	
2.3	4.2	4.9	3.0	5.5	5.0	2.7	4.5	5.1	4.2	4.2	4.7
6.4	7.4	8.9	6.8	12.7	8.2	7.1	9.5	9.8	8.9	10.7	8.4
56.9	58.1	59.6	57.4	57.9	59.8	58.3	59.9	59.8	59.4	59.8	59.7
76	74	84	76	80	81	92	92	81	88	92	88
72	90	107	79	95	88	70	82	105	86	84	85
1.05	0.82	0.78	0.96	0.84	0.92	1.30	1.13	0.78	1.02	1.09	1.04
201	219	287	211	278	227	241	271	283	266	284	256
481/797	436/750	505/812	470/785	581/1014	431/677	512/849	513/892	464/783	497/843	540/924	473/722
13.9/11.3	14.5/13.1	15.2/13.5	14.1/11.9	14.3/11.8	14.3/13.5	13.6/11.0	14.1/11.9	15.5/14.1	14.4/12.4	14.2/11.8	14.1/12.9
88/108	83/122	101/133	87/113	109/149	80/111	90/112	94/128	95/135	93/125	103/133	93/121
62.0	62.6	64.8	62.3	63.9	62.9	62.9	64.1	65.0	64.0	63.2	63.2
6.0	6.4	6.7	6.2	6.8	6.3	5.3	5.4	6.3	5.7	6.0	6.3
834	900	933	858	924	859	814	878	955	884	835	832
52	23	3	78			7	8	7	22		

¹Protein Range: Low, <11.5%; Med, 11.5 - 12.5%; High, >12.5%.

HARD RED WINTER

CALIFORNIA HARVEST DATA

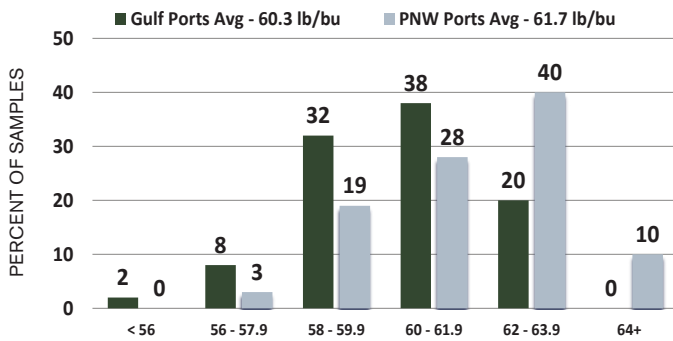
EXPORT CARGO DATA

	MEDIUM PROTEIN ¹		HIGH PROTEIN ¹		GULF		PNW	
	2019	2018	2019	2018	2019	2018	2019	2018
WHEAT GRADE DATA:								
Test Weight (lb/bu)	62.5	62.8	62.2	61.9	60.7	60.8	62.6	63.0
(kg/hl)	82.2	81.8	81.8	81.3	79.8	80.0	82.3	82.9
Damaged Kernels (%)	0.1	0.0	0.1	0.1	0.7	0.9	0.1	0.1
Foreign Material (%)	0.1	0.2	0.1	0.2	0.2	0.2	0.1	0.1
Shrunken and Broken (%)	0.7	0.6	0.8	1.1	1.2	1.5	1.1	1.0
Total Defects (%)	0.8	0.8	1.0	1.3	2.1	2.7	1.2	1.2
Grade	1 HRW	1 HRW	1 HRW	1 HRW	1 HRW	1 HRW	1 HRW	1 HRW
WHEAT NON-GRADE DATA:								
Dockage (%)	0.9	0.9	0.9	1.3	0.6	0.6	0.3	0.3
Moisture (%)	9.2	8.3	9.3	8.3	11.6	11.3	9.9	10.1
Protein (%) 12%/0% moisture basis	11.8/13.4	12.4/14.1	12.9/14.7	13.3/15.2	11.4/13.0	11.6/13.2	11.9/13.5	11.8/13.4
Ash (%) 14%/0% moisture basis	1.43/1.67	1.51/1.76	1.58/1.83	1.57/1.82	1.53/1.78	1.50/1.74	1.43/1.66	1.37/1.59
1000 Kernel Weight (g)	42.2	43.1	42.7	43.1	28.3	27.2	29.2	30.8
Kernel Size (%) lg/md/sm	84/15/1	87/13/0	91/9/0	82/18/0	71/28/1	64/34/2	71/28/1	71/28/1
Single Kernel: Hardness	60.9	70.0	60.5	72.1				
Weight (mg)	38.2	42.1	40.3	39.3				
Diameter (mm)	2.92	3.09	2.99	2.98				
Sedimentation (cc)	41.0	52.0	49.0	55.0	29.1	28.0	38.9	38.1
Falling Number (sec)	321	360	316	382	408	462	402	439
DON (ppm)		<0.5	<0.5	<0.5				
FLOUR DATA:								
Lab Mill Extraction (%)	71.3	67.1	70.2	67.4	71.0	71.4	70.4	71.4
Color: L*	92.3	92.5	92.5	93.0	90.1	89.5	90.5	89.7
a*	-0.7	-0.8	-0.6	-0.9	-2.1	-1.9	-2.1	-2.0
b*	7.9	7.3	7.4	7.7	9.0	9.3	8.8	9.4
Protein (%) 14%/0% moisture basis	10.7/12.4	11.6/13.5	11.9/13.9	11.9/13.8	10.0/11.7	10.3/12.0	10.6/12.3	10.7/12.4
Ash (%) 14%/0% moisture basis	0.47/0.55	0.51/0.59	0.49/0.58	0.52/0.60	0.47/0.54	0.50/0.59	0.45/0.52	0.48/0.56
Wet Gluten (%)	29.5	31.6	35.1	33.0	26.2	26.8	26.9	27.6
Gluten Index	93	93	92	87	98	98	99	97
Falling Number (sec)	356	408	348	385	418	467	404	444
Amylograph Viscosity: 65g (BU)	593	823	531	910	707	779	733	683
Starch Damage (%)	6.2	7.9	5.8	8.7				
SRC: GPI	0.71	0.69	0.78	0.72				
Water / 50% Sucrose	64/107	67/111	65/104	68/114				
5% Lactic Acid / 5% Na ₂ CO ₃	135/83	138/88	142/79	144/86				
DOUGH PROPERTIES:								
Farinograph: Peak Time (min)	6.7	6.8	6.7	6.6	6.0	6.2	6.1	6.0
Stability (min)	10.6	13.4	13.2	15.1	11.7	11.7	10.8	10.2
Absorption (%)	61.4	63.2	63.0	64.0	59.2	59.2	60.7	61.0
Alveograph: P (mm)	94	118	97	114	113	113	126	119
L (mm)	108	71	125	109	73	83	66	82
P/L Ratio	0.87	1.66	0.78	1.05	1.55	1.36	1.93	1.46
W (10 ⁻⁴ J)	349	295	405	390	299	317	309	339
Extensograph: Resistance (BU)	238/276	255/267	208/272	268/300				
(45/135 min) Extensibility (cm)	22.5/22.3	21.3/21.4	25.6/23.0	22.2/19.9				
Area (cm ²)	142/152	136/145	152/154	150/145				
BAKING EVALUATION:								
Pan Bread: Bake Absorption (%)	61.5	63.3	62.5	64.0	61.2	61.1	62.5	62.7
Crumb Grain and Texture (1-10)	8.0	8.0	8.0	8.0	7.0	6.5	7.0	6.5
Loaf Volume (cc)	890	973	945	1005	856	851	856	846
SAMPLE COUNT:								
	86	196	10	126				

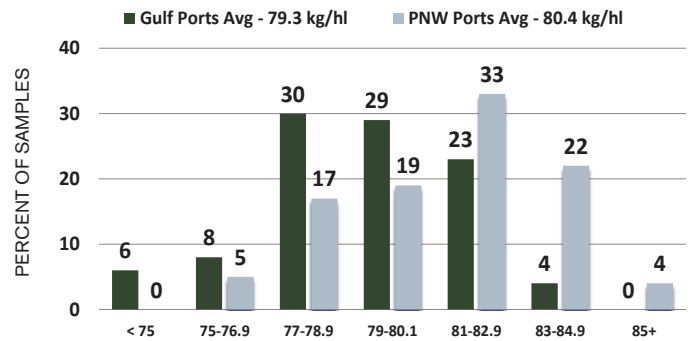
¹California HRW Protein Range: Med, 11.0 - 12.5%; High, >12.5%.



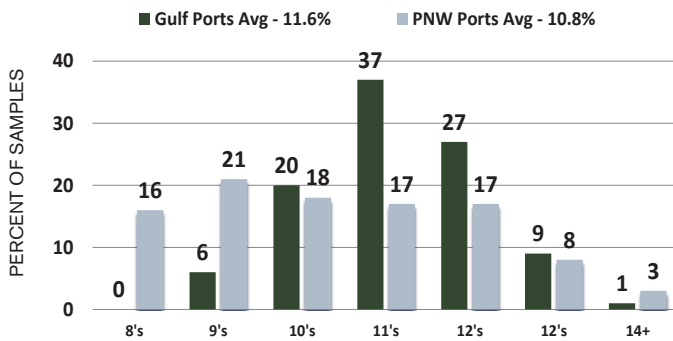
TEST WEIGHT Pounds/Bushel



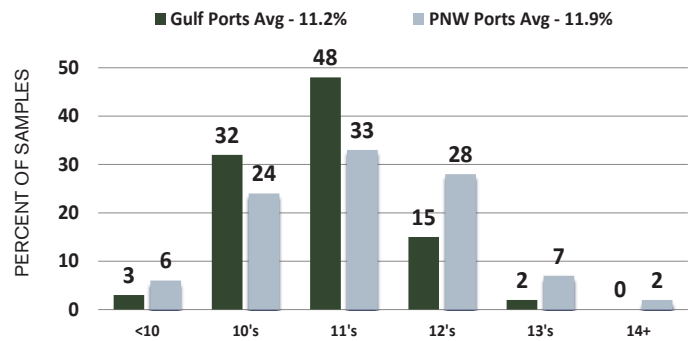
HECTOLITER WEIGHT Kilograms/Hectoliter



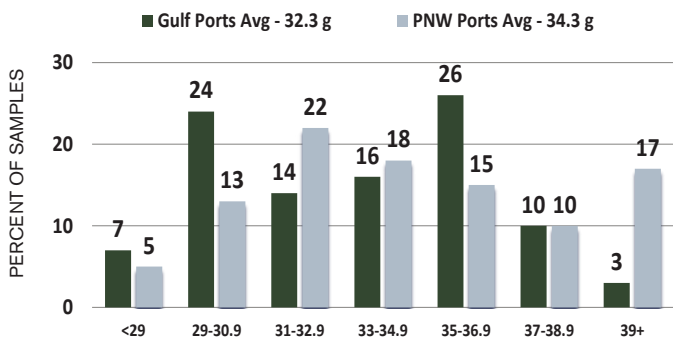
WHEAT MOISTURE Percent



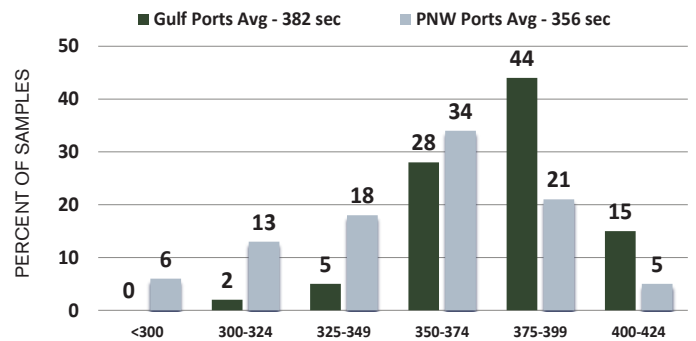
PROTEIN (12% MB) Percent



1000 KERNEL WEIGHT Grams



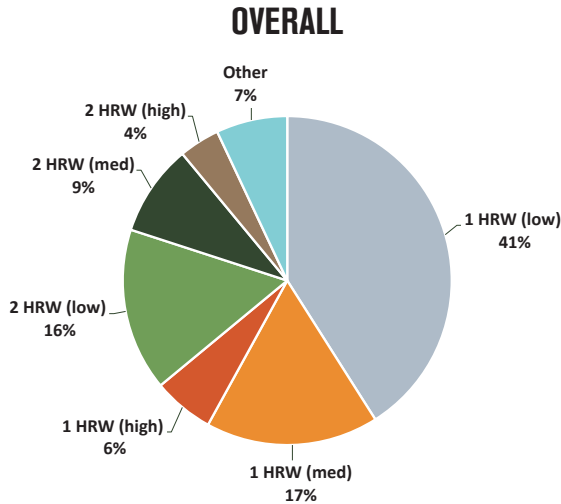
FALLING NUMBER Seconds



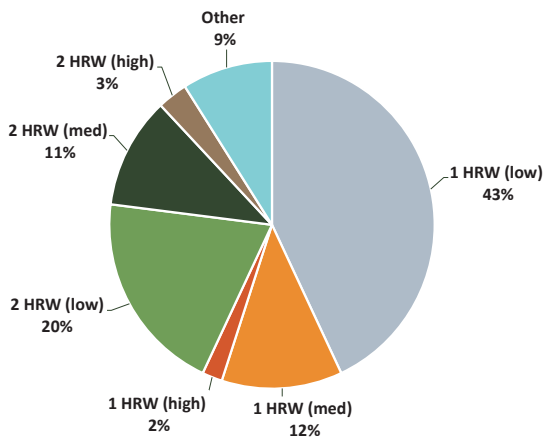
HARD RED WINTER

DISTRIBUTION BY GRADE

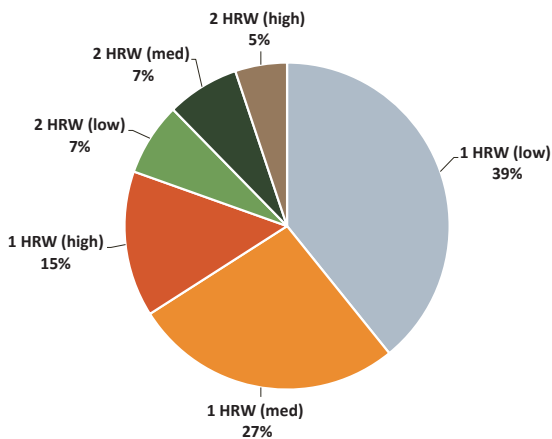
PROTEIN RANGE, 12% MB, DENOTED IN PARENTHESIS:
 LOW, <11.5%; MED, 11.5-12.5%; HIGH, >12.5%



GULF EXPORTABLE



PNW EXPORTABLE



HARD RED WINTER PRODUCTION

FOR THE MAJOR PRODUCING STATES (MILLION METRIC TONS)

	2019	2018	2017	2016	2015
California	0.1	0.2	0.2	0.3	0.3
Colorado	2.5	1.7	2.1	2.7	2.1
Idaho	0.3	0.3	0.3	0.4	0.4
Kansas	8.8	7.2	8.8	12.3	8.5
Montana	2.6	2.1	1.8	2.9	2.5
Nebraska	1.4	1.3	1.2	1.8	1.2
Oklahoma	3.0	1.9	2.7	3.7	2.7
Oregon	0.1	0.1	0.1	0.1	0.0
South Dakota	1.1	0.9	0.6	1.7	1.2
Texas	1.8	1.4	1.7	2.4	2.7
Washington	0.5	0.5	0.5	0.5	0.3
Wyoming	0.1	0.1	0.1	0.1	0.1
Twelve-State Total	22.3	17.7	20.1	28.9	22.0
Total HRW Production	22.7	18.0	20.4	29.4	22.6

Based on USDA crop estimates as of September 30, 2019.



EXPORT CARGO SURVEY

The export cargo data represent 418 subplot samples provided by USDA's Federal Grain Inspection Service for crop years 2019 and 2018. Of 96 2019-crop samples collected in July and August, 86 are from Gulf and 10 from PNW ports. Of the 322 2018-crop samples, 196 are from Gulf and 126 from PNW ports. Grade data are the official grades on the individual sublots. Great Plains Analytical Laboratory conducted the milling and baking analyses.



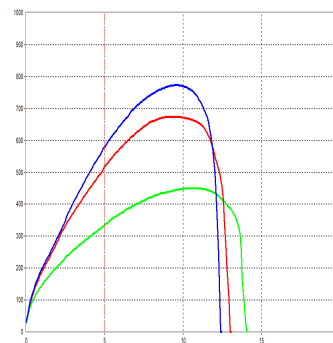
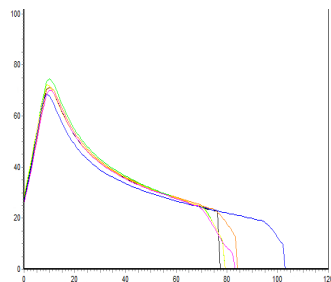
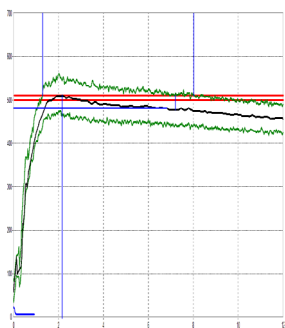
COMPOSITE DOUGH PROPERTIES

FARINOGRAMS

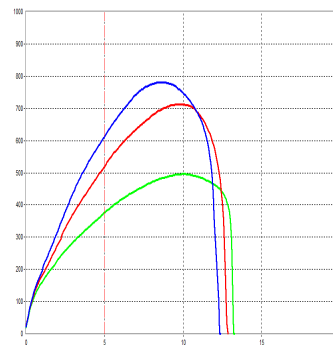
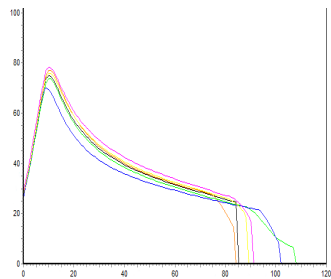
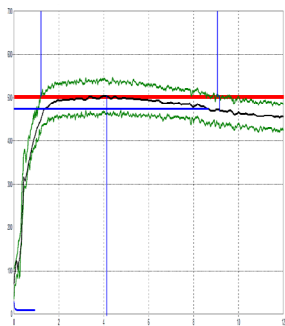
ALVEOGRAMS

EXTENSOGRAMS

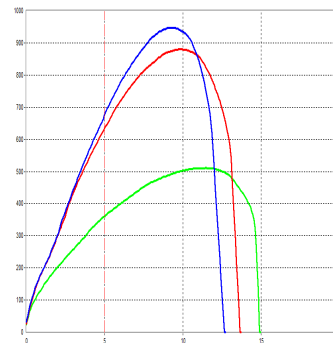
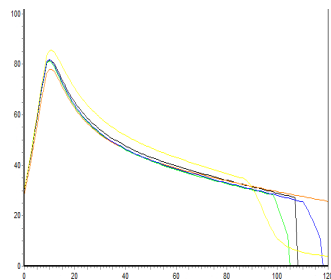
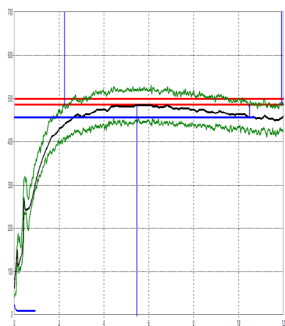
**LOW
PROTEIN**



**MEDIUM
PROTEIN**



**HIGH
PROTEIN**





HARD RED SPRING

The aristocrat of wheat when it comes to “designer” wheat foods like hearth breads, rolls, croissants, bagels and pizza crust. HRS is also a valued improver in flour blends.



781

Samples collected from fields, on-farm bins sites or elevators, and separated by export region.

Official grade and non-grade factors were determined on 60% of samples. Functionality tests were conducted on 24 composite samples categorized by export region and protein ranges of <13.5%, 13.5 to 14.5% and >14.5%. Production-weighted results are presented as Composite, Eastern and Western Region averages based on composite samples. Eastern and Western Region states are highlighted on the map below. The methods are described in the Analysis Methods section of this booklet.



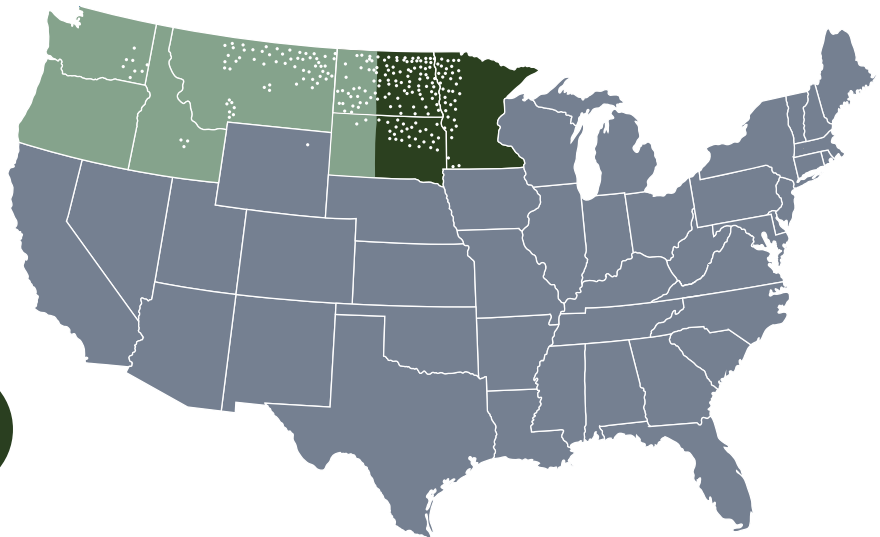
The HRS Wheat Quality Lab Department of Plant Sciences, North Dakota University (NDSU), Fargo, ND, collected samples and conducted quality analyses.

7

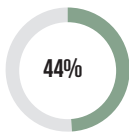
STATES SURVEYED

92%

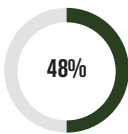
OF TOTAL HRS PRODUCTION REPRESENTED



PERCENTAGE OF TOTAL U.S. HRS PRODUCTION BY REGION.



WESTERN REGION



EASTERN REGION



HARVEST SURVEY

OVERVIEW: The 2019 U.S. hard red spring wheat (HRS) crop is one of contrasts with above average yields and high protein, but with key kernel parameters impacted by harvest rains. Due to the unusual harvest conditions and delay, the entire crop is not represented in this year's data. Functional performance of the 2019 crop shows weaker dough properties and lower absorption but excellent baking properties. Premium quality will command higher prices, but good value can be obtained with diligent contract specifications. Ample carryover from the excellent quality 2018 crop will be helpful in meeting traditional quality needs of buyers.

WEATHER AND HARVEST: Planting began in late April, well behind the five-year average due to cool, wet conditions and late season snow. Planting continued to be slow until late-May when weather conditions improved, allowing most of the crop to be planted by early June.

Cool temperatures slowed emergence and crop development during the first half of the growing season. As June progressed, southern areas benefitted from frequent moisture while northern areas endured a period of drought stress. Frequent and widespread rains developed across the region in late-June, boosting yield potential but also elevating disease pressures.

Harvest began in mid-August with scattered precipitation and high humidity slowing initial progress. Approximately 50% of the crop was harvested by September 1, but by mid-September record rains interrupted harvest and affected the quality of the remaining crop. Continued precipitation and saturated soils allowed only 90% of the crop to be harvested by early October; the remaining 5 to 10% was not harvested. Regional production is estimated at 559 mil bu

(15.2 MMT), up 8% from the 5-year average but down 5% from 2018 on reduced planted area.

WHEAT AND GRADE DATA: For the portion of the crop surveyed, the average grade is U.S. No. 1 Northern Spring (NS), down from No. 1 Dark Northern Spring (DNS) in 2018; 85% of Eastern Region samples and 87% of Western Region samples grade U.S. No. 1. Average test weight of 60.7 lb/bu (79.8 kg/hl) is lower than 2018 and the 5-year average; 52% of Eastern samples and 70% of Western samples are above 60 lb/bu (78.9 kg/hl). Average damage is 1.0%, up notably from 2018 with higher damage levels in Eastern samples. Overly wet harvest conditions resulted in a very low vitreous kernel (DHV) average of 52% compared to the 5-year average of 74%. Average DHV is 61% for Western samples and 44% for Eastern.

Even with record yields and low DHV, the crop averages 14.4% (12% mb) protein, similar to 2018 and slightly above the 5-year average, which adds value to the crop. Western average protein is 14.4%, down marginally from 2018, while Eastern average protein held steady at 14.3%. One-half of all samples have greater than 14.5% protein in 2019 with just 18% below 13.5% protein.

Disease pressures were higher in portions of the crop due to moisture patterns, with the heaviest pressure from Fusarium head blight across southern parts of the region. The crop's overall DON average is 0.6 ppm, up from 0.3 ppm in 2018, and ranging from 0.1 to 0.4 ppm for Western composites and 0.7 to 1.1 ppm for Eastern composites. Average 1000 kernel weight (TKW) is 31 g, similar to the 5-year average. Given the unusually wet harvest period, falling numbers (FN) across the entire region averaged 339 sec, down

from 403 in 2018; FN averages 375 sec in Western samples and 307 in Eastern.

FLOUR, DOUGH AND BAKING DATA: Buhler laboratory mill flour yield averages 68.4%, higher than 2018 and the 5-year average. Flour ash increased slightly to 0.54%, compared to 0.52% a year ago. Wet gluten averages 34%, slightly lower than 2018. Amylograph values average 406 BU for 65 g of flour, down sharply from 2018 and the 5-year average, with the lowest values in Eastern samples.

Farinograph indicates the crop has 1.3 percentage point lower absorption compared to 2018, but similar to the 5-year average, with Western area average at 63.6% and Eastern area at 62.1%. The average farinograph stability is 10.1 min, lower than 2018 and the 5-year average. Dough strength is similar across the region with the Eastern crop declining more compared to the 2018 crop and with no correlating increase at higher protein levels; the Western area does show increased dough strength at higher protein levels.

Alveograph and extensograph analyses show more extensibility and less resistance. The average alveograph P/L ratio is 0.61 compared to 0.72 in 2018, and the W-value is 342 (10⁻⁴ J), down from 415 last year. The overall extensibility and resistance to extension of the 135 min extensograph are 15.6 cm and 639 BU, notably more extensible than 2018 crop values of 13.2 and 855.

The average loaf volume is 1026 cc, up notably from 973 in 2018; Western area averages 1004 cc and Eastern area averages 1046 cc. Average bake absorption is 67.6%, down from 2018 but higher than the 5-year average. Bread scores are similar to 2018 with the Western area scoring slightly higher than the Eastern area.



HARD RED SPRING



HARVEST DATA

COMPOSITE AVERAGE

	2019 BY PROTEIN ¹			2018	5-YEAR	
	Low	Med	High	Overall	OVERALL AVERAGE	
WHEAT GRADE DATA:						
Test Weight (lb/bu)	61.2	61.0	60.2	60.7	62.2	61.7
(kg/hl)	80.5	80.3	79.2	79.8	81.7	81.2
Damaged Kernels (%)	0.4	1.3	0.9	1.0	0.3	0.1
Foreign Material (%)	0.0	0.0	0.0	0.0	0.0	0.0
Shrunken & Broken (%)	0.7	0.6	0.9	0.8	1.0	0.9
Total Defects (%)	1.1	1.9	1.8	1.7	1.3	1.0
Vitreous Kernels (%)	50	43	59	52	87	74
Grade	1 NS	1 NS	1 NS	1 NS	1 DNS	1 NS
WHEAT NON-GRADE DATA:						
Dockage (%)	0.5	0.5	0.6	0.6	0.5	0.5
Moisture (%)	12.4	12.9	12.7	12.7	11.8	12.1
Protein (%) 12%/0% moisture basis	12.8/14.5	14.0/15.9	15.2/17.3	14.4/16.3	14.5/16.5	14.2/16.1
Ash (%) 14%/0% moisture basis	1.48/1.72	1.52/1.77	1.60/1.86	1.55/1.80	1.58/1.84	1.51/1.76
1000 Kernel Weight (g)	31.7	31.6	30.4	31.0	31.1	31.2
Kernel Size (%) lg/md/sm	50/48/2	53/44/2	47/50/3	49/48/3	45/52/3	46/51/3
Single Kernel: Hardness						
Weight (mg)	69	68	67	68	72	79
Diameter (mm)	33.4	33.3	32.6	33.0	33.7	32.3
Sedimentation (cc)	2.71	2.76	2.73	2.73	2.74	2.42
Falling Number (sec)	64.0	66.2	67.5	66.4	66.6	64.9
DON (ppm)	368	307	349	339	403	374
	<0.5	0.6	0.8	0.6	<0.5	<0.5
FLOUR DATA:						
Lab Mill Extraction (%)	68.8	69.3	67.8	68.4	67.8	67.9
Color: L*	90.1	89.9	89.7	89.9	90.7	90.5
a*	-2.1	-1.9	-2.0	-2.0	-1.0	-1.1
b*	9.1	9.0	9.3	9.2	9.0	9.5
Protein (%) 14%/0% moisture basis	11.9/13.8	13.1/15.2	14.3/16.6	13.4/15.6	13.6/15.8	13.2/15.3
Ash (%) 14%/0% moisture basis	0.52/0.60	0.53/0.62	0.55/0.64	0.54/0.63	0.52/0.60	0.51/0.59
Wet Gluten (%)	28.7	32.4	36.9	34.0	35.3	34.2
Gluten Index	97	92	87	90	92	92
Falling Number (sec)	377	347	364	361	414	393
Amylograph Viscosity: 65g (BU)	450	348	425	406	635	617
Starch Damage (%)	7.7	7.7	6.8	7.3	8.1	7.3
SRC: GPI	0.63	0.65	0.66	0.65	0.62	0.66
Water / 50% Sucrose	75/119	74/120	75/123	75/121	76/127	72/121
5% Lactic Acid / 5% Na ₂ CO ₃	145/112	148/107	150/105	149/107	149/112	145/103
DOUGH PROPERTIES:						
Farinograph: Peak Time (min)	6.6	7.3	8.9	8.0	7.7	7.4
Stability (min)	9.9	9.8	10.5	10.1	10.8	10.8
Absorption (%)	61.2	62.4	63.6	62.8	64.1	62.9
Alveograph: P (mm)	89	79	79	81	97	89
L (mm)	110	126	144	132	134	127
P/L Ratio	0.81	0.62	0.55	0.61	0.72	0.70
W (10 ⁻⁴ J)	326	326	357	342	415	375
Extensograph: Resistance (BU)	457/686	476/591	448/652	458/639	523/855	481/835
(45/135 min) Extensibility (cm)	18.2/16.1	17.2/15.7	18.3/15.4	17.9/15.6	16.0/13.2	16.5/13.1
Area (cm ²)	107/148	108/121	107/133	108/132	116/147	104/143
BAKING EVALUATION:						
Pan Bread: Bake Absorption (%)	65.9	67.3	68.5	67.6	69.6	66.3
Crumb Grain and Texture (1-10)	7.0	7.7	8.0	7.7	7.7	7.9
Loaf Volume (cc)	918	998	1083	1026	973	969
PRODUCTION OF 7 STATES (%):	18	31	50	100		

¹Protein Range: Low, <13.5%; Med, 13.5 - 14.5%; High, >14.5%.

WESTERN REGIONAL AVERAGE						EASTERN REGIONAL AVERAGE					
2019 BY PROTEIN ¹			2018	5-YEAR		2019 BY PROTEIN ¹			2018	5-YEAR	
Low	Med	High	Overall	OVERALL	AVERAGE	Low	Med	High	Overall	OVERALL	AVERAGE
61.5	61.6	60.4	60.9	61.9	61.4	60.9	60.7	60.0	60.4	62.4	61.9
80.8	81.1	79.5	80.2	81.4	80.7	80.0	79.8	78.9	79.4	82.0	81.4
0.2	0.4	0.8	0.6	0.3	0.2	0.7	1.8	1.1	1.3	0.2	0.2
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.9	0.8	1.0	0.9	1.1	1.1	0.5	0.5	0.7	0.6	0.8	0.6
1.1	1.2	1.8	1.5	1.4	1.3	1.2	2.3	1.8	1.9	1.0	0.8
62	59	62	61	90	78	35	33	56	44	84	69
1 NS	1 NS	1 NS	1 NS	1DNS	1 DNS	1 NS	1 NS	1 NS	1 NS	1 DNS	1 NS
0.6	0.5	0.6	0.6	0.5	0.6	0.5	0.6	0.5	0.5	0.4	0.5
11.7	12.4	12.4	12.2	11.2	11.4	13.2	13.2	13.0	13.1	12.4	12.7
12.7/14.5	14.0/16.0	15.3/17.4	14.4/16.4	14.6/16.6	14.4/16.4	12.8/14.6	14.0/15.9	15.1/17.1	14.3/16.3	14.4/16.4	14.0/15.9
1.43/1.66	1.43/1.66	1.55/1.80	1.50/1.74	1.52/1.77	1.50/1.74	1.54/1.79	1.57/1.83	1.65/1.91	1.60/1.86	1.64/1.90	1.53/1.78
31.0	31.0	30.2	30.6	30.0	30.3	32.7	32.0	30.7	31.5	32.1	32.1
42/55/3	47/50/3	43/54/3	44/53/3	39/58/3	38/58/3	60/39/1	57/41/2	51/46/3	55/43/2	51/47/2	54/44/2
69	70	67	68	71	78	68	67	68	68	73	79
33.4	33.2	33.0	33.1	32.9	31.8	33.5	33.4	32.2	32.9	34.4	32.8
2.68	2.73	2.73	2.72	2.68	2.38	2.75	2.77	2.73	2.75	2.79	2.45
63.9	65.0	67.9	66.4	67.2	66.2	64.1	66.9	67.0	66.5	66.1	63.6
386	355	379	375	423	372	346	279	316	307	385	378
<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.7	0.8	1.1	0.9	0.6	<0.5
68.2	69.0	68.0	68.3	67.6	67.5	69.6	69.4	67.6	68.6	68.0	68.3
90.1	90.1	89.8	89.9	90.7	90.6	90.1	89.8	89.7	89.8	90.7	90.5
-2.1	-2.1	-2.1	-2.1	-1.1	-1.1	-2.0	-1.9	-1.9	-1.9	-0.9	-1.0
9.3	9.4	9.6	9.5	9.4	9.7	8.8	8.8	8.9	8.9	8.7	9.3
11.8/13.7	13.1/15.2	14.4/16.7	13.5/15.7	13.7/15.9	13.4/15.6	12.0/13.9	13.1/15.2	14.1/16.4	13.4/15.6	13.4/15.6	13.0/15.1
0.52/0.60	0.53/0.61	0.53/0.62	0.53/0.61	0.52/0.61	0.51/0.59	0.52/0.60	0.54/0.63	0.56/0.65	0.55/0.63	0.51/0.60	0.51/0.59
28.1	34.1	36.9	34.3	36.4	35.1	29.4	31.4	37.0	33.7	34.4	33.2
97	85	85	88	89	90	97	96	89	93	95	95
398	392	382	388	423	392	350	320	344	336	405	393
554	506	495	510	642	609	321	255	350	309	629	627
7.8	7.6	6.8	7.2	8.2	7.1	7.6	7.8	6.9	7.4	8.1	7.4
0.62	0.64	0.66	0.64	0.63	0.65	0.64	0.66	0.66	0.66	0.62	0.67
77/123	76/124	75/124	76/123	78/128	71/121	73/116	73/118	74/122	74/119	75/126	72/120
146/114	150/112	152/108	150/110	152/115	147/108	144/109	147/104	148/101	147/104	146/109	144/98
7.0	8.2	9.3	8.5	8.2	7.6	6.0	6.8	8.5	7.5	7.2	7.1
8.8	9.7	10.5	9.9	10.0	10.1	11.2	9.8	10.4	10.3	11.6	11.5
62.0	63.3	64.3	63.6	65.2	63.4	60.1	61.9	62.9	62.1	63.0	62.3
94	87	80	85	101	90	82	74	77	77	93	88
102	125	143	130	129	127	119	127	145	134	139	127
0.92	0.70	0.56	0.65	0.78	0.71	0.69	0.58	0.53	0.57	0.67	0.69
325	349	362	351	419	371	328	312	352	333	410	378
470/710	436/695	446/638	449/667	494/906	449/842	440/657	500/530	450/668	467/614	551/807	514/829
17.8/15.8	16.1/15.0	18.6/16.1	17.8/15.8	15.8/13.4	16.5/13.0	18.6/16.5	17.8/16.1	17.9/14.6	18.0/15.5	16.3/13.1	16.5/14.3
112/150	94/138	111/134	107/138	114/160	99/143	101/145	117/111	103/131	108/126	119/136	111/144
66.8	68.3	69.4	68.6	70.7	68.9	64.8	66.7	67.5	66.8	68.6	67.6
7.0	8.0	8.5	8.1	7.9	8.0	7.0	7.5	7.5	7.4	7.5	7.8
865	935	1090	1004	956	976	985	1035	1075	1046	989	960
10	12	26	48			8	20	24	52		

¹Protein Range: Low, <13.5%; Med, 13.5 to 14.5%; High, >14.5%.

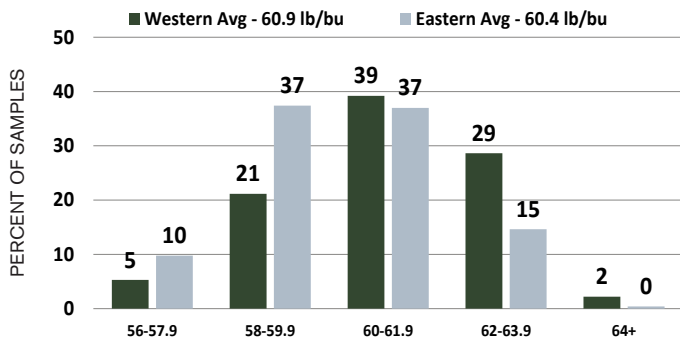
HARD RED SPRING

EXPORT CARGO DATA

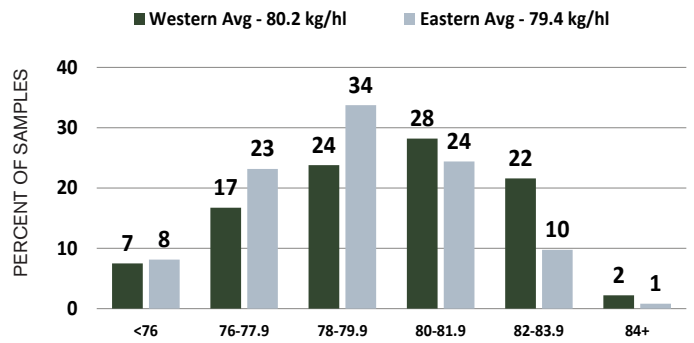
	PNW AVERAGE		GREAT LAKES AVERAGE		GULF AVERAGE	
	2018	2017	2018	2017	2018	2017
WHEAT GRADE DATA:						
Test Weight (lb/bu)	62.5	62.5	63.1	62.6	62.5	62.2
(kg/hl)	82.2	82.2	82.9	82.3	82.2	81.8
Damaged Kernels (%)	0.2	0.3	1.1	1.0	0.9	0.8
Foreign Material (%)	0.1	0.1	0.1	0.0	0.1	0.2
Shrunken & Broken (%)	1.1	1.1	0.8	0.8	0.7	0.7
Total Defects (%)	1.4	1.5	2.0	1.8	1.8	1.7
Vitreous Kernels (%)	81	75	63	44	69	56
Grade	1 DNS	1 DNS	1 NS	1 NS	1 NS	1 NS
WHEAT NON-GRADE DATA:						
Dockage (%)	0.3	0.3	0.5	0.5	0.7	0.7
Moisture (%)	11.7	11.4	12.5	12.2	12.8	12.4
Protein (%) 12%/0% moisture basis	14.4/16.3	14.1/16.0	13.9/15.8	13.7/15.5	13.9/15.8	13.6/15.4
Ash (%) 14%/0% moisture basis	1.40/1.62	1.44/1.67	1.38/1.60	1.43/1.66	1.37/1.59	1.47/1.71
1000 Kernel Weight (g)	31.2	30.8	33.2	32.7	33.6	33.4
Kernel Size (%) lg/md/sm	23/54/22	42/55/3	31/41/27	56/42/2	22/39/39	59/38/2
Single Kernel: Hardness		79		79		77
Weight (mg)		32.8		34.5		34.9
Diameter (mm)		2.67		2.76		2.77
Sedimentation (cc)						
Falling Number (sec)	448	429	434	409	436	410
DON (ppm)		<0.5		0.5		<0.5
FLOUR DATA:						
Lab Mill Extraction (%)	69.9	69.8	71.1	70.7	70.6	70.5
Color: L*	90.5	90.3	90.3	90.2	90.5	90.2
a*	-0.9	-0.9	-0.8	-0.9	-0.8	-0.8
b*	9.4	9.1	9.0	8.9	8.9	8.7
Protein (%) 14%/0% moisture basis	13.5/15.7	13.4/15.6	13.1/15.3	13.0/15.1	13.1/15.2	12.9/15.0
Ash (%) 14%/0% moisture basis	0.55/0.63	0.57/0.66	0.55/0.63	0.57/0.67	0.54/0.63	0.59/0.69
Wet Gluten (%)	35.8	34.3	34.9	32.6	34.7	32.2
Gluten Index	85	84	89	90	88	89
Falling Number (sec)	469	452	452	421	456	410
Amylograph Viscosity: 65g (BU)	594	573	585	546	607	482
Starch Damage (%)						
SRC: GPI						
Water / 50% Sucrose						
5% Lactic Acid / 5% Na ₂ CO ₃						
DOUGH PROPERTIES:						
Farinograph: Peak Time (min)	7.9	7.6	7.6	7.6	7.4	7.6
Stability (min)	10.1	10.1	10.6	11.2	11.6	11.3
Absorption (%)	64.9	65.1	64.7	64.2	64.0	64.3
Alveograph: P (mm)	105	107	100	107	101	107
L (mm)	113	116	116	114	111	110
P/L Ratio	0.93	0.92	0.87	0.94	0.91	0.98
W (10 ⁻⁴ J)	387	405	377	406	371	394
Extensograph: Resistance (BU)						
(45/135 min) Extensibility (cm)						
Area (cm ²)						
BAKING EVALUATION:						
Pan Bread: Bake Absorption (%)	71.1	73.0	71.1	72.0	69.9	72.4
Crumb Grain and Texture (1-10)	7.6	7.6	7.3	7.3	7.6	7.5
Loaf Volume (cc)	976	962	974	971	985	956
SAMPLE COUNT	109	179	26	29	32	46



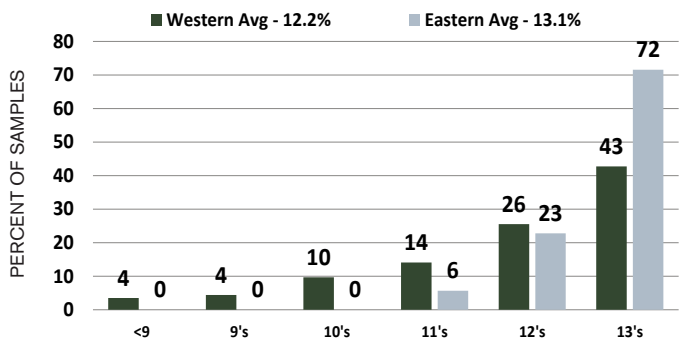
TEST WEIGHT Pounds/Bushel



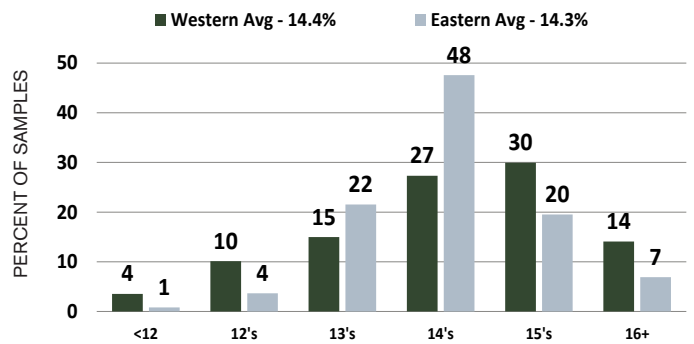
HECTOLITER WEIGHT Kilograms/Hectoliter



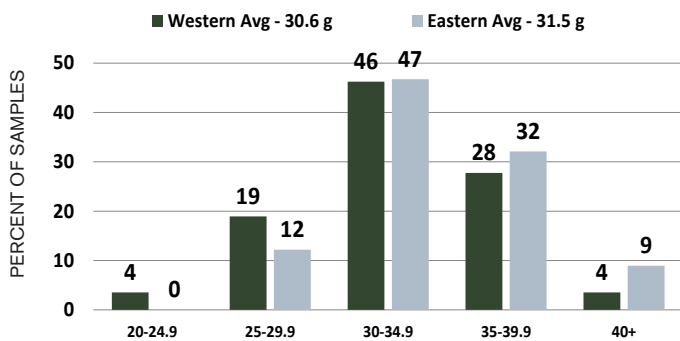
WHEAT MOISTURE Percent



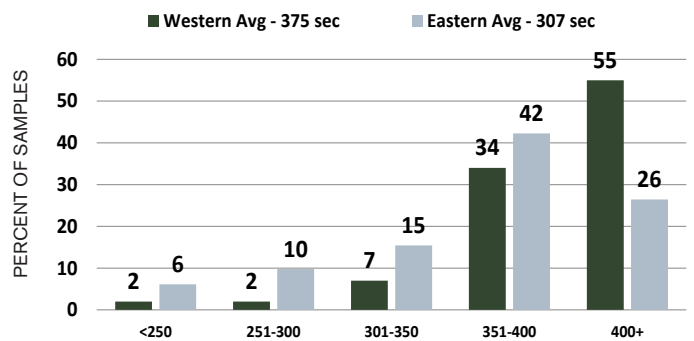
PROTEIN (12% MB) Percent



1000 KERNEL WEIGHT Grams



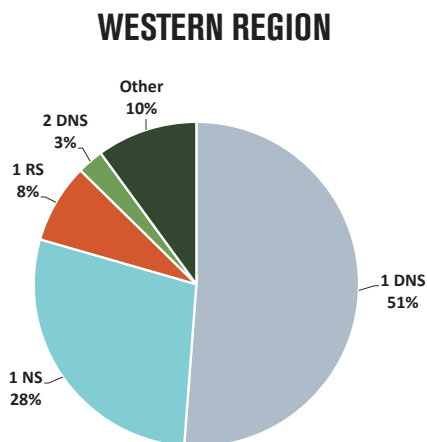
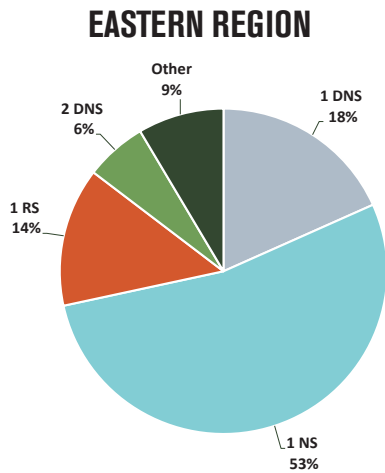
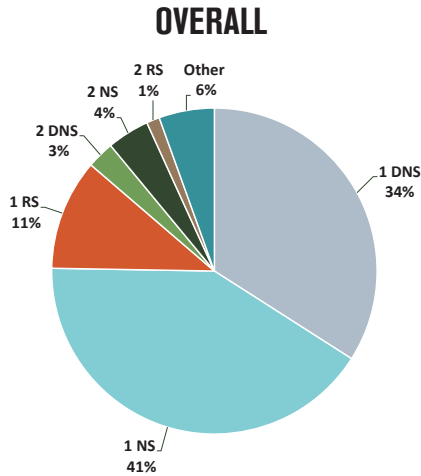
FALLING NUMBER Seconds



HARD RED SPRING

DISTRIBUTION BY GRADE

PROTEIN RANGE, 12% MB, DENOTED IN PARENTHESIS:
 LOW, <13.5%; MED, 13.5-14.5%; HIGH, >14.5%



HARD RED SPRING PRODUCTION

FOR THE MAJOR PRODUCING STATES (MILLION METRIC TONS)

	2019	2018	2017	2016	2015
Idaho	0.4	0.6	0.5	0.4	0.4
Minnesota	2.2	2.5	2.1	2.0	2.3
Montana	2.9	2.6	1.3	2.1	2.1
North Dakota	8.8	8.7	5.7	7.3	8.7
Oregon	0.0	0.1	0.1	0.0	0.0
South Dakota	0.7	1.1	0.6	1.3	1.6
Washington	0.2	0.4	0.3	0.3	0.2
Seven-State Total	15.2	16.0	10.5	13.4	15.4
Total HRS Production	15.2	16.0	10.5	13.4	15.4

Based on USDA crop estimates as of September 30, 2019.



EXPORT CARGO SURVEY

The export cargo data represent 421 individual subplot samples provided by USDA's Federal Grain Inspection Service for crop years 2018 (collected from October 2018 through June 2019) and 2017. Of 167 2018-crop samples, 109 were from the PNW, 26 from Gulf ports and 32 from Great Lakes ports. Grade data are the official grades on the individual subplots. North Dakota State University conducted the milling and baking analyses.



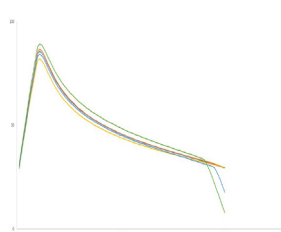
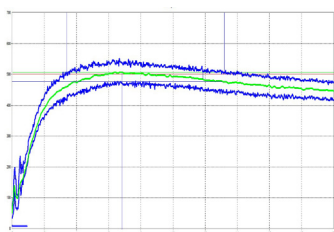
COMPOSITE DOUGH PROPERTIES

FARINOGRAMS

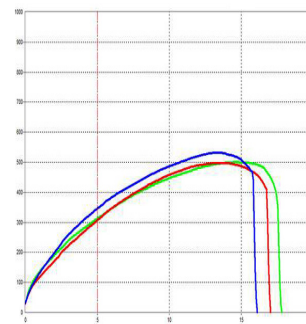
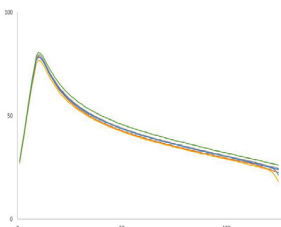
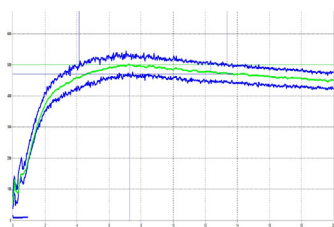
ALVEOGRAMS

EXTENSOGRAMS

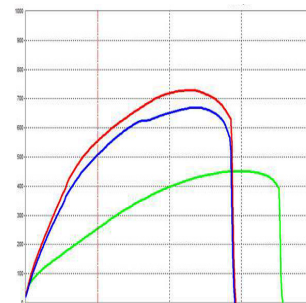
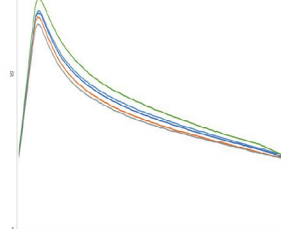
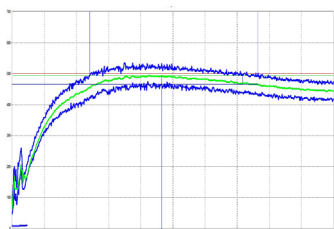
**LOW
PROTEIN**



**MEDIUM
PROTEIN**



**HIGH
PROTEIN**





HARD WHITE

HW receives enthusiastic reviews when used for Asian noodles, whole wheat or high extraction applications, pan breads or flat breads.



32

Samples collected by state and private inspection agencies; commercial wheat handlers; Plains Grains, Inc.; and state wheat commissions.

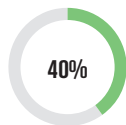
Official grade factors were determined on each sample. Non-grade factors and functionality tests were conducted on 6 composite samples categorized by growing region and protein ranges of <11.5%, 11.5 to 12.5%, 12.6 to 13.5% and >13.5%. The growing regions are highlighted on the map below. The methods are described in the Analysis Methods section of this booklet.



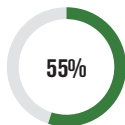
The Wheat Marketing Center (WMC) conducted the quality analyses. The Federal Inspection Service (FGIS) graded the samples.

5
STATES SURVEYED
97%
OF TOTAL HW PRODUCTION REPRESENTED

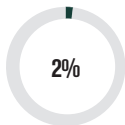
PERCENTAGE OF TOTAL U.S. HW PRODUCTION BY REGION.



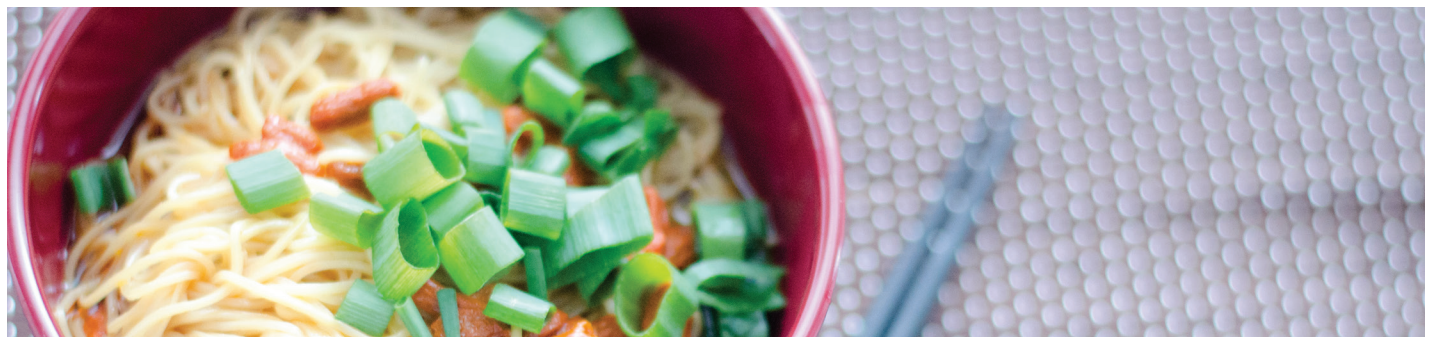
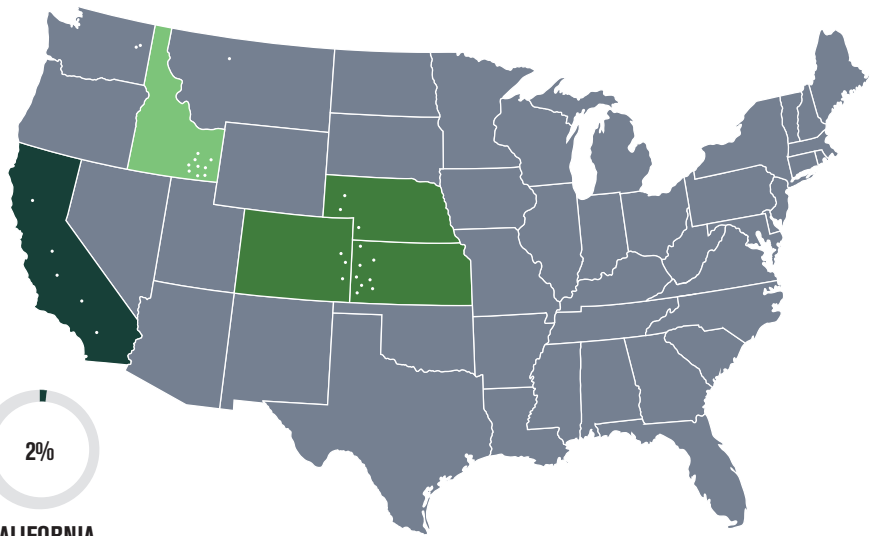
PNW



SOUTHERN PLAINS



CALIFORNIA



HARVEST SURVEY

OVERVIEW: This year's hard white (HW) samples show good quality performance in milling, dough rheological properties and end products, including pan breads, Asian noodles and steamed breads. Pacific Northwest (PNW) medium- and high-protein and California very high-protein composites have good bread baking potential. For Asian noodle applications, using 60% extraction patent flour is recommended to improve noodle color while maintaining noodle texture. For steamed breads, it is recommended that high-protein HW flour be blended with a small portion of soft white (SW) flour to improve product quality.

HARVEST SURVEY: The 2019 HW wheat crop was grown primarily in Kansas, Colorado, Nebraska, Idaho and California, with some production in Montana, North Dakota and South Dakota. U.S. Wheat Associates estimates 2019 HW production at 979,321 metric tons (MT), up slightly from 2018's 894,311 MT reported by USDA.

WHEAT AND GRADE DATA: All six composites graded U.S. No. 1 with test weight ranging from 60.2 to 66.3 lb/bu (79.2 to 87.1 kg/hl). The value ranges of composites are: wheat moisture from 9.2 to 11.2%; wheat protein from 10.6 to 14.0% (12% mb); wheat ash from 1.50 to 1.63% (14% mb); kernel hardness from 54.7 to 75.6; and kernel diameters from 2.52 to 3.03 mm. The 1000 kernel weight (TKW) values of the Southern Plains medium-protein composite is 27.6 g and all others are greater than 31.8 g. Falling number (FN) values are 369 sec or higher for PNW and

Southern Plains composites. California composites had FN values of 285 and 274 sec, respectively.

FLOUR, DOUGH AND BAKING DATA:

Buhler laboratory mill straight-grade flour extractions range from 69.9 to 73.4%; L* values (whiteness) from 91.2 to 92.2; flour protein from 9.7 to 12.5% (14% mb); and flour ash from 0.40 to 0.53% (14% mb). These values are within the historical ranges of HW flour considering the wide production area.

Flour wet gluten contents range from 20.4 to 35.9% depending on flour protein content. Amylograph peak viscosities are between 885 and 934 BU for PNW and Southern Plains composites, but California low- and very high-protein are 335 and 388 BU, respectively. Starch damage values are in the range of 3.2 to 5.5%. Lactic acid SRC values range from 144 to 186%, indicating medium to strong gluten strength.

Farinograph water absorptions range from 54.9 to 63.4% and stability times from 5.5 to 20.0 min, exhibiting medium to strong dough characteristics. HW farinograph water absorption is usually similar to hard red winter (HRW), but historically longer stability time indicates more tolerance to overmixing. The ranges of alveograph values are: P values 60 to 89 mm; L values 84 to 130 mm; and W values 201 to 370 (10^{-4} J). Extensograph data at 135 min resting show that maximum resistance is in the range of 610 to 1389 BU, extensibility from 10.4 to 20.3 cm and area from 130 to 252 cm².

Samples show good baking performance relative to protein

content, with bake absorptions in the range of 60.5 to 68.7%, loaf volumes of 790 to 985 cc, and crumb grain and texture scores of 6.0 to 7.0 points.

NOODLE EVALUATION: HW flours and a control flour were evaluated for both Chinese raw noodles (white salted) and Chinese wet noodles (yellow alkaline). For Chinese raw noodles, the L* values at 0 hr of production and after 24 hr of storage at room temperature are acceptable for all samples except for the California low- and very high-protein composites, which have L* 24-hr values of 71.0 and 69.5, respectively (72 is the minimum value at 24 hr). The sensory color stability scores for PNW medium- and high-protein samples are equivalent to the control noodle (7.0 is the control noodle). Cooked noodle texture is softer for California and Southern Plains composites. For Chinese wet noodles, sensory color stability scores are acceptable for the Southern Plains low- and medium-protein composite. The cooked noodle texture values of PNW high- and Southern Plains low- and medium-protein composites are acceptable. Overall, this year's HW samples will produce noodles with acceptable color if low ash patent flour is used.

STEAMED BREAD EVALUATION: HW flours were evaluated for Asian steamed breads in comparison with a control flour. Results show PNW medium- and high-protein composites are acceptable for steamed bread with specific volumes and total scores equivalent to the control flour. Blending a small percentage of SW flour with high protein HW flour would improve overall steamed bread quality.



HARD WHITE

HARVEST DATA

PACIFIC NORTHWEST
2019 BY PROTEIN¹
Med High

CALIFORNIA
2019 BY PROTEIN¹
Low Very High

SOUTHERN PLAINS
2019 BY PROTEIN¹
Low Med

WHEAT GRADE DATA:						
Test Weight (lb/bu)	64.0	63.9	62.5	66.3	61.7	60.2
(kg/hl)	84.1	84.0	82.2	87.1	81.1	79.2
Damaged Kernels (%)	0.0	0.0	0.0	0.0	0.0	0.0
Foreign Material (%)	0.0	0.0	0.1	0.0	0.0	0.0
Shrunken & Broken (%)	0.3	0.3	0.7	0.1	0.6	0.9
Total Defects (%)	0.3	0.3	0.8	0.1	0.6	0.9
Grade	1 HW	1 HW	1 HW	1 HW	1 HW	1 HW
WHEAT NON-GRADE DATA:						
Dockage (%)	0.1	0.4	0.0	0.0	0.0	0.0
Moisture (%)	10.1	9.2	9.8	9.8	11.2	10.6
Protein (%) 12%/0% moisture basis	11.9/13.5	13.0/14.8	10.3/11.7	14.0/15.9	10.6/12.0	12.2/13.9
Ash (%) 14%/0% moisture basis	1.60/1.86	1.63/1.90	1.62/1.89	1.50/1.75	1.55/1.80	1.62/1.80
1000 Kernel Weight (g)	39.5	36.3	31.8	41.0	32.0	27.6
Kernel Size (%) lg/md/sm	91/9/0	92/8/1	83/16/1	95/5/0	74/25/1	72/27/1
Single Kernel: Hardness	64.9	66.8	70.7	75.6	58.8	54.7
Weight (mg)	40.7	37.5	35.6	43.4	34.6	30.0
Diameter (mm)	2.87	2.80	2.77	3.03	2.72	2.52
Sedimentation (cc)	36.1	43.3	24.7	53.0	30.8	34.5
Falling Number (sec)	369	394	285	274	392	444
FLOUR DATA:						
Lab Mill Extraction (%)	73.4	72.9	70.2	71.9	70.4	69.9
Color: L*	92.0	91.7	91.2	92.2	92.2	91.5
a*	-1.7	-1.8	-1.8	-1.2	-2.2	-2.2
b*	8.5	9.1	7.9	6.0	9.4	10.0
Protein (%) 14%/0% moisture basis	11.2/13.0	12.1/14.1	9.7/11.3	12.5/14.6	9.8/11.3	10.6/12.3
Ash (%) 14%/0% moisture basis	0.53/0.62	0.46/0.54	0.58/0.68	0.40/0.46	0.41/0.47	0.42/0.49
Wet Gluten (%)	29.3	33.4	24.0	35.9	20.4	27.5
Gluten Index	96	99	98	95	100	69
Falling Number (sec)	381	387	301	295	394	419
Amylograph Viscosity 65 g (BU)	885	928	335	388	934	925
Starch Damage (%)	5.3	4.8	5.5	5.0	4.3	3.2
SRC: GPI	0.73	0.77	0.68	0.89	0.84	0.87
Water / 50% Sucrose	64/114	65/112	69/113	69/118	58/97	55/97
5% Lactic Acid / 5% Na ₂ CO ₃	146/85	150/82	144/97	186/90	144/74	145/71
DOUGH PROPERTIES:						
Farinograph: Peak Time (min)	7.4	9.5	2.5	7.2	1.7	2.4
Stability (min)	9.4	14.7	5.5	11.7	8.0	20.0
Absorption (%)	59.0	60.9	61.0	63.4	54.9	55.6
Alveograph: P (mm)	69	74	79	89	63	60
L (mm)	130	129	84	117	89	120
P/L Ratio	0.53	0.57	0.94	0.76	0.71	0.50
W (10 ⁻⁴ J)	277	309	213	370	201	245
Extensograph: Resistance (BU)	549/846	730/1223	450/610	772/1389	440/719	646/1092
(45/135 min) Extensibility (cm)	22.8/18.4	23.2/17.8	23.1/20.3	19.6/12.8	19.5/18.2	18.7/10.4
Area (cm ²)	154/189	204/252	139/163	172/196	118/165	143/130
BAKING EVALUATION:						
Pan Bread: Bake Absorption (%)	64.0	66.1	66.1	68.7	60.1	60.5
Crumb Grain and Texture (1-10)	7.0	7.0	6.5	6.5	6.0	6.3
Loaf Volume (cc)	930	985	790	902	852	872

¹Protein Range: Low, <11.5%; Med, 11.5 - 12.5%; High, 12.6 - 13.5%; Very high, >13.5%.

HARVEST DATA

PACIFIC NORTHWEST
2019 BY PROTEIN¹

Med High

CALIFORNIA
2019 BY PROTEIN¹

Low Very High

SOUTHERN PLAINS
2019 BY PROTEIN¹

Low Med

CHINESE RAW NOODLE-MAKING QUALITY:						
Color at 0/24 hour: L*	89.3/84.8	83.1/73.5	82.5/71.0	80.8/69.5	84.3/75.0	83.3/73.9
a*	-0.2/0.4	-0.2/0.7	-0.2/0.5	0.8/1.6	-0.8/-0.3	-0.8/-0.2
b*	11.7/14.2	19.8/25.5	14.7/19.2	16.3/19.9	18.5/24.1	20.3/26.3
Change in L* (0-24 hr)	4.4	9.6	11.5	11.3	9.3	9.4
Cooking Yield (5 min, %)	110	128	137	124	144	142
Sensory Color Stability Score	7.5	7.0	5.3	5.3	6.0	6.0
Instrumental Texture:						
Firmness (g)	905	939	821	793	960	789
Springiness (%)	94.5	95.1	95.9	94.1	94.6	94.8
Cohesiveness	0.65	0.69	0.68	0.69	0.64	0.71
Chewiness (g)	557	613	534	518	577	527
CHINESE WET NOODLE-MAKING QUALITY:						
Uncooked Color at 0/24 hour: L*	79.8/68.4	78.7/68.1	79.6/68.8	77.0/66.1	82.7/73.8	79.5/69.4
a*	-1.9/-0.5	-1.8/-0.6	-1.8/-0.6	-0.9/-0.1	-2.0/-1.0	-1.9/-0.6
b*	22.0/22.9	23.8/23.8	19.6/22.3	19.3/20.7	21.4/24.7	23.5/25.2
Change in L* (0-24 hr)	11.4	10.7	10.8	10.9	8.9	10.1
Parboiled Color at 0/24 hour: L*	75.8/76.1	75.9/76.3	75.1/75.2	73.9/73.8	78.0/78.6	77.3/77.7
a*	-2.6/-2.8	-2.7/-3.0	-3.2/-3.0	-1.8/-1.7	-3.5/-3.4	-3.3/-3.2
b*	29.1/28.3	29.2/28.7	28.1/27.2	24.5/23.4	30.4/29.5	29.9/29.3
Cooking Yield (1.5 min, %)	38	40	39	40	36	37
Uncooked Color Stability Score	5.2	5.2	6.3	6.0	7.8	7.0
Parboiled Color Stability Score	6.5	6.3	6.0	6.0	7.6	7.0
Instrumental Texture:						
Firmness (g)	623	773	681	698	750	775
Springiness (%)	92.2	98.7	98.7	95.9	99.1	97.7
Cohesiveness	0.69	0.68	0.69	0.72	0.66	0.66
Chewiness (g)	397	516	464	483	491	500
ASIAN-TYPE STEAMED BREAD EVALUATION:						
Specific Volume (ml/g)	2.5	2.5	2.0	1.4	1.6	1.9
Total Score	70.0	68.9	65.3	59.4	60.6	63.2

¹Protein Range: Low, <11.5%; Med, 11.5 - 12.5%; High, 12.6 - 13.5%; Very high, >13.5%.



HARD WHITE

HARD WHITE PRODUCTION

FOR THE MAJOR PRODUCING STATES (MILLION METRIC TONS)

	2019	2018	2017	2016	2015
California	0.01	0.02	0.01	0.02	0.02
Colorado	0.16	0.17	0.26	0.20	0.12
Idaho	0.31	0.36	0.23	0.20	0.14
Kansas	0.28	0.23	0.27	0.38	0.26
Nebraska	0.09	0.09	0.09	0.08	0.04
Five-State Total	0.85	0.87	0.87	0.88	0.58
Total HW Production	0.87	0.89	0.88	0.90	0.61

Based on USDA crop estimates as of September 30, 2019.

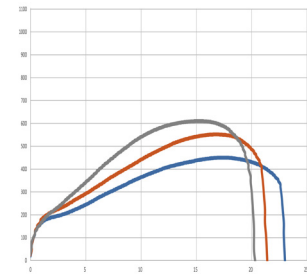
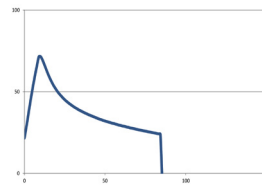
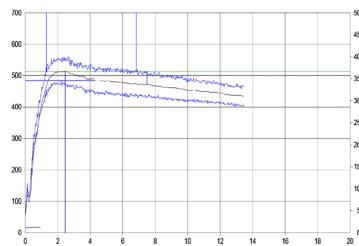
DOUGH PROPERTIES

FARINOGRAMS

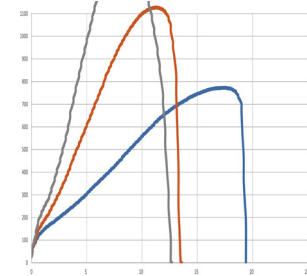
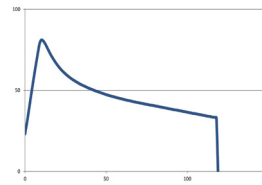
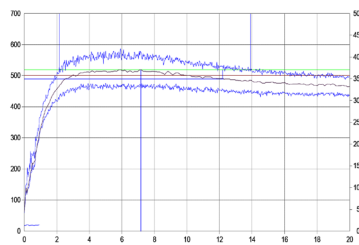
ALVEOGRAMS

EXTENSOGRAMS

**CALIFORNIA
LOW**



**CALIFORNIA
VERY HIGH**



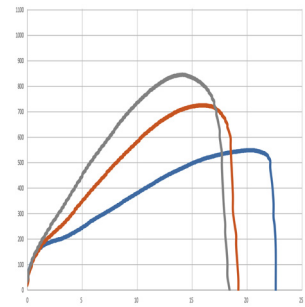
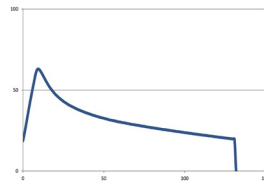
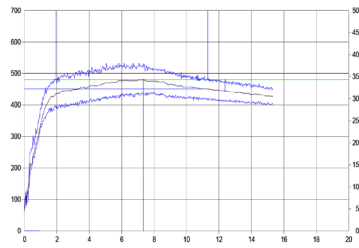


FARINOGRAMS

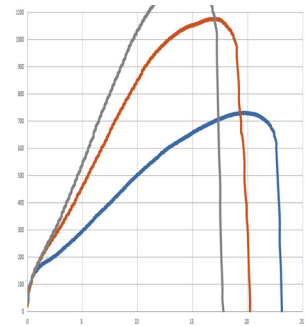
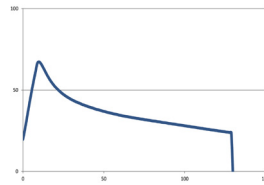
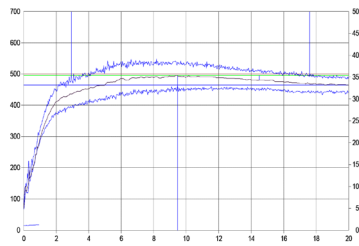
ALVEOGRAMS

EXTENSOGRAMS

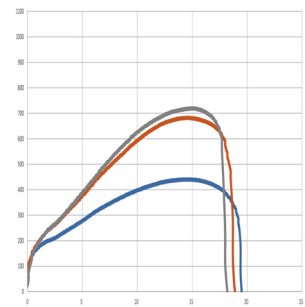
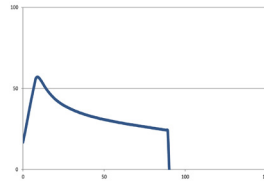
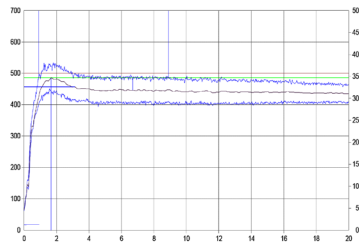
PNW MED



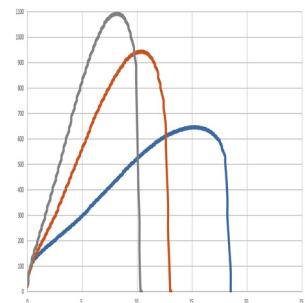
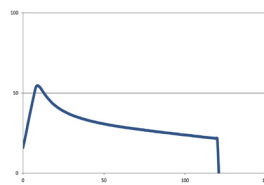
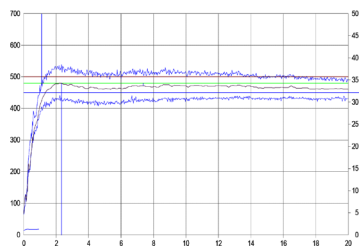
PNW HIGH



**SOUTHERN
PLAINS
LOW**



**SOUTHERN
PLAINS
MEDIUM**





SOFT WHITE

Low moisture wheat with excellent milling results, SW provides a whiter and brighter product for Asian-style noodles and is ideal for exquisite cakes, pastries and other confectionary products.



438 113

Soft White White Club
Samples collected from state, private grain inspection agencies and commercial wheat handling operations.

Official grade, protein, moisture, 1000 kernel weight and falling number tests were determined on each sample. The remaining tests were conducted on 3 composite samples categorized by protein ranges of <9.0%, 9.0 to 10.5%, >10.5% and one composite of all WC samples. The growing region is highlighted on the map below. The methods are described in the Analysis Methods section of this booklet.



Wheat Marketing Center (WMC) conducted wheat and flour quality testing and analyses. Federal Grain Inspection Service (FGIS) graded and tested wheat protein content.

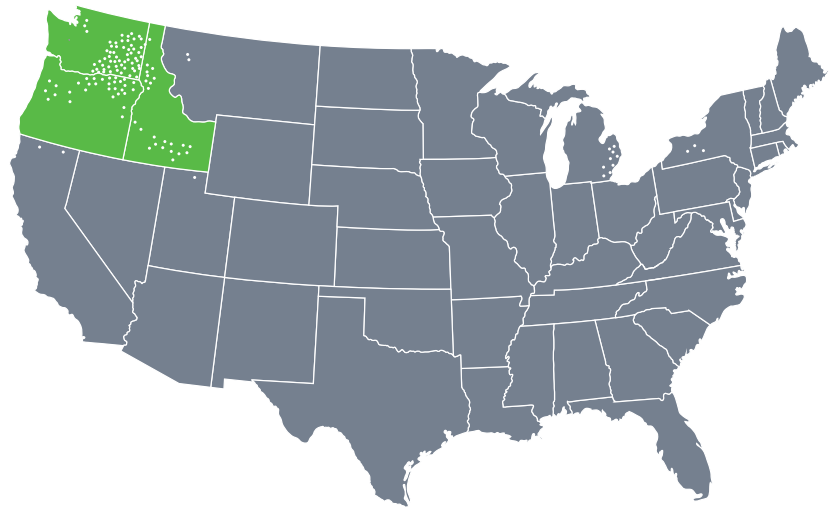
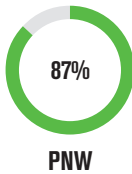
3

STATES SURVEYED

87%

OF TOTAL SW PRODUCTION REPRESENTED

PERCENTAGE OF TOTAL U.S. SW PRODUCTION BY EXPORT TRIBUTARY REGION



HARVEST SURVEY

OVERVIEW: The 2019 Pacific Northwest (PNW) soft white wheat (SW) harvest produced another fine crop with good test weight and acceptable finished product characteristics. Compared to 2018, the crop had higher moisture and protein content. This year's white club (WC) wheat quality characteristics follow the same trend as SW. The high protein segment of the SW crop provides opportunities in blends for crackers, Asian noodles, steamed breads, flat breads and pan breads.

WEATHER AND HARVEST: The PNW had good growing conditions for the 2019 SW crop. There was adequate soil moisture at planting and most of the region received adequate rainfall during winter and spring. Spring planting was delayed in some areas due to extended winter weather. Late spring was mild, while summer wheat harvest was mostly dry. Planted acres were up in all three states while yields were lower. USDA estimates total 2019 PNW SW production at 6.10 million metric tons (MMT), up slightly from 2018's 6.04 MMT. Of that, the Washington Grain Commission estimates WC accounts for 170,000 metric tons (MT), down from last year.

WHEAT AND GRADE DATA: The Overall average grade of the 2019 SW and WC crops is U.S. No. 1. The average SW test weight of 61.6 lb/bu (81.0 kg/hl) is slightly lower than last year's 61.7 lb/bu (81.1 kg/hl); WC test weight of 60.6 lb/bu (79.7 kg/hl) is slightly higher than 2018's 60.4 lb/bu (79.5 kg/hl). SW has fewer damaged kernels, fewer shrunken and broken kernels, and less foreign material than the 5-year averages; all other grade factors and dockage are similar to last year and the 5-year averages. WC shrunken and broken

kernel percentages are lower than last year and the 5-year averages. WC foreign material is higher than last year and 5-year averages. WC dockage is slightly higher than last year and the 5-year averages. Other WC grade factors are similar to past averages. Wheat moisture for both SW and WC is above last year and the 5-year averages.

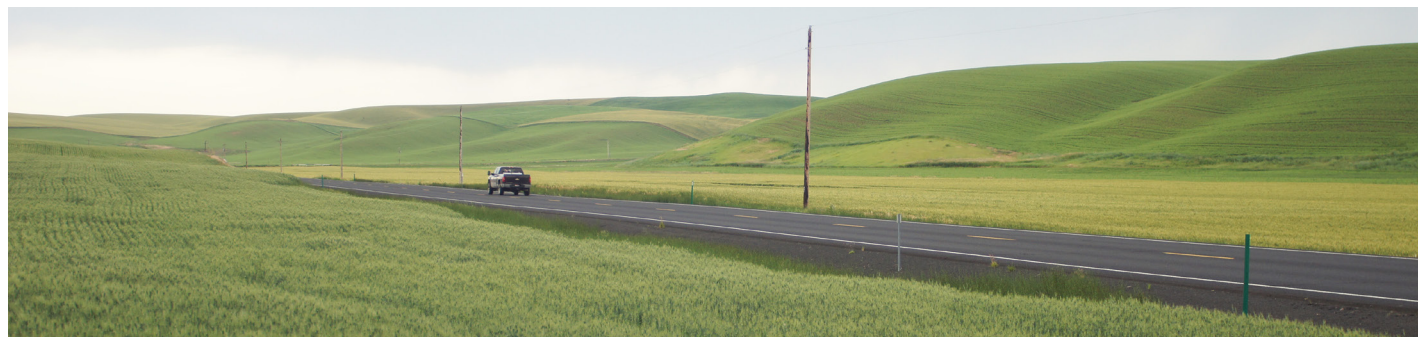
The Overall SW and WC wheat protein content (12% mb) of 10.0 and 9.8%, respectively, are 0.7 and 0.8 percentage points above the respective 2018 values, but below those of 5-year averages. SW and WC wheat ash contents (14% mb) are similar to last year and the 5-year averages. Thousand kernel weight for SW is above 2018 and the 5-year average levels, but that of WC is lower than last year and higher than the 5-year average. SW kernel diameter is the same as last year, but larger than the 5-year average. WC kernel diameter is smaller than last year, but larger than the 5-year average. Falling number values are 317 sec for SW and 355 sec for WC.

FLOUR, DOUGH AND BAKE DATA: The 2019 crop Buhler laboratory mill flour extraction average for SW and WC at 72.1 and 72.8% respectively are lower than last year and the 5-year averages. Flour protein content (14% mb) is 8.9% for both SW and WC. Flour ash content (14% mb) for both SW and WC are higher than last year but the same as 5-year averages. Amylograph peak viscosity value for SW is 485 BU, slightly lower than last year, and for WC is 523 BU, much higher than last year. Starch damage value is slightly higher for SW than last year but lower than the 5-year averages. WC starch damage is lower than last year and the 5-year averages. SW and WC solvent retention capacity (SRC) water values are less than last

year and 5-year averages. SW lactic acid and sodium carbonate values are similar to last year and the 5-year averages. WC lactic acid values are higher than last year, but same as 5-year average. SW and WC gluten performance index (GPI) values are similar to last year and 5-year averages. SW farinograph peak and stability times are shorter than last year and the 5-year averages. WC peak time is slightly longer than last year and 5-year averages. SW and WC water absorptions are similar to last year, but less than the 5-year averages. The SW and WC alveograph L values are considerably longer than last year and 5-year averages. SW and WC extensograph resistance is larger than last year and the 5-year averages. SW and WC extensibility values are longer than last year and the 5-year averages. Sponge cake volume for SW at 1104 cc is larger than last year, but smaller than the 5-year average, and the total score is slightly lower than last year and the 5-year averages. The sponge cake volume for WC at 1141 cc is slightly larger than last year, but smaller than the 5-year average, and total score the same as last year and much higher than the 5-year averages. SW and WC cookie diameter values are smaller than last year, but similar to the 5-year averages. SW and WC cookie spread factors are more than last year and the 5-year averages.

CHINESE SOUTHERN-TYPE STEAMED

BREAD: Each flour sample was made into southern-type steamed bread and compared to a control flour. SW and WC specific volumes are slightly less than last year and the 5-year averages. The SW total score is higher than last year and the 5-year averages, while that of WC is the same as last year, but lower than the 5-year average.



SOFT WHITE

HARVEST DATA

2019 SOFT WHITE BY PROTEIN¹

CLUB

2018

5-YEAR AVERAGE

Low Med High Overall AVERAGE SW Club SW Club

WHEAT GRADE DATA:									
Test Weight (lb/bu)	61.3	61.9	61.3	61.6	60.6	61.7	60.4	60.7	60.2
(kg/hl)	80.6	81.4	80.6	81.0	79.7	81.1	79.5	79.8	79.2
Damaged Kernels (%)	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.1	0.0
Foreign Material (%)	0.0	0.1	0.1	0.1	0.2	0.0	0.0	0.0	0.1
Shrunken & Broken (%)	0.4	0.4	0.6	0.5	0.2	0.5	0.7	0.7	1.3
Total Defects (%)	0.4	0.5	0.7	0.5	0.4	0.6	0.7	0.7	1.3
Grade	1 SW	1 SW	1 SW	1 SW	1 WC	1 SW	1 WC	1 SW	1 WC
WHEAT NON-GRADE DATA:									
Dockage (%)	0.4	0.4	0.3	0.4	0.6	0.5	0.5	0.5	0.5
Moisture (%)	10.1	10.0	9.7	9.9	9.5	8.6	8.1	9.1	8.4
Protein (%) 12%/0% moisture basis	8.4/9.5	9.9/11.2	11.3/12.8	10.0/11.4	9.8/11.1	9.3/10.6	9.0/10.2	10.1/11.5	10.3/11.7
Ash (%) 14%/0% moisture basis	1.38/1.60	1.35/1.57	1.40/1.63	1.35/1.57	1.29/1.50	1.36/1.58	1.29/1.50	1.35/1.57	1.30/1.51
1000 Kernel Weight (g)	38.6	37.3	34.9	36.4	31.4	35.7	32.8	34.2	30.7
Kernel Size (%) lg/md/sm	94/6/0	90/10/0	83/17/0	89/11/0	76/23/1	87/12/1	80/20/0	83/16/1	72/27/1
Single Kernel: Hardness	19.1	22.3	22.2	21.8	19.9	27.2	27.9	29.6	32.5
Weight (mg)	41.1	40.3	38.9	40.0	34.9	39.3	35.2	37.1	32.9
Diameter (mm)	2.78	2.77	2.74	2.77	2.55	2.77	2.62	2.71	2.53
Sedimentation (cc)	13.2	16.0	22.6	17.4	12.5	16.6	10.8	16.2	11.6
Falling Number (sec)	316	315	323	317	355	315	316	335	338
FLOUR DATA:									
Lab Mill Extraction (%)	73.2	72.8	70.0	72.1	72.8	72.5	76.9	73.9	74.6
Color: L*	92.9	92.9	92.9	92.9	92.6	93.0	92.3	92.3	92.1
a*	-2.1	-2.1	-2.0	-2.1	-2.0	-2.2	-2.1	-2.2	-2.2
b*	8.2	8.3	8.0	8.2	8.2	8.5	8.9	7.9	7.9
Protein (%) 14%/0% moisture basis	7.3/8.5	8.6/10.0	10.2/11.9	8.9/10.3	8.9/10.3	8.1/9.4	8.0/9.3	9.0/10.5	9.1/10.6
Ash (%) 14%/0% moisture basis	0.47/0.55	0.44/0.51	0.45/0.52	0.45/0.52	0.47/0.55	0.41/0.49	0.41/0.48	0.45/0.52	0.47/0.54
Wet Gluten (%)	17.5	23.8	29.6	24.5	21.2	22.2	17.5	24.5	23.3
Gluten Index	79	76	73	76	58	83	55	65	36
Falling Number (sec)	321	339	314	330	347	344	349	365	377
Amylograph Viscosity 65 g (BU)	463	476	515	485	523	492	415	505	507
Starch Damage (%)	4.1	3.8	3.3	3.7	3.2	3.5	3.4	4.1	3.7
SRC: GPI	0.56	0.59	0.64	0.60	0.46	0.62	0.46	0.59	0.48
Water/50% Sucrose	48/91	53/89	52/95	52/91	50/90	53/90	52/94	55/101	53/95
5% Lactic Acid / 5% Na ₂ CO ₃	99/87	107/93	122/94	110/92	81/87	102/75	77/76	106/78	81/73
DOUGH PROPERTIES:									
Farinograph: Peak Time (min)	1.2	1.7	1.9	1.7	1.2	2.7	1.5	2.7	1.7
Stability (min)	1.2	2.7	3.1	2.6	1.5	2.9	1.4	2.8	1.3
Absorption (%)	51.1	52.1	53.1	52.2	50.2	52.2	49.9	53.4	52.0
Alveograph: P (mm)	30	30	30	30	18	32	21	39	28
L (mm)	92	124	157	129	102	121	79	99	72
P/L Ratio	0.33	0.24	0.19	0.23	0.18	0.26	0.27	0.41	0.40
W (10 ⁻⁴ J)	68	82	100	85	35	83	31	96	45
Extensograph: Resistance (BU)	217	236	251	238	142	221	118	191	102
(45 min) Extensibility (cm)	16.7	20.7	22.1	20.5	20.1	18.9	14.2	18.1	16.7
Area (cm ²)	57	74	82	74	40	62	20	51	24
BAKING EVALUATION:									
Sponge Cake: Volume (cc)	1188	1101	1069	1104	1141	1070	1115	1166	1196
Score	56	45	37	44	53	47	53	45	47
Cookie: Diameter (cm)	9.0	8.8	8.7	8.8	9.0	9.2	9.6	8.7	9.1
Spread Ratio (width/height)	11.1	10.3	9.6	10.2	11.9	9.5	11.1	9.4	11.1
Pan Bread: Bake Absorption (%) ²			59.3						
Crumb Grain and Texture (1-10) ²			5.0						
Loaf Volume (cc) ¹			762						
CHINESE SOUTHERN-TYPE STEAMED BREAD EVALUATION:									
Specific Volume (ml/g)	1.9	2.0	2.1	2.0	2.1	2.1	2.2	2.2	2.3
Total Score	69.0	69.0	69.0	69.0	62.0	63.4	62.0	67.0	64.9
PRODUCTION OF 3 STATES (%)	14	58	28	100	100	100	100	100	100

¹Protein Range: Low, <9.0%; Medium, 9.0 - 10.5%; High, >10.5%.

²Bread Bake for High Protein SW only

EXPORT CARGO DATA

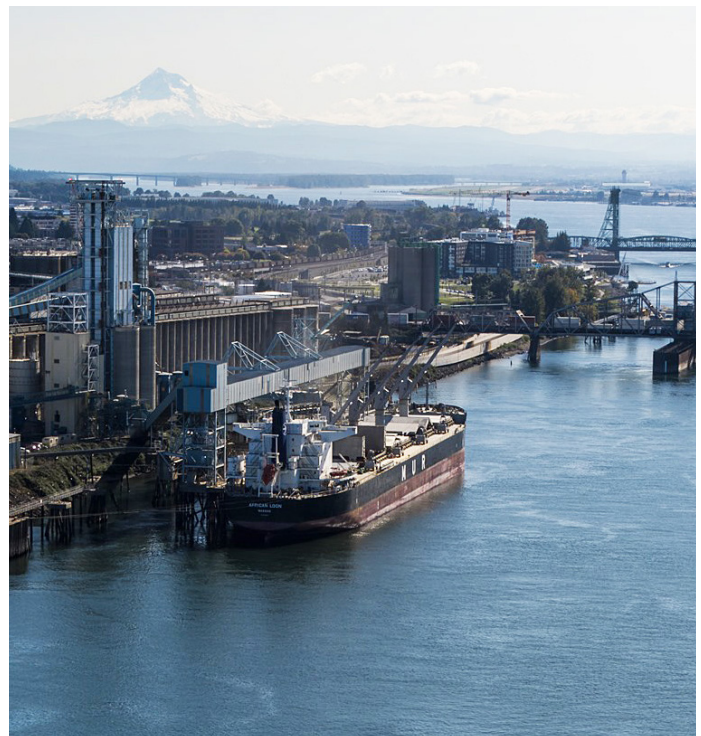
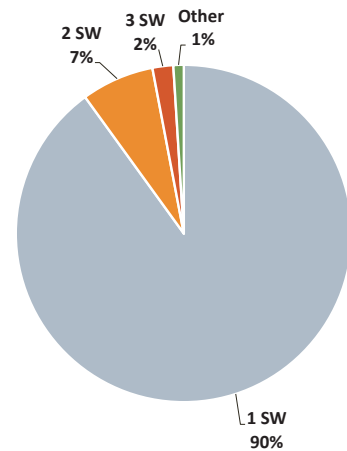
	2018	2017
WHEAT GRADE DATA:		
Test Weight (lb/bu)	63.2	62.5
(kg/hl)	83.1	82.2
Damaged Kernels (%)	0.1	0.1
Foreign Material (%)	0.0	0.0
Shrunken & Broken (%)	0.7	0.9
Total Defects (%)	0.8	1.0
Grade	1 SW	1 SW
WHEAT NON-GRADE DATA:		
Dockage (%)	0.3	0.3
Moisture (%)	8.0	8.5
Protein (%) 12%/0% moisture basis	9.3/10.6	9.8/11.1
Ash (%) 14%/0% moisture basis	1.28/1.48	1.31/1.53
1000 Kernel Weight (g)	39.3	37.3
Kernel Size (%) lg/md/sm	89/11/0	84/16/0
Single Kernel: Hardness		32.4
Weight (mg)		38.0
Diameter (mm)		2.70
Sedimentation (cc)	14.4	15.2
Falling Number (sec)	341	367
FLOUR DATA:		
Lab Mill Extraction (%)	74.3	74.6
Color: L*	92.7	92.5
a*	-2.0	-1.9
b*	8.0	8.0
Protein (%) 14%/0% moisture basis	8.2/9.5	8.6/10.0
Ash (%) 14%/0% moisture basis	0.42/0.49	0.46/0.53
Wet Gluten (%)	20.2	21.1
Gluten Index	79	66
Falling Number (sec)	378	391
Amylograph Viscosity 65 g (BU)	483	517
Starch Damage (%)		
SRC: GPI		
Water/50% Sucrose		
5% Lactic Acid / 5% Na ₂ CO ₃		
DOUGH PROPERTIES:		
Farinograph: Peak Time (min)	1.6	1.9
Stability (min)	3.1	3.1
Absorption (%)	51.6	51.4
Alveograph: P (mm)	32	37
L (mm)	90	90
P/L Ratio	0.35	0.41
W (10 ⁻⁴ J)	77	84
Extensograph: Resistance (BU)		
(45 min) Extensibility (cm)		
Area (cm ²)		
BAKING EVALUATION:		
Sponge Cake: Volume (cc)	1205	1080
Score	51	44
Cookie: Diameter (cm)	8.6	8.6
Spread Factor (width/height)		
Pan Bread: Bake Absorption (%) ¹		
Crumb Grain and Texture (1-10) ¹		
Loaf Volume (cc) ¹		
CHINESE SOUTHERN-TYPE STEAMED BREAD EVALUATION:		
Specific Volume (ml/g)		
Total Score		
SAMPLE COUNT:	61	90



EXPORT CARGO SURVEY

The export cargo data represent 61 individual subplot samples provided by USDA's Federal Grain Inspection Service for crop year 2018 (August 2018 through May 2019) and 90 samples for 2017 all from PNW ports. Grade data are the official grades on the individual sublots. Wheat Marketing Center conducted the milling and processing analyses.

SW DISTRIBUTION BY GRADE



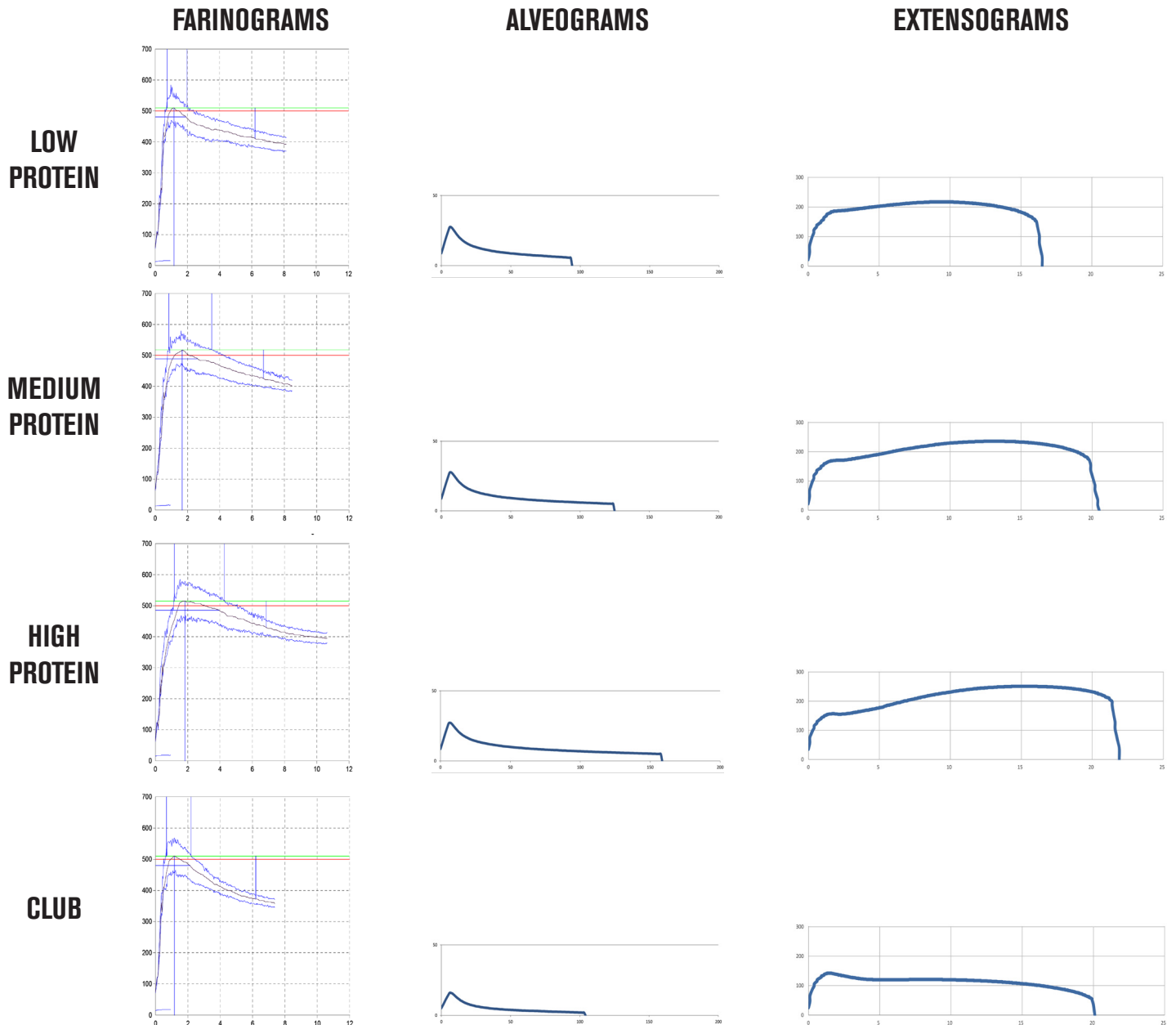
SOFT WHITE

PACIFIC NORTHWEST SOFT WHITE WHEAT PRODUCTION FOR THE MAJOR PRODUCING STATES (MILLION METRIC TONS)

	2019		2018		2017		2016		2015	
	SW	CLUB	SW	CLUB	SW	CLUB	SW	CLUB	SW	CLUB
Washington	3.1	0.1	3.0	0.3	2.8	0.3	3.1	0.4	2.3	0.2
Oregon	1.2	0.0	1.2	0.0	1.1	0.0	1.0	0.0	1.0	0.0
Idaho	1.6	0.0	1.5	0.0	1.4	0.0	1.7	0.0	1.5	0.0
Three-State Total	5.9	0.2	5.7	0.4	5.3	0.4	5.8	0.5	4.7	0.3
Three-State Total Soft White Wheat	6.1		6.1		5.7		6.3		5.0	
Total US Soft White Wheat	6.6		6.5		6.2		6.9		5.4	

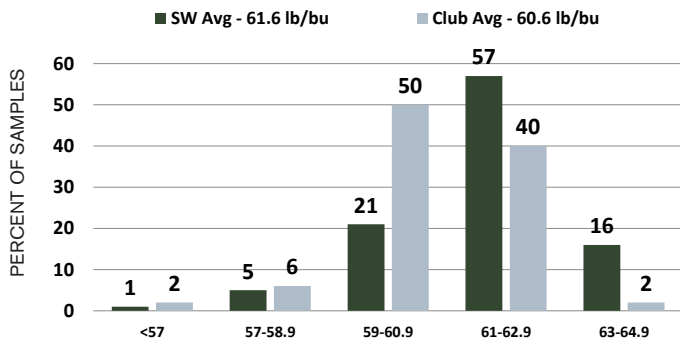
Based on USDA crop estimates as of September 30, 2019.

SOFT WHITE DOUGH PROPERTIES

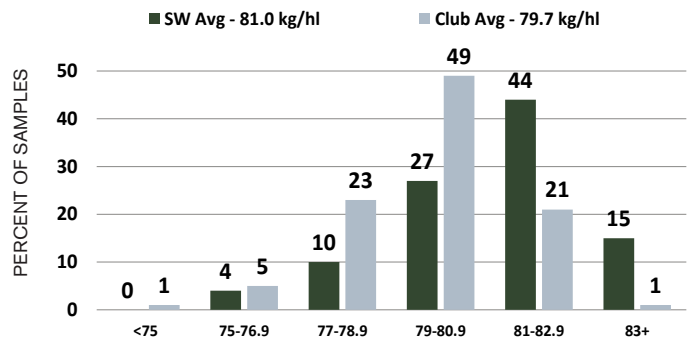




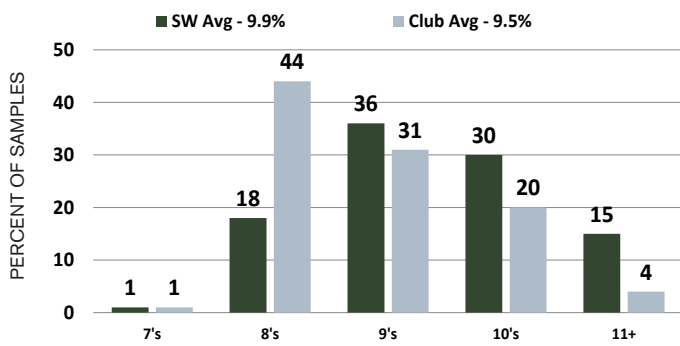
TEST WEIGHT Pounds/Bushel



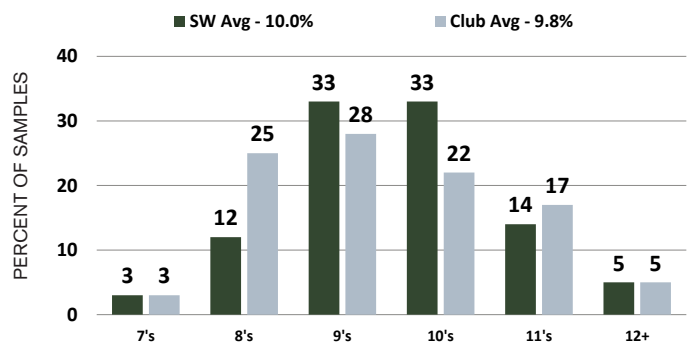
HECTOLITER WEIGHT Kilograms/Hectoliter



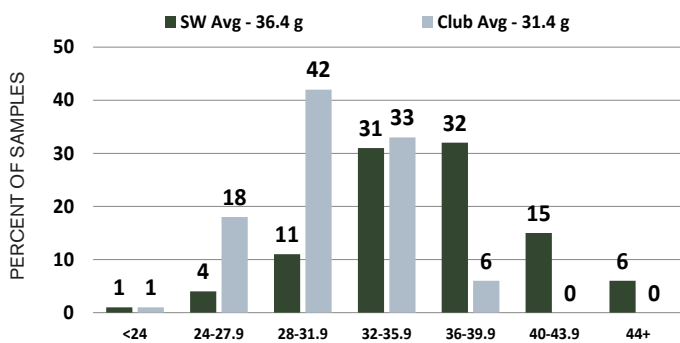
WHEAT MOISTURE Percent



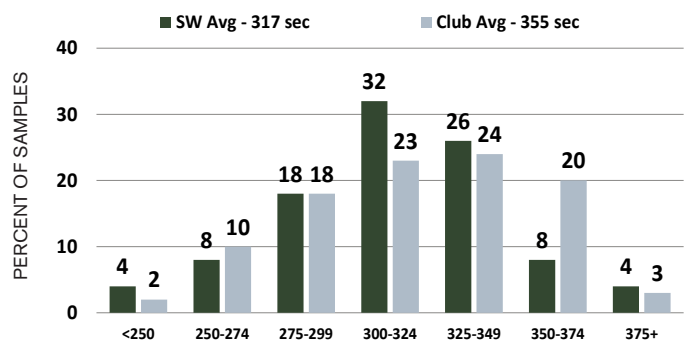
PROTEIN (12% MB) Percent



1000 KERNEL WEIGHT Grams



FALLING NUMBER Seconds





SOFT RED WINTER

SRW is a profitable choice for producing a wide range of confectionary products like cookies, crackers and cakes and for blending for baguettes and other bread products.



261

Samples collected from elevators in 18 reporting areas.

Test weight, moisture, protein, 1000 kernel weight, wheat ash and falling number were determined on each sample, and DON on a portion of the samples. The remaining tests were determined on 18 composite samples. Results were weighted by estimated production for each reporting area and combined into Composite, East Coast and Gulf Port averages. Gulf Port States and East Coast states are highlighted on the map below. The methods are described in the Analysis Methods section of this booklet.



Great Plains Analytical Laboratory in Kansas City, MO, collected the samples and conducted the quality analyses.

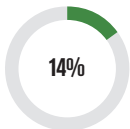
11

STATES SURVEYED

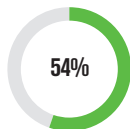
68%

OF TOTAL SRW PRODUCTION REPRESENTED

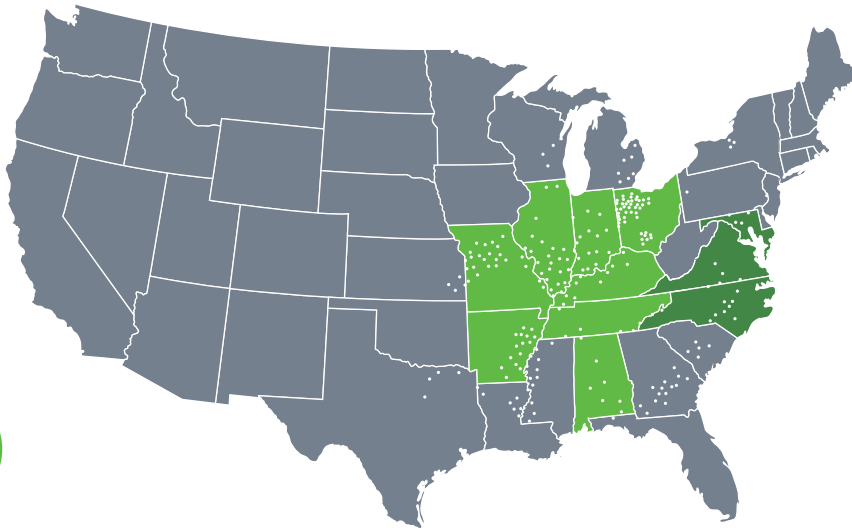
PERCENTAGE OF TOTAL U.S. SRW PRODUCTION BY EXPORT TRIBUTARY REGION.



EAST COAST



GULF PORT



HARVEST SURVEY

OVERVIEW: Some Soft Red Winter (SRW) production areas, especially in the Gulf Port states, experienced difficult growing conditions in 2019 with excessive moisture affecting test weight, falling number (FN) and DON values. Processors should find good qualities for cookies and crackers and segments of the crop with good cake qualities. Buyers are encouraged to review their quality specifications to ensure that their purchases meet their expectations.

WEATHER AND HARVEST: SRW is grown over a wide area of the eastern United States. The area seeded to SRW in fall 2018 for the 2019 harvest is estimated by USDA at 5.54 million acres (2.24 million hectares), down from 6.08 million acres (2.46 million hectares) seeded for the 2018 harvest, well below the average SRW planted area of the past five years. The reduced area is attributed mainly to choices made by growers based on commodity prices. The 2019 SRW production, estimated at 7.01 million metric tons (MMT), is down from 7.77 MMT in 2018 and well below the 5-year average.

Planting started at a normal pace but slowed as fall progressed due to extensive precipitation. In the six SRW survey states where USDA estimates wheat crop conditions, by late fall the winter wheat crop was rated 58% good to excellent and 92% fair to excellent. Much of the SRW growing area received excessive moisture throughout the winter and spring, and rain continued to cause lengthy harvest delays in many areas. The excessive moisture adversely affected quality by reducing test weight and increasing DON

values in some areas. In addition, the average yield per harvested acre is estimated to be below last year and the 5-year average, reflecting the excessive moisture received during the growing season.

WHEAT AND GRADE DATA: The overall average grade of the samples collected for the 2019 SRW harvest survey is U.S. No. 2. The average test weight is 58.1 lb/bu (76.5 kg/hl), equal to the 5-year average and above the 57.9 lb/bu (76.2 kg/hl) average in 2018. The Gulf Port average of 58.5 lb/bu (76.9 kg/hl) is above both last year and the 5-year average. The East Coast test weight average of 56.9 lb/bu (75.0 kg/hl) is above last year but below the 5-year average of 57.4 lb/bu (75.6 kg/hl).

The East Coast total defects average of 2.5% is above last year and the 5-year average, indicating that damaged and shrunken and broken kernels are slightly higher than usual in that portion of the crop. The Gulf Port total defects is 1.1%, above 2018 but almost half of the 5-year average. Other Gulf Port grade factors, dockage and moisture are similar to or higher than 2018 and 5-year average values.

The Composite average wheat protein content of 9.5% (12% mb) is lower than 2018's 9.9% and the 5-year average of 9.7%. Both the Gulf Port protein average of 9.4% and East Coast average of 9.7% are below the respective 2018 and 5-year averages. The Composite average FN of 288 sec is significantly lower than 2018 and the 5-year averages. The Gulf Port average of 289 sec and the East Coast average of 283 sec are both

significantly below 2018 and the 5-year averages. Approximately 21% of samples had a FN below 250 sec in 2019, with 13% below 225. The Composite DON average of 1.3 ppm is above the 2018 average but similar to the 5-year average of 1.2 ppm. The East Coast value of 0.5 ppm is below the 5-year average while the Gulf Port value of 1.5 ppm is above the 5-year average. Of the samples tested for DON, 33% of the Gulf Port results and 84% of the East Coast results were less than 1.0 ppm.

FLOUR AND BAKING DATA: The Composite, East Coast and Gulf Port Buhler laboratory mill flour extraction averages are below 2018 and the 5-year averages. The farinograph peak and absorption values are similar to 5-year averages, but the stability values are all below the 5-year averages. The SRC values generally indicate good quality for cookies. The Composite, East Coast and Gulf Port alveograph L averages of 81 are lower than last year and the 5-year average, indicating lower extensibility. All other alveograph averages are similar to the respective 5-year averages given the variability of alveograph analysis. The Gulf amylograph average of 392 BU and East average of 462 indicate relatively high levels of amylase activity in the crop and are consistent with the low falling numbers. The Composite, East Coast and Gulf Port cookie spread ratios are all higher than last year and the 5-year averages, indicating good extensibility. Average loaf volumes are all lower than last year and the 5-year averages.



SOFT RED WINTER

HARVEST DATA	COMPOSITE AVERAGE			EAST COAST ¹			GULF PORTS ¹		
	2019	2018	5-YEAR AVERAGE	2019	2018	5-YEAR AVERAGE	2019	2018	5-YEAR AVERAGE
WHEAT GRADE DATA:									
Test Weight (lb/bu)	58.1	57.9	58.1	56.9	56.6	57.4	58.5	58.2	58.3
(kg/hl)	76.5	76.2	76.5	75.0	74.5	75.6	76.9	76.6	76.7
Damaged Kernels (%)	0.6	0.5	1.4	1.4	1.3	1.2	0.4	0.4	1.4
Foreign Material (%)	0.1	0.0	0.1	0.2	0.1	0.1	0.1	0.0	0.1
Shrunken & Broken (%)	0.8	0.5	0.5	1.5	0.6	0.6	0.6	0.5	0.5
Total Defects (%)	1.4	1.1	2.0	2.5	2.0	1.9	1.1	0.8	2.1
Grade	2 SRW	3 SRW	2 SRW	3 SRW	3 SRW	3 SRW	2 SRW	2 SRW	2 SRW
WHEAT NON-GRADE DATA:									
Dockage (%)	0.4	0.4	0.5	0.4	0.3	0.5	0.4	0.4	0.5
Moisture (%)	13.7	12.8	12.9	13.6	13.1	12.8	13.7	12.7	12.9
Protein (%) 12%/0% moisture basis	9.5/10.8	9.9/11.3	9.7/11.0	9.7/11.0	10.2/11.6	10.0/11.3	9.4/10.7	9.9/11.3	9.7/11.0
Ash (%) 14%/0% moisture basis	1.37/1.59	1.45/1.69	1.46/1.70	1.39/1.62	1.43/1.66	1.46/1.70	1.37/1.59	1.45/1.69	1.46/1.70
1000 Kernel Weight (g)	31.8	29.9	31.9	31.7	30.8	32.4	31.8	29.7	31.8
Kernel Size (%) lg/md/sm	85/14/01	77/21/02	83/16/01	84/14/02	74/22/04	83/16/01	85/14/01	78/21/01	83/16/01
Single Kernel: Hardness	18.7	17.3	21.4	17.5	15.0	18.7	19.0	17.8	22.0
Weight (mg)	33.7	33.2	33.6	34.0	34.0	34.0	33.7	33.0	33.5
Diameter (mm)	2.66	2.59	2.61	2.64	2.59	2.62	2.67	2.59	2.62
Sedimentation (cc)	10.5	11.4	12.2	10.5	11.7	12.9	10.5	11.3	12.1
Falling Number (sec)	288	322	309	283	301	318	289	327	307
DON (ppm)	1.3	0.7	1.2	0.5	1.1	0.9	1.5	0.7	1.3
FLOUR DATA:									
Lab Mill Extraction (%)	67.5	68.0	69.5	67.6	67.9	69.5	67.4	68.0	69.5
Color: L*	91.0	91.0	91.3	91.1	90.7	91.6	91.0	91.1	91.3
a*	-2.4	-2.2	-2.5	-2.4	-2.2	-2.6	-2.4	-2.2	-2.5
b*	9.1	8.8	8.6	8.9	8.8	8.8	9.1	8.8	8.5
Protein (%) 14%/0% moisture basis	7.5/8.7	8.5/9.9	8.1/9.4	7.7/8.9	8.4/9.8	8.3/9.7	7.4/8.6	8.5/9.9	8.1/9.4
Ash (%) 14%/0% moisture basis	0.44/0.51	0.47/0.55	0.45/0.53	0.44/0.52	0.46/0.53	0.45/0.52	0.44/0.51	0.47/0.55	0.46/0.53
Wet Gluten (%)	20.5	23.6	22.2	21.6	23.0	22.6	20.2	23.7	22.1
Gluten Index	88	80	82	88	74	81	88	82	82
Falling Number (sec)	286	322	309	291	301	317	285	327	307
Amylograph Viscosity 65 g (BU)	406	568	481	462	371	436	392	614	493
Starch Damage (%)	3.3	5.5	5.0	3.4	5.0	4.7	3.2	5.6	5.1
SRC: GPI	0.65	0.59	0.58	0.66	0.60	0.56	0.65	0.59	0.58
Water / 50% Sucrose	54/99	57/109	57/110	52/96	56/113	59/111	55/99	57/108	57/109
5% Lactic Acid / 5% Na ₂ CO ₃	111/72	113/81	112/81	109/70	118/83	110/84	111/72	111/81	110/81
DOUGH PROPERTIES:									
Farinograph: Peak Time (min)	1.1	1.2	1.3	1.3	1.2	1.4	1.0	1.2	1.3
Stability (min)	1.7	1.8	2.3	1.9	1.7	2.3	1.6	1.8	2.4
Absorption (%)	52.5	51.9	52.6	52.2	52.6	53.2	52.6	51.7	52.5
Alveograph: P (mm)	37	34	36	39	35	37	37	34	36
L (mm)	81	97	90	81	93	90	81	98	90
P/L Ratio	0.46	0.35	0.40	0.48	0.38	0.41	0.46	0.34	0.40
W (10 ⁻⁴ J)	80	81	81	84	79	82	79	81	80
Extensograph: Resistance (BU)	151	182	180	158	152	172	149	188	182
(45 min) Extensibility (cm)	16.4	15.3	16.1	16.8	15.9	16.6	16.3	15.2	16.0
Area (cm ²)	43	48	50	46	42	50	42	49	50
BAKING EVALUATION:									
Cookie: Diameter (cm)	9.0	8.7	9.6	9.0	8.4	9.5	9.0	8.8	9.6
Spread Ratio (width/height)	9.9	9.3	9.2	9.6	8.5	8.6	10.0	9.5	9.4
Pan Bread: Bake Absorption (%)	54.3	53.7	54.6	54.0	54.4	54.9	54.3	53.5	54.6
Crumb Grain and Texture (1-10)	4.8	4.8	5.1	5.1	4.8	5.1	4.7	4.8	5.1
Loaf Volume (cc)	711	735	720	719	738	733	709	734	717
PRODUCTION OF 11 STATES (%):	100			20			80		

¹East Coast - Maryland, Virginia and North Carolina; Gulf Ports - Alabama, Arkansas, Illinois, Indiana, Kentucky, Missouri, Ohio and Tennessee

EXPORT CARGO DATA

2019 2018

WHEAT GRADE DATA:		
Test Weight (lb/bu)	59.0	58.8
(kg/hl)	77.7	77.3
Damaged Kernels (%)	1.7	1.8
Foreign Material (%)	0.1	0.1
Shrunken & Broken (%)	0.6	1.0
Total Defects (%)	2.5	2.9
Grade	2 SRW	2 SRW
WHEAT NON-GRADE DATA:		
Dockage (%)	0.8	0.8
Moisture (%)	12.7	12.0
Protein (%) 12%/0% moisture basis	9.6/10.9	10.0/11.4
Ash (%) 14%/0% moisture basis	1.39/1.61	1.47/1.71
1000 Kernel Weight (g)	32.8	28.5
Kernel Size (%) lg/md/sm	88/11/1	79/20/1
Single Kernel: Hardness		
Weight (mg)		
Diameter (mm)		
Sedimentation (cc)	9.1	10.0
Falling Number (sec)	299	338
DON (ppm)		
FLOUR DATA:		
Lab Mill Extraction (%)	66.6	67.7
Color: L*	91.6	90.8
a*	-2.2	-2.1
b*	8.6	8.6
Protein (%) 14%/0% moisture basis	7.4/8.6	7.9/9.2
Ash (%) 14%/0% moisture basis	0.43/0.50	0.44/0.51
Wet Gluten (%)	19.4	21.4
Gluten Index	92	92
Falling Number (sec)	306	353
Amylograph Viscosity 65 g (BU)	435	739
Starch Damage (%)		
SRC: GPI		
Water / 50% Sucrose		
5% Lactic Acid/5% Na ₂ CO ₃		
DOUGH PROPERTIES:		
Farinograph: Peak Time (min)	1.1	1.1
Stability (min)	1.5	1.6
Absorption (%)	51.4	52.2
Alveograph: P (mm)	42	45
L (mm)	61	89
P/L Ratio	0.68	0.51
W (10 ⁻⁴ J)	81	107
Extensograph: Resistance (BU)		
(45 min) Extensibility (cm)		
Area (cm ²)		
BAKING EVALUATION:		
Cookie: Diameter (cm)		
Spread Ratio (width/height)	53.0	54.0
Pan Bread: Bake Absorption (%)	5.1	5.0
Crumb Grain and Texture (1-10)	734.4	734.3
Loaf Volume (cc)	10	10
SAMPLE COUNT:		
	27	125



SOFT RED WINTER

SOFT RED WINTER PRODUCTION

FOR THE MAJOR PRODUCING STATES (MILLION METRIC TONS)

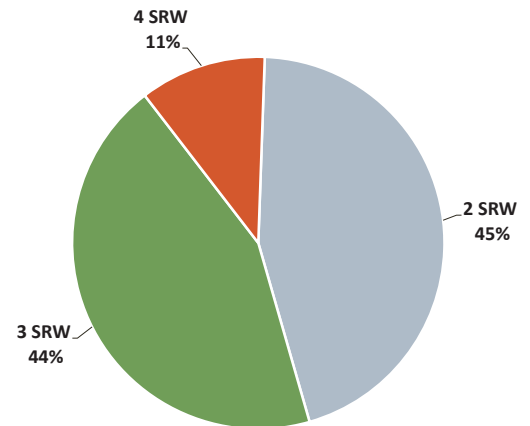
	2019	2018	2017	2016	2015
<i>Alabama</i>	0.2	0.2	0.2	0.3	0.4
<i>Arkansas</i>	0.1	0.1	0.2	0.2	0.4
<i>Georgia</i>	0.1	0.1	0.1	0.1	0.2
<i>Illinois</i>	1.0	1.0	1.0	0.9	0.9
<i>Indiana</i>	0.4	0.5	0.5	0.6	0.5
<i>Kentucky</i>	0.7	0.5	0.6	0.9	0.9
<i>Maryland</i>	0.3	0.3	0.4	0.5	0.5
<i>Michigan</i>	0.6	0.6	0.5	0.8	0.7
<i>Missouri</i>	0.7	0.8	1.0	1.1	0.9
<i>North Carolina</i>	0.3	0.6	0.6	0.4	0.8
<i>New York</i>	0.1	0.2	0.2	0.2	0.2
<i>Ohio</i>	0.6	0.9	0.9	1.2	0.9
<i>Pennsylvania</i>	0.3	0.3	0.3	0.3	0.3
<i>Tennessee</i>	0.4	0.5	0.5	0.7	0.7
<i>Virginia</i>	0.2	0.3	0.3	0.3	0.4
<i>Wisconsin</i>	0.3	0.4	0.3	0.5	0.4
Surveyed-States Total*	4.9	5.8	6.1	7.0	7.2
Sixteen-State Total	6.3	7.3	7.5	9.0	8.9
Total SRW Production	6.5	7.8	7.9	9.4	9.8

Based on USDA crop estimates as of September 30, 2019.

*Eleven states denoted by italics were surveyed accounting for 68% of 2019 SRW

DISTRIBUTION BY GRADE

(BASED ON 18 COMPOSITE SAMPLES)



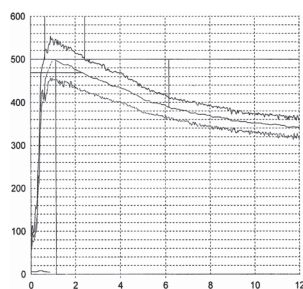
EXPORT CARGO SURVEY

The export cargo data represent 152 subplot samples provided by USDA's Federal Grain Inspection Service for Export for crop years 2019 and 2018 from Gulf of Mexico and East Coast ports. Grade data are the official grades on the individual subplots. Great Plains Analytical Laboratory conducted the milling and baking analyses.

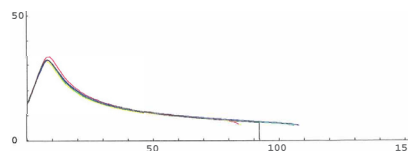
REGIONAL DOUGH PROPERTIES

EAST COAST & GULF

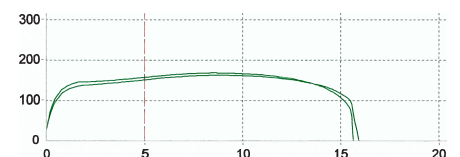
FARINOGRAM



ALVEOGRAM



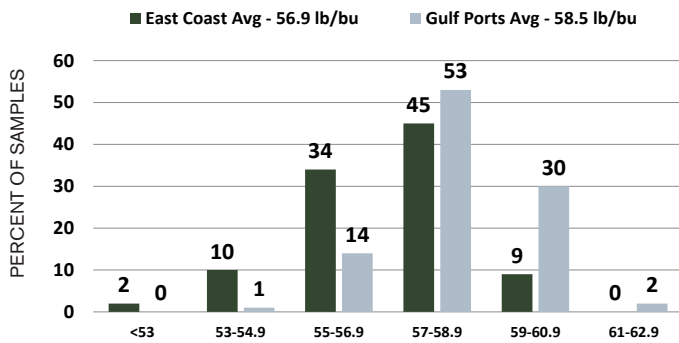
EXTENSOGRAM





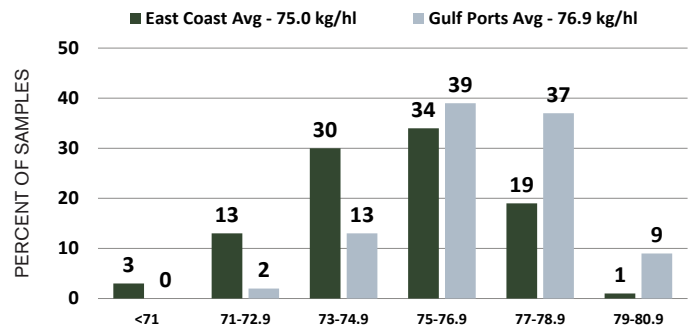
TEST WEIGHT

Pounds/Bushel



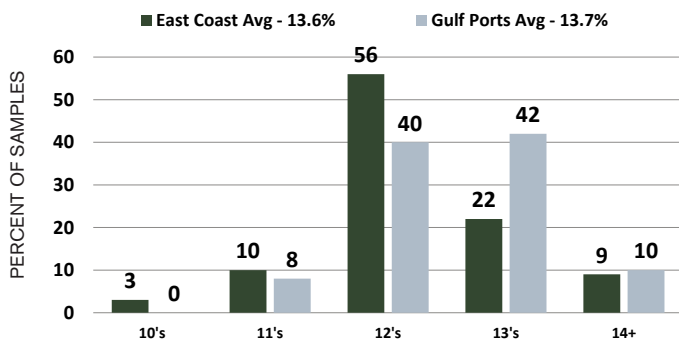
HECTOLITER WEIGHT

Kilograms/Hectoliter



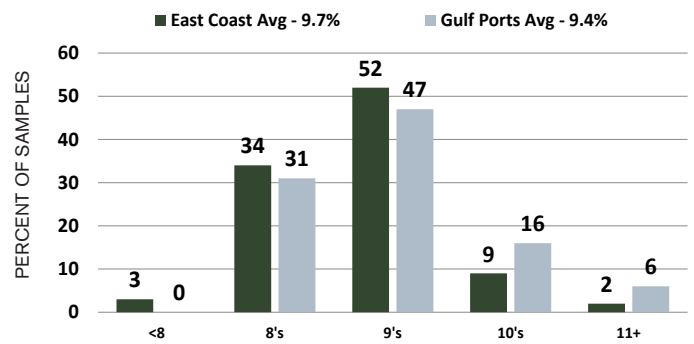
WHEAT MOISTURE

Percent



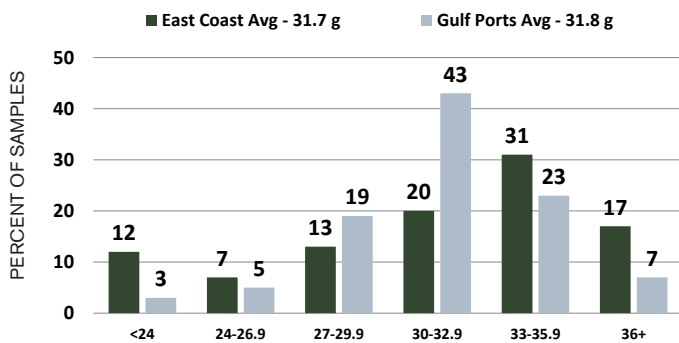
PROTEIN (12% MB)

Percent



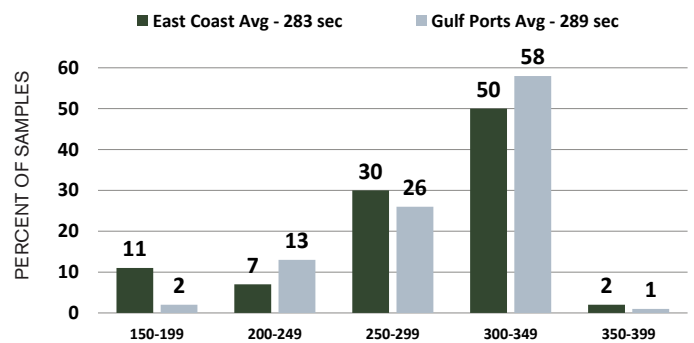
1000 KERNEL WEIGHT

Grams



FALLING NUMBER

Seconds





DURUM

Hardest of all wheats, durum has a rich amber color and high gluten content. Hard Amber Durum (HAD) sets the “gold standard” for premium pasta products, couscous and some Mediterranean breads.



NORTHERN DURUM

166

Collected from fields, farm bins and local elevators by the National Agricultural Statistics Service.

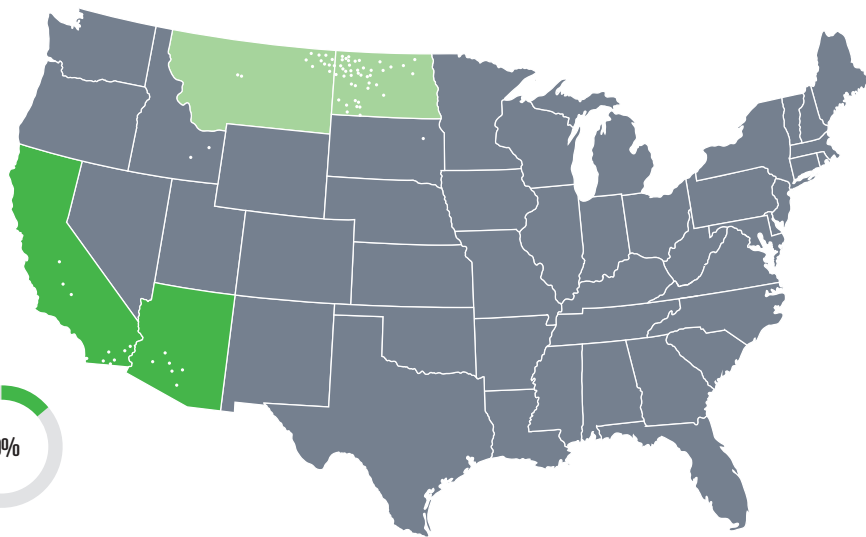
Official grade, test weight, vitreous kernel, 1000 kernel weight, protein and falling number were determined on each sample. The remaining tests were conducted on 6 composite samples categorized by growing region for Northern Durum. Northern Durum production area is highlighted on the map below. The methods are described in the Analysis Methods section of this booklet.



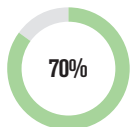
The Durum Quality Lab, North Dakota State University, Fargo, ND, conducted the quality analyses.

4
STATES SURVEYED

80%
OF TOTAL DURUM PRODUCTION REPRESENTED



PERCENTAGE OF TOTAL U.S. DURUM PRODUCTION BY REGION.



NORTHERN DURUM



DESERT DURUM®

DESERT DURUM®

7

Collected by a Federal Grain Inspection Service (FGIS) licensed inspection agency or submitted by handlers to a licensed agency.

All tests were conducted on each sample. Production-weighted results are reported. The Desert Durum® production area is highlighted on the map above. The methods are described in the Analysis Methods section of this booklet.



California Wheat Commission Laboratory conducted the quality analyses.

NORTHERN DURUM HARVEST SURVEY

OVERVIEW: U.S. Northern Plains durum production is down from 2018 with a reduction in quality due to late season rain and snow that also interrupted harvest. Due to unusual harvest conditions, the entire crop is not represented in this year's data. Ample carryover from the excellent quality 2018 crop will help meet traditional needs of buyers, but some parameters may still prove challenging. Buyers should be extra vigilant and evaluate the importance of each factor for their end-use needs.

WEATHER AND HARVEST: Planting was initially slow but was complete the first week of June; crop emergence was slow due to cool weather and overly dry topsoil. Southern growing areas benefitted from frequent rains in June, while dryness stressed northern areas. Mid-season rain in the northern areas boosted development and yield potential but elevated disease pressures.

Harvest began in mid-August, well behind average. Cool temperatures and delayed crop development slowed harvest progress but did not affect quality. However, with historic rainfall less than 50% of the crop had been harvested by mid-September. The adverse weather continued into October, including periods of heavy snow, compromising quality on a large portion of the crop.

Regional production is estimated at 52 mil bu (1.4 MMT), down 20% from

2018. Final production will likely be lower, as roughly 20% of the crop remained unharvested as of mid-October. With only 77% of expected samples collected and analyzed and a higher than normal percentage of the crop moving directly into feed channels, this report does not represent the entire crop.

WHEAT AND GRADE DATA: The average grade of the survey samples is U.S. No. 2 Amber Durum (AD); 37% of them grade U.S. No. 1 or 2 Hard Amber Durum (HAD), down from 86% a year ago. Average test weight of 61.1 lb/bu (79.6 kg/hl) is similar to 2018 and above the 5-year average. The total kernel defects average of 3% is higher than 2018 and the 5-year average, likely due to elevated disease pressures and damage from the prolonged harvest.

The average vitreous kernel (HVAC) content is 64%, down sharply from 90% in 2018. Harvest rains and localized lower protein levels led to reduced HVAC levels. Protein averages 13.9% (12% mb), equal to the 5-year average but down from 2018. Distribution data shows that nearly 25% of the crop is above 90% HVAC and 38% is above 75% HVAC.

Excellent conditions during kernel development are reflected in the crop average thousand kernel weight (TKW) of 44 g and the percent of large kernels, which is notably higher than last year and 5-year averages. The average falling

number of 345 sec compares to 425 in 2018 with 75% of the crop above 300 sec. Disease pressures were higher in 2019, with some areas impacted by Fusarium. The crop average DON is 0.6 ppm, up from 0.2 ppm last year, but slightly below the 5-year average.

SEMOLINA AND PROCESSING DATA: Milling for the 2019 survey was performed on a Quadromat® Junior mill, limiting direct comparisons to the Buhler laboratory mill used previously. Semolina extraction is 57.5%, down sharply from 2019, likely attributable to the notable decline in vitreous kernels and shift in milling equipment. Semolina shows a marked decline in ash levels, 0.6%, with just a slight increase in speck counts compared to 2019. Gluten index values are higher at 67% compared to 57% in 2018.

Semolina and cooked spaghetti evaluations show lower values compared to last year and the 5-year averages. Semolina color values are lower for both color and brightness, and cooked pasta scores are also lower. Mixing properties reveal a stronger crop with an average mixogram of 6.4 compared to 5.3 in 2018. Cooked pasta evaluations show higher cooked weight compared to the 5-year average, but also higher cooking loss and less cooked firmness.

DESERT DURUM® HARVEST SURVEY

OVERVIEW: Desert Durum® is a registered certification mark of the Arizona Grain Research and Promotion Council and the California Wheat Commission, which authorize its use only to designate durum grown under irrigation in the desert valleys and lowlands of Arizona and California.

Desert Durum® can be produced and delivered "identity preserved" to domestic and export markets, which allows customers to purchase grain with quality traits specific to their processing needs. Annual requirements can be pre-contracted with grain merchandisers ahead of the fall-winter planting season for harvest in late May through early July. Varietal identity is maintained by experienced growers planting certified seed and merchandisers who store and

ship according to customers' preferred delivery schedules.

Desert Durum® production acreage in 2019 was greater compared to 2018. According to USDA, yields were above average, and quality was uniformly good. In California, the varieties Tiburon and Desert King HP accounted for approximately 32% and 26%, respectively, of all durum planted acreage in California.

WHEAT AND GRADE DATA: In 2019, the average grade is U.S. No. 1 Hard Amber Durum (HAD). Test weight average is 63.0 lb/bu (82.0 kg/hl). The average vitreous kernel content (HVAC) is 98.2%, a high average typical of Desert Durum®. Average damaged kernels are 0.1% and total defects are 0.7%. Desert Durum® is characterized by its low moisture content

and this year's average is 6.8%. Protein content average is 13.8% (12% mb).

SEMOLINA AND PROCESSING DATA: The semolina b* value is 29.2, similar to 2018 b* value of 30.5. Wet gluten is 34.7% and gluten index is 70. Semolina mixograph score is 8 and alveograph W value is 212 (10⁻⁴ J), both of which indicate high strength. Pasta color b* value is 41 and score is 8.9. Pasta cooked firmness is 6.8, similar to 2018.

SUMMARY: Desert Durum® exhibits consistently large kernels and low moisture, traits that contribute to efficient transportation costs and high extraction rates. The 2019 crop will deliver the valuable milling, semolina and pasta quality traits that customers have learned to expect and appreciate.

HARVEST DATA

EXPORT CARGO DATA

	NORTHERN DURUM						DESERT DURUM®			
	NORTHERN DURUM			DESERT DURUM®			NORTHERN DURUM		DESERT DURUM®	
	2019	2018	5-Year Avg	2019	2018	5-Year Avg	2018	2017	2018	2017
WHEAT GRADE DATA:										
Test Weight (lb/bu)	61.1	61.4	60.5	63.0	62.8	62.7	61.6	61.1	62.3	62.0
(kg/hl)	79.6	79.9	78.8	82.0	81.8	81.8	80.2	79.5	81.1	80.7
Damaged Kernels (%)	2.3	0.3	0.4	0.1	0.2	0.2	1.5	2.5	0.8	0.5
Foreign Material (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1
Shrunken and Broken (%)	0.7	0.7	1.0	0.5	0.4	0.5	1.0	1.3	0.7	0.6
Total Defects (%)	3.0	1.0	1.3	0.7	0.6	0.8	2.5	3.9	1.7	1.3
Contrasting Classes (%)	0.0	0.4	0.3	0.0	0.0	0.0	1.0	0.9	0.1	0.1
Vitreous Kernels (%)	64	90	87	98	98	96	80	69	97	97
Grade	2 AD	1 HAD	1HAD	1 HAD	1 HAD	1 HAD	1 HAD	2 AD	1 HAD	1 HAD
WHEAT NON-GRADE DATA:										
Dockage (%)	1.3	0.7	0.7	0.3	0.3	0.4	0.4	0.5	0.4	0.5
Moisture (%)	12.2	11.2	11.5	6.6	6.7	6.8	12.0	11.8	6.9	6.8
Protein (%) 12%/0% moisture basis	13.9/15.8	14.5/16.4	13.9/15.8	13.8/15.7	13.4/15.2	13.6/15.5	14.3/16.2	13.7/15.6	14.2/16.1	14.1/16.0
Ash (%) 14%/0% moisture basis	1.51/1.76	1.54/1.79	1.57/1.83	1.70/1.93	1.70/1.93	1.71/1.98	1.63/1.89	1.58/1.84	1.70/1.97	1.64/1.90
1000 Kernel Weight (g)	44.2	41.2	39.2	47.8	46.3	49.1	40.3	40.9	45.2	45.5
Kernel Size (%) lg/md/sm	59/38/3	54/43/3	49/48/3	91/9/0	91/9/0	91/9/0	56/41/3	50/46/4	69/29/2	68/30/2
Falling Number (sec)	345	425	384	699	615	582	421	439	1852	2196
Sedimentation (cc)	61	61	65	62	60	63				
DON (ppm)	0.6	<0.5	0.8					2.2		
SEMOLINA DATA:¹										
Lab Mill Extraction (%)		74.0		79.7	77.0	74.9		74.9		76.3
Semolina Extraction (%)	57.5	69.3	67.1	71.7	71.0	65.6	58.9	68.4	61.4	70.4
Color: L*	82.9	83.6	84	85.8	86.3	86.9	83.1	83.3	82.4	82.9
a*	-2.4	-2.5	-2.9	-3.2	-3.8	-2.7	-2.3	-2.2	-2.1	-2.1
b*	29.3	29.9	29.5	29.2	30.5	28.3	28.4	27.7	28.0	27.8
Protein (%) 14%/0% moisture basis	12.3/14.3	13.4/15.6	13.0/15.1	12.8/14.9	12.6/14.7	12.6/14.7	12.6/14.6	12.7/14.7	12.8/14.8	13.0/15.1
Ash (%) 14%/0% moisture basis	0.60/0.70	0.73/0.85	0.70/0.81	0.90/1.05	0.80/0.93	0.83/0.96	0.68/0.79	0.78/0.90	0.73/0.85	0.84/0.98
Specks (no/10 sq in)	31	29	27	20	21	24	28	34	28	33
Wet Gluten (%)	33.1	37.4	34.3	34.7	32.3	33.3				
Gluten Index	67	57	60	70	75	76	70	64	92	87
Mixograph: Classification	6.4	5.3	5.3	8.0	8.0	7.8	5.8	5.7	7.7	7.8
Peak Time (min)	3.2	2.9		3.0	3.5	3.0	3.6	3.0	4.4	3.5
Peak Height (MU)	5.0	5.8		5.5	5.6	6.1	5.1	5.4	5.5	5.9
Alveograph: P (mm)	101	73	84	105	112	108				
L (mm)	72	66	76	54	61	63				
P/L Ratio	1.5	1.2	1.2	2.1	2.0	1.8				
W (10 ⁻⁴ J)	255	162	211	212	231	239				
SPAGHETTI PROCESSING DATA:										
Color Score	7.8	8.3	8.7	8.9	9.6	8.9	7.7	7.7	7.9	8.2
Cooked Weight (g)	32.2	30.5	31.1	29.4	29.7	29.3	31.2	30.6	31.0	29.8
Cooking Loss (%)	7.1	5.7	6.1	5.5	5.3	5.5	6.7	6.1	6.4	6.0
Cooked Firmness (g cm)	3.8	4.5	4.4	6.7	6.9	6.4	3.8	4.5	4.3	5.3
SAMPLE COUNT:							18	15	7	10

¹ Comparable annual data are not available to determine 5-year averages for milling and pasta quality result. Correction factor was used to adjust Lab Mill Extraction (%) and Semolina Extraction (%) for 2019.

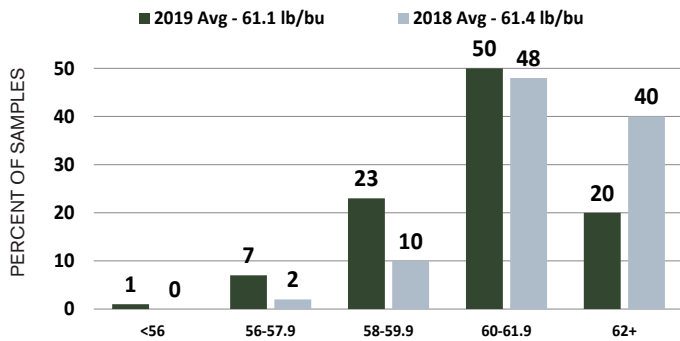
NOTE: Semolina extraction values for Desert Durum® and Northern Durum cannot be compared since they were milled using different laboratory mills. In contrast, milling data for the Durum Export Cargo samples can be compared to Northern Durum since these samples were milled on the same mill.



NORTHERN DURUM DISTRIBUTIONS

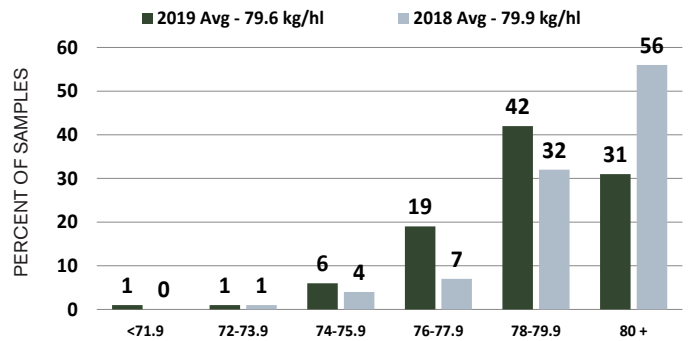
TEST WEIGHT

Pounds/Bushel



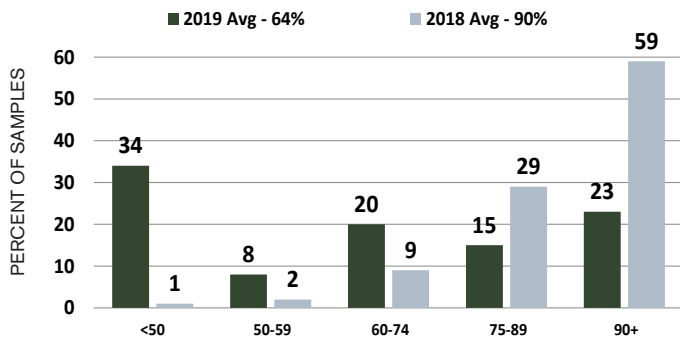
HECTOLITER WEIGHT

Kilograms/Hectoliter



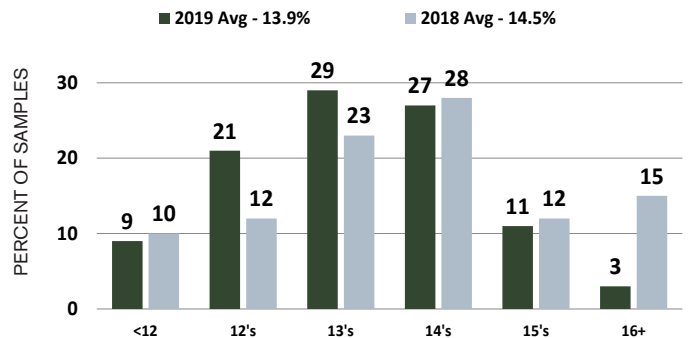
VITREOUS KERNELS

Percent



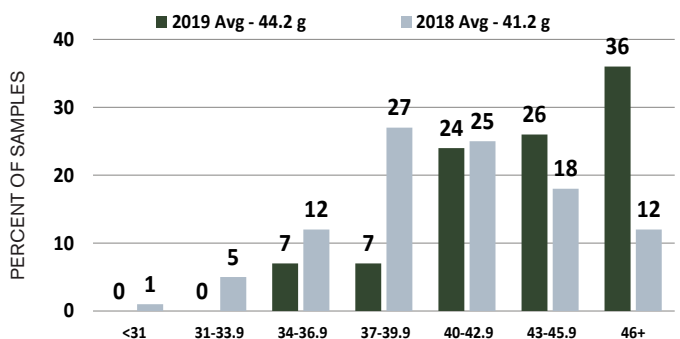
PROTEIN (12% MB)

Percent



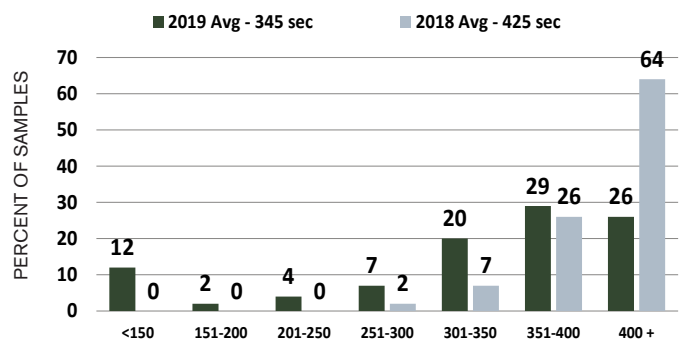
1000 KERNEL WEIGHT

Grams



FALLING NUMBER

Seconds



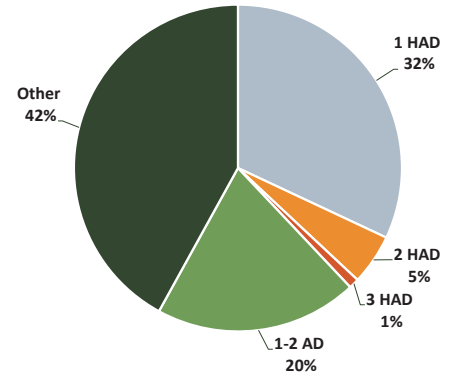
DURUM PRODUCTION

FOR THE MAJOR PRODUCING STATES (MILLION METRIC TONS)

	2019	2018	2017	2016	2015
Arizona	0.1	0.2	0.2	0.3	0.4
California	0.1	0.1	0.1	0.1	0.2
Montana	0.6	0.6	0.3	0.9	0.5
North Dakota	0.8	1.2	0.8	1.6	1.2
Total Durum Production	1.6	2.1	1.5	2.8	2.3

Based on USDA crop estimates as of September 30, 2019.

NORTHERN DURUM DISTRIBUTION BY GRADE



EXPORT CARGO SURVEY

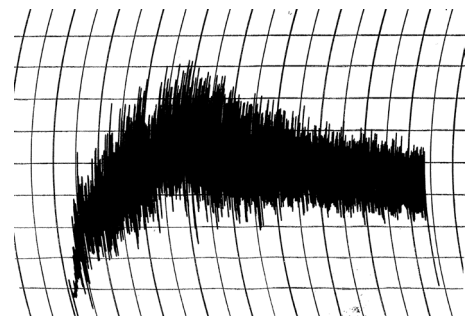
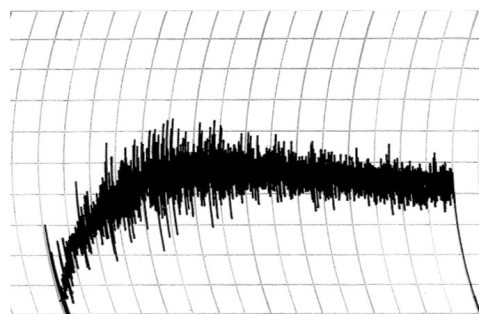
The export cargo data represent 25 individual subplot samples provided by USDA's Federal Grain Inspection Service for crop year 2018 (collected from October 2018 through June 2019) and 25 samples for 2017. Grade data are the official grades on the individual sublots. North Dakota State University conducted the milling and processing analyses.

REGIONAL SEMOLINA PROPERTIES

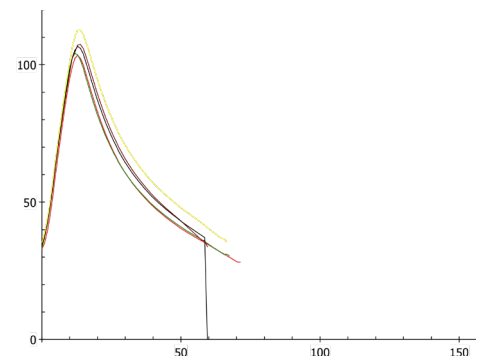
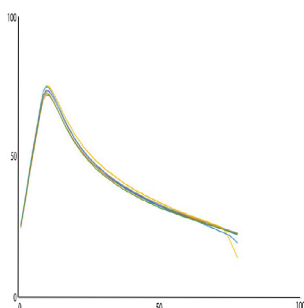
NORTHERN DURUM REGIONAL AVERAGE

DESERT DURUM® REGIONAL AVERAGE

MIXOGRAMS

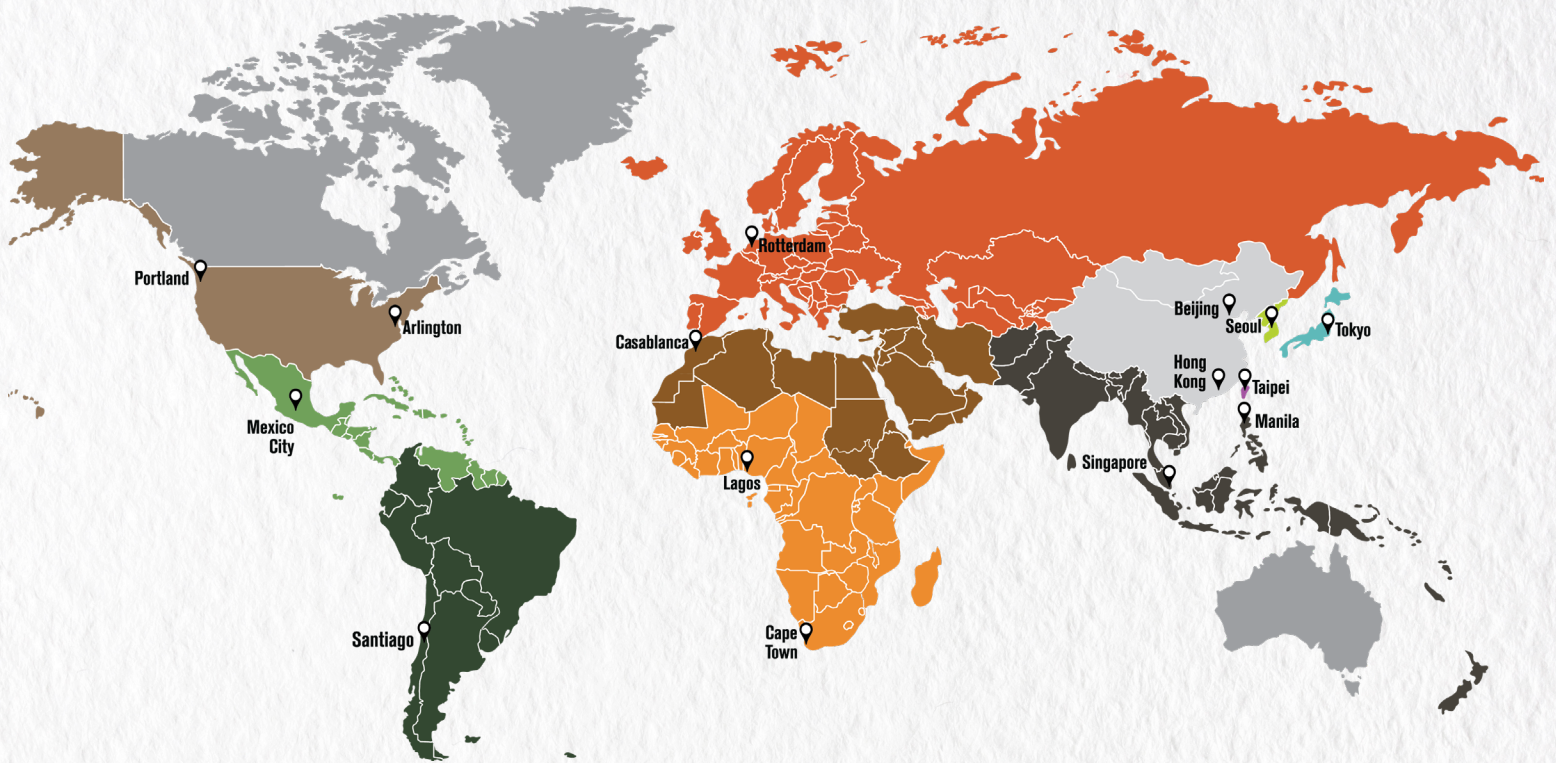


ALVEOGRAMS



U.S. WHEAT GRADES AND GRADE REQUIREMENTS

U.S. GRADING FACTORS	GRADES U.S. NO.				
	1	2	3	4	5
MINIMUM LIMITS:					
Test Weight (lb/bu)					
Hard Red Spring or White Club	58.0	57.0	55.0	53.0	50.0
All other classes and subclasses	60.0	58.0	56.0	54.0	51.0
Test Weight (kg/hl)					
Hard Red Spring or White Club	76.4	75.1	72.5	69.9	66.0
Durum	78.2	75.6	73.0	70.4	66.5
All other classes and subclasses	78.9	76.4	73.8	71.2	67.3
MAXIMUM PERCENT LIMITS:					
Defects					
Damaged kernels:					
- Heat (part of total)	0.2	0.2	0.5	1.0	3.0
- Total	2.0	4.0	7.0	10.0	15.0
Foreign material	0.4	0.7	1.3	3.0	5.0
Shrunken and broken kernels	3.0	5.0	8.0	12.0	20.0
Total ¹	3.0	5.0	8.0	12.0	20.0
Wheat of Other Classes²					
Contrasting classes	1.0	2.0	3.0	10.0	10.0
Total ³	3.0	5.0	10.0	10.0	10.0
Stones	0.1	0.1	0.1	0.1	0.1
MAXIMUM COUNT LIMITS (ALL GRADES):					
Other material (1000 gram sample)					
Animal filth			1		
Castor beans			1		
Crotalaria seeds			2		
Glass			0		
Stones			3		
Unknown foreign substance			3		
Total ⁴			4		
Insect-damaged kernels in 100 grams			31		
U.S. Sample grade:					
Wheat that:					
(a) Does not meet the requirements for U.S. Nos. 1, 2, 3, 4, 5; or					
(b) Has a musty, sour or commercially objectionable foreign odor (except smut or garlic odor); or					
(c) Is heating or of distinctly low quality.					
Notes:					
1. Includes damaged kernels (total), foreign material, and shrunken and broken kernels.					
2. Unclassed wheat of any grade may contain not more than 10.0% of wheat of other classes.					
3. Includes contrasting classes.					
4. Includes any combination of animal filth, castor beans, crotalaria seeds, glass, stones, or unknown foreign substance.					
Wheat Equivalents:			Metric Equivalents:		
1 bushel* =	60 pounds (27.2 kg)	1 pound =	0.4536 kg		
36.74 bushels =	1 metric ton	1 metric ton (MT) =	2204.6 lbs		
37.33 bushels =	1 long ton	1 short ton (2000 lbs) =	0.9072 MT, or 907.2 kg		
33.33 bushels =	1 short ton	1 long ton (2240 lbs) =	1.0160 MT, or 1016.0 kg		
3.67 bushels =	1 quintal	1 metric ton =	10 quintals		
tons/ha =	0.06725 bu/acre	1 hectare =	2.47 acres		
durum kg/hl =	lbs/bu x 1.292 + 0.630	1 acre =	0.40 hectare		
other wheat kg/hl =	lbs/bu x 1.292 + 1.419	1 hundredweight =	100 pounds or 45.36 kg		
*Winchester bushel					




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