



2021 CROP QUALITY REPORT



FROM THE PRESIDENT

To Our Valued Customers:

On behalf of the U.S. farm families we represent, I am very pleased to share the 2021 U.S. Wheat Associates (USW) Crop Quality Report.

This year has once again provided its share of uncertainty for wheat producers, handlers and buyers. We have seen challenges from drought, variable trade policies and the ongoing global pandemic. Through it all, the entire U.S. wheat industry remained fixed on providing the highest quality wheat for almost every customer need, backed by transparent pricing, trusted third-party certification and unmatched service before and after the sale.

For example, USW published weekly Harvest Reports and provided early supply and quality information in several virtual meetings. This report provides a complete summary of wheat, flour and end-product qualities for all six U.S. wheat classes in 2021 – objective information that is so important for your enterprise. And now, our farmers and industry experts will share that crop quality data through web-based and in-person presentations. As always, our local representatives are ready to help you review your purchase specifications to receive the best value possible.

USW's work would not be possible without steadfast support from USDA's Foreign Agricultural Service, our educational partner organizations, our 17 state wheat commission members and, most of all, the hard-working farmers who overcome significant risk every year to meet domestic wheat demand and still offer half their crop to the rest of the world.

We wish you much success in the year ahead. Thank you!

Sincerely,

Vince Peterson,
USW President



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

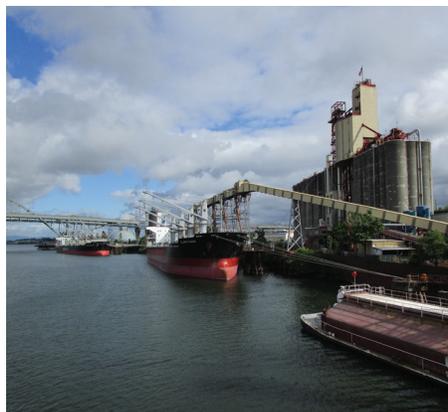
Washington Grain Commission

Wyoming Wheat Marketing
Commission



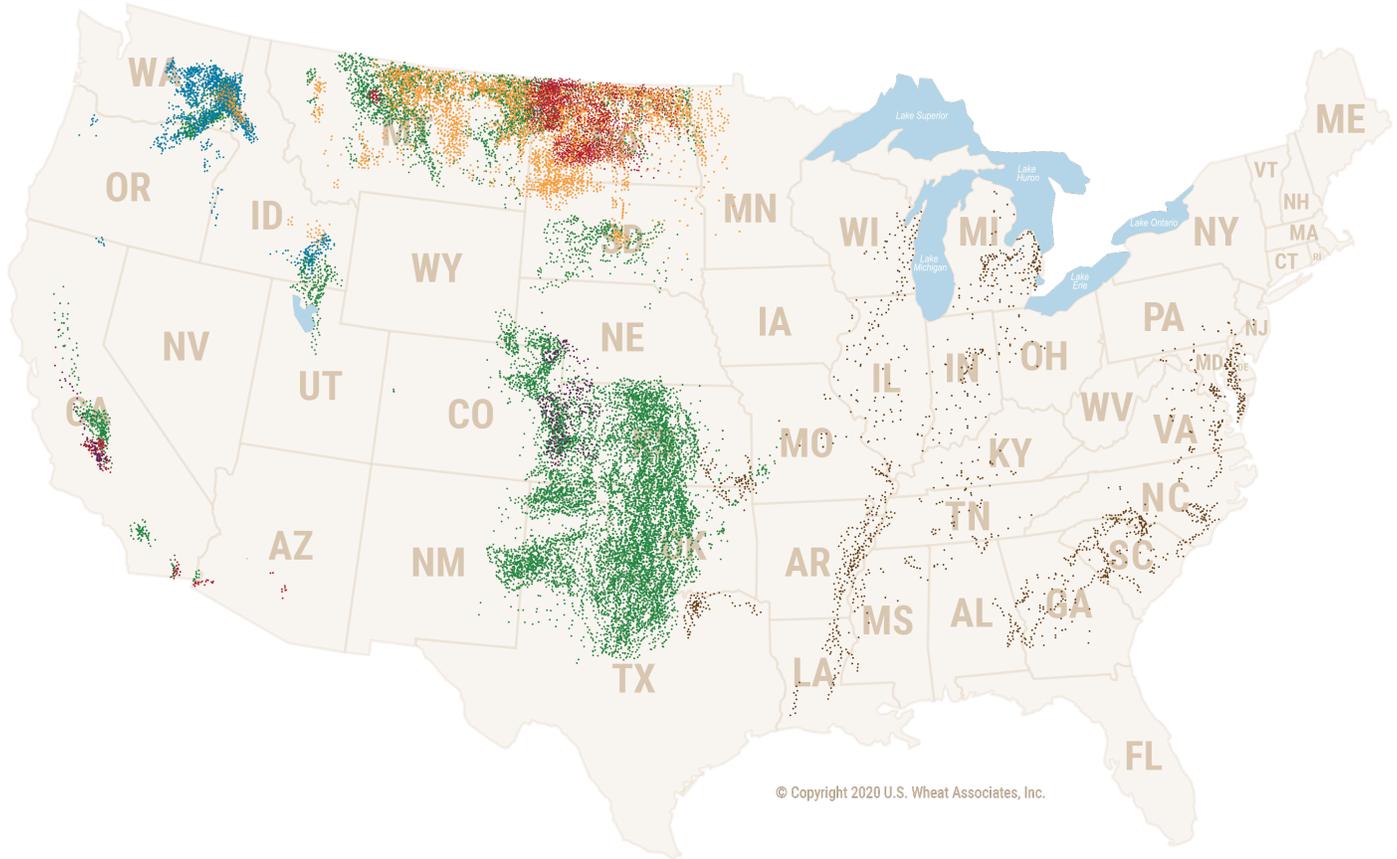
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2021 CROP QUALITY OVERVIEW



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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) (MMT)

	2021	2020	2019	2018	2017
Hard Red Winter	20.4	17.9	22.7	18.0	20.4
Hard Red Spring	8.1	14.4	15.2	16.0	10.5
Hard White	0.7	0.6	0.9	0.9	0.9
Durum	1.0	1.9	1.6	2.1	1.5
Soft White	4.8	7.6	6.6	6.5	6.2
Soft Red Winter	9.8	7.2	7.9	7.8	8.0
Total	44.8	49.7	53.4	51.3	47.4

Based on USDA crop estimates as of 30 September 2021.

U.S. SUPPLY AND DEMAND

ESTIMATED FOR 2021/22 (YEAR BEGINNING JUNE 1) (MMT)

	HRW	HRS	SRW	White ¹	Durum	Total
Beginning stocks	11.6	6.4	2.3	1.9	0.7	23.0
Production	20.4	8.1	9.8	5.5	1.0	44.8
Imports	0.1	1.6	0.1	0.1	1.4	3.4
Total Supply	32.2	16.1	12.3	7.5	3.1	71.2
Domestic Use	13.9	6.9	6.5	2.2	2.2	31.6
Exports	9.8	6.1	3.3	4.2	0.4	23.8
Total demand	23.7	13.0	9.7	6.4	2.6	55.4
Ending stocks	8.5	3.1	2.6	1.1	0.5	15.8
Stocks 5-year average	12.7	6.7	2.3	4.3	1.1	27.1

Based on USDA crop estimates as of 12 October 2021.

¹Includes both SW and HW.



SUMMARY OF CLASSES

	Hard Red Winter ²		Hard Red Spring		Soft White ¹		Soft Red Winter		Northern Durum ³		Desert Durum ³	
	2021	5-Year Avg	2021	5-Year Avg	2021	5-Year Avg	2021	5-Year Avg	2021	5-Year Avg	2021	5-Year Avg
Test Weight (lb/bu)	60.4	60.8	61.3	61.6	59.3	61.4	59.7	58.7	60.5	61.2	63.9	62.6
(kg/hl)	79.5	79.9	80.6	81.0	77.9	80.7	78.6	77.2	78.8	79.7	83.2	81.7
Grade	1 HRW	1 HRW	1 DNS	1 NS	2 SW	1 SW	2 SRW	2 SRW	1 HAD	1 HAD	1 HAD	1 HAD
Dockage (%)	0.5	0.5	0.6	0.5	0.5	0.5	0.3	0.4	0.5	0.8	0.2	0.4
Moisture (%)	11.2	11.1	11.6	12.1	8.8	9.3	13.6	13.0	10.9	11.4	7.5	6.7
Wheat Protein (%), 12% mb	11.9	11.7	15.4	14.4	11.3	9.8	9.3	9.5	15.5	13.9	13.9	13.8
Wheat Ash (%), 14% mb	1.59	1.50	1.51	1.55	1.48	1.34	1.35	1.41	1.69	1.54	1.62	1.71
1000 Kernel Weight (g)	30.5	31.5	29.3	31.0	29.0	36.0	34.4	32.4	41.2	42.1	49.3	47.2
Falling Number (sec)	372	376	377	376	344	321	297	316	428	398	503	687
Flour/Semolina Extraction (%) ³	74.9	75.5	66.0	68.3	70.1	73.1	65.9	67.7	54.6	n/a	72.9	69.1
Flour/Semolina Ash (%) ³	0.50	0.52	0.49	0.53	0.45	0.42	0.41	0.44	0.65	n/a	0.78	0.85
Wet Gluten (%)	27.0	25.9	37.4	34.4	23.7	22.9	19.9	21.4	37.1	33.6	36.1	33.6
Farinograph:												
Peak Time (min)	5.1	4.4	9.2	7.8	2.0	2.2	1.2	1.2	n/a	n/a	n/a	n/a
Stability (min)	9.3	8.5	18.8	11.2	2.5	2.7	1.6	2.0	n/a	n/a	n/a	n/a
Absorption (%)	58.2	58.9	62.4	62.9	52.5	52.4	52.1	52.5	n/a	n/a	n/a	n/a
W (10 ⁻⁴ J)	203	235	430	376	74	86	78	84	260	179	191	247
Loaf Volume (cc)	877	850	952	985	n/a	n/a	602	698	n/a	n/a	n/a	n/a
Production (MMT)	20.4	19.9	8.1	12.8	4.8	6.3	9.8	7.9	0.8	1.4	0.2	0.2

¹HW data is not included.

²HRW data does not include California.

³Durum extraction and ash values are for semolina.

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GRADING, ABBREVIATIONS & CONVERSIONS

GRADES AND GRADE REQUIREMENTS

GRADING FACTORS:	GRADES U.S. NO.:				
	1	2	3	4	5
MINIMUM LIMITS:					
Test Weight (lb/bu)					
HRS 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)					
HRS 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 g 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 g			31		

U.S. Sample Grade is 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);
- (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.

ABBREVIATIONS

°C	Celsius	in	inch
°F	Fahrenheit	J	joules
α-amylase	alpha-amylase	kg	kilogram
AACC	American Association of Cereal Chemists	kg/hl	kilograms/hectoliter
AD	Amber Durum	lb	pound
BU	Brabender Unit	lb/bu	pounds/bushel
bu	Winchester bushel	mb	moisture basis
cc	cubic centimeter (also cm ³ , ccm)	mg	milligram
Club	White Club	min	minute
cm	centimeter	mL	milliliter
cm ²	square centimeters	mm	millimeter
cwt	quintal or hundredweight	MMT	million metric tons
db	dry basis	MT	metric tons
DNS	Dark Northern Spring	NS	Northern Spring
DON	Deoxynivalenol (vomitoxin)	PGI	Plains Grains Inc.
Durum	Durum	PNW	Pacific Northwest
FGIS	Federal Grain Inspection Service	ppm	parts per million
g	gram	PPO	polyphenol oxidase
GIPSA	Grain Inspection, Packers and Stockyards Administration	sec	second
GPAL	Great Plains Analytical Lab	SKCS	Single Kernel Characterization System
GPI	Gluten Performance Index	SRC	Solvent Retention Capacity
Gulf	Gulf of Mexico	SRW	Soft Red Winter
HAD	Hard Amber Durum	SW	Soft White
hl	hectoliter	TKW	1000 kernel weight
hr	hour	USDA	United States Department of Agriculture
HRS	Hard Red Spring	WMC	Wheat Marketing Center
HRW	Hard Red Winter	WW	Western White
HW	Hard White		

UNIT CONVERSION FACTORS

The weight units conversion matrix should be read from the top, left. For example: **1 MT** is equal to **1000 kg**.

LEGEND:

bu (Winchester bushel)

lb (pound)

MT (metric ton)

cwt (quintal or hundredweight)

kg (kilogram)

LAND AREA:

1 hectare (ha) = 2.47 acres (ac)

1 acre (ac) = 0.40 hectare (ha)

TEST WEIGHT:

Durum wheat: kg/hl = lb/bu x 1.292 + 0.630

Common wheat: kg/hl = lb/bu x 1.292 + 1.419

SOLVENT RETENTION CAPACITY:

GPI = Lactic Acid/(Sodium Carbonate + Sucrose)

	1 bu	1 lb	1 MT	1 long ton	1 short ton	1 cwt	1 kg
bu	1	0.017	36.74	37.33	33.33	3.674	0.037
lb	60	1	2,204.60	2,240	2,000	100	2.205
MT	0.0272	0.0005	1	1.016	0.9072	22.046	0.0010
long ton	0.0268	0.0004	0.984	1	0.893	0.045	0.0010
short ton	0.030	0.0005	1.102	1.11993	1	0.05	0.0011
cwt	0.600	0.01	22.046	22.3986	20.3748	1	0.022
kg	27.2	0.4536	1000	1,016	907.2	45.36	1

FLOUR PROTEIN:

14% mb to dry basis = Protein (14% mb) x 0.86

Dry basis to 14% mb = Protein (14% mb) / 0.86

WHEAT PROTEIN:

12% mb to dry basis = Protein (12% mb) x 0.88

Dry basis to 12% mb = Protein (12% mb) / 0.88



HARD RED WINTER



Grown in the Great Plains, Pacific Northwest (PNW) and California, hard red winter (HRW) is the most widely grown



class in the United States. It is shipped via the Gulf and Pacific ports. It has medium to high protein of 10.0 to 13.0% (12% mb), medium hard endosperm, red bran, medium gluten content and mellow gluten.



For the miller, HRW brings consistency to the grist. A balanced mill optimizes flour extraction and helps maximize milling efficiency. Maintaining HRW as the foundation of the mill grist allows the miller to blend other U.S. classes, local wheat or wheat from other origins as cost advantages or product differentiation opportunities develop.

For the baker, HRW benefits include improved baking characteristics, including dough stability and water absorption, either alone or as part of a blend. HRW delivers consistency as it is always available and provides the most reliable foundational ingredient for most wheat-based products.



APPLICATIONS

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

Applications include:

- Baguettes
- Blending improver
- Cereals
- Croissants
- Dumplings, Chinese
- Flatbreads
- Flours (general-purpose, bread)
- Hard rolls
- Hearth breads
- Noodles, Asian-style
- Pan breads (white, whole wheat, whole grain, etc.)
- Pasta
- Steamed bread (mushipan)
- Wide variety of other baked goods
- Yeast breads and rolls

Scan this QR code with the camera application on your smart phone to access more information on the USW website at www.uswheat.org/cropquality.



HARD RED WINTER PRODUCTION

FOR THE MAJOR PRODUCING STATES (MMT)

	2021	2020	2019	2018	2017
California	0.2	0.1	0.1	0.2	0.2
Colorado	1.8	1.1	2.5	1.7	2.1
Idaho	0.2	0.3	0.3	0.3	0.3
Kansas	9.3	7.3	8.8	7.2	8.8
Montana	1.5	2.1	2.6	2.1	1.8
Nebraska	1.1	0.9	1.4	1.3	1.2
Oklahoma	3.1	2.8	3.0	1.9	2.7
Oregon	0.1	0.1	0.1	0.1	0.1
South Dakota	0.7	0.9	1.1	0.9	0.6
Texas	1.9	1.6	1.8	1.4	1.7
Washington	0.2	0.3	0.5	0.5	0.5
Wyoming	0.1	0.1	0.1	0.1	0.1
Twelve-State Total	20.1	17.7	22.3	17.7	20.1
Gulf-Tributary	16.6	13.2	16.7	12.8	15.8
PNW-Tributary	3.4	4.3	5.5	4.7	4.0
Total HRW Production	20.4	17.9	22.7	18.0	20.4

Based on USDA crop estimates as of 30 September 2021.



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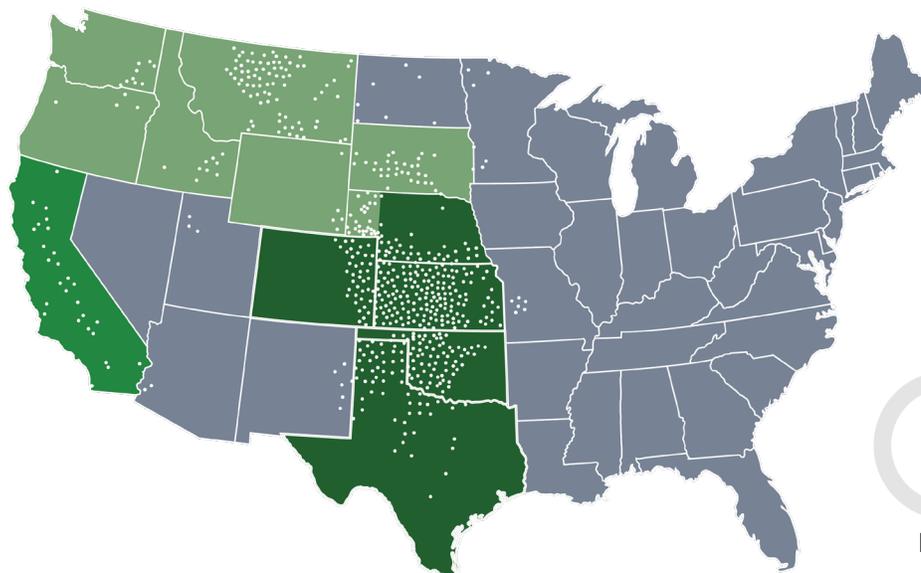
Samples collected from grain elevators in 40 reporting areas after at least 30% of the local harvest was complete.

SAMPLE COLLECTION AND ANALYSIS

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

SAMPLE TESTING

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. The methods are described in the Analysis Methods section of this booklet.

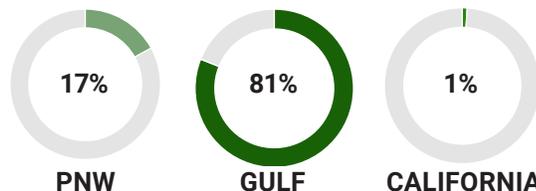


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STATES SURVEYED FOR QUALITY DATA

99%

OF TOTAL HRW PRODUCTION REPRESENTED



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

GULF AND PACIFIC NORTHWEST HARVEST SURVEY

Variable growing conditions greatly influenced the 2021 HRW wheat crop. In areas with favorable growing conditions, high yields resulted in lower protein but excellent kernel characteristics. However, regional swings in temperature and drought led to high protein, lower yields and smaller kernels. As a result, the overall crop has generally good kernel characteristics with flour, dough and bake attributes equal to or better than last year and many of the 5-year averages. The loaf volumes achieved indicate there is sufficient protein quality to make pan bread that easily exceeds the U.S. quality target for loaf volume, with dough mix times and stabilities that are slightly greater than the 5-year averages. This crop meets or exceeds typical HRW contract specifications and should provide high value to customers.

WEATHER AND HARVEST

PLANTED area for the 2021 HRW crop recovered from last year's historic lows with an estimated 9.6 million hectares (23.6 million acres) seeded in fall 2020, a 10% increase over last year.

GROWING conditions varied among the HRW production regions. Eastern areas of the Southern and

Central Great Plains experienced favorable growing conditions resulting in high yields, very good kernel characteristics, but lower protein. While western areas of the Southern and Central Plains experienced drought and record freeze events resulting in lower yields and smaller kernels, but higher protein. The Northern Great Plains and PNW suffered historic

drought conditions that hurt yield and kernel characteristics. With very few exceptions, disease and insect pressures were not major issues.

PRODUCTION of the 2021 HRW crop is estimated to be 20.4 MMT, up from 17.9 MMT in 2020 and similar to the 5-year average of 19.9 MMT.

2021 CROP HIGHLIGHTS

The Composite average **GRADE** for the 2021 HRW harvest survey is U.S. No. 1 HRW. Despite challenging growing conditions in some regions, overall, 84% of Composite, 85% of Gulf-tributary and 83% of PNW-tributary samples graded U.S. No. 2 or better.

TEST WEIGHT Composite average is 60.4 lb/bu (79.5 kg/hl), indicative of sound wheat.

PROTEIN content distribution varies by growing region; Composite average is 11.9% (12% mb), equal to last year but below the 5-year average.

Composite averages for **DOCKAGE** (0.5%), **TOTAL DEFECTS** (1.7%),

and **FOREIGN MATERIAL** (0.3%) are above 2020 and 5-year averages.

SHRUNKEN AND BROKEN (0.8%), values reflect the environmental challenges for this year's crop.

WHEAT FALLING NUMBER

Composite average is 372 sec, indicative of sound wheat.

The Buhler **LAB MILL EXTRACTION** Composite average is 74.9%, above last year but below the 5-year average.

FLOUR ASH Composite average of 0.50% (14% mb) is comparable to last year and 5-year averages.

FARINOGRAPH PEAK and **STABILITY** times of 5.1 and 9.3 min, respectively, are shorter than

last year but higher than the 5-year average.

DOUGH PROPERTIES suggest that this crop has similar resistance to extension (tenacity) to both last year and 5-year averages, but slightly weaker dough strength (Alveograph W value) compared to last year and 5-year averages. Dough extensibility was significantly lower than last year but similar to the 5-year average.

Average **BAKE ABSORPTION** is 62.1%, below last year but comparable to the 5-year average.

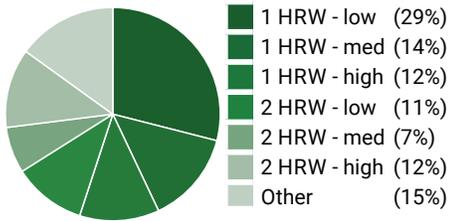
Average **LOAF VOLUME** of 877 cc is well above last year and 5-year averages, indicative of acceptable baking quality.



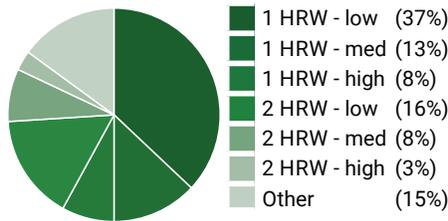
DISTRIBUTIONS BY GRADE

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

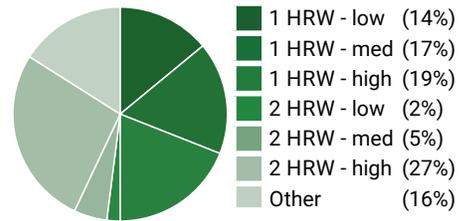
OVERALL



GULF EXPORTABLE



PNW EXPORTABLE



Montana, June 2021, Cassidy Marn



Nebraska, May 2021, Sarah Ahrens

"We produced good quality hard red winter wheat in 2021. As U.S. wheat farmers we strive to provide the best wheat that millers and bakers can continually source in the international markets. We know quality is the key to success for our buyers, so the research, reporting and analysis of what we grow is compiled into crop quality reports that help us work in partnership with you."

– RJ Parrish, Oklahoma wheat farmer



Kansas, June 2021, Martin Kerschner



Oklahoma, June 2021, Mandi Gammill



Colorado, April 2021, Madison Andersen

COMPOSITE HARVEST DATA

	2021 BY PROTEIN ¹			2021 Avg	2020 Avg	5-Year Avg
	Low	Med	High			
WHEAT GRADE DATA:						
Test Weight (lb/bu)	60.8	60.6	59.9	60.4	61.4	60.8
(kg/hl)	80.0	79.7	78.8	79.5	80.8	79.9
Damaged Kernels (%)	2.2	2.1	1.9	2.1	0.2	0.2
Foreign Material (%)	0.2	0.3	0.4	0.3	0.1	0.2
Shrunken & Broken (%)	0.8	0.7	1.1	0.8	1.1	1.0
Total Defects (%)	1.5	1.7	2.2	1.7	1.4	1.3
Grade	1 HRW	1 HRW	2 HRW	1 HRW	1 HRW	1 HRW
WHEAT NON-GRADE DATA:						
Dockage (%)	0.5	0.5	0.5	0.5	0.5	0.5
Moisture (%)	11.3	11.4	10.8	11.2	11.0	11.1
Protein (%) 12%/0% mb	10.8/12.3	11.9/13.5	13.5/15.3	11.9/13.5	11.9/13.5	11.7/13.3
Ash (%) 14%/0% mb	1.57/1.78	1.59/1.82	1.65/1.87	1.59/1.82	1.53/1.77	1.50/1.75
1000 Kernel Weight (g)	31.0	30.6	29.5	30.5	31.2	31.5
Kernel Size (%) lg/md/sm	70/29/1	69/30/1	62/37/1	68/31/1	63/35/2	67/32/1
Single Kernel: Hardness	59.5	64.0	64.4	62.0	66.1	61.9
Weight (mg)	31.2	30.7	29.3	30.4	31.2	31.5
Diameter (mm)	2.63	2.61	2.55	2.60	2.61	2.62
Sedimentation (cc)	41.5	46.4	52.7	46.6	50.2	47.5
Falling Number (sec)	364	376	373	372	369	376
DON (ppm)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
FLOUR DATA:						
Lab Mill Extraction (%)	75.1	75.1	74.5	74.9	73.5	75.5
Color: L*	90.7	90.6	90.4	90.6	91.1	90.8
a*	-1.5	-1.5	-1.4	-1.5	-1.6	-1.4
b*	9.8	9.8	9.9	9.9	10.2	10.2
Protein (%) 14%/0% mb	9.7/11.3	10.8/12.6	12.2/14.2	10.8/12.5	10.9/12.7	10.6/12.4
Ash (%) 14%/0% mb	0.50/0.58	0.50/0.59	0.52/0.60	0.50/0.59	0.49/0.57	0.52/0.61
Wet Gluten (%)	22.9	27.4	33.0	27.0	27.1	25.9
Gluten Index	98	96	90	96	97	96
Falling Number (sec)	398	416	419	415	421	376
Amylograph Viscosity: 65g (BU)	755	787	781	776	868	616
Damaged Starch (%)	5.7	5.7	5.6	5.6	6.5	6.5
SRC: Water/50% Sucrose (%)	66/107	67/109	68/112	67/109	60/109	
5% Lactic Acid/5% Na ₂ CO ₃ (%)	119/88	125/89	132/91	125/90	135/97	
Gluten Performance Index (GPI) (%)	0.61	0.63	0.65	0.63	0.65	
DOUGH PROPERTIES:						
Farinograph: Peak Time (min)	4.2	5.1	5.8	5.1	5.3	4.4
Stability (min)	8.5	9.1	9.4	9.3	10.3	8.5
Absorption (%)	56.8	58.3	60.1	58.2	58.7	58.9
Alveograph: P (mm)	87	89	89	89	97	87
L (mm)	58	66	74	64	77	78
P/L Ratio	1.47	1.33	1.15	1.36	1.26	1.13
W (10 ⁻⁴ J)	180	205	224	203	261	235
Extensograph (45/135 min): Resistance (BU)	500/795	464/764	448/750	478/781	496/838	432/716
Extensibility (cm)	13.5/11.1	14.6/13.2	15.5/14.1	14.4/12.7	14.5/12.4	14.1/12.4
Area (cm ²)	89/111	75/102	91/127	90/121	94/133	86/117
BAKING EVALUATION:						
Pan Bread: Bake Absorption (%)	60.4	62.2	64.4	62.1	63.1	63.0
Crumb Grain and Texture (1-10)	6.0	6.9	6.9	6.6	6.2	6.2
Loaf Volume (cc)	824	883	940	877	859	850
PRODUCTION OF 11 STATES (%):	100%					

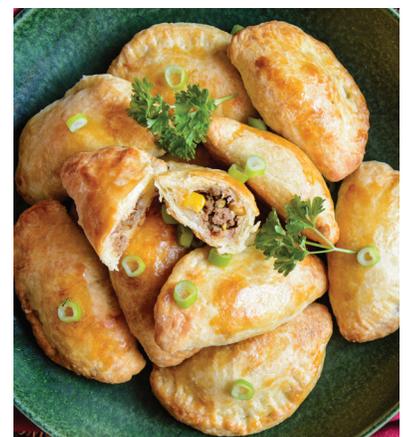
¹Protein Range: Low, <11.5%; Med, 11.5 - 12.5%; High, >12.5%.



GULF-TRIBUTARY HARVEST DATA

	2021 BY PROTEIN ¹			2021 Avg	2020 Avg	5-Year Avg
	Low	Med	High			
WHEAT GRADE DATA:						
Test Weight (lb/bu)	60.8	60.5	60.1	60.6	61.1	60.5
(kg/hl)	79.9	79.6	79.0	79.7	80.4	79.6
Damaged Kernels (%)	0.5	0.6	0.4	0.5	0.2	0.2
Foreign Material (%)	0.2	0.3	0.4	0.3	0.1	0.2
Shrunken & Broken (%)	0.9	0.8	1.2	0.9	1.2	1.0
Total Defects (%)	1.6	1.9	2.4	1.8	1.5	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	0.5
Moisture (%)	11.3	11.7	10.9	11.4	11.0	11.3
Protein (%) 12%/0% mb	10.8/12.3	11.9/13.5	13.4/15.2	11.6/13.2	11.8/13.4	11.7/13.3
Ash (%) 14%/0% mb	1.57/1.78	1.60/1.82	1.65/1.87	1.59/1.81	1.53/1.78	1.51/1.76
1000 Kernel Weight (g)	31.2	30.7	29.9	30.9	30.4	30.8
Kernel Size (%) lg/md/sm	73/26/1	71/28/1	65/34/1	71/28/1	60/38/2	65/34/1
Single Kernel: Hardness	57.9	63.2	63.8	61.0	65.0	60.9
Weight (mg)	31.5	30.8	29.6	30.8	30.4	30.8
Diameter (mm)	2.64	2.62	2.57	2.62	2.58	2.59
Sedimentation (cc)	40.9	45.2	50.8	44.2	48.7	45.8
Falling Number (sec)	368	377	375	373	371	379
DON (ppm)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
FLOUR DATA:						
Lab Mill Extraction (%)	75.2	75.2	74.7	75.1	73.3	75.7
Color: L*	90.7	90.6	90.4	90.6	91.2	90.7
a*	-1.5	-1.5	-1.4	-1.5	-1.6	-1.5
b*	9.9	9.8	9.8	9.9	10.2	10.3
Protein (%) 14%/0% mb	9.7/11.2	10.7/12.5	12.0/14.0	10.5/12.2	10.8/12.6	10.6/12.3
Ash (%) 14%/0% mb	0.50/0.58	0.50/0.59	0.52/0.60	0.50/0.59	0.50/0.58	0.53/0.62
Wet Gluten (%)	22.8	27.4	33.0	26.2	26.4	25.6
Gluten Index	98	96	89	96	98	96
Falling Number (sec)	399	417	419	415	426	379
Amylograph Viscosity: 65g (BU)	771	791	787	782	890	626
Damaged Starch (%)	5.6	5.7	5.6	5.5	6.3	6.4
SRC: Water/50% Sucrose (%)	67/108	68/111	69/113	68/110	65/105	
5% Lactic Acid/5% Na ₂ CO ₃ (%)	122/90	127/90	134/93	126/91	126/89	
Gluten Performance Index (GPI) (%)	0.62	0.62	0.63	0.65	0.65	
DOUGH PROPERTIES:						
Farinograph: Peak Time (min)	4.2	5.0	5.5	4.8	5.2	4.4
Stability (min)	8.8	8.9	8.9	8.9	10.5	8.4
Absorption (%)	56.7	58.4	60.0	57.9	58.1	58.5
Alveograph: P (mm)	86	88	87	87	93	84
L (mm)	59	66	76	64	78	78
P/L Ratio	1.46	1.33	1.14	1.36	1.20	1.09
W (10 ⁻⁴ J)	182	201	219	195	255	226
Extensograph (45/135 min): Resistance (BU)	486/788	449/745	429/729	462/761	497/910	427/726
Extensibility (cm)	13.5/11.3	14.6/13.1	15.6/14.2	14.3/12.6	14.5/12.1	14.0/12.3
Area (cm ²)	87/113	86/119	88/124	87/117	94/132	84/116
BAKING EVALUATION:						
Pan Bread: Bake Absorption (%)	60.2	62.1	64.2	61.6	62.8	62.8
Crumb Grain and Texture (1-10)	5.9	6.9	6.9	6.5	6.3	6.2
Loaf Volume (cc)	826	884	938	867	857	852
PRODUCTION OF 11 STATES (%):	36%	35%	13%	84%		

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



PNW-TRIBUTARY HARVEST DATA

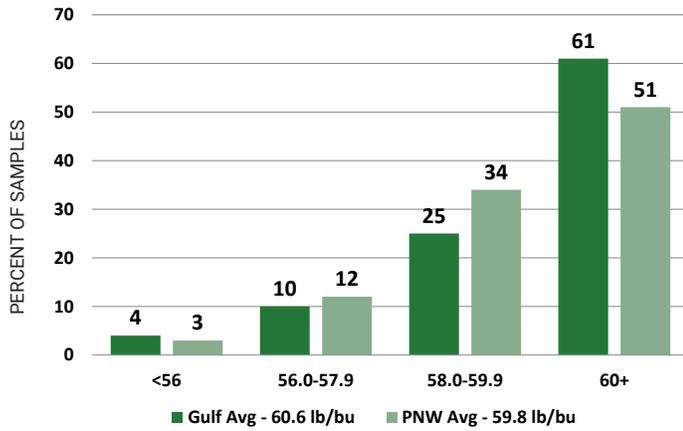
	2021 BY PROTEIN ¹			2021	2020	5-Year
	Low	Med	High	Avg	Avg	Avg
WHEAT GRADE DATA:						
Test Weight (lb/bu)	61.2	60.8	59.1	59.6	62.4	61.8
(kg/hl)	80.5	79.9	77.8	78.4	82.0	81.2
Damaged Kernels (%)	0.1	0.2	0.3	0.2	0.2	0.1
Foreign Material (%)	0.1	0.3	0.2	0.2	0.1	0.1
Shrunken & Broken (%)	0.3	0.1	0.1	0.1	0.6	0.7
Total Defects (%)	1.1	1.1	1.2	1.1	1.0	1.0
Grade	1 HRW	1 HRW	2 HRW	2 HRW	1 HRW	1 HRW
WHEAT NON-GRADE DATA:						
Dockage (%)	0.5	0.5	0.4	0.4	0.4	0.5
Moisture (%)	11.4	10.2	10.0	10.2	10.8	10.4
Protein (%) 12%/0% mb	10.8/12.3	12.0/13.7	13.8/15.6	13.2/15.0	12.3/13.9	11.9/13.5
Ash (%) 14%/0% mb	1.55/1.77	1.52/1.81	1.58/1.86	1.56/1.85	1.54/1.75	1.47/1.71
1000 Kernel Weight (g)	30.1	29.7	27.5	28.2	33.7	33.4
Kernel Size (%) lg/md/sm	57/42/1	58/40/2	47/51/2	50/48/2	72/27/1	71/28/1
Single Kernel: Hardness	68.2	68.0	67.4	67.6	69.6	65.2
Weight (mg)	30.1	29.7	27.5	28.2	33.7	33.4
Diameter (mm)	2.55	2.57	2.49	2.51	2.69	2.71
Sedimentation (cc)	44.8	52.7	63.2	59.6	54.9	53.2
Falling Number (sec)	345	367	367	366	362	365
DON (ppm)	<0.5	<0.5	<0.5	<0.5		
FLOUR DATA:						
Lab Mill Extraction (%)	74.4	74.5	73.6	73.9	74.0	74.9
Color: L*	90.9	90.7	90.6	90.6	90.9	90.9
a*	-1.5	-1.5	-1.4	-1.4	-1.6	-1.4
b*	9.4	9.8	9.9	9.9	10.0	10.0
Protein (%) 14%/0% mb	10.0/11.7	11.2/13.1	13.0/15.1	12.4/14.4	11.3/13.1	11.0/12.8
Ash (%) 14%/0% mb	0.51/0.59	0.51/0.59	0.52/0.61	0.52/0.61	0.47/0.54	0.49/0.57
Wet Gluten (%)	23.3	27.6	33.3	31.4	29.5	27.2
Gluten Index	98	98	95	96	97	96
Falling Number (sec)	389	408	417	413	403	365
Amylograph Viscosity: 65g (BU)	674	763	748	746	798	588
Damaged Starch (%)	6.1	6.0	5.7	5.8	7.0	6.8
SRC: Water/50% Sucrose (%)	59/99	62/100	63/104	63/103	70/111	
5% Lactic Acid/5% Na ₂ CO ₃ (%)	101/77	115/80	123/81	118/81	138/100	
Gluten Performance Index (GPI) (%)	0.57	0.64	0.66	0.64	0.65	
DOUGH PROPERTIES:						
Farinograph: Peak Time (min)	4.3	5.9	7.0	6.6	5.4	4.7
Stability (min)	7.1	10.5	11.8	11.2	9.5	8.8
Absorption (%)	57.4	58.3	60.6	59.9	60.7	60.3
Alveograph: P (mm)	89	93	101	98	106	97
L (mm)	52	66	66	65	74	77
P/L Ratio	1.71	1.41	1.53	1.51	1.45	1.25
W (10 ⁻⁴ J)	170	229	255	243	279	258
Extensograph (45/135 min): Resistance (BU)	572/830	542/864	546/863	563/883	491/833	451/686
Extensibility (cm)	13.7/10.2	14.6/13.5	15.2/13.8	14.8/13.3	14.5/13.4	14.2/7.0
Area (cm ²)	102/102	103/142	106/144	106/142	92/135	92/122
BAKING EVALUATION:						
Pan Bread: Bake Absorption (%)	61.9	63.0	65.4	64.6	63.8	63.7
Crumb Grain and Texture (1-10)	6.5	6.8	7.0	6.9	6.0	6.1
Loaf Volume (cc)	815	877	950	925	867	847
PRODUCTION OF 11 STATES (%):	1%	4%	11%	16%		



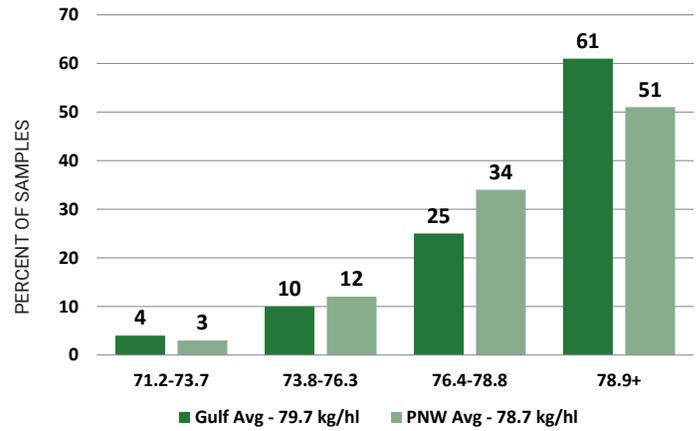
¹Protein Range: Low, <11.5%; Med, 11.5 - 12.5%; High, >12.5%.

DISTRIBUTIONS

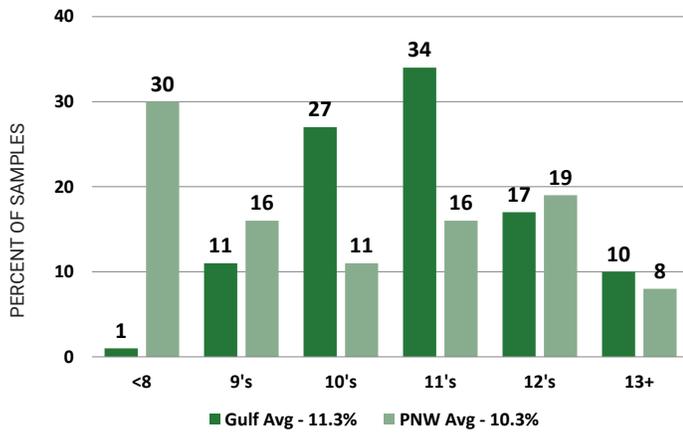
TEST WEIGHT | Pounds/Bushel



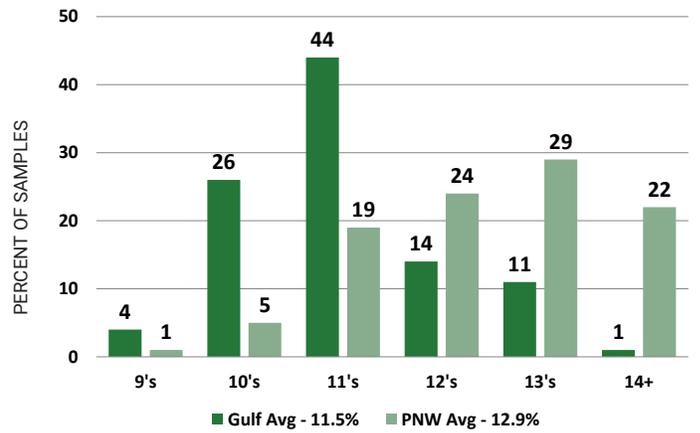
TEST WEIGHT | Kilograms/Hectoliter



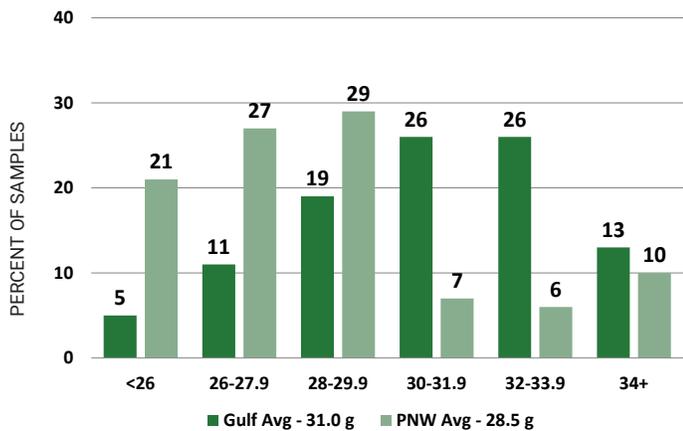
WHEAT MOISTURE | Percent



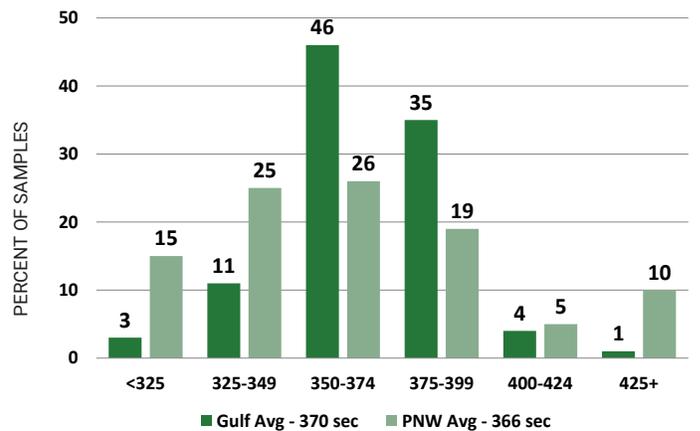
PROTEIN (12% MB) | Percent



1000 KERNEL WEIGHT | Grams



FALLING NUMBER | Seconds



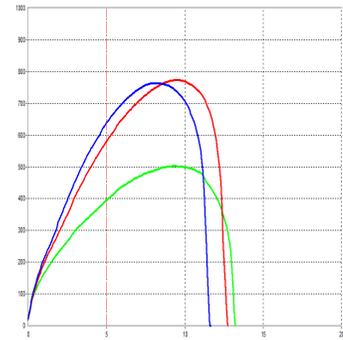
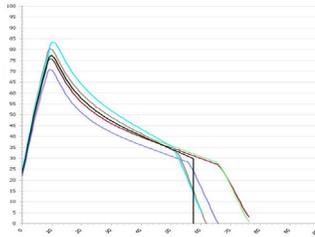
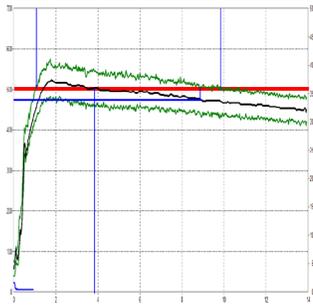
COMPOSITE DOUGH PROPERTIES

FARINOGRAMS

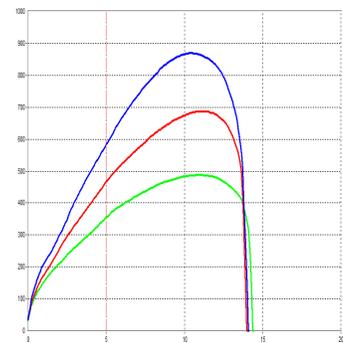
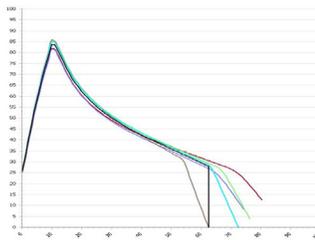
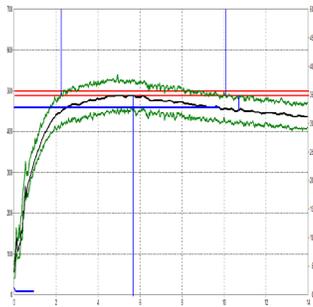
ALVEOGRAMS

EXTENSOGRAMS

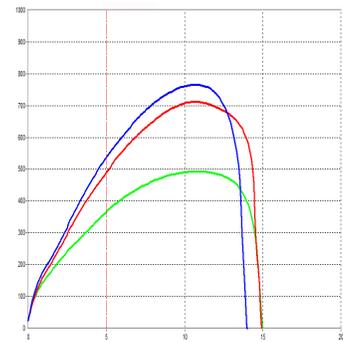
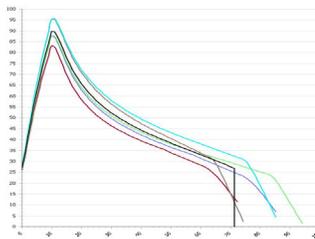
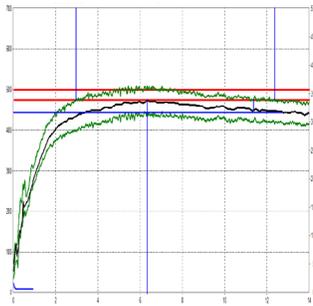
LOW
PROTEIN



MEDIUM
PROTEIN



HIGH
PROTEIN



CALIFORNIA HARVEST AND DATA 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 below average rainfall in 2020/21 and in wheat growing regions, rainfall was just over 50% of the 10-year average. Drought in the Sacramento Valley and the northern San Joaquin Valley was even more pronounced; this negatively affected stand establishment and early growth and was compounded by predation of stands by migratory geese. Disease incidence was relatively low; however, stripe rust was reported in the Delta region and the northern San Joaquin Valley. Weather during grain filling was dry and average-to-cooler-than-average in much of the state. Overall, yields were average or below average.

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 2021 crop has medium protein. Consistent with other years, the 2021 crop has low moisture, high flour extraction and strong baking performance – all of which make California wheat suitable for blending.

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Samples collected from grain elevators during local harvest.

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

	MEDIUM PROTEIN ¹		HIGH PROTEIN ¹	
	2021	2020	2021	2020
WHEAT GRADE DATA:				
Test Weight (lb/bu)	63.3	63.2	62.1	62.3
(kg/hl)	83.2	83.1	81.7	81.9
Damaged Kernels (%)	0.0	0.0	0.0	0.0
Foreign Material (%)	0.1	0.0	0.3	0.1
Shrunken & Broken (%)	0.6	0.6	0.8	0.5
Total Defects (%)	0.7	0.7	1.0	0.6
Grade	1 HRW	1 HRW	1 HRW	1 HRW
WHEAT NON-GRADE DATA:				
Dockage (%)	0.7	0.9	1.2	0.9
Moisture (%)	9.6	9.1	9.7	9.0
Protein (%) 12%/0% mb	11.9/13.5	11.8/13.4	12.6/14.3	13.0/14.8
Ash (%) 14%/0% mb	1.45/1.68	1.48/1.72	1.51/1.76	1.49/1.74
1000 Kernel Weight (g)	43.5	43.2	42.9	41.4
Kernel Size (%) lg/md/sm	93/7/0	90/10/0	84/16/0	87/13/0
Single Kernel: Hardness	69.5	62.5	69.5	65.3
Weight (mg)	41.9	41.7	40.0	39.9
Diameter (mm)	3.09	3.04	2.93	2.99
Sedimentation (cc)	43.0	47.6	56.0	56.1
Falling Number (sec)	344	343	369	355
DON (ppm)	<0.5	<0.5	<0.5	<0.5
FLOUR DATA:				
Lab Mill Extraction (%)	68.2	68.7	66.6	68.7
Color: L*	92.4	92.5	92.0	92.4
a*	-1.1	-1.1	-1.1	-1.1
b*	8.9	8.4	8.8	8.4
Protein (%) 14%/0% mb	10.8/12.6	10.6/12.4	11.3/13.1	11.9/13.9
Ash (%) 14%/0% mb	0.44/0.51	0.45/0.52	0.47/0.54	0.45/0.52
Wet Gluten (%)	28.6	27.1	29.6	31.6
Gluten Index	98	96	99	94
Falling Number (sec)	352	392	406	406
Amylograph Viscosity: 65g (BU)	864	909	882	960
Damaged Starch (%)	6.6	7.0	6.6	6.6
SRC: Water/50% Sucrose (%)	66/103	63/104	68/106	64/106
5% Lactic Acid/5% Na ₂ CO ₃ (%)	131/83	124/79	138/84	136/80
Gluten Performance Index (GPI) (%)	0.70	0.68	0.73	0.73
DOUGH PROPERTIES:				
Farinograph: Peak Time (min)	6.2	5.5	6.5	6.6
Stability (min)	17.0	11.1	18.0	13.8
Absorption (%)	61.3	59.3	61.4	60.8
Alveograph: P (mm)	97	89	98	89
L (mm)	130	117	139	133
P/L Ratio	0.75	0.76	0.71	0.67
W (10 ⁻⁴ J)	372	332	431	380
Extensograph (45/135 min): Resistance (BU)	539/598	537/851	604/626	537/871
Extensibility (cm)	19.2/17.8	19.2/15.5	20.8/18.9	20.5/16.4
Area (cm ²)	133/136	132/167	160/151	141/179
BAKING EVALUATION:				
Pan Bread: Bake Absorption (%)	64.0	60.0	64.0	61.0
Crumb Grain and Texture (1-10)	8.0	7.0	8.5	7.0
Loaf Volume (cc)	900	944	945	970
SAMPLE COUNT:				
	95	89	34	72

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



HARD RED SPRING



Grown primarily in the North Central region and shipped via the Pacific, Gulf and Great Lakes ports, hard red spring (HRS) wheat is the second largest class of U.S. wheat. It has high protein of 12.0 to 15.0% (12% mb), hard endosperm, red bran, strong gluten and high water absorption.



For the miller, the reward for incorporating HRS into the grist includes a higher-than-average flour yield from its harder, more compact endosperm. This creates excellent granulation through the break system, providing an abundance of stock to the purifiers producing the maximum amount of low ash, bright color flour.

For the baker, HRS delivers strong dough characteristics used alone or as part of a blend to improve the overall performance of the desired dough. In markets where consumers are demanding a “clean label,” HRS flour blended with HRW or other wheat flour can create better water absorption and loaf volume while reducing or eliminating the use of chemical improvers. And many pasta makers around the world know that when traditional durum wheat semolina is not needed, HRS wheat flour or semolina is a very acceptable alternative.

APPLICATIONS

The aristocrat of wheat when it comes to “designer” wheat foods like bagels, artisan hearth breads, pizza crust and other strong dough applications, HRS also has excellent milling and baking characteristics and is a valued improver in flour blends.

Applications include:

- Bagels
- Blending improver
- Buns (hamburger, hotdog)
- Croissants
- Flours (general-purpose, bread)
- Frozen doughs
- Hard rolls
- Ramen noodles
- Pan breads
- Pizza crust
- Specialty/artisan breads
- Yeast breads and rolls
- Wide variety of other baked goods

Scan this QR code with the camera application on your smart phone to access more information on the USW website at www.uswheat.org/cropquality.



HARD RED SPRING PRODUCTION

FOR THE MAJOR PRODUCING STATES (MMT)

	2021	2020	2019	2018	2017
Idaho	0.3	0.4	0.4	0.6	0.5
Minnesota	1.5	2.0	2.2	2.5	2.1
Montana	1.0	3.4	2.9	2.6	1.3
North Dakota	4.8	7.5	8.8	8.7	5.7
Oregon	0.0	0.0	0.0	0.1	0.1
South Dakota	0.5	1.0	0.7	1.1	0.6
Washington	0.1	0.2	0.2	0.4	0.3
Seven-State Total	8.1	14.4	15.2	16.0	10.5
Western-Tributary	3.6	7.5	7.6	7.9	4.9
Eastern-Tributary	4.5	6.9	7.6	8.1	5.6
Total HRS Production	8.1	14.4	15.2	16.0	10.5

Based on USDA crop estimates as of 30 September 2021.



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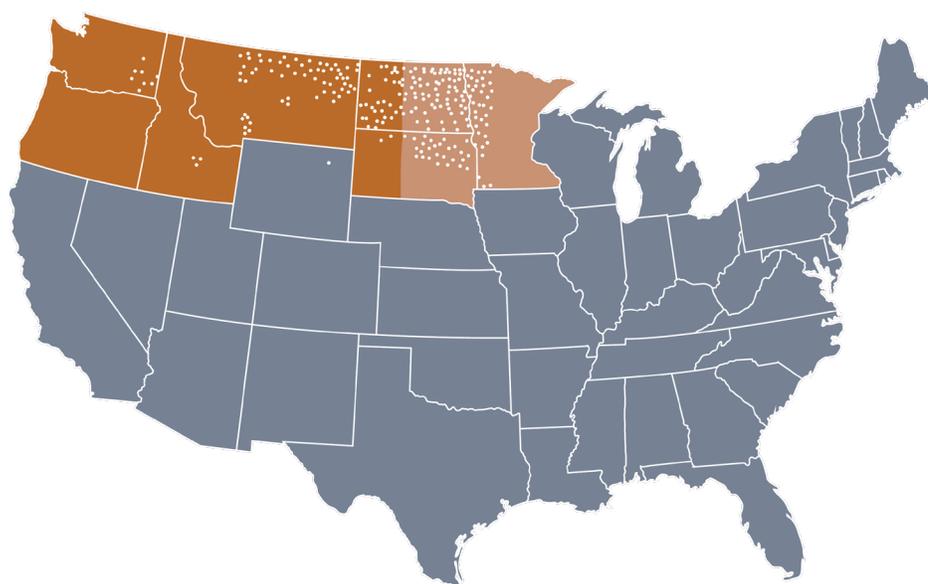
Samples collected from fields, on-farm bins sites or elevators, and separated by export region.

SAMPLE COLLECTION AND ANALYSIS

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

SAMPLE TESTING

Official grade and non-grade factors were determined on 60% of samples. Functionality tests were conducted on 6 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. The methods are described in the Analysis Methods section of this booklet.

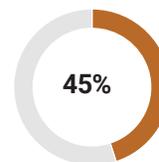


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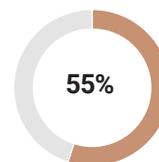
STATES SURVEYED

100%

OF TOTAL HRS PRODUCTION REPRESENTED



WESTERN REGION



EASTERN REGION

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

HARVEST SURVEY

The 2021 U.S. HRS crop endured significant drought conditions, leading to a sharp reduction in yields and increased abandonment. Despite the moisture stressed growing season, quality parameters of the crop are very good, with high protein content, high vitreous levels, low kernel moisture and sound kernels. Buyers will be pleased with this year's improved dough strength and higher absorption values. With reduced supply and isolated areas with higher levels of shrunken and broken and lighter 1000 kernel weights, buyers should always remain diligent in their contract specifications.

WEATHER AND HARVEST

PLANTING began in early April, slightly ahead of normal. Limited winter snowfall and below normal spring precipitation allowed for a fast-planting pace with most of the crop planted by late May. Cool temperatures or drought conditions resulted in regional delays.

Crop **EMERGENCE** was hindered in central parts of the region by overly dry topsoil, while the rest of the

growing region had more favorable topsoil moisture.

As the crop **DEVELOPED**, above normal temperatures, minimal precipitation and frequent winds stressed a significant share of the crop, although some areas benefited from timely rains or subsoil moisture reserves. In central and western parts of the region, a larger than normal share of the planted acres were harvested as hay. The dry conditions pushed crop

development ahead of normal but kept disease pressures minimal.

HARVEST began in late July and moved rapidly due to wide-spread drought conditions and advanced maturity of the crop. Rains slowed progress in some northern areas, but for much of the region, harvest was completed by early September. These conditions secured a very sound, high-quality crop. Total production is estimated at 8.1 MMT, 44% below last year.

2021 CROP HIGHLIGHTS

The average **GRADE** for the 2021 HRS harvest survey is U.S. No. 1 Dark Northern Spring (DNS); 98% of Eastern samples and 76% of Western samples grade U.S. No. 1.

Average **TEST WEIGHT** is 61.3 lb/bu (80.6 kg/hl), slightly lower than the 2020 and 5-year averages; 99% of Eastern samples and 82% of Western samples are above 58 lb/bu (76.4 kg/hl).

Average **DAMAGE** is 0.2%, below the 5-year average, but shrunken and broken kernels at 1.1%, is above the 5-year average.

The crop has improved **VITREOUS KERNEL LEVELS (DHV)**, averaging 80% compared to 71% in 2020. Average DHV is 84% for Western samples and 76% for Eastern.

PROTEIN averages 15.4% (12% mb), above 2020 and 5-year averages. Nearly three-fourths of samples collected have greater than 14.5% protein, with just 9% below 13.5%.

DON levels were near zero due to minimal disease pressures.

Average **1000 KERNEL WEIGHT** is 29 g, below 2020 and 5-year averages.

A rapid, dry harvest produced a very sound crop with an average **FALLING NUMBER** of 377 sec.

BUHLER LABORATORY MILL FLOUR YIELD averages 66.0%, lower than 2020 and 5-year averages. Mill yields are lower in the Western region where drought impacted kernel size.

Average **FLOUR ASH** is 0.49%, lower than the 5-year average of 0.53%.

WET GLUTEN averages 37.4%, notably higher than 2020 and 5-year averages, supported by high kernel protein content.

AMYLOGRAPH values average 732 BU for 65 g of flour, up notably from recent levels.

FARINOGRAPH testing indicates a much stronger crop than recent years, with an average stability of

18.8 min, compared to 12.1 in 2020, and 11.2 for the 5-year average. Absorption values average 62.4%, up from 2020, but slightly below the 5-year average.

ALVEOGRAPH and **EXTENSOGRAPH** analyses show greater resistance and less extensibility. The average alveograph P/L ratio is 0.64 compared to 0.59 in 2020, and the W-value is 430 (10⁻⁴ J), up from 368 last year. The overall extensibility and resistance to extension of the 135 min extensograph are 12.0 cm and 1344 BU, notably stronger than 2020 crop values of 12.8 and 856.

The average **LOAF VOLUME** is 952 cc, lower than 2020 and 5-year averages; Western region averages 935 cc and Eastern region averages 970 cc.

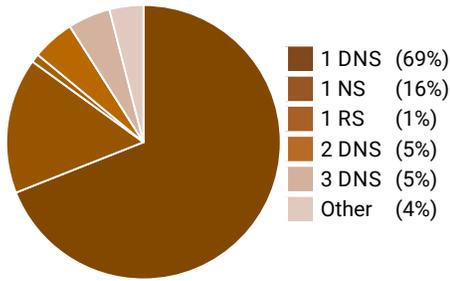
Average **BAKE ABSORPTION** is 66.4%, down from 2020 but similar to the 5-year average.

BREAD SCORES are higher than 2020 and 5-year averages, with the highest scores in the Eastern region.

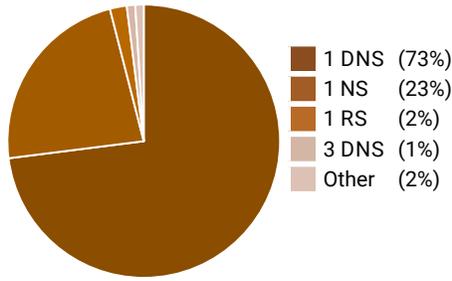
DISTRIBUTION BY GRADE

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

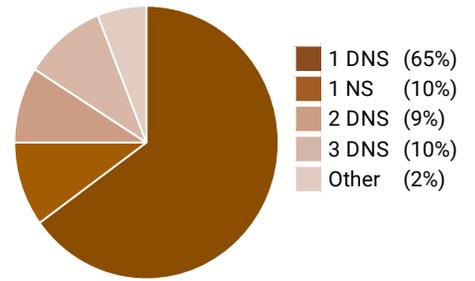
OVERALL



EASTERN REGION



WESTERN REGION



South Dakota, August 2021, Brian Jones



Montana, August 2021, Laura Boroughs-Haffner

"The 2021 wheat year was quite challenging for much of the region ... dry and not enough moisture. Fortunately, a good share caught enough timely precipitation to be pleasantly surprised by the final yields, including myself. Wheat is a miraculous crop. The hard red spring wheat we have is exceptional quality with high protein, good color and good kernel weights."

– Philip Volk, North Dakota wheat farmer



Idaho, June 2021, Kaitlin Calvert



North Dakota, August 2021, Dustin Johnsrud



North Dakota, July 2021, Phil Volk

SUBCLASSES

Under the Official United States Standards for Grain, Hard Red Spring wheat is divided into the three subclasses based on vitreous kernel content:



Vitreous kernel

DARK NORTHERN SPRING (DNS)

- Contains at least 75% or more dark, hard, vitreous kernels.

NORTHERN SPRING (NS)

- Contains between 25-74% dark, hard, vitreous kernels.



Non-vitreous kernel

RED SPRING (RS)

- Contains less than 25% dark, hard, vitreous kernels.



COMPOSITE HARVEST DATA

	2021 BY PROTEIN ¹			2021 Avg	2020 Avg	5-Year Avg
	Low	Med	High			
WHEAT GRADE DATA:						
Test Weight (lb/bu)	62.1	62.3	60.9	61.3	61.8	61.6
(kg/hl)	81.7	81.9	80.1	80.6	81.3	81.0
Damaged Kernels (%)	0.4	0.2	0.2	0.2	0.0	0.3
Foreign Material (%)	0.0	0.0	0.0	0.0	0.0	0.0
Shrunken & Broken (%)	1.2	0.8	1.2	1.1	0.8	0.8
Total Defects (%)	1.5	1.0	1.4	1.3	0.9	1.1
Vitreous Kernels (%)	67	77	82	80	71	74
Grade	1 NS	1 DNS	1 DNS	1 DNS	1 NS	1 NS
WHEAT NON-GRADE DATA:						
Dockage (%)	0.5	0.6	0.6	0.6	0.6	0.5
Moisture (%)	11.9	12.1	11.5	11.6	11.9	12.1
Protein (%) 12%/0% mb	13.0/14.8	14.0/15.9	16.0/18.2	15.4/17.5	14.3/16.3	14.4/16.3
Ash (%) 14%/0% mb	1.50/1.74	1.46/1.70	1.52/1.77	1.51/1.76	1.59/1.85	1.55/1.80
1000 Kernel Weight (g)	29.9	29.9	29.2	29.3	31.5	31.0
Kernel Size (%) lg/md/sm	35/62/4	36/60/4	28/67/5	30/65/5	50/48/3	45/52/3
Single Kernel: Hardness	72	74	70	71	68	73
Weight (mg)	33.5	32.7	32.0	32.2	35.0	33.2
Diameter (mm)	2.74	2.67	2.65	2.66	2.81	2.59
Sedimentation (cc)	63.0	67.0	69.0	68.0	65.0	66.0
Falling Number (sec)	370	381	377	377	374	376
DON (ppm)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
FLOUR DATA:						
Lab Mill Extraction (%)	67.1	67.7	65.4	66.0	67.4	68.3
Color: L*	90.3	90.7	90.4	90.4	90.7	90.4
a*	-1.1	-1.2	-1.2	-1.2	-1.2	-1.3
b*	9.6	9.3	9.7	9.6	9.6	9.4
Protein (%) 14%/0% mb	12.1/14.0	13.1/15.3	14.7/17.1	14.2/16.5	13.3/15.5	13.4/15.6
Ash (%) 14%/0% mb	0.47/0.55	0.48/0.56	0.50/0.58	0.49/0.57	0.51/0.60	0.53/0.61
Wet Gluten (%)	29.6	33.1	39.4	37.4	33.4	34.4
Gluten Index	98	95	90	91	91	91
Falling Number (sec)	387	396	402	400	388	392
Amylograph Viscosity: 65g (BU)	709	787	722	732	642	588
Damaged Starch (%)	6.1	5.9	5.5	5.6	7.1	7.3
SRC: Water/50% Sucrose (%)	70/118	73/121	71/121	71/121	72/118	72/120
5% Lactic Acid/5% Na ₂ CO ₃ (%)	142/101	147/101	151/100	149/100	147/102	146/103
Gluten Performance Index (GPI) (%)	0.65	0.66	0.68	0.68	0.67	0.65
DOUGH PROPERTIES:						
Farinograph: Peak Time (min)	6.8	7.8	9.8	9.2	7.9	7.8
Stability (min)	13.2	15.7	20.2	18.8	12.1	11.2
Absorption (%)	60.2	61.4	62.9	62.4	61.8	62.9
Alveograph: P (mm)	87	87	89	88	83	84
L (mm)	122	131	140	137	140	138
P/L Ratio	0.71	0.66	0.63	0.64	0.59	0.61
W (10 ⁻⁴ J)	371	398	444	430	368	376
Extensograph (45/135 min): Resistance (BU)	593/998	608/1084	660/1449	645/1344	513/856	497/825
Extensibility (cm)	15.9/12.6	16.1/13.4	14.7/11.6	15.1/12.0	15.6/12.8	16.5/13.4
Area (cm ²)	120/166	125/186	126/217	125/207	103/142	108/143
BAKING EVALUATION:						
Pan Bread: Bake Absorption (%)	64.2	65.3	66.9	66.4	67.4	66.2
Crumb Grain and Texture (1-10)	7.5	7.5	8.2	8.0	7.7	7.8
Loaf Volume (cc)	883	957	960	952	973	985
PRODUCTION OF 7 STATES (%):	8	19	73	100		

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



WESTERN REGIONAL HARVEST DATA

	2021 BY PROTEIN ¹			2021	2020	5-Year
	Low	Med	High	Avg	Avg	Avg
WHEAT GRADE DATA:						
Test Weight (lb/bu)	61.4	61.3	60.0	60.2	62.4	61.6
(kg/hl)	80.7	80.6	78.9	79.3	82.0	81.0
Damaged Kernels (%)	0.5	0.2	0.1	0.1	0.0	0.2
Foreign Material (%)	0.0	0.0	0.0	0.0	0.0	0.0
Shrunken & Broken (%)	1.7	1.5	1.8	1.8	0.9	1.0
Total Defects (%)	2.2	1.7	1.9	1.9	0.9	1.2
Vitreous Kernels (%)	73	84	85	84	82	81
Grade	1 NS	1 DNS	1 DNS	1 DNS	1 DNS	1 DNS
WHEAT NON-GRADE DATA:						
Dockage (%)	0.7	0.9	0.8	0.8	0.6	0.6
Moisture (%)	11.1	11.1	10.8	10.8	11.1	11.4
Protein (%) 12%/0% mb	13.0/14.7	14.2/16.1	16.4/18.6	15.8/18.0	14.4/16.4	14.5/16.5
Ash (%) 14%/0% mb	1.54/1.79	1.53/1.78	1.55/1.80	1.55/1.80	1.54/1.80	1.50/1.80
1000 Kernel Weight (g)	28.0	26.6	27.0	27.0	31.8	30.3
Kernel Size (g) lg/md/sm	22/72/6	23/71/6	19/74/7	20/73/7	44/53/3	38/58/4
Single Kernel: Hardness	72	70	69	69	68	73
Weight (mg)	32.9	31.8	31.2	31.4	35.7	32.8
Diameter (mm)	2.73	2.56	2.58	2.59	2.81	2.50
Sedimentation (cc)	65.0	69.0	70.0	69.0	65.0	66.0
Falling Number (sec)	358	388	374	374	372	383
DON (ppm)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
FLOUR DATA:						
Lab Mill Extraction (%)	66.2	66.7	64.0	64.5	66.9	68.1
Color: L*	90.3	91.0	90.6	90.6	90.7	90.4
a*	-1.2	-1.3	-1.3	-1.3	-1.3	-1.3
b*	9.8	9.6	9.9	9.8	9.8	9.7
Protein (%) 14%/0% mb	11.8/13.7	13.1/15.2	14.4/16.7	13.5/15.7	13.7/15.9	13.4/15.6
Ash (%) 14%/0% mb	0.52/0.60	0.53/0.61	0.53/0.62	0.53/0.61	0.52/0.61	0.51/0.59
Wet Gluten (%)	29.6	33.4	40.0	38.3	34.1	35.2
Gluten Index	98	95	86	88	87	88
Falling Number (sec)	396	413	404	404	395	400
Amylograph Viscosity: 65g (BU)	716	794	747	750	708	621
Damaged Starch (%)	6.1	5.8	5.4	5.5	7.2	7.3
SRC: Water/50% Sucrose (%)	77/123	76/124	75/124	76/123	78/128	71/121
5% Lactic Acid/5% Na ₂ CO ₃ (%)	146/114	150/112	152/108	150/110	152/115	147/108
Gluten Performance Index (GPI) (%)	0.64	0.65	0.68	0.68	0.65	0.65
DOUGH PROPERTIES:						
Farinograph: Peak Time (min)	6.4	8.1	10.6	9.9	8.1	8.1
Stability (min)	12.1	15.9	20.5	19.2	11.5	10.3
Absorption (%)	60.2	61.0	62.8	62.4	63.3	63.8
Alveograph: P (mm)	90	90	87	88	89	87
L (mm)	122	126	146	142	130	136
P/L Ratio	0.74	0.71	0.60	0.62	0.68	0.60
W (10 ⁻⁴ J)	390	405	447	437	366	374
Extensograph (45/135 min): Resistance (BU)	632/1048	639/1247	676/1483	668/1418	455/873	460/849
Extensibility (cm)	15.9/11.6	14.8/12.4	14.7/11.4	14.8/11.5	15.4/12.1	16.4/13.1
Area (cm ²)	127/161	123/198	130/216	129/209	91/138	101/144
BAKING EVALUATION:						
Pan Bread: Bake Absorption (%)	64.1	64.2	66.6	66.1	69.3	69.3
Crumb Grain and Texture (1-10)	7.5	7.5	8.0	7.9	7.7	8.0
Loaf Volume (cc)	905	960	935	935	975	987
% OF REGIONAL PRODUCTION:	8	12	80	100		

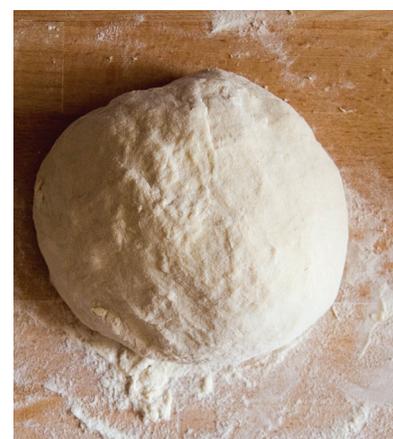
¹Protein Range: Low, <13.5%; Med, 13.5 - 14.5%; High, >14.5%.



EASTERN REGIONAL HARVEST DATA

	2021 BY PROTEIN ¹			2021 Avg	2020 Avg	5-Year Avg
	Low	Med	High			
WHEAT GRADE DATA:						
Test Weight (lb/bu)	62.8	62.8	62.1	62.3	61.3	61.5
(kg/hl)	82.6	82.6	81.6	81.9	80.7	80.9
Damaged Kernels (%)	0.2	0.2	0.3	0.3	0.1	0.4
Foreign Material (%)	0.0	0.0	0.0	0.0	0.0	0.0
Shrunken & Broken (%)	0.6	0.5	0.5	0.5	0.7	0.7
Total Defects (%)	0.8	0.7	0.8	0.8	0.8	1.1
Vitreous Kernels (%)	60	74	79	76	60	66
Grade	1 NS	1 NS	1 DNS	1 DNS	1 NS	1 NS
WHEAT NON-GRADE DATA:						
Dockage (%)	0.4	0.4	0.4	0.4	0.5	0.5
Moisture (%)	12.7	12.6	12.3	12.4	12.5	12.7
Protein (%) 12%/0% mb	13.1/14.9	13.9/15.8	15.5/17.6	14.9/16.9	14.2/16.2	14.3/16.2
Ash (%) 14%/0% mb	1.46/1.70	1.43/1.66	1.49/1.73	1.47/1.71	1.63/1.89	1.58/1.83
1000 Kernel Weight (g)	31.7	31.5	31.8	31.7	31.3	31.8
Kernel Size (%) lg/md/sm	47/51/2	43/54/3	40/58/2	41/56/2	55/43/2	52/46/3
Single Kernel: Hardness	72	76	71	72	68	74
Weight (mg)	34.0	33.1	32.9	33.0	34.4	33.7
Diameter (mm)	2.75	2.72	2.73	2.73	2.82	2.64
Sedimentation (cc)	62.0	67.0	69.0	67.0	64.0	65.0
Falling Number (sec)	382	377	380	379	376	369
DON (ppm)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
FLOUR DATA:						
Lab Mill Extraction (%)	68.1	68.3	67.1	67.5	67.9	68.6
Color: L*	90.3	90.6	90.1	90.2	90.6	90.4
a*	-1.1	-1.1	-1.1	-1.1	-1.2	-1.2
b*	9.5	9.1	9.5	9.4	9.3	9.2
Protein (%) 14%/0% mb	12.2/14.1	13.1/15.2	14.5/16.8	13.9/16.2	13.2/15.4	13.3/15.4
Ash (%) 14%/0% mb	0.47/0.55	0.48/0.56	0.50/0.58	0.49/0.57	0.52/0.61	0.53/0.62
Wet Gluten (%)	29.7	32.9	38.7	36.5	32.8	33.7
Gluten Index	97	96	94	95	94	94
Falling Number (sec)	377	388	400	395	381	384
Amylograph Viscosity: 65g (BU)	702	784	691	714	582	558
Damaged Starch (%)	6.1	6.0	5.6	5.8	7.0	7.3
SRC: Water/50% Sucrose (%)	69/114	73/120	71/120	71/120	70/115	71/118
5% Lactic Acid/5% Na ₂ CO ₃ (%)	139/98	145/99	150/99	148/99	145/97	144/100
Gluten Performance Index (GPI) (%)	0.66	0.66	0.68	0.68	0.68	0.66
DOUGH PROPERTIES:						
Farinograph: Peak Time (min)	7.2	7.6	8.9	8.4	7.6	7.6
Stability (min)	14.2	15.6	19.8	18.3	12.6	12.1
Absorption (%)	60.1	61.6	63.0	62.4	60.4	62.1
Alveograph: P (mm)	84	85	91	89	77	82
L (mm)	122	133	133	132	149	140
P/L Ratio	0.69	0.64	0.68	0.67	0.51	0.59
W (10 ⁻⁴ J)	351	395	441	422	371	378
Extensograph (45/135 min): Resistance (BU)	553/948	593/1002	640/1406	621/1268	565/840	535/801
Extensibility (cm)	15.8/13.6	16.8/13.9	14.8/11.9	15.4/12.5	15.8/13.4	16.7/14.7
Area (cm ²)	112/171	126/180	120/219	121/205	115/146	116/142
BAKING EVALUATION:						
Pan Bread: Bake Absorption (%)	64.3	65.9	67.3	66.6	65.7	67.1
Crumb Grain and Texture (1-10)	7.5	7.5	8.5	8.2	7.6	7.7
Loaf Volume (cc)	860	955	990	970	972	982
% OF REGIONAL PRODUCTION:	8	25	67	100		

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



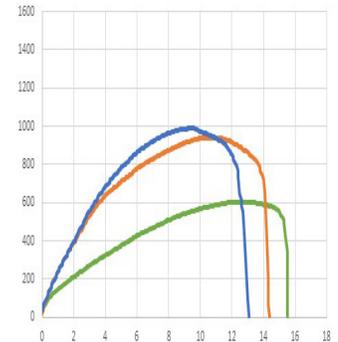
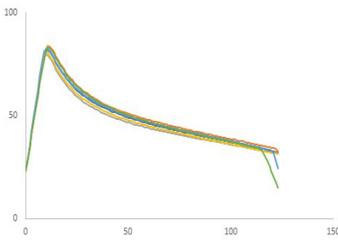
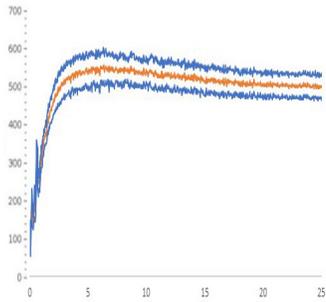
COMPOSITE DOUGH PROPERTIES

FARINOGRAMS

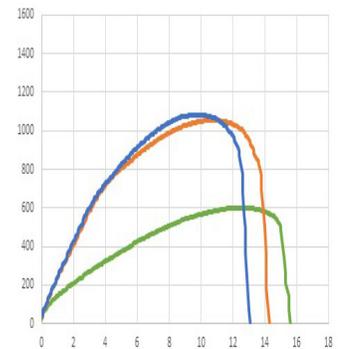
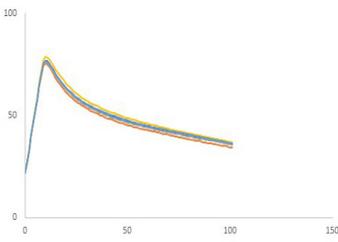
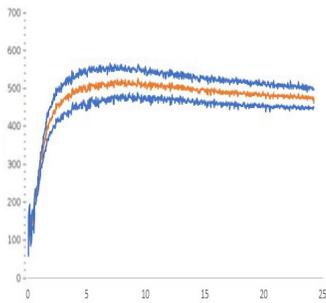
ALVEOGRAMS

EXTENSOGRAMS

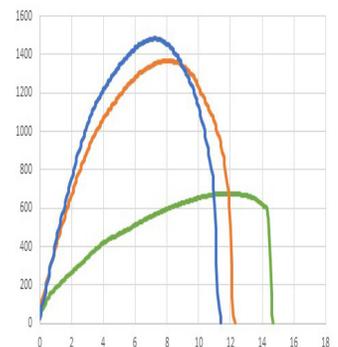
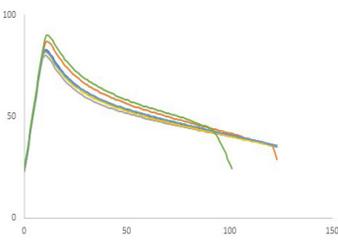
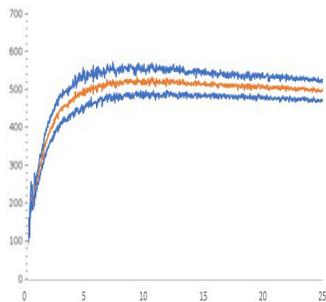
**LOW
PROTEIN**



**MEDIUM
PROTEIN**

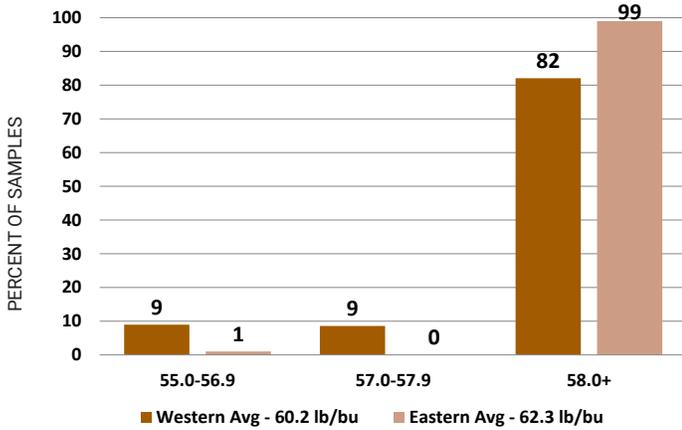


**HIGH
PROTEIN**

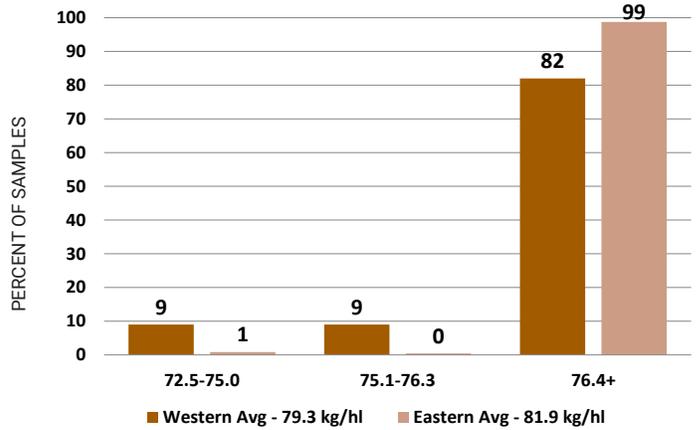


DISTRIBUTIONS

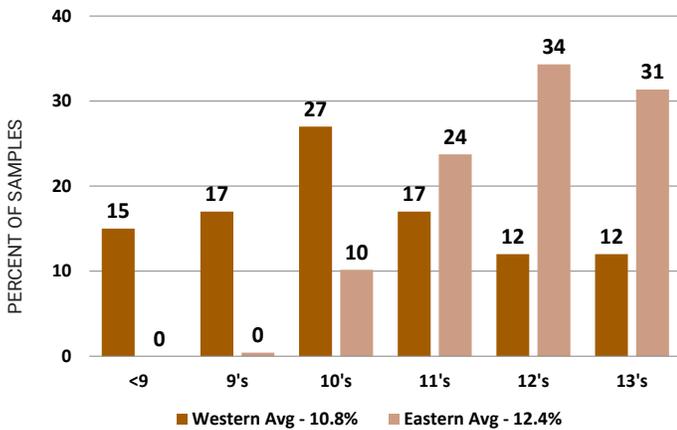
TEST WEIGHT | Pounds/Bushel



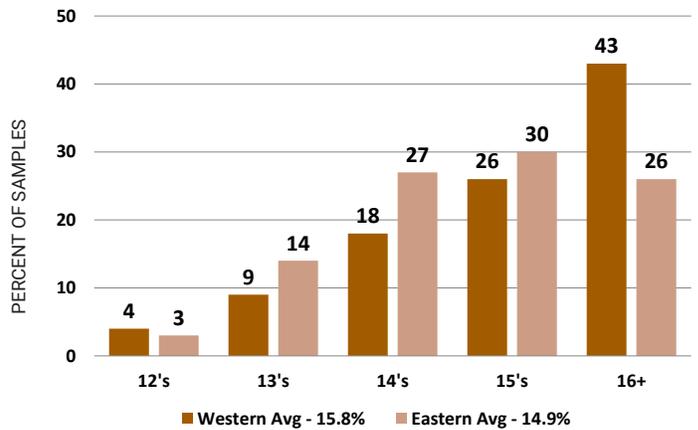
TEST WEIGHT | Kilograms/Hectoliter



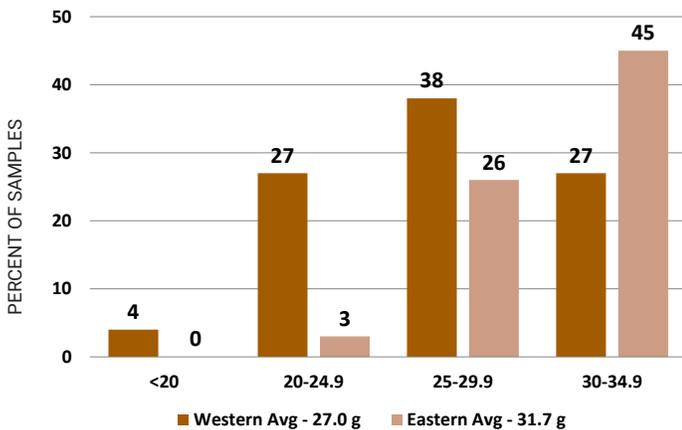
WHEAT MOISTURE | Percent



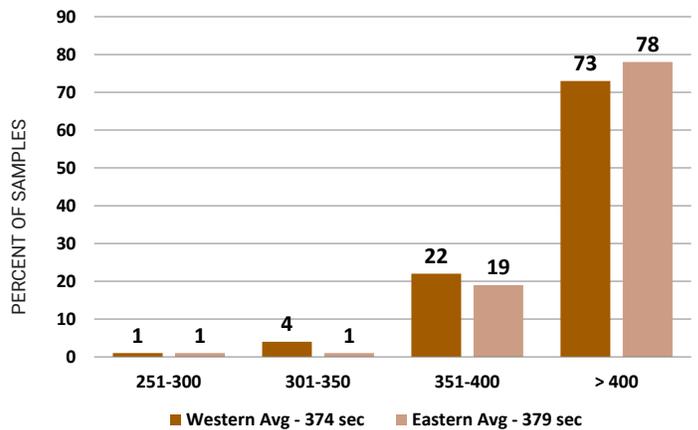
PROTEIN (12% MB) | Percent



1000 KERNEL WEIGHT | Grams



FALLING NUMBER | Seconds





HARD WHITE



The smallest class of wheat in the United States, hard white (HW) is grown in the Central Plains, Montana, Idaho and California, and when available for export, shipped via Pacific and Gulf ports. HW wheat has a hard endosperm, white bran and a medium to high protein content of 10.0 to 14.0% (12% mb). HW includes winter and spring varieties increasing the protein range and functionality within the class.



For the miller, HW delivers whiter flour at higher extraction levels due to its lighter bran color. HW is a true hard wheat creating excellent granulation, maximizing course semolina production and low ash flour.



For the baker, the greatest advantage of HW wheat flour is the whiter end product color. Higher extraction rates generally improve water absorption. Using ultra fine, white whole wheat flour, whole wheat bread can be produced with the color and texture of bread from white flour. HW wheat flour is also lower in polyphenol oxidase (PPO), an enzyme that can cause dough browning. Lower PPO content improves the color of wet noodles and Asian steamed bread products.



APPLICATIONS

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

Applications include:

- Bulgur
- Flat breads
- Hard rolls
- High extraction applications
- Asian noodles
- Pan breads
- Tortillas
- Whole wheat breads
- Yeast raised products

Scan this QR code with the camera application on your smart phone to access more information about HW wheat on the USW website at www.uswheat.org/cropquality.



HARD WHITE PRODUCTION

FOR THE MAJOR PRODUCING STATES (MMT)

	2021	2020	2019	2018	2017
California	0.01	0.01	0.01	0.02	0.01
Colorado	0.08	0.03	0.16	0.17	0.26
Idaho	0.16	0.30	0.31	0.36	0.23
Kansas	0.40	0.23	0.28	0.23	0.27
Nebraska	0.06	0.04	0.09	0.09	0.09
Five-State Total	0.70	0.61	0.85	0.87	0.87
PNW-Tributary	0.16	0.30	0.31	0.36	0.23
Southern Plains-Tributary	0.53	0.30	0.53	0.49	0.62
Total HW Production	0.71	0.62	0.87	0.89	0.88

Based on USDA crop estimates as of 30 September 2021.

“Overall, I was really happy with the performance of the hard white wheat we grew this year. It had an average test weight of 59 pounds per bushel and an average protein of 13.2%.”

– Brian Starkebaum,
Colorado wheat farmer

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

SAMPLE COLLECTION AND ANALYSIS

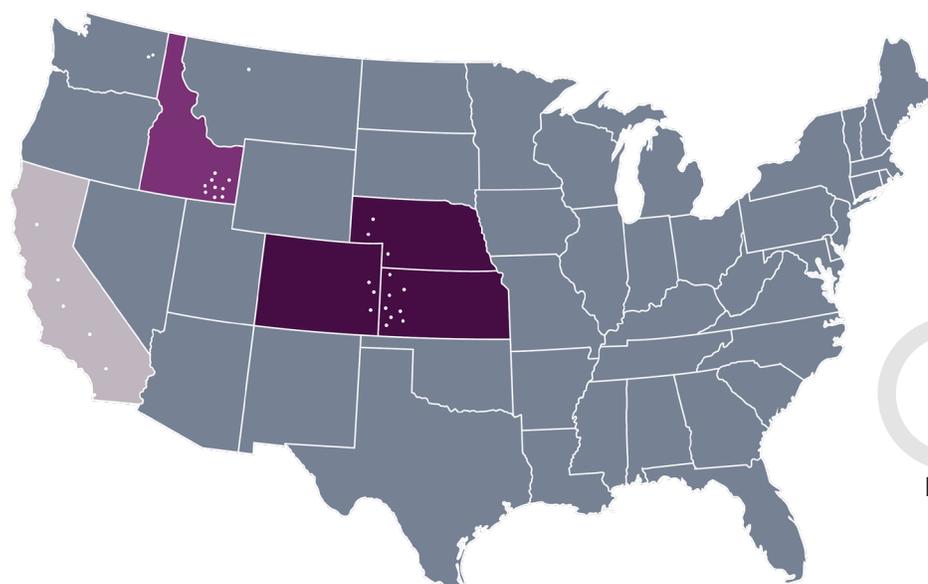
The Wheat Marketing Center (WMC) conducted the quality analyses. The Federal Inspection Service (FGIS) graded and ran wheat proteins on the samples.

SAMPLE TESTING

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 methods are described in the Analysis Methods section of this booklet.



Nebraska, May 2021, Tyson Narjes

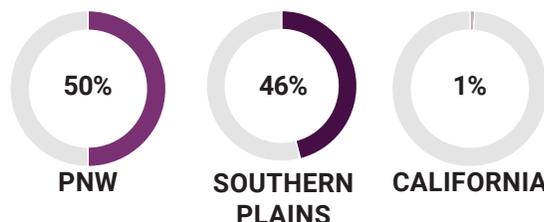


5

STATES SURVEYED

97%

OF TOTAL HW PRODUCTION REPRESENTED



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

HARD WHITE 27

HARVEST SURVEY

The 2021 HW samples show good quality performance in milling, dough properties and finished products, including pan breads, Asian noodles and steamed breads. The Pacific Northwest (PNW), California and Southern Plains composites all show good bread baking potential according to their respective protein contents. 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 portion of soft white (SW) flour to improve product quality.

2021 CROP HIGHLIGHTS

PRODUCTION of the 2021 HW crop is 0.71 MMT, up 13% over last year. Much of the increase is due to additional seeded acres and good production in Kansas, Colorado and Nebraska. Spring seeded HW was down due to the drought, which trimmed yields in southern Idaho.

GRADE average for six of the eight composites is U.S. No. 1. The low- and med-protein Southern Plains composites graded U.S. No. 2 due primarily to low test weights.

TEST WEIGHT averages range from 58.4 to 63.2 lb/bu (76.9 to 83.1 kg/hl).

WHEAT MOISTURE ranges are 8.9 to 11.7%; **WHEAT PROTEIN** 11.0 to 13.7% (12% mb).

1000 KERNEL WEIGHT for the Southern Plains low- and California high-protein composites are 20.1 and 28.6 g, respectively. All others are greater than or equal to 30.0 g.

KERNEL CHARACTERISTICS include kernel hardness averages 42.5 to 84.2 and kernel diameters 2.46 to 2.71 mm.

FALLING NUMBER averages 349 sec or higher for all composites.

LABORATORY MILL straight-grade flour extractions range 69.8 to 73.1%, L* values (whiteness) 91.2 to 92.1, flour protein 10.0 to 13.0%

(14% mb) and flour ash 0.45 to 0.53% (14% mb).

Flour **WET GLUTEN** contents range 25.1 to 29.8% depending on flour protein content.

AMYLOGRAPH peak viscosities are between 553 and 1051 BU for all composites.

FARINOGRAPH absorptions range 52.4 to 62.9% and stability times 7.3 to 35.1 min, exhibiting medium to strong dough characteristics. HW farinograph absorption indicates more tolerance to overmixing.

EXTENSOGRAPH at a 135 min rest shows maximum resistance in the range of 294 to 1203 BU, extensibility 6.2 to 18.4 cm and area 58 to 183 cm². Maximum resistance of the Southern Plains low- and med-protein composites were 294 and 528 BU, respectively. All other composites were greater than or equal to 885 BU.

ALVEOGRAPH ranges are P (38 to 120 mm); L (83 to 137 mm); and W (107 to 393 (10⁻⁴ J)).

DAMAGED STARCH values are in the range of 3.9 to 5.6%.

Lactic acid **SRC** values range 86 to 153%, indicating weak to strong gluten strength. The range shrinks to 116-153% if the Southern Plains low-protein composite is removed from the set.

BAKE EVALUATION for all composites shows acceptable to good baking performance relative to protein content, with bake absorptions in the range of 57.6 to 67.8%, loaf volumes of 742 to 950 cc, and crumb grain and texture scores of 6.0 to 8.0 points.

CHINESE RAW NOODLES (white salted) L* values at 0 hr of production and after 24 hr of storage at room temperature are acceptable for the Southern Plains low- and med-protein composites. The sensory color stability scores for PNW and Southern Plains low- and med-protein composites are similar to or better than the control noodle of 7.0. Cooked noodle texture is softer for the California med-protein composite.

CHINESE WET NOODLES (yellow alkaline) sensory color stability scores are slightly to moderately worse than the control for parboiled noodles from all composites. The cooked noodle texture is similar for all composites. Overall, this year's HW will produce noodles with acceptable color and texture if low ash patent flour is used.

STEAMED BREAD results show higher protein composites have larger specific volumes with total scores equivalent to the control flour. Blending 25% SW flour with high protein HW flour may improve overall steamed bread quality.



HARVEST DATA

	PNW 2021 BY PROTEIN ¹			CALIFORNIA 2021 BY PROTEIN ¹		SOUTHERN PLAINS 2021 BY PROTEIN ¹		
	Med	High	Very High	Med	High	Low	Med	High
WHEAT GRADE DATA:								
Test Weight (lb/bu)	63.1	61.2	61.2	62.9	63.2	58.4	59.9	62.2
(kg/hl)	82.9	80.5	80.5	82.7	83.1	76.9	78.8	81.8
Damaged Kernels (%)	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0
Foreign Material (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Shrunken & Broken (%)	0.7	1.5	0.5	0.4	0.4	0.7	0.3	0.1
Total Defects (%)	0.7	1.5	0.5	0.4	0.4	0.8	0.4	0.1
Grade	1 HW	1 HW	1 HW	1 HW	1 HW	2 HW	2 HW	1 HW
WHEAT NON-GRADE DATA:								
Dockage (%)	0.2	0.5	0.3	0.0	0.0	0.2	0.0	0.0
Moisture (%)	9.6	9.1	10.1	9.2	8.9	11.7	12.5	10.6
Protein (%) 12%/0% mb	11.9/13.5	12.8/14.5	13.7/15.6	11.8/13.4	12.7/14.4	11.0/12.5	12.0/13.6	13.2/15.0
Ash (%) 14%/0% mb	1.58/1.84	1.67/1.94	1.59/1.85	1.37/1.59	1.42/1.65	1.63/1.90	1.52/1.80	1.58/2.80
1000 Kernel Weight (g)	32.0	31.2	34.1	30.0	28.6	20.1	31.1	32.1
Kernel Size (%) lg/md/sm	83/16/1	75/24/1	84/16/0	76/24/0	74/26/0	66/26/8	78/22/0	83/17/0
Single Kernel: Hardness	72.0	67.4	61.8	84.2	84.4	42.5	49.7	62.4
Weight (mg)	35.2	32.9	35.1	33.3	30.6	28.1	30.5	33.4
Diameter (mm)	2.71	2.67	2.74	2.69	2.57	2.46	2.57	2.63
Sedimentation (cc)	26.8	25.7	33.0	35.3	31.9	25.3	32.7	42.7
Falling Number (sec)	375	394	349	398	421	409	383	437
FLOUR DATA:								
Lab Mill Extraction (%)	71.3	71.8	71.4	71.8	73.1	69.8	71.2	71.0
Color: L*	91.9	92.1	92.0	91.4	91.2	91.9	91.9	91.6
a*	-1.7	-1.5	-1.6	-1.9	-1.7	-2.0	-1.9	-2.0
b*	8.3	7.7	8.0	8.7	8.7	9.0	9.0	9.7
Protein (%) 14%/0% mb	11.5/13.4	12.0/13.9	13.0/15.1	11.3/13.2	12.1/14.1	10.0/11.6	11.0/12.8	12.5/14.6
Ash (%) 14%/0% mb	0.48/0.56	0.53/0.62	0.49/0.57	0.45/0.53	0.48/0.56	0.49/0.57	0.45/0.53	0.46/0.53
Wet Gluten (%)	28.4	27.1	29.8	25.1	28.7	26.2	27.8	28.7
Gluten Index	97	97	96	98	97	89	88	96
Falling Number (sec)	419	390	389	451	399	397	412	473
Amylograph Viscosity: 65g (BU)	962	946	932	1031	1051	920	656	553
Damaged Starch (%)	5.2	4.7	4.5	5.6	5.6	3.9	4.0	4.9
SRC: Water/50% Sucrose (%)	61/111	53/107	59/116	65/118	59/118	55/93	55/98	63/106
5% Lactic Acid/5% Na ₂ CO ₃ (%)	116/77	129/71	121/79	153/84	142/89	86/65	134/71	145/77
Gluten Performance Index (GPI) (%)	0.62	0.73	0.62	0.75	0.68	0.55	0.79	0.79
DOUGH PROPERTIES:								
Farinograph: Peak Time (min)	8.3	8.3	9.4	6.5	6.4	2.2	6.3	13.3
Stability (min)	19.0	9.3	12.2	35.1	19.1	7.3	9.3	18.5
Absorption (%)	60.3	58.6	60.2	62.1	62.9	52.4	55.7	58.3
Alveograph: P (mm)	97	67	81	108	104	38	52	120
L (mm)	129	134	137	103	125	107	121	83
P/L Ratio	0.75	0.50	0.59	1.05	0.83	0.36	0.43	1.45
W (10 ⁻⁴ J)	374	275	365	361	393	107	181	379
Extensograph (45/135 min): Resistance (BU)	528/1163	434/885	622/1203	332/879	339/1063	281/294	460/528	574/1150
Extensibility (cm)	13.8/10.0	15.6/11.2	19.4/11.1	10.3/6.2	11.4/7.6	17.6/18.4	19.5/16.9	12.1/7.7
Area (cm ²)	95/131	76/107	148/138	45/58	49/88	70/77	118/116	90/96
BAKING EVALUATION:								
Pan Bread: Bake Absorption (%)	65.0	63.5	65.2	67.3	67.8	57.6	60.6	59.2
Crumb Grain and Texture (1-10)	6.5	8.0	7.5	6.5	6.0	6.0	7.0	7.0
Loaf Volume (cc)	848	924	950	817	846	742	827	855

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

HARVEST DATA

	PNW 2021 BY PROTEIN ¹			CALIFORNIA 2021 BY PROTEIN ¹		SOUTHERN PLAINS 2021 BY PROTEIN ¹		
	Med	High	Very High	Med	High	Low	Med	High
CHINESE RAW NOODLE-MAKING QUALITY:								
Color at 0-24 hr: L*	82.3/71.6	81.6/71.2	81.1/71.1	83.8/70.5	83.8/71.5	84.4/74.7	84.3/74.7	82.2/70.9
a*	-0.2/0.4	-0.3/1.2	-0.6/1.3	-0.3/0.0	-0.0/0.8	-0.4/1.1	-0.1/1.2	-0.3/0.3
b*	19.2/24.5	18.8/23.6	18.4/24.8	18.7/22.8	19.0/23.3	18.0/21.6	17.1/22.2	23.7/26.8
Change in L* (0-24 hr)	10.7	10.4	10.0	13.3	12.3	9.7	9.6	11.3
Cooking Yield (1.5 min, %)	123	121	114	121	117	132	123	117
Sensory Color Stability Score	7.0	7.1	7.2	6.8	6.8	7.5	7.6	6.7
Instrumental Texture:								
Firmness (g)	1213	1202	1205	1144	1242	1204	1287	1303
Springiness (%)	94.1	95.1	95.1	94.0	95.4	94.1	95.9	95.6
Cohesiveness (%)	0.68	0.68	0.68	0.71	0.71	0.61	0.62	0.61
Chewiness (g)	583	582	584	560	636	514	582	589
CHINESE WET NOODLE-MAKING QUALITY:								
Uncooked Color at 0-24 hr: L*	77.6/70.1	80.6/69.7	80.6/69.4	81.2/68.1	81.0/66.8	81.7/69.7	81.9/68.9	79.4/65.2
a*	-3.2/-1.0	-1.3/-0.5	-1.5/-0.7	-2.3/-1.1	-2.4/-1.1	-1.5/-0.7	-1.2/-0.6	-1.8/-0.7
b*	27.6/24.2	20.2/23.3	21.2/24.0	22.3/23.0	21.0/22.2	20.2/22.6	18.3/22.2	20.6/21.4
Change in L* (0-24 hr)	7.5	10.9	11.3	13.1	14.2	12.0	13.0	14.2
Parboiled Color at 0-24 hr: L*	76.6/77.6	77.8/78.5	80.3/77.9	78.1/77.6	78.1/79.5	78.5/79.2	78.2/77.8	75.9/75.9
a*	-3.0/-3.5	-1.4/-2.9	-1.6/-3.0	-3.4/-3.3	-0.5/-3.5	-2.1/-3.2	-2.4/-3.0	-1.7/-2.7
b*	28.7/27.7	23.1/24.1	21.2/26.1	28.3/27.3	22.4/25.9	29.6/27.6	29.5/27.9	29.5/28.0
Cooking Yield (1.5 min, %)	44	42	42	42	42	45	42	41
Uncooked Color Stability Score	7.2	6.7	6.7	6.5	6.0	6.8	6.6	6.0
Parboiled Color Stability Score	6.8	6.5	6.0	6.8	6.5	6.7	6.9	6.8
Instrumental Texture:								
Firmness (g)	855	947	866	815	839	803	914	858
Springiness (%)	86.8	83.3	91.9	91.4	84.2	79.9	83.4	83.6
Cohesiveness (%)	0.68	0.68	0.67	0.68	0.68	0.63	0.64	0.63
Chewiness (g)	504	534	530	508	481	403	488	455
ASIAN-TYPE STEAMED BREAD EVALUATION:								
Specific Volume (ml/g)	2.3	2.5	2.4	2.2	2.4	2.2	2.4	2.4
Total Score	66.0	71.0	72.5	66.5	74.0	58.0	66.6	67.7

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

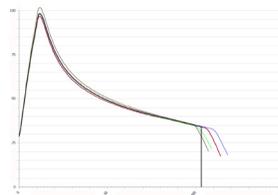
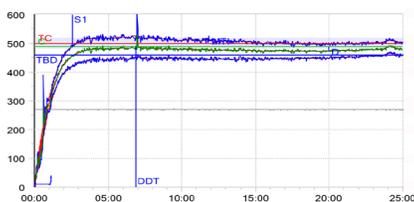
DOUGH PROPERTIES

FARINOGRAMS

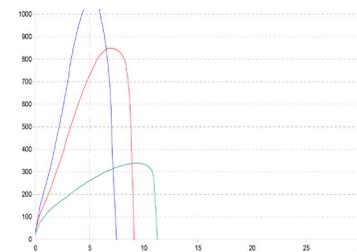
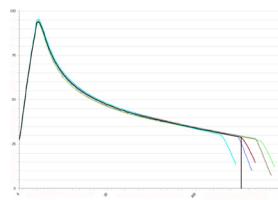
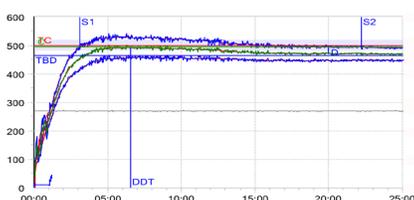
ALVEOGRAMS

EXTENSOGRAMS

CALIFORNIA
MED



CALIFORNIA
HIGH



HARD WHITE 30

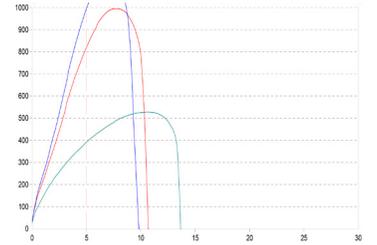
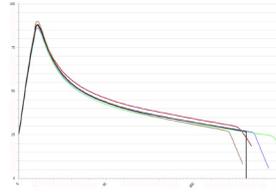
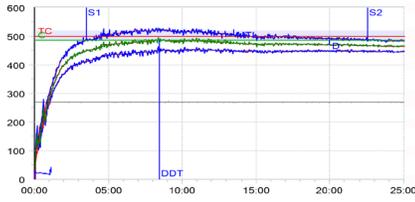
DOUGH PROPERTIES CONTINUED

FARINOGRAMS

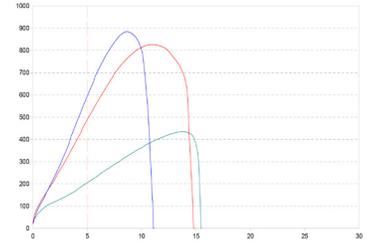
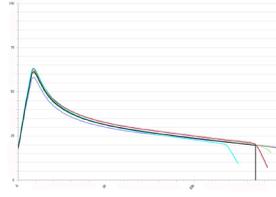
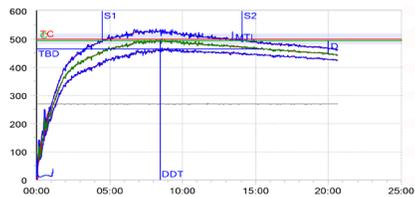
ALVEOGRAMS

EXTENSOGRAMS

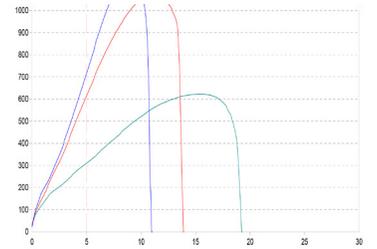
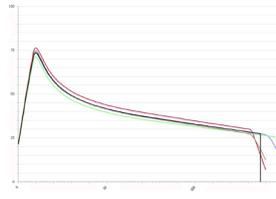
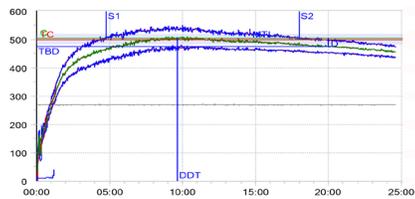
PNW MED



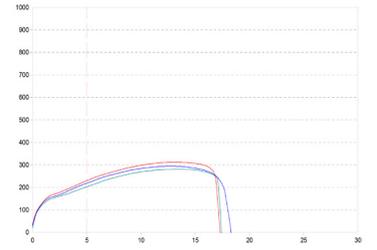
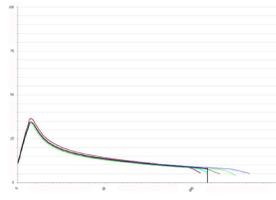
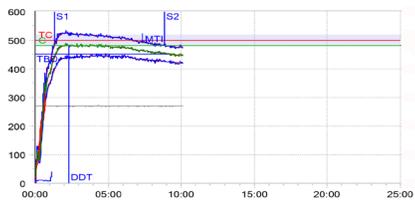
PNW HIGH



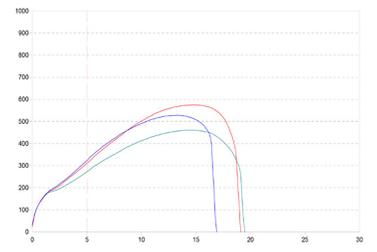
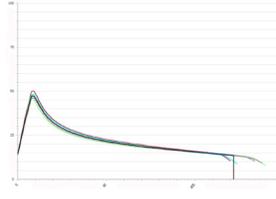
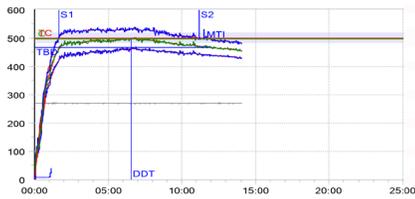
PNW VERY HIGH



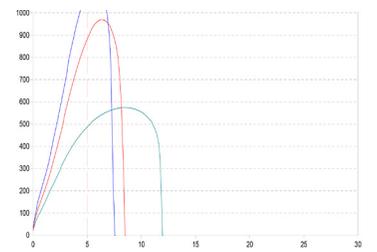
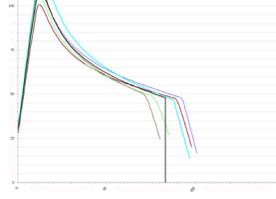
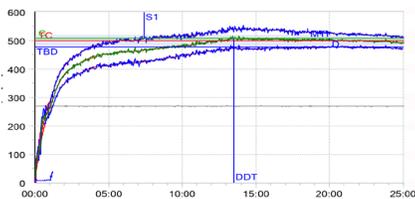
SOUTHERN PLAINS LOW



SOUTHERN PLAINS MED



SOUTHERN PLAINS HIGH





SOFT WHITE



Grown primarily in the Pacific Northwest (PNW) and shipped via Pacific ports, approximately 80% of soft white (SW) wheat is exported from the United States. It typically has a low protein of 8.5 to 10.5% (12% mb), low moisture and weak gluten. SW includes winter and spring varieties increasing the protein range and functionality within the class.



For the miller, SW delivers excellent results. Arriving at the mill with an average moisture of less than 10%, an average test weight of more than 80 hectoliter mass and a low quantity of screenings, SW wheat provides the millers every opportunity for high flour extraction. The lower wheat moisture allows the miller to temper the wheat to a lower average target moisture optimizing flour extraction, particle size and color.

For the baker, low moisture content creates an advantage by optimizing water absorption and product quality to the consumer. The finer particle size may increase the rate of water absorption, decreasing mix time and improving production efficiencies. With the fine particle size and starch characteristics, SW flour creates a unique and tender texture for many end-products.

APPLICATIONS

From specialty products such as sponge cakes or Asian noodles to blending with HRS for improving bread color, U.S. SW wheat flour has the versatility to improve the quality of a wide variety of products.

Applications include:

- Biscuits
- Cakes
- Cereals and cereal bars
- Crackers
- Flat Breads
- Flours (cake, pastry, self-rising)
- Fried Spring Rolls
- Muffins
- Noodles, Asian-style
- Pastries
- Quick breads
- Snack foods
- Steamed bread, Chinese southern-type
- Sugar snap cookies
- Tempura batter
- Wafers/Ice cream cones
- Other confectionary products

Scan this QR code with the camera application on your smart phone to access more information on the USW website at www.uswheat.org/cropquality.



SOFT WHITE PRODUCTION

FOR THE MAJOR PRODUCING STATES (MMT)

	2021		2020		2019		2018		2017	
	SW	CLUB								
Washington	1.9	0.1	3.8	0.2	3.1	0.1	3.0	0.3	2.8	0.3
Oregon	0.8	0.0	1.2	0.0	1.2	0.0	1.2	0.0	1.1	0.0
Idaho	1.4	0.0	2.0	0.0	1.6	0.0	1.5	0.0	1.4	0.0
Three-State Total	4.1	0.2	6.9	0.3	5.9	0.2	5.7	0.4	5.3	0.4
Three-State SW Total	4.3		7.2		6.0		6.0		5.6	
Total SW Production	4.8		7.6		6.6		6.5		6.2	

Based on USDA crop estimates as of 30 September 2021.

375

SOFT WHITE

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

67

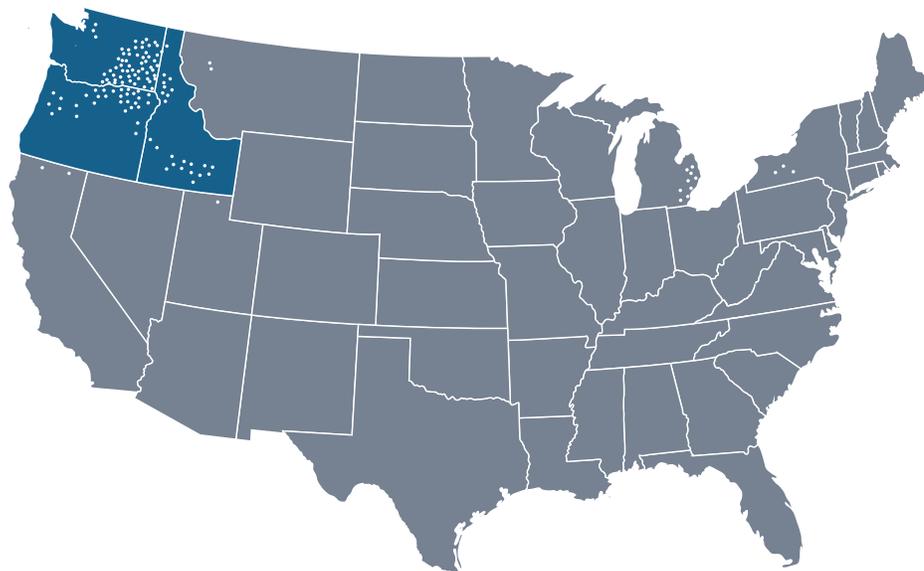
WHITE CLUB

SAMPLE COLLECTION AND ANALYSIS

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

SAMPLE TESTING

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 White Club (Club) samples. The methods are described in the Analysis Methods section of this booklet.

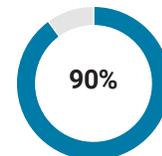


3

STATES SURVEYED

90%

OF TOTAL SW PRODUCTION REPRESENTED



PNW

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



HARVEST SURVEY

The PNW experienced challenging drought conditions in the 2021 crop year, which resulted in a wheat crop with higher protein and lower yields. This year's SW crop has weak to medium gluten strength and acceptable finished product characteristics. SW is especially suited for use in cakes, pastries, cookies and snack foods. The high protein segment of the SW crop provides opportunities in blends for crackers, Asian noodles, steamed breads, flat breads and pan breads. Club, with very weak gluten strength, is typically used in a Western White blend with SW for cakes and delicate pastries.

WEATHER AND HARVEST

WINTER PLANTING conditions were generally good including sufficient moisture overall to develop a strong stand; however, less winter moisture impacted crop development coming out of dormancy.

SPRING PLANTING conditions were poor due to the very dry conditions and excessive heat throughout much of the PNW.

As the crop **DEVELOPED**, in many areas, extreme sustained heat in

late June accelerated crop maturity which put the harvest timeframe generally ahead of average.

PRODUCTION of the 2021 PNW SW crop is estimated at 4.3 MMT, the lowest for the region since 1966.

2021 CROP HIGHLIGHTS

The overall average **GRADE** of the 2021 SW crop is U.S. No. 2 due to lower test weights. Although the test weight was lower than last year, the Club grade remained U.S. No. 1.

TEST WEIGHT SW averages range from 59.0 to 60.7 lb/bu (77.6 to 79.8 kg/hl) with an average of 59.3 lb/bu (77.9 kg/hl); Club averages 59.7 lb/bu (78.5 kg/hl).

PROTEIN (12% mb) ranges from 8.1 to 11.9% for SW, with the weighted average 11.3%. Club averages 11.5%.

WHEAT MOISTURE ranges from 8.7 to 9.7% for SW with a weighted average of 8.8%. Club averages 8.0%.

FALLING NUMBER average is 319 sec or higher for all SW composites and 345 sec for Club.

SW flour **WET GLUTEN** contents range 8.4 to 24.5% depending on flour protein content. Club averages 6.1%.

SW lactic acid **SRC** values range 91 to 109%, indicating weak to medium

gluten strength. Water SRC values range from 53 to 54% for SW. Lactic acid and water SRC values for Club are 75 and 49%, respectively, and are indicative of very weak gluten with low water holding capacity.

SW **AMYLOGRAPH** peak viscosities are between 472 and 542 BU for all composites. Club averages on amylograph peak viscosity of 529 BU.

FARINOGRAPH SW absorptions range from 51.5 to 53.1% with stability times of 2.2 to 2.6 min, showing desirable weak dough characteristics. The low farinograph absorptions are typical for SW and in line with the water SRC values. Average Club farinograph absorption is 51.1% with a stability of 1.1 min, showing very weak dough characteristics typical for Club.

EXTENSOGRAPH SW data at 45 min show maximum resistance in the range of 174 to 284 BU, extensibility 16.8 to 18.4 cm and area 46 to 79 cm². Club extensograph 45 min maximum resistance, extensibility,

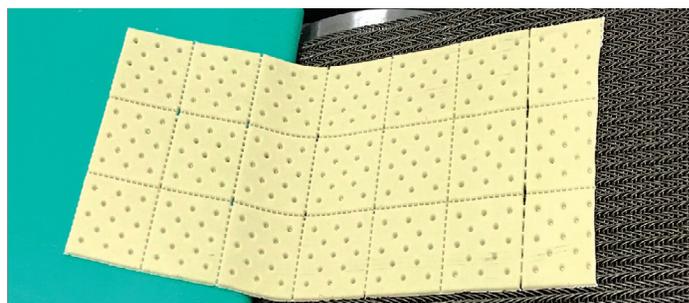
and area are 107 BU, 17.2 cm, and 23 cm², respectively.

ALVEOGRAPH SW ranges include P values 37 to 42 mm; L values 57 to 68 mm; and W values 63 to 78 (10⁻⁴ J). Average Club alveograph P, L and W values of 27 mm, 43 mm, and 29 (10⁻⁴ J), respectively.

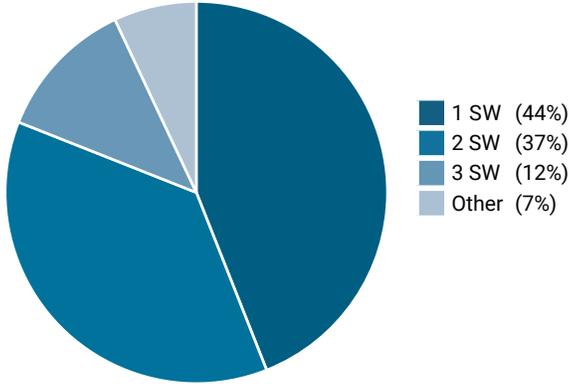
SPONGE CAKE SW volumes range 1077 to 1104 cc, depending on protein content, with a weighted average of 1081 cc. Total sponge cake score is 33 to 49 with a weighted average of 35. Club sponge cake volume is 1070 cc with a total score of 34. Scores were lower due to firmer textures.

Average **COOKIE** SW diameters are 8.6 to 8.7 cm with spread factors of 10.1 to 10.4. Club diameter and spread factor are 9.1 and 12.6 cm, respectively.

CHINESE SOUTHERN-TYPE STEAMED BREAD specific volumes are 2.2 to 2.4 mL/g with total scores less than the control score of 70.0. Club specific volume is 2.3 mL/g with a total score below the control.



DISTRIBUTION BY GRADE



Oregon, July 2021, Amanda Spoo



Washington, August 2021, Lori Maricle



Washington, July 2021, Brian Cochrane

“The extreme heat and dryness challenged PNW soft white wheat growers unlike anything we have seen in decades. We have done the best we can to harvest as much wheat as possible for the marketing channels. We know that high proteins cause challenges for our customers and I would say two things to them: Friends, thank you for your past business and we are committed to working with you to meet your needs as best we can with what’s available.”

– Mike Carstensen, Washington wheat farmer



Idaho, August 2021, Cory Kress



Washington, June 2021, Brett Blankenship



Idaho, June 2021, Idaho Wheat Commission

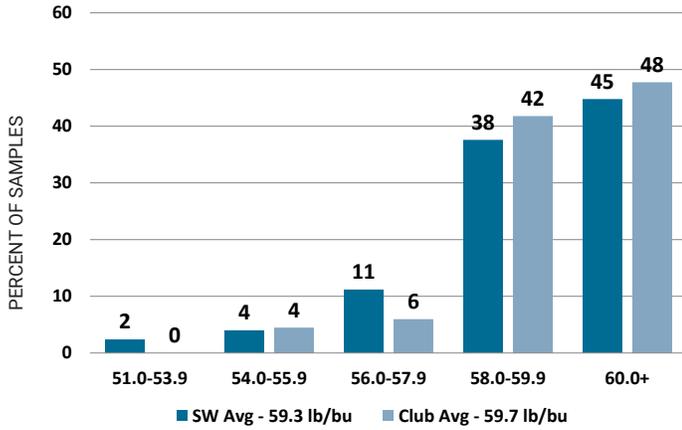
HARVEST DATA

	2021					2020		5-Year	
	SW BY PROTEIN ¹			SW	Club	SW	Club	SW	Club
	Low	Med	High	Avg	Avg	Avg	Avg	Avg	Avg
WHEAT GRADE DATA:									
Test Weight (lb/bu)	60.7	60.3	59.0	59.3	59.7	61.9	61.6	61.4	60.6
(kg/hl)	79.8	79.3	77.6	77.9	78.5	81.4	81.0	80.7	79.7
Damaged Kernels (%)	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.1	0.0
Foreign Material (%)	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1
Shrunken & Broken (%)	0.6	0.7	1.1	1.0	1.6	0.4	0.8	0.5	0.8
Total Defects (%)	0.6	0.7	1.2	1.1	1.7	0.5	0.9	0.6	0.9
Grade	1 SW	1 SW	2 SW	2 SW	1 WC	1 SW	1 WC	1 SW	1 WC
WHEAT NON-GRADE DATA:									
Dockage (%)	0.3	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6
Moisture (%)	9.7	9.1	8.7	8.8	8.0	9.2	8.5	9.3	8.6
Protein (%) 12%/0% mb	8.1/9.0	9.8/10.8	11.9/13.0	11.3/12.3	11.5/12.5	9.8/11.2	9.8/11.1	9.8/11.1	9.7/11.0
Ash (%) 14%/0% mb	1.43/1.59	1.46/1.60	1.50/1.64	1.48/1.63	1.35/1.47	1.35/1.57	1.29/1.50	1.34/1.56	1.29/1.49
1000 Kernel Weight (g)	35.4	32.2	27.7	29.0	27.1	36.3	32.3	36.0	32.1
Kernel Size (%) lg/md/sm	84/15/1	79/21/0	63/36/1	67/32/1	54/45/1	90/10/0	83/17/0	88/11/1	79/21/0
Single Kernel: Hardness	30.7	32.8	32.9	32.7	38.3	32.2	31.4	28.5	28.7
Weight (mg)	37.8	33.0	31.2	31.8	33.0	39.1	32.8	38.7	34.3
Diameter (mm)	2.72	2.59	2.50	2.54	2.42	2.77	2.61	2.75	2.58
Sedimentation (cc)	15.8	15.0	19.3	18.1	11.4	21.7	11.0	16.9	11.5
Falling Number (sec)	319	337	349	344	345	323	322	321	334
FLOUR DATA:									
Lab Mill Extraction (%)	74.0	72.1	69.4	70.1	72.0	72.6	74.7	73.1	74.7
Color: L*	92.8	92.8	92.6	92.5	92.9	92.6	92.6	92.5	92.3
a*	-2.4	-2.1	-2.0	-2.1	-1.9	-2.1	-2.0	-2.1	-2.1
b*	9.5	8.5	8.3	8.3	8.1	8.1	8.0	8.0	8.1
Protein (%) 14%/0% mb	7.5/8.7	8.8/10.2	11.0/12.8	10.3/12.0	10.5/12.2	8.8/10.2	8.9/10.4	8.6/10.0	8.7/10.0
Ash (%) 14%/0% mb	0.48/0.56	0.44/0.51	0.45/0.52	0.45/0.52	0.42/0.49	0.43/0.50	0.48/0.56	0.42/0.49	0.45/0.52
Wet Gluten (%)	8.4	23.9	24.5	23.7	6.1	22.3	13.1	22.9	19.1
Gluten Index	76	65	93	86	31	84	38	74	41
Falling Number (sec)	366	387	396	392	387	364	365	351	362
Amylograph Viscosity: 65g (BU)	472	542	530	530	529	461	439	464	483
Damaged Starch (%)	3.9	4.3	3.9	4.0	3.6	4.3	3.8	3.8	3.4
SRC: Water/50% Sucrose (%)	54/95	53/94	53/95	53/94	49/86	54/101	54/96	53/95	52/92
5% Lactic Acid/5% Na ₂ CO ₃ (%)	91/72	93/69	109/69	104/69	75/63	106/77	79/74	103/79	79/75
Gluten Performance Index (GPI) (%)	0.55	0.57	0.67	0.64	0.51	0.60	0.47	0.59	0.47
DOUGH PROPERTIES:									
Farinograph: Peak Time (min)	1.4	1.3	2.3	2.0	1.2	1.9	1.3	2.2	1.4
Stability (min)	2.2	2.4	2.6	2.5	1.1	2.3	1.1	2.7	1.3
Absorption (%)	51.5	51.2	53.1	52.5	51.1	52.2	49.2	52.4	50.4
Alveograph: P (mm)	42	37	40	39	27	37	21	36	24
L (mm)	57	61	68	66	43	112	101	104	83
P/L Ratio	0.74	0.61	0.59	0.60	0.63	0.23	0.21	0.35	0.32
W (10 ⁻⁴ J)	65	63	78	74	29	94	37	86	40
Extensograph (45 min): Resistance (BU)	174	202	284	260	107	215	125	212	121
Extensibility (cm)	16.8	17.0	18.4	18.0	17.2	18.7	14.9	17.8	16.2
Area (cm ²)	46	53	79	71	23	62	23	57	27
BAKING EVALUATION:									
Sponge Cake: Volume (cc)	1104	1098	1077	1081	1070	1120	1129	1119	1159
Score	49	41	33	35	34	45	47	46	50
Cookie: Diameter (cm)	8.6	8.7	8.6	8.6	9.1	8.7	9.2	8.8	9.2
Spread Ratio (width/thickness)	10.1	10.3	10.4	10.3	12.6	10.0	11.4	9.7	11.6
Pan Bread: Bake Absorption (%)			57.9						
Crumb Grain and Texture (1-10)			5.5						
Loaf Volume (cc)			694						
CHINESE SOUTHERN-TYPE STEAMED BREAD EVALUATION:									
Specific Volume (ml/g)	2.2	2.3	2.4	2.3	2.3	1.8	2.1	2.0	2.2
Total Score	57.4	55.9	54.9	55.1	53.5	71.5	65.6	67.8	64.3
PRODUCTION OF 3 STATES (%):	4	24	72	100	100	100	100	100	100

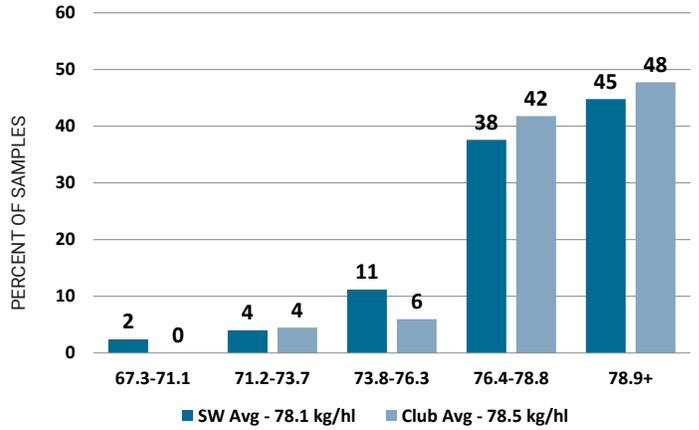
¹Protein Range: Low, <9.0%; Medium, 9.0 - 10.5%; High, >10.5%.

DISTRIBUTIONS

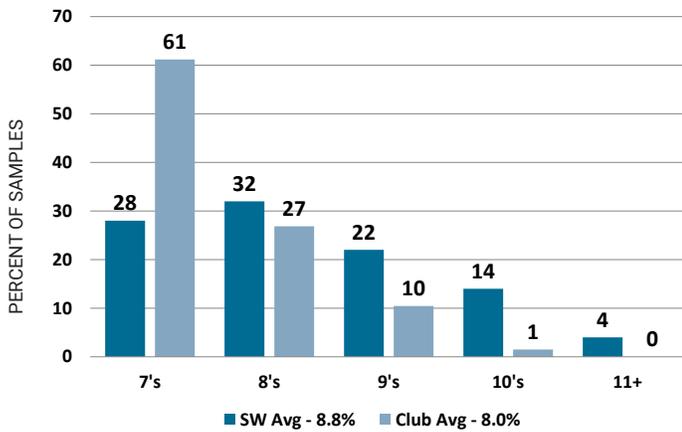
TEST WEIGHT | Pounds/Bushel



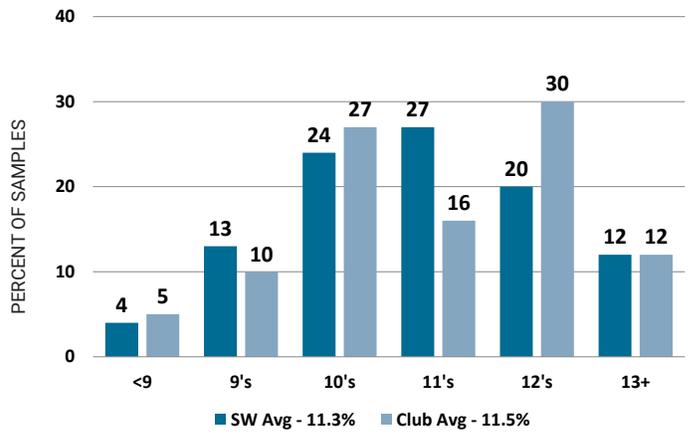
TEST WEIGHT | Kilograms/Hectoliter



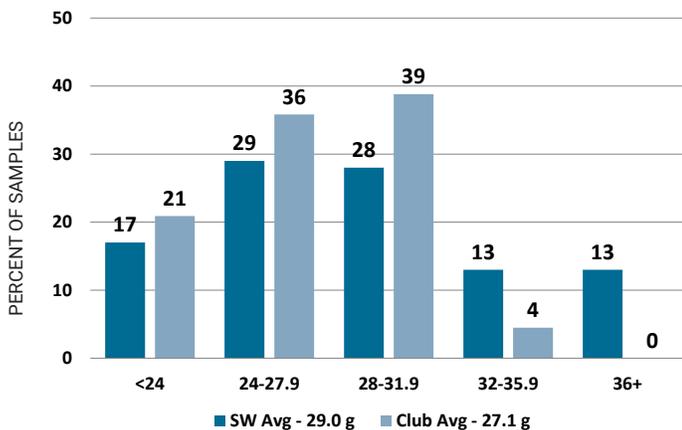
WHEAT MOISTURE | Percent



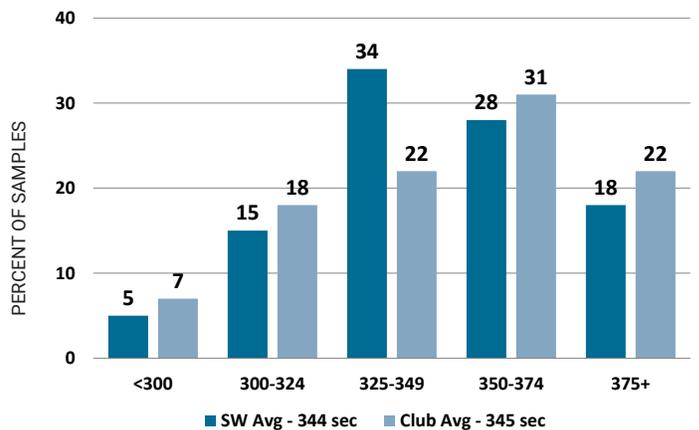
PROTEIN (12% MB) | Percent



1000 KERNEL WEIGHT | Grams



FALLING NUMBER | Seconds



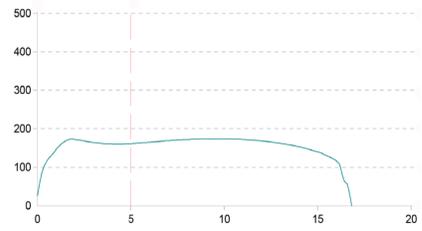
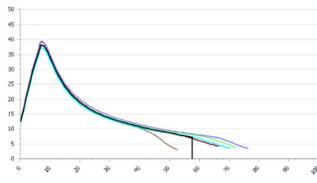
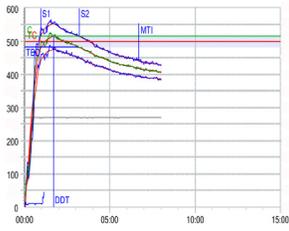
DOUGH PROPERTIES

FARINOGRAMS

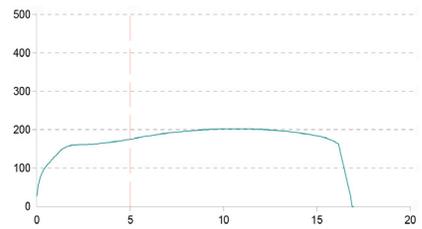
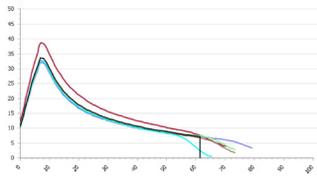
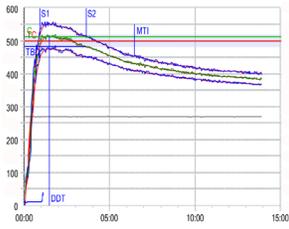
ALVEOGRAMS

EXTENSOGRAMS

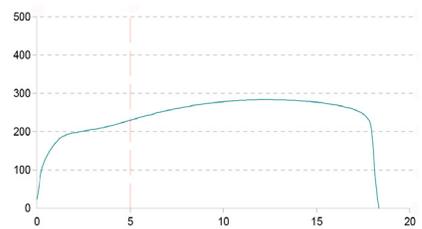
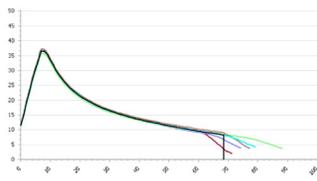
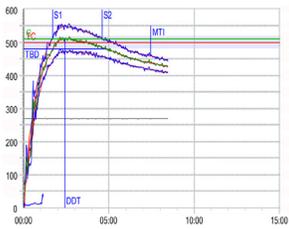
LOW
PROTEIN



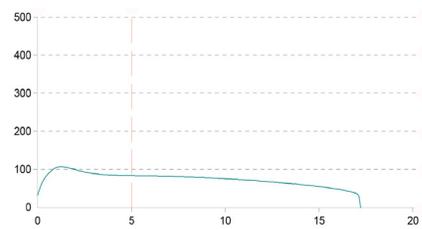
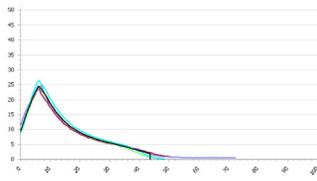
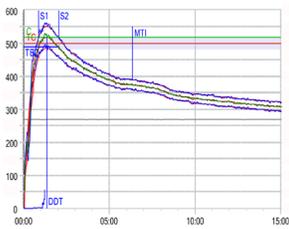
MEDIUM
PROTEIN



HIGH
PROTEIN



CLUB



SUBCLASSES

Under the Official United States Standards for Grain, Soft White wheat is divided into the following three subclasses:



SOFT WHITE (SW)

- Contains not more than 10% of white club wheat.



WHITE CLUB (WC)

- Contains not more than 10% of other soft white wheats.



WESTERN WHITE (WW)

- Contains more than 10% of white club wheat.
- Some customers specify varying levels of the soft white wheat and white club wheat blend to take advantage of club wheat's weaker gluten characteristics for sponge cake and other confections.





SOFT RED WINTER



Grown in the eastern third of the United States and shipped via Gulf, Atlantic, and Great Lakes ports, soft red winter (SRW) wheat is the third largest class of wheat grown in the United States. SRW is a high-yielding wheat with low protein of 8.5 to 10.5% (12% mb), soft endosperm, red bran, and weak gluten. It is used in pastries, cakes, cookies, crackers, pretzels, flat breads and for blending flours.



For the miller, SRW helps diversify the types of flour produced to improve the quality of many products. SRW blended with hard red spring (HRS) and hard red winter (HRW) wheat can lower grist cost and improve bread crumb texture or improve the quality and appearance of a wide variety of products.

For the baker, the lower moisture content of the flour produced with SRW creates an advantage by increasing the added water volume while optimizing water absorption and product quality to the consumer.

APPLICATIONS

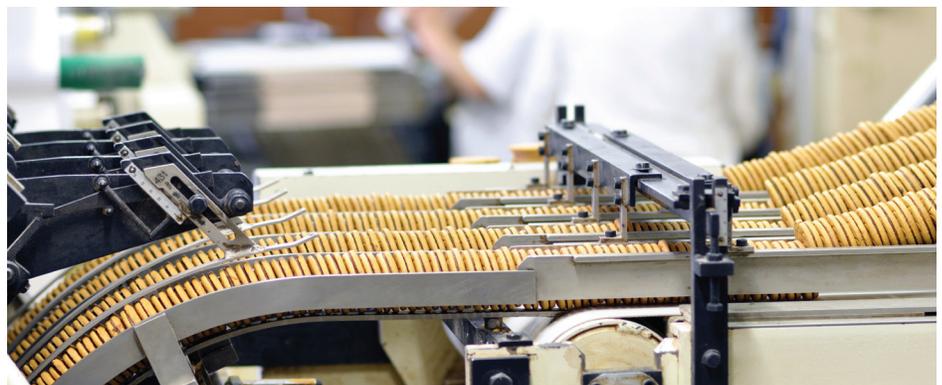


U.S. SRW wheat, commonly used for specialty products such as sponge cakes, cookies, crackers and other confectionary products, also adds value to the miller and baker as a blending wheat.

Applications include:

- Baguette
- Blending wheat
- Cakes
- Cereals or cereal bars
- Cookies
- Crackers
- Empanadas
- Flat breads
- Flours (cake, pastry, self-rising)
- Fried Spring Rolls
- Pastries
- Pretzels
- Snack foods
- Other confectionary products

Scan this QR code with the camera application on your smart phone to access more information on the USW website at www.uswheat.org/cropquality.



SOFT RED WINTER PRODUCTION

FOR THE MAJOR PRODUCING STATES (MMT)

	2021	2020	2019	2018	2017
<i>Alabama</i>	0.2	0.1	0.2	0.2	0.2
<i>Arkansas</i>	0.2	0.1	0.1	0.1	0.2
<i>Georgia</i>	0.2	0.1	0.1	0.1	0.1
<i>Illinois</i>	1.3	1.0	1.0	1.0	1.0
<i>Indiana</i>	0.6	0.5	0.4	0.5	0.5
<i>Kentucky</i>	0.8	0.6	0.7	0.5	0.6
<i>Maryland</i>	0.3	0.3	0.3	0.3	0.4
Michigan	0.8	0.6	0.6	0.6	0.5
<i>Missouri</i>	0.9	0.6	0.7	0.8	1.0
<i>North Carolina</i>	0.5	0.6	0.3	0.6	0.6
<i>New York</i>	0.2	0.2	0.1	0.2	0.2
<i>Ohio</i>	1.2	0.9	0.6	0.9	0.9
<i>Pennsylvania</i>	0.4	0.4	0.3	0.3	0.3
<i>Tennessee</i>	0.6	0.4	0.4	0.5	0.5
<i>Virginia</i>	0.2	0.2	0.2	0.3	0.3
Wisconsin	0.5	0.2	0.3	0.4	0.3
Surveyed-States Total*	7.0	5.3	4.8	5.8	6.1
East Coast-Tributary	1.1	1.1	0.8	1.2	1.2
Gulf-Tributary	5.9	4.2	4.0	4.6	4.9
Sixteen-State Total	9.1	6.8	6.1	7.3	7.5
Total SRW Production	9.8	7.2	6.5	7.8	8.0

Based on USDA crop estimates as of 30 September 2021.

*Eleven states denoted by italics were surveyed accounting for 71% of 2021 SRW production.

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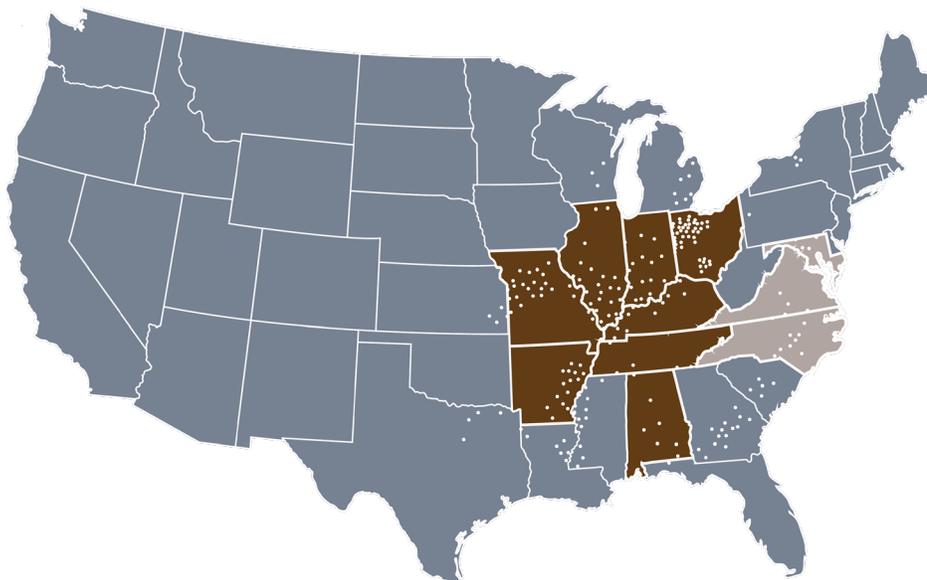
Samples collected from elevators in 18 reporting areas.

SAMPLE COLLECTION AND ANALYSIS

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

SAMPLE TESTING

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 averages. The methods are described in the Analysis Methods section of this booklet.

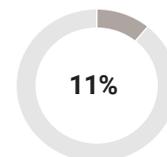


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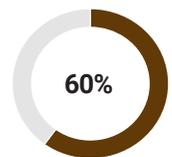
STATES SURVEYED

71%

OF TOTAL SRW PRODUCTION REPRESENTED



EAST COAST



GULF

PERCENTAGE OF TOTAL U.S. SRW SAMPLED CROP PRODUCTION BY EXPORT TRIBUTARY

HARVEST SURVEY

SRW is grown over a wide area of the eastern United States. The production region experienced generally good growing conditions in the 2021 crop year. There were pockets of lower falling numbers from the East Coast, but overall, buyers should be extremely happy with the quality of the entire 2021 SRW crop, especially the excellent characteristics for soft wheat products in Gulf supplies. Buyers are encouraged to review their quality specifications to ensure that their purchases meet their expectations.

WEATHER AND HARVEST

PLANTING started at a normal pace the first week of September 2020 with similar progress as the 5-year average. The area seeded to SRW in fall 2020 for the 2021 harvest is estimated by USDA at 2.67 million hectares, up from 2.28 million hectares seeded for the 2020 harvest and up from the 5-year average.

As the crop **DEVELOPED**, much of the SRW growing area received plentiful moisture through the winter and spring; however, by late spring North Carolina and Virginia began experiencing drought conditions. Overall, timely mild temperatures and rainfall benefited critical kernel development.

HARVEST began slowly at the beginning of June due to a cool, wet

spring. Sporadic rainfall continued through June that changed in most of the growing region to hot, dry conditions that pushed the crop to maturity with harvest finishing in line with the 5-year average pace.

PRODUCTION of the 2021 SRW crop is estimated to be 9.8 MMT, up from 7.2 MMT in 2020 and above the 5-year average of 7.8 MMT.

2021 CROP HIGHLIGHTS

The overall **GRADE** sample average collected for the 2021 SRW harvest survey is U.S. No. 2 SRW; the Gulf average is U.S. No. 1 SRW.

TEST WEIGHT averages are indicative of sound wheat and a uniform crop with Composite 59.7 lb/bu (78.6 kg/hl); Gulf average 60.0 lb/bu (79.8 kg/hl) and East Coast 58.8 lb/bu (77.4 kg/hl).

1000 KERNEL WEIGHT, KERNEL DIAMETER and **WHEAT PROTEIN** values reflect a relatively uniform crop.

WHEAT FALLING NUMBER averages trended lower this year due to localized rainfall during harvest with Composite (297 sec), East Coast (257 sec) and Gulf (307 sec). While

low falling number values are not eliminated from our survey, those below 250 sec typically divert to domestic feed channels.

DAMAGED STARCH values are slightly higher this year and can be attributed to higher enzymatic activity in isolated areas.

AMYLOGRAPH averages indicate relatively high levels of amylase activity in portions of the crop with low falling numbers. Averages for Composite (440 BU), East Coast (290 BU) and Gulf (477 BU) are lower than last year and 5-year averages.

SOLVENT RETENTION CAPACITY values generally indicate excellent quality for cookies and crackers. Lactic Acid values are above 100, and below

120, indicating excellent quality for crackers

DOUGH PROPERTIES suggest that this crop has similar protein qualities to last year, but weaker than the 5-year average.

ALVEOGRAPH L averages for Composite, East Coast and Gulf are 56 mm, significantly lower than 2020 and 5-year average values, indicating low extensibility.

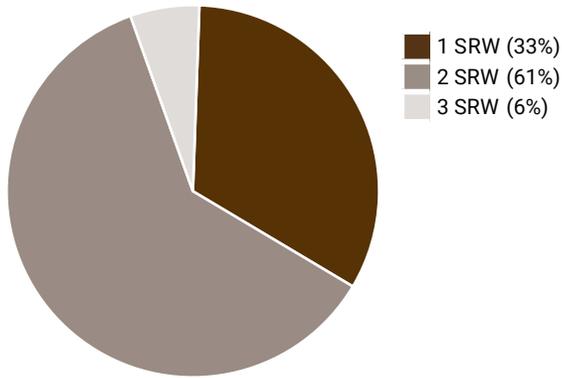
Average **LOAF VOLUMES** are lower than last year and 5-year averages.

The **COOKIE SPREAD RATIOS** for Composite (10.6), East Coast (10.8) and Gulf (10.5) are all higher than last year and 5-year averages, indicating good spreadability.



DISTRIBUTION BY GRADE

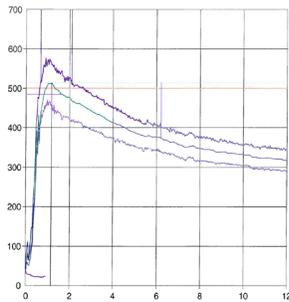
(BASED ON 18 COMPOSITE SAMPLES)



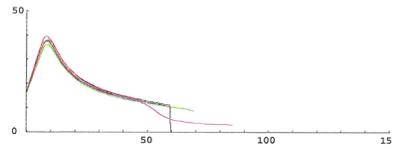
Maryland, April 2021, Jenell Eck

EAST COAST & GULF DOUGH PROPERTIES

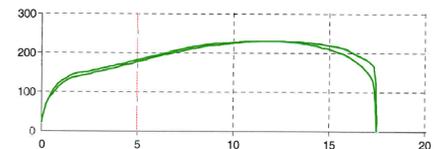
FARINOGRAMS



ALVEOGRAMS



EXTENSOGRAMS

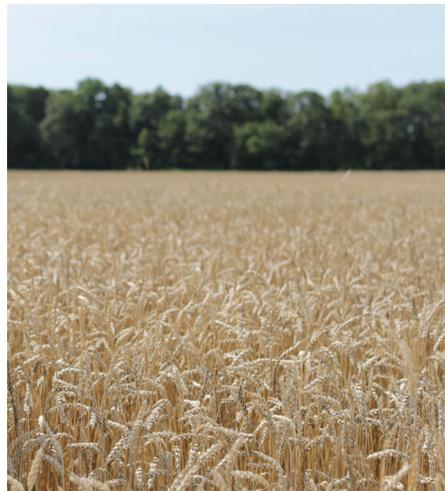


“The Ohio soft red winter wheat crop was great this year. Across Ohio, we had nearly ideal weather that helped us produce 43.8 million bushels (1.19 million metric tons) of wheat. Ohio averaged 85 bushels (5.7134 mt/ha) and we had great quality. On my farm in 2021, we had our best wheat production and quality in generations.”

– Rachael Vonderhaar, Ohio wheat farmer



North Carolina, June 2021,
Donny Lassiter



Ohio, June 2021,
Rachael Vonderhaar



Missouri, June 2021,
Matt Wehmeyer

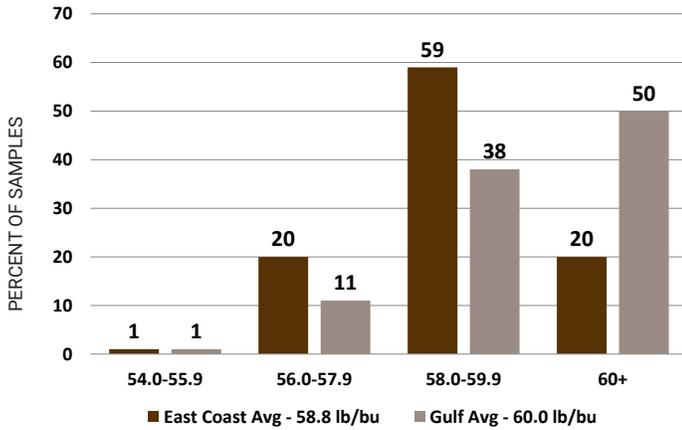
HARVEST DATA

	COMPOSITE			EAST COAST ¹			GULF ¹		
	2021 Avg	2020 Avg	5-Year Avg	2021 Avg	2020 Avg	5-Year Avg	2021 Avg	2020 Avg	5-Year Avg
WHEAT GRADE DATA:									
Test Weight (lb/bu)	59.7	59.7	58.7	58.8	59.3	57.5	60.0	59.8	59.0
(kg/hl)	78.6	78.6	77.2	77.4	78.0	75.7	78.9	78.7	77.6
Damaged Kernels (%)	0.3	0.2	0.6	0.3	0.8	1.4	0.3	0.1	0.5
Foreign Material (%)	0.1	0.0	0.1	0.1	0.2	0.2	0.1	0.0	0.1
Shrunken & Broken (%)	0.5	0.5	0.6	0.6	0.5	0.8	0.5	0.5	0.5
Total Defects (%)	0.9	0.8	1.3	0.9	1.5	2.2	0.9	0.6	1.0
Grade	2 SRW	2 SRW	2 SRW	2 SRW	2 SRW	3 SRW	1 SRW	2 SRW	2 SRW
WHEAT NON-GRADE DATA:									
Dockage (%)	0.3	0.3	0.4	0.2	0.3	0.4	0.3	0.3	0.4
Moisture (%)	13.6	13.4	13.0	14.2	13.6	13.2	13.4	13.3	13.0
Protein (%) 12%/0% mb	9.3/10.5	9.4/10.7	9.5/10.8	9.5/10.8	9.4/10.7	9.8/11.2	9.2/10.5	9.4/10.7	9.5/10.8
Ash (%) 14%/0% mb	1.35/1.57	1.32/1.53	1.41/1.64	1.31/1.53	1.24/1.44	1.41/1.64	1.36/1.59	1.34/1.56	1.41/1.64
1000 Kernel Weight (g)	34.4	34.0	32.4	35.7	36.5	32.8	34.1	33.2	32.3
Kernel Size (%) lg/md/sm	88/11/01	88/11/01	84/15/01	86/13/01	91/09/00	83/15/02	89/10/01	87/12/01	84/15/01
Single Kernel: Hardness	24.3	24.7	21.8	27.4	25.2	20.0	23.5	24.5	22.3
Weight (mg)	34.5	34.4	34.4	34.0	37.0	35.1	34.6	33.7	34.2
Diameter (mm)	2.65	2.64	2.63	2.61	2.73	2.64	2.66	2.62	2.62
Sedimentation (cc)	10.1	11.0	11.4	12.4	11.2	12.0	9.5	11.0	11.3
Falling Number (sec)	297	319	316	257	283	298	307	329	320
DON (ppm)	0.8	0.5	0.7	0.2	0.2	0.7	0.9	0.6	0.7
FLOUR DATA:									
Lab Mill Extraction (%)	65.9	66.8	67.7	65.4	67.0	67.5	66.1	66.7	67.7
Color: L*	91.2	91.4	91.2	91.1	91.5	91.2	91.2	91.3	91.2
a*	-2.3	-2.4	-2.3	-2.3	-2.3	-2.3	-2.3	-2.4	-2.3
b*	9.0	9.2	9.0	8.6	8.9	9.0	9.1	9.3	9.0
Protein (%) 14%/0% mb	7.4/8.6	7.5/8.7	7.8/9.0	7.6/8.8	7.6/8.8	8.0/9.3	7.3/8.5	7.5/8.7	7.7/8.9
Ash (%) 14%/0% mb	0.41/0.48	0.41/0.48	0.44/0.51	0.44/0.52	0.42/0.49	0.44/0.51	0.40/0.47	0.40/0.47	0.44/0.51
Wet Gluten (%)	19.9	20.4	21.4	19.4	22.0	22.4	20.1	20.0	21.2
Gluten Index	84	89	84	90	95	84	82	87	84
Falling Number (sec)	282	319	316	258	283	298	288	329	320
Amylograph Viscosity: 65g (BU)	440	662	552	290	322	418	477	760	588
Damaged Starch (%)	5.1	3.9	4.4	4.2	4.5	4.5	5.3	3.7	4.4
SRC: Water/50% Sucrose (%)	54/95	54/74	56/102	54/100	57/83	58/104	54/93	53/72	56/101
5% Lactic Acid/5% Na ₂ CO ₃ (%)	106/73	101/72	112/78	112/77	105/78	112/81	104/72	100/70	111/77
Gluten Performance Index (GPI) (%)	0.63	0.69	0.62	0.64	0.65	0.61	0.63	0.70	0.62
DOUGH PROPERTIES:									
Farinograph: Peak Time (min)	1.2	1.2	1.2	1.4	1.2	1.3	1.1	1.2	1.2
Stability (min)	1.6	1.6	2.0	2.0	1.5	1.9	1.5	1.6	2.0
Absorption (%)	52.1	52.4	52.5	52.3	53.6	53.1	52.1	52.0	52.4
Alveograph: P (mm)	44	39	38	43	44	40	44	38	37
L (mm)	56	78	88	56	75	89	56	78	88
P/L Ratio	0.78	0.51	0.43	0.76	0.59	0.45	0.79	0.48	0.42
W (10 ⁻⁴ J)	78	83	84	78	87	87	78	82	84
Extensograph (45/135 min): Resistance (BU)	177	188	182	183	164	168	175	195	186
Extensibility (cm)	15.8	16.1	15.8	16.4	16.9	16.5	15.7	15.8	15.7
Area (cm ²)	50	53	50	54	48	49	48	54	51
BAKING EVALUATION:									
Cookie: Diameter (cm)	8.9	9.2	9.2	8.9	9.0	9.1	8.9	9.3	9.3
Spread Ratio (width/thickness)	10.6	10.2	9.6	10.8	9.7	9.0	10.5	10.3	9.7
Pan Bread: Bake Absorption (%)	53.4	54.4	54.4	53.2	55.6	55.0	53.4	54.0	54.2
Crumb Grain and Texture (1-10)	4.4	5.6	5.1	4.5	5.7	5.2	4.4	5.6	5.1
Loaf Volume (cc)	602	605	698	603	589	704	602	609	696
PRODUCTION OF 11 STATES (%):	100%			20%			80%		

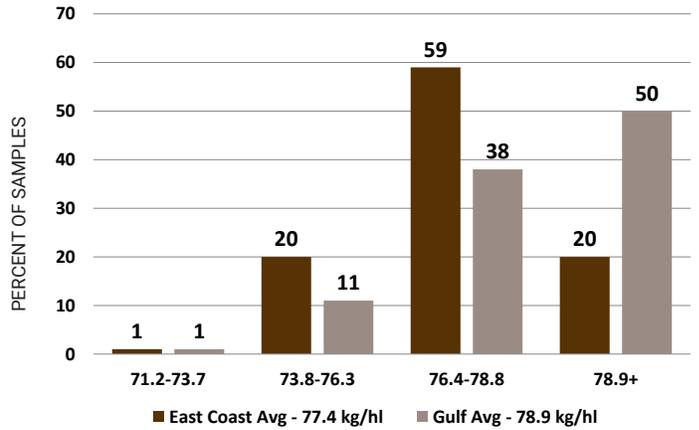
¹East Coast - Maryland, Virginia and North Carolina; Gulf - Alabama, Arkansas, Illinois, Indiana, Kentucky, Missouri, Ohio and Tennessee.

DISTRIBUTIONS

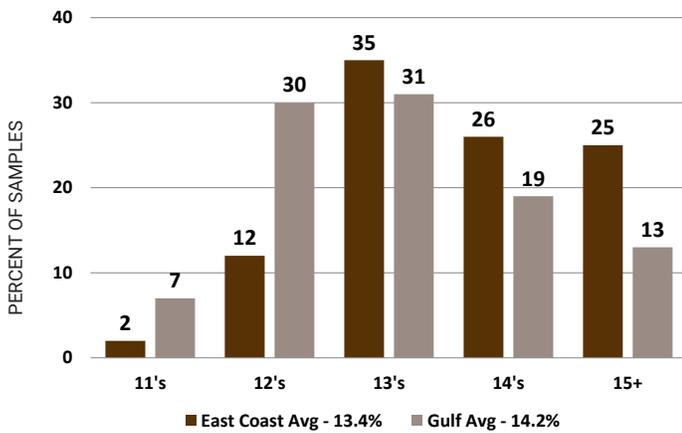
TEST WEIGHT | Pounds/Bushel



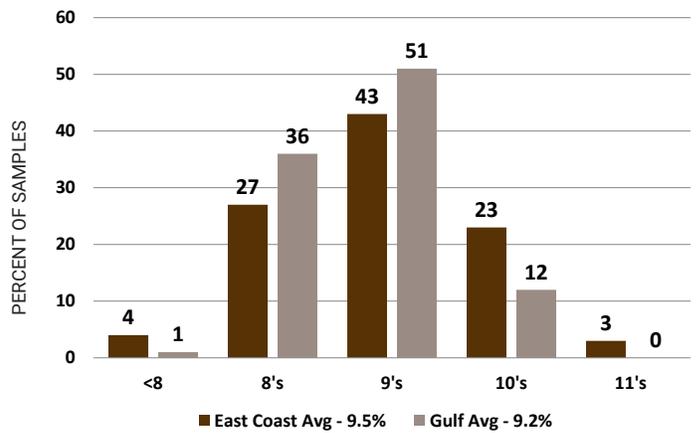
TEST WEIGHT | Kilograms/Hectoliter



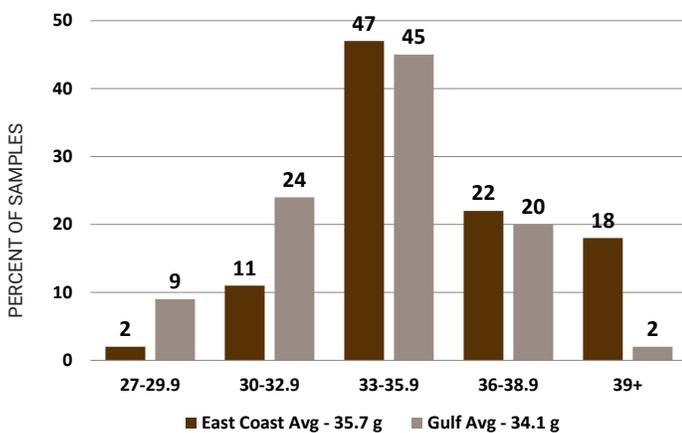
WHEAT MOISTURE | Percent



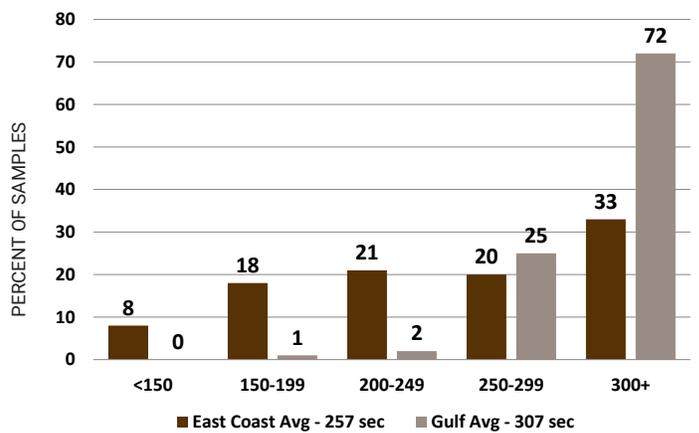
PROTEIN (12% MB) | Percent



1000 KERNEL WEIGHT | Grams



FALLING NUMBER | Seconds





DURUM



Northern durum is grown primarily in the North Central region and shipped via Gulf, Great Lakes and Pacific ports, while Desert Durum®, is grown primarily under contract in the desert Southwest (Arizona and California) and shipped via the Gulf or West Coast. Durum is the fifth largest class of wheat grown in the United States and has a high protein content of 12.0% to 15.0% (12% mb), rich amber color, yellow endosperm, high gluten and white bran.



For the miller, durum is a large, very hard kernel with the potential for very high extraction of high quality, low ash semolina that is ideal for fine pasta. Desert Durum® is harvested and shipped at a very low moisture content, an advantage to millers that contributes to efficient transportation costs and high extraction rates.

For consumers of pasta, couscous and Mediterranean breads, durum helps deliver excellent color and texture.

APPLICATIONS



Hard Amber Durum (HAD) sets the “gold standard” for premium pasta products, couscous and some Mediterranean breads.

Applications include:

- Couscous
- Mediterranean breads and cakes
- Pastas
- Pizza doughs
- Semolina flour

Scan this QR code with the camera application on your smart phone to access more information on the USW website at www.uswheat.org/cropquality.



SUBCLASSES

Under the Official United States Standards for Grain, durum wheat is divided into the following three subclasses based on vitreous kernel content:

- Hard Amber Durum (HAD) – at least 75% hard, vitreous kernels of amber color
- Amber Durum (AD) – between 60-74% hard, vitreous kernels of amber color
- Durum (D) – less than 60% hard, vitreous kernels of amber color

DURUM PRODUCTION

FOR THE MAJOR PRODUCING STATES (MMT)

	2021	2020	2019	2018	2017
Arizona	0.1	0.1	0.1	0.2	0.2
California	0.1	0.0	0.1	0.1	0.1
Montana	0.3	0.7	0.6	0.6	0.3
North Dakota	0.5	1.0	0.8	1.2	0.8
Four-State Total	1.0	1.9	1.6	2.1	1.4
Northern Durum	0.8	1.7	1.4	1.8	1.1
Desert Durum®	0.2	0.2	0.2	0.3	0.3
Total Durum Production	1.0	1.9	1.6	2.1	1.5

Based on USDA crop estimates as of 30 September 2021.

226

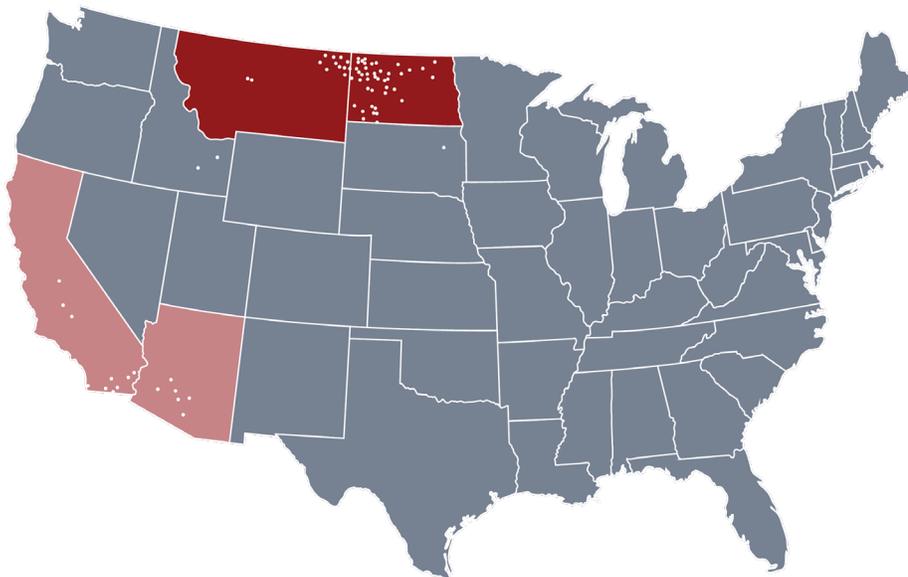
Northern durum samples collected from fields, farm bins and local elevators by the National Agricultural Statistics Service.

SAMPLE COLLECTION AND ANALYSIS

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

SAMPLE TESTING

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. The methods are described in the Analysis Methods section of this booklet.

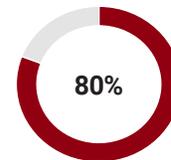


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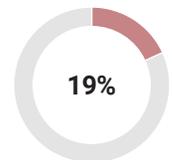
STATES SURVEYED

99%

OF TOTAL DURUM PRODUCTION REPRESENTED



NORTHERN DURUM



DESERT DURUM®

PERCENTAGE OF TOTAL U.S. DURUM PRODUCTION BY REGION

7

Desert Durum® samples collected by a Federal Grain Inspection Service (FGIS) licensed inspection agency or submitted by handlers to a licensed agency.

SAMPLE COLLECTION AND ANALYSIS

California Wheat Commission Laboratory conducted the quality analyses.

SAMPLE TESTING

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.

NORTHERN DURUM HARVEST SURVEY

Buyers will find the 2021 durum crop to be of high quality, especially for grading and kernel characteristics. Although lower than previous years, test weights are stronger than expected, and damage is low. There is no shortage of protein this year and falling number values indicate a sound crop. Lower 1000 kernel weights and a reduction in the percentage of large sized kernels will likely reduce milling yields. Dough properties look to be strong as well as cooked pasta characteristics. The main issues buyers will face is lower supply levels. Customers should continue to be diligent in contract specifications given that a small portion of the crop did see some rainfall at harvest.

WEATHER AND HARVEST

Durum **PRODUCTION** in the U.S. Northern Plains is down by more than 50% from 2020 due to a small decline in acreage and sharply lower yields caused by severe drought.

Throughout the **GROWING SEASON**, overly dry soil conditions were a

concern. Emergence was slow in areas due to lack of moisture, and yield potential across the region was quite low with some acres abandoned.

The dry conditions pushed crop **DEVELOPMENT** ahead of normal but kept disease pressures minimal.

Most of the **HARVEST** was completed under dry conditions, allowing for excellent grading and kernel characteristics. Scattered rain delays toward the end of harvest affected some quality factors but did not have a significant impact on overall quality.

2021 CROP HIGHLIGHTS

The average **GRADE** of the 2021 crop is U.S. No. 1 Hard Amber Durum (HAD); 74% of the crop grades U.S. No. 1 or No. 2 HAD.

Average **TEST WEIGHT** of 60.5 lb/bu (78.8 kg/hl), is below last year and 5-year averages, a result of drought pressure.

DAMAGE was quite low at 0.1% due to minimal disease pressure, but **SHRUNKEN AND BROKEN KERNELS** were higher at 1.0%. Overall **TOTAL DEFECTS** were lower than average at 1.2%.

The average **VITREOUS KERNEL (HVAC)** content is 86%, similar to last year and 5-year averages due to drought conditions. Nearly two-thirds of the samples were above 90% HVAC, but a portion of the crop saw lower HVAC levels due to rain at harvest.

PROTEIN averages 15.5% (12% mb), higher than 2020; nearly 90% of the crop has a minimum protein of 14%.

The average **1000 KERNEL WEIGHT** is 41.2 g, a drop from last year's high value of 46.7 and slightly below the 5-year average of 42.1, due to dry conditions during kernel fill.

For the second year, **KERNEL MOISTURE** was lower than average due to a mostly dry harvest period.

FALLING NUMBER values are high, with the average for the region being 428 sec. Almost all of the crop had a falling number value above 300 sec and 73% was 400 sec or higher.

DON is nearly non-existent in this year's crop due to very minimal disease pressure.

LABORATORY MILLING for the 2021 survey was performed on a Quadromat® Junior mill, the same as in 2019 and 2020, limiting direct comparisons to the Buhler laboratory mill used for 5-year average values. Semolina extraction is 54.6%, indicating a reduction in extraction from last year.

ASH is slightly higher at 0.68%, mirroring the higher kernel ash in this year's crop.

SPECK COUNTS are lower than last year and 5-year averages.

SEMOLINA PROTEIN is 14.2%, much higher than last year due to higher kernel protein.

GLUTEN INDEX values are 81%, higher than both 2020 and 5-year averages, in part due to cultivar impacts.

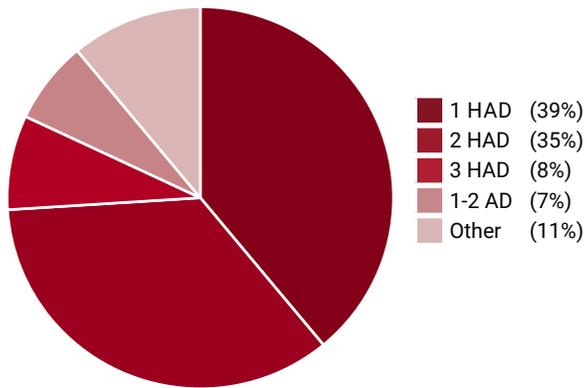
SEMOLINA COLOR values are similar to last year, with brightness and yellowness slightly lower.

MIXING PROPERTIES reveal a stronger crop than last year and the 5-year average with a mixogram classification of 6.7.

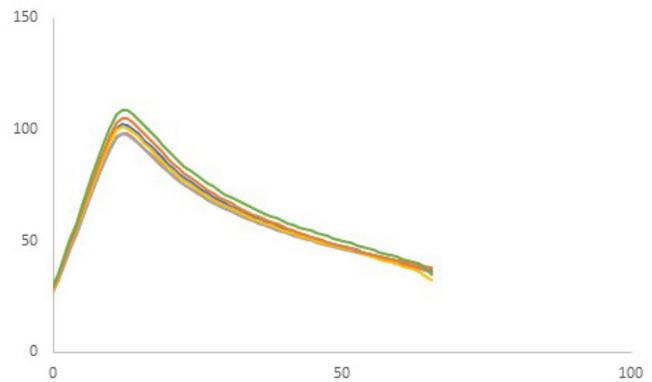
COOKED SPAGHETTI EVALUATIONS show color similar to the 5-year average and higher cooked weight and firmness. Cooking loss is higher than last year.



NORTHERN DURUM GRADE DISTRIBUTION



NORTHERN DURUM REGIONAL AVERAGE ALVEOGRAM



North Dakota, July 2021, Erica Oakley

"This was a year of ups and downs. A few producers saw near normal yields, but most had well below average yields. Most of the durum was taken off under dry conditions and produced good quality – high test weights, excellent color, great protein and very little damage that should meet customer expectations."

– Dustin Johnsrud, North Dakota wheat farmer

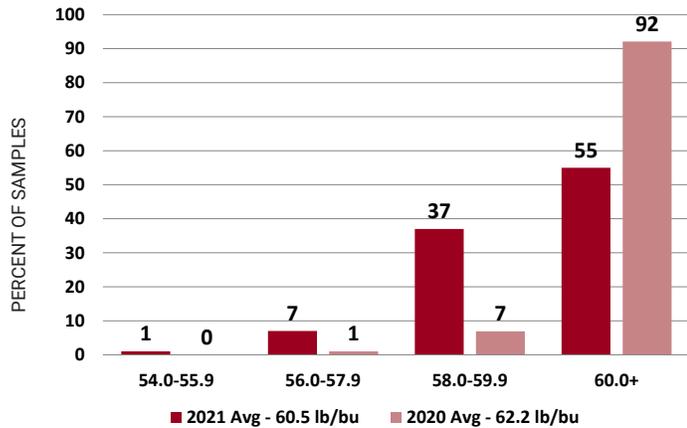
NORTHERN DURUM HARVEST DATA

	2021 Avg	2020 Avg	5-Year Avg
WHEAT GRADE DATA:			
Test Weight (lb/bu)	60.5	62.2	61.2
(kg/hl)	78.8	80.9	79.7
Damaged Kernels (%)	0.1	0.9	0.7
Foreign Material (%)	0.1	0.0	0.0
Shrunken & Broken (%)	1.0	0.6	0.8
Total Defects (%)	1.2	1.5	1.6
Contrasting Classes (%)	0.9	0.4	0.3
Vitreous Kernels (%)	86	88	84
Grade	1 HAD	1 HAD	1 HAD
WHEAT NON-GRADE DATA:			
Dockage (%)	0.5	0.8	0.8
Moisture (%)	10.9	10.7	11.4
Protein (%) 12%/0% mb	15.5/17.6	13.4/15.3	13.9/15.8
Ash (%) 14%/0% mb	1.69/1.96	1.57/1.83	1.54/1.79
1000 Kernel Weight (g)	41.2	46.7	42.1
Kernel Size (%) lg/md/sm	36/59/5	58/40/2	53/44/3
Falling Number (sec)	428	419	398
Sedimentation (cc)	79	62	65
DON (ppm)	0.0	0.2	0.4
SEMOLINA DATA:			
Lab Mill Extraction (%)	n/a	n/a	n/a
Semolina Extraction (%)	54.6	58.5	n/a
Color: L*	83.3	83.7	83.6
a*	-2.3	-2.4	-2.5
b*	30.3	30.4	29.9
Protein (%) 14%/0% mb	14.2/16.5	12.3/14.3	12.8/14.9
Ash (%) 14%/0% mb	0.65/0.76	0.64/0.74	0.67/0.78
Specks (no/10 in ²)	21	30	29
Wet Gluten (%)	37.1	33.2	33.6
Gluten Index	81	74	69
Mixograph: Classification	6.7	6.0	5.7
Peak Time (min)	3.2	3.2	2.9
Peak Height (MU)	4.9	4.6	5.6
Alveograph: P (mm)	107	79	72
L (mm)	66	61	84
P/L Ratio	1.6	1.3	0.9
W (10 ⁻⁴ J)	260	163	179
SPAGHETTI PROCESSING DATA:			
Color Score	8.3	8.8	8.4
Cooked Weight (g)	32.4	31.0	31.1
Cooking Loss (%)	8.0	7.2	6.5
Cooked Firmness (g cm)	4.8	3.6	4.2
SAMPLE COUNT:	226	187	

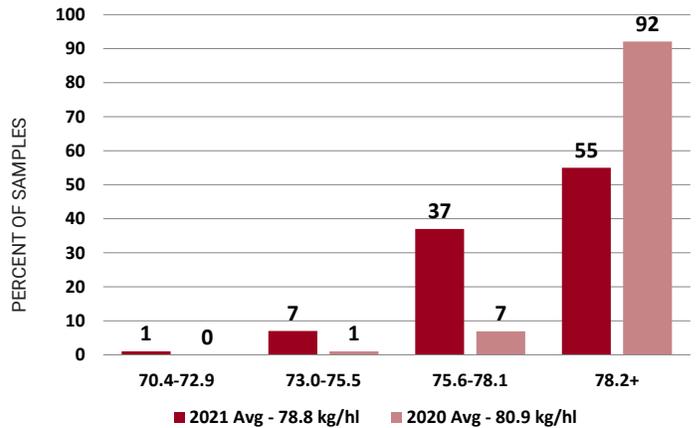


NORTHERN DURUM DISTRIBUTIONS

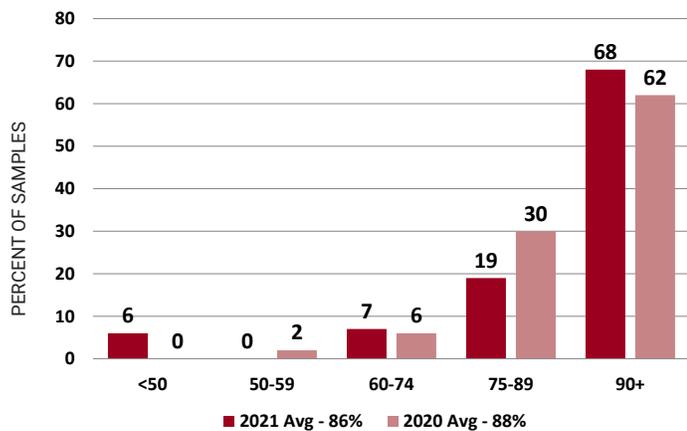
TEST WEIGHT | Pounds/Bushel



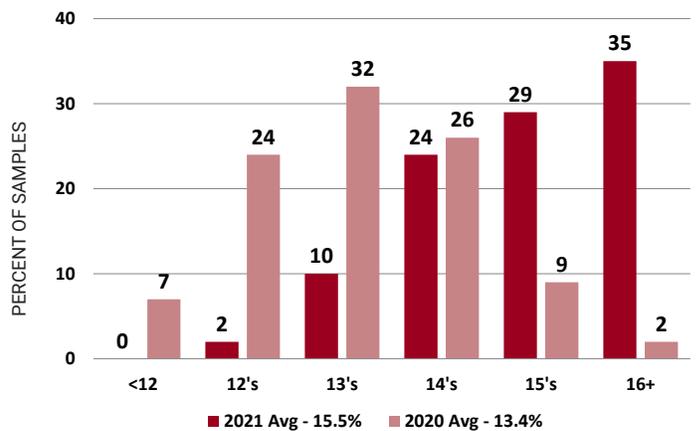
TEST WEIGHT | Kilograms/Hectoliter



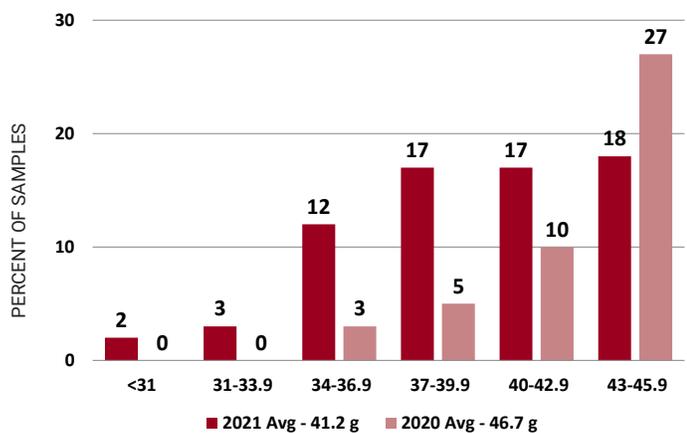
VITREOUS KERNELS | Percent



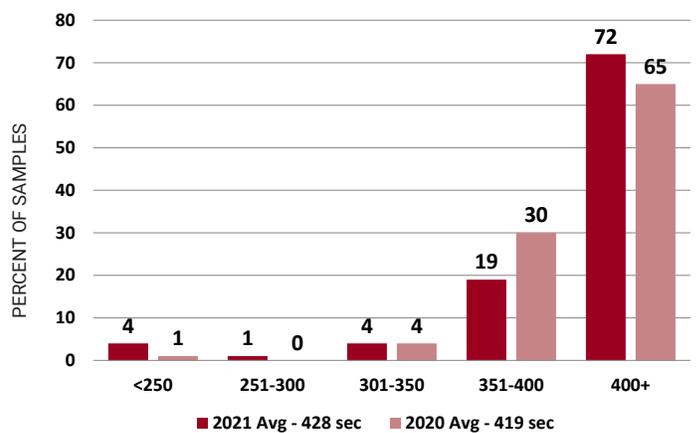
PROTEIN (12% MB) | Percent



1000 KERNEL WEIGHT | Grams



FALLING NUMBER | Seconds



DESERT DURUM® HARVEST SURVEY

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 designated 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® exhibits consistently large kernels and low moisture, traits that contribute to efficient transportation costs and high extraction rates. The 2021 crop will deliver the valuable milling, semolina and pasta quality traits that customers have learned to expect and appreciate.

2021 CROP HIGHLIGHTS

Desert Durum® **PRODUCTION** acreage in 2021 was lower than 2020. According to USDA, yields were 2.6 tons/acre, and quality was uniformly good. Powell was the most widely grown variety in California and Arizona. Alberto was the second most grown durum variety.

The overall **GRADE** sample average for the 2021 Desert Durum® harvest survey is U.S. No. 1 Hard Amber Durum (HAD).

TEST WEIGHT is indicative of sound

wheat and a uniform crop with an average of 83.2 kg/hl (63.9 lb/bu).

Average **DAMAGED KERNELS** are 0% and **TOTAL DEFECTS** are 0.6%.

The average **VITREOUS KERNEL** (HVAC) content is 98.7%, a high average typical of Desert Durum®.

WHEAT PROTEIN content average is 13.9% (12% mb), consistent with the 5-year average.

Kernel **MOISTURE** content is low at 7.5%, a characteristic of Desert Durum®.

The semolina **COLOR b*** value is 32.5, similar to last year’s 32.7.

WET GLUTEN average is 36.1% and **GLUTEN INDEX** average is 69.

Semolina **MIXOGRAPH** score is 7.0 and **ALVEOGRAPH W** value is 191 (10⁻⁴ J).

Spaghetti **COLOR b*** value is 44 and **COLOR SCORE** is 10.1, higher than last year and the 5-year average.

Spaghetti **COOKED FIRMNESS** average is 7.2, similar to last year and above the 5-year average.



“Once again, Desert Durum® growers produced a crop with the qualities needed to make premium pasta products. Quality in 2021 was equal to or better than our typical crop. We are proud that the world’s best pasta makers continue to demand semolina from Desert Durum®.”

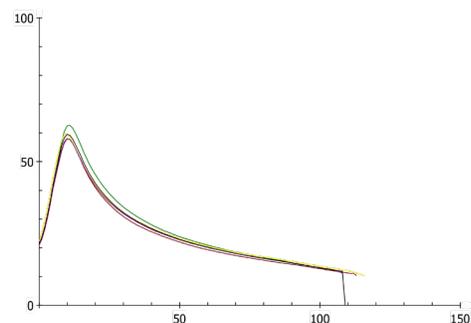
– Eric Wilkey,
Arizona wheat farmer



DESERT DURUM® HARVEST DATA

	2021 Avg	2020 Avg	5-Year Avg
WHEAT GRADE DATA:			
Test Weight (lb/bu)	63.9	62.3	62.6
(kg/hl)	83.2	81.1	81.7
Damaged Kernels (%)	0.0	0.2	0.2
Foreign Material (%)	0.1	0.0	0.0
Shrunken & Broken (%)	0.5	0.4	0.5
Total Defects (%)	0.6	0.6	0.7
Contrasting Classes (%)	0.0	0.0	0.0
Vitreous Kernels (%)	99	99	98
Grade	1 HAD	1 HAD	1 HAD
WHEAT NON-GRADE DATA:			
Dockage (%)	0.2	0.4	0.4
Moisture (%)	7.5	6.9	6.7
Protein (%) 12%/0% mb	13.9/15.8	14.5/16.5	13.8/15.7
Ash (%) 14%/0% mb	1.62/1.88	1.74/2.02	1.71/1.97
1000 Kernel Weight (g)	49.3	43.3	47.2
Kernel Size (%) lg/md/sm	94/6/0	87/13/0	90/10/0
Falling Number (sec)	503	790	687
Sedimentation (cc)	72	63	62
DON (ppm)	N/A	N/A	N/A
SEMOLINA DATA:			
Lab Mill Extraction (%)	78.5	75.5	76.6
Semolina Extraction (%)	72.9	70.7	69.1
Color: L*	86.2	85.3	85.9
a*	-4.0	-3.9	-3.4
b*	32.5	32.7	30.4
Protein (%) 14%/0% mb	12.6/14.7	13.6/15.8	12.9/14.9
Ash (%) 14%/0% mb	0.78/0.91	0.86/1.00	0.85/0.99
Specks (no/10 in ²)	14	23	23
Wet Gluten (%)	36.1	34.7	33.6
Gluten Index	69	87	77
Mixograph: Classification	7.0	7.0	7.6
Peak Time (min)	2.5	3.3	3.5
Peak Height (MU)	5.6	4.8	5.5
Alveograph: P (mm)	67	95	104
L (mm)	114	103	72
P/L Ratio	0.6	0.9	1.4
W (10 ⁻⁴ J)	191	294	247
SPAGHETTI PROCESSING DATA:			
Color Score	10.1	9.6	9.2
Cooked Weight (g)	31.1	29.4	29.4
Cooking Loss (%)	5.9	5.6	5.4
Cooked Firmness (g cm)	7.2	7.4	6.6
SAMPLE COUNT:	7	10	

DESERT DURUM® REGIONAL AVERAGE ALVEOGRAM





ANALYSIS METHODS



WHEAT GRADE FACTORS

U.S. WHEAT GRADE 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 4](#).) Unless otherwise noted, all Wheat Grade Factor methodology can be found in the [Official U.S. Standards for Grain](#). 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 indicate potential milling yield and the general condition of the sample. Problems during the growing season or at harvest often reduce test weight.

- **Method:** AACCI 55-10.01. (See conversion table on [page 5](#)).



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

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

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

VITREOUS KERNELS in HRS 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. Vitreous kernel is the percentage handpicked from a 15 gram (g) clean wheat sub-sample.

Scan this QR code with the camera application on your smart phone to access more information on the USW website at www.uswheat.org/working-with-buyers/wheat-glossary.



WHEAT NON-GRADE FACTORS

NON-GRADE FACTORS do not affect numerical grades but can be used to determine the suitability of the wheat. Non-grade testing services are available from FGIS or private, unofficial inspection companies if requested in the sales contract.

DOCKAGE is the percentage by weight of material removed from a sample by the Carter Dockage Tester and does not influence the numerical grade. Being easy to remove, dockage should not affect milling quality but may have other economic effects for buyers. U.S. Wheat Grade Factors are determined after dockage is removed. Official USDA procedures.

MOISTURE content is the percentage of water by weight in 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 should be mathematically converted to a standard moisture basis (mb), such as 14%, 12% or dry matter, so test results can be consistently evaluated (see [page 5](#)).

- **Methods:** Moisture content for HRW, HRS, SW, HW is determined by Official USDA conductance method; Durum (Northern) AACCI 44-11.01, Motomco Moisture Meter; Desert Durum® and SRW AACCI 44-15.02, air oven method.

PROTEIN content is the percentage of protein by weight in a sample. Because there is no rapid way to measure wheat protein quality, protein quantity is used in trade and by millers as an indicator of the suitability of wheat or flour for various products and is an important factor in determining wheat value. High protein is usually desired for products such as pan



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bread, pasta, buns and frozen yeast-raised products. Low protein is usually desired for products such as snacks or cakes.

- **WHEAT PROTEIN** (12% mb) measured for HRW, HRS, SW, HW – AACCI 39-25.01 (NIR method); all other classes – AACCI 46-30.01 (Dumas combustion nitrogen analysis or CNA method) on ground wheat.

- **FLOUR AND SEMOLINA PROTEIN** (14% mb) measured for HRW, HRS – AACCI 39-10.01 (NIR method); all other classes of flour and semolina – AACCI 46-30.01 (Dumas CNA method).

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 expected flour yield during milling. In flour, ash content indicates milling performance by indirectly revealing the amount of bran contamination in flour. Ash in flour can impart a darker color to finished products. Products requiring white color call for low ash

content, while whole wheat flour has higher ash content.

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

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

- **Methods:** 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), Desert Durum® – use 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, are “Medium,” and passing through the No. 9 or No. 10 screen are “Small.”

WHEAT NON-GRADE FACTORS CONTINUED

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 indicate the uniformity of the sample and help millers experienced with the system to optimize flour milling yields. Kernel characteristics may help millers optimize tempering and adjust roll gap settings.

- **Method:** AACCI 54-31.01 using Perten SKCS 4100.

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

- **Methods:** HRS, Durum (Northern, Desert Durum®), SRW, HRW (CA) – based on a 10 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% mb; HRW (Midwestern) – average of

SKCS kernel weight in milligrams (mg) x 1000 equals in grams (g).

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 high molecular weight glutenin sub-units (strong gluten) while low sedimentation volume indicates weaker gluten.

- **Methods:** HRS, HRW (Midwestern), SRW, SW, HW – AACCI 56-61.02; Durum (Northern, Desert Durum®) – AACCI 56-70.01; HRW (CA) – AACCI 56-63.01.

FALLING NUMBER is the time required for a plunger to fall through a heated mixture of flour and water and is an indirect measure of enzyme activity. Sprouted wheat releases alpha-amylase (α -amylase), which breaks down starch into sugars. High falling number values indicate low α -amylase activity. Some α -amylase is required for certain products such as yeast-raised bread. However, excessive α -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, poor crumb grain and weak texture. Falling number usually correlates closely with amylograph peak viscosity results.

- **Methods:** AACCI 56-81.04 for all classes. SW, HW, SRW, HRW (Midwestern) and HRS use the 2019 FGIS barometric pressure correction procedure; average value is a simple mean of sample results.

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

- **Methods:** All analysis is on ground wheat. HRS, Durum (Northern, Desert Durum®) – gas chromatograph with electron capture detector as described in the Journal of AOAC International 79,472 (1996). SRW, HRW (CA), HW – Neogen ELISA; HRW (Midwestern) – Charm ROSA DonQ2 Quantitative Test.

FLOUR AND SEMOLINA FACTORS

See “WHEAT NON-GRADE FACTORS” for **PROTEIN, ASH** and **FALLING NUMBER**.

LABORATORY MILLING

EXTRACTION is the percentage by weight of flour obtained from a wheat sample. The extraction rate is always significantly lower from a laboratory mill than the rate than can be obtained on a commercial mill. Lab milling is done mainly to obtain flour for other tests.

- **Methods:** Laboratory samples are cleaned and tempered according to AACCI 26-10.02. All extraction rates are calculated against total products on an “as is” mb. Samples for the following are milled on a Buhler Laboratory mill (MLU 202): SW – AACCI 26-31.01; HRW (Midwestern), SRW, HRS and HW – AACCI 26-



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21.02; SRW – uses a 183-micron (μ) sieve. HRW (CA) is milled on a Brabender® Quadrumat Senior Mill using the Brabender® procedure; Durum (Northern) is milled using a Brabender® Quadromatic Junior Semolina Mill; grain is tempered to 15.5% moisture one day before milling. Desert Durum® is milled on a Modified Roller Mill.

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 finished product color. Durum semolina color is heavily influenced by particle size.

• **Methods:** CIE 1976 $L^*a^*b^*$ color system. The following used the Minolta method using Minolta Chroma Meter with Granular-Materials attachment: HRW (Midwestern) CR-110; HRW (CA), Desert Durum® – CR-210; Semolina color (Northern) CR-410; HRS, SW, SRW, HW – CR-410 with Granular-Materials attachment CR-A50.

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

• **Methods:** HRW (Midwestern, CA), HRS, SRW, HW – AACCI 38-12.02; SW – AACCI 38-12.02 (water reduced from 4.8 to 4.2 ml); Semolina (Northern, Desert Durum®) AACCI 38-12.02 (Glutomatic procedure).

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 can affect the results, though very low gluten index may be an indication of protein

damage from insect or disease activity.

AMYLOGRAPH PEAK VISCOSITY measures flour starch pasting properties that are important to products such as sheeted Asian noodles. Amylograph also measures enzyme (α -amylase) activity indirectly, which is usually from sprout damage.

• **Methods:** AACCI 22-10.01 modified to use 65 g flour (14% mb) and 450

original flour weight on a 14% mb. The solvents – deionized water (measuring overall water absorption/control solvent), sucrose (measuring pentosans), lactic acid (glutenins) and sodium carbonate (starch damage) – indicate the ability of flour to absorb water during mixing and either sequester or release water during dough handling. Specific ranges of lower SRC values are desirable for specific soft wheat products, while



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ml distilled water with paddle (HRS) or pins (all other classes).

DAMAGED STARCH, the percentage by weight of damaged starch in a flour sample, is a measure of the physical damage done to starch granules during milling. Hard wheat flour typically has higher starch damage than soft wheat flour. Damaged starch granules readily absorb 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 reported results.

• **Methods:** SRW – AACCI 76-30.02; all other classes – AACCI 76-33.01 (SDmatic method).

SOLVENT RETENTION CAPACITY (SRC) is the weight, expressed as percentages, of four solvents held by flour after centrifugation to the

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 in baking applications.

• **Methods:** Determined by SRC machine (Chopin) for SW, HW and AACCI 56-11.02 for all other classes.

SPECKS: are visually counted in a semolina sample and reported as the number in 16 in². 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. Sample is pressed under a clear plate and the specks within a 1 in² marked on the plate are counted. Average of three determinations is expressed as specks per 16 in².

DOUGH PROPERTY FACTORS

FARINOGRAPH generates a curve that indicates the resistance of dough to mixing (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 curve-center consistency of 500 Brabender Units (BU) 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 time 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



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bread, while short stability times indicate weaker gluten useful in many other 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 in bread products provides economic advantages by producing more

dough pieces with the same amount of flour compared to lower water absorption. Low water absorption is ideal for cookie and cracker products because water has to be baked off for stable finished products.

- **Method:** AACCI 54-21.02 (constant flour weight method) with 50 g bowl.

EXTENSOGRAPH generates a force-time curve for a piece of dough that is unilaterally 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 baseline in centimeters, reflects how far the dough was stretched.

- **AREA** is the area under the curve reported in cm^2 .

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. Methods:

- **Methods:** AACCI 54-10.01, modified 45 and 135-min rest for HRS, HRW (Midwestern, CA) and HW; 45 min rest for SW and SRW.



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 of water 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), measured in 10^{-4} J, 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 using a



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Consistograph, for stronger wheats including durum. Requirements differ depending on intended flour use. Low P values (indicating weak gluten) and short L values (low 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.

- **Methods:** HRW (Midwestern, CA), SRW – AACCI 54-30.02. SW, HW, HRS, Durum (Northern, Desert Durum®) – Alveolab.

EVALUATION OF END-PRODUCTS

End-product tests are the final laboratory testing in the evaluation of wheat quality. Standardized methods are used to evaluate the suitability of the sample for that product or similar products.

BREAD

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.

METHODS:

- **MIDWESTERN HRW:** AACCI 10-10.03 (“pup loaf” method). 100 g flour at 14% mb with optimized water absorption is mixed to optimum



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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

EVALUATION OF END-PRODUCTS CONTINUED

- 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 ("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, 2.12% active dry yeast and 0.10% malted barley flour) in a 200 g Swanson pin mixer with head speed of 100 to 120 rpm and 90 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.
- **HRS:** AACCI 10-09.01 (long fermentation method) modified: 15 SKB units (fungal amylase/100 g



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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.

- **HW AND SW HIGH PROTEIN:** AACCI 10-10.03 with 180 min fermentation.*



COOKIES (BISCUITS)

DIAMETER is a function of spread rate and set time during baking and is an indicator of good pastry-making and specifically cookie-baking potential. Larger diameter is preferred.

SPREAD FACTOR is width (W) and thickness (T), ratio with adjustments to constant atmospheric pressure and conditions. Values over 9 are preferred, over 10 are ideal.

METHODS:

- **SW:** cookie diameter – AACCI 10-52.02.
- **SRW:** cookie spread factor – AACCI 10-50.05.



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NOODLES, CHINESE

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 (Width x Thickness); 1.7 x 1.7 mm for wet noodles (Wheat Marketing Center (WMC) procedures), W x T using a Stable Micro Systems TA.XTPlus 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.

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.

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

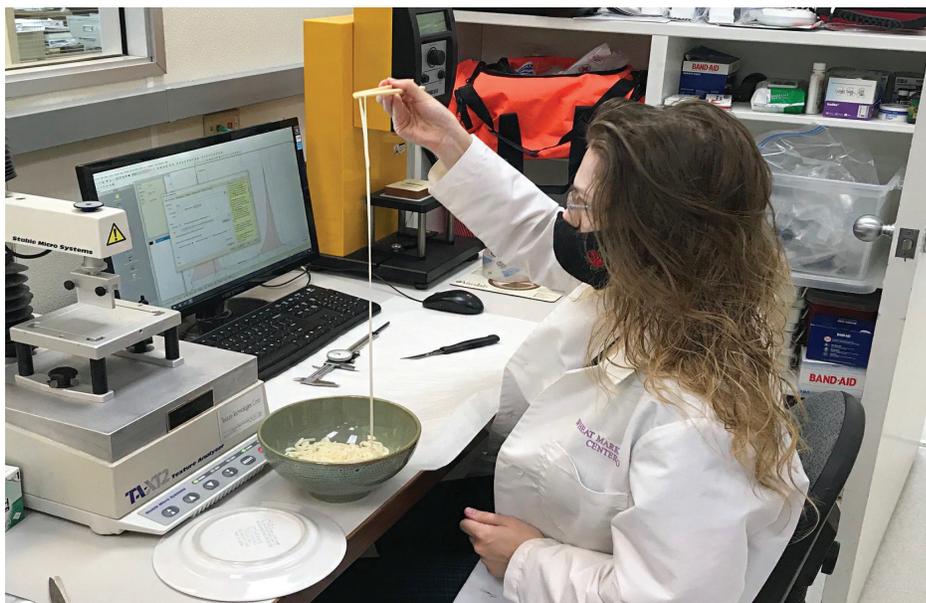


PHOTO TAKEN AT THE WHEAT MARKETING CENTER

scores indicate better color stability.

METHODS: Two noodle types are prepared from each HW flour:

- **RAW NOODLE FORMULA:** HW flour 100%, salt 1.2% and deionized water 28%. Noodle sheet color is measured twice on each side of a dough sheet that is resting atop 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.

- **WET NOODLE FORMULA:** HW flour 100%, salt 2%, K_2CO_3 0.45%, Na_2CO_3 0.45% and deionized water 32%. 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 1.5 min, rinsing in 26 to 27°C (79 to 81°F) tap water and draining.

EVALUATION OF END-PRODUCTS CONTINUED

SPAGHETTI

COLOR SCORE is based on the relative brightness and yellowness of spaghetti as measured by a reflectance colorimeter. Higher values (scale 1 to 12) are preferred.

COOKED WEIGHT is best used in conjunction with firmness values to determine the cooking qualities of a spaghetti sample; high weight and high firmness values indicate high quality while high weight and low firmness indicate poor quality.

COOKING LOSS is a measure of the amount of solubles that leach from pasta during cooking.

FIRMNESS is a measure of the amount of work required to bite through a strand of spaghetti.

METHODS: Durum pasta is made using

the laboratory procedure described by Walsh, Ebeling and Dick, *Cereal Foods World*: 16: (11) 385 (1971). Water (Desert Durum® – 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 as described by AACCI 14-22.01 are determined by the procedure described by Walsh, *Macaroni Journal* 52: (4) 20 (1970), using a Minolta Color Difference Meter (Northern CR-410, Desert Durum® CR-210). Cooked weight, cooking loss and firmness are determined by AACCI 16-50.01.



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SPONGE CAKE

VOLUME is measured by Tex-Vol Volumeter. Large volume indicates better flour.

TEXTURE SCORE: Each cake is measured by TA-XT Plus texture analyzer for softness and compared to the control. The maximum score is 30 and the control is set at 70%, which is 21.

EXTERNAL SCORE: Each cake is

subjectively evaluated against the control. The maximum score is 20 and the control is set at 70%, which is 14.

INTERNAL SCORE: Each cake is subjectively evaluated against the control. The maximum score is 30 and the control is set at 70%, which is 21.

TOTAL SCORE comprises texture, external factors, and internal factors. The control flour is scored 56; maximum score is 80.

• **Method:** Sponge cake volume* and score are measured by the Japanese standard method described by Nagao in *Cereal Chemistry* 53:977-988, 1976. Sponge cake control flour is Japanese commercial "western white." Flour with low protein content, low ash content, and weak gluten characteristics make good quality sponge cake.

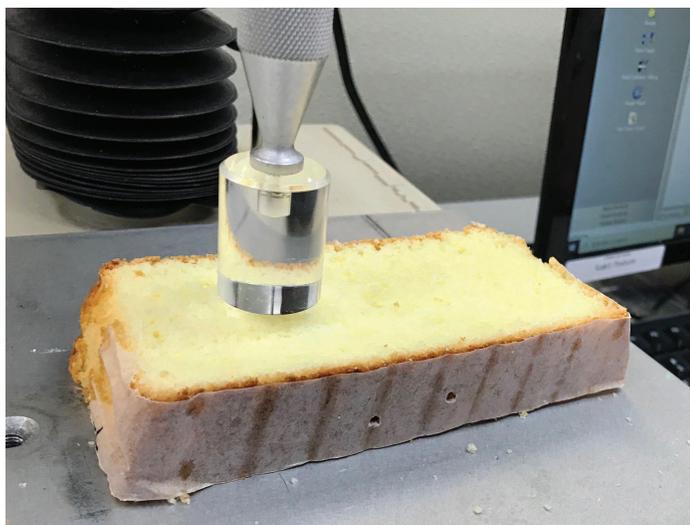


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STEAMED BREAD

SPECIFIC VOLUME is defined as the ratio of volume in milliliters to the weight in grams. Larger specific volume is usually preferred.

TOTAL 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.

METHODS: Two types of steamed breads are prepared using no-time dough methods (WMC procedures):

- **CHINESE SOUTHERN-TYPE:**

SW and white club (WC and Club) flours; flour 100%, sugar 15%, shortening 4%, baking powder 1.2%, instant yeast 0.8%, nonfat dry milk powder 3% and water 39 to 43%. Yeast is dissolved in water before use.

- **ASIAN-TYPE:** HW flour; flour 100%, instant yeast 1.5%, sugar 12%, shortening 2% and water 42.5 to 45.0%. Yeast is dissolved in water before use.



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

Cereals & Grains Association (formerly American Association of Cereal Chemists International) publishes approved methods for determining kernel, flour and end-product testing.

DEPENDABLE PEOPLE. RELIABLE WHEAT.

The U.S. farm families who produce the wheat and the industry that supplies it remain committed to operating a transparent and open market. Today, U.S. Wheat Associates (USW) and the entire U.S. wheat industry remain fixed on the mission of the farmers who created an enduring legacy of commitment and partnership to provide the highest quality wheat for almost every customer need, backed by transparent pricing, trusted third-party certification and unmatched service before and after the sale. Here are some of the reasons why our overseas customers know they can depend on the integrity of our supply chain, the quality of U.S. wheat and our unmatched reliability as a supplier.

THE U.S. WHEAT “STORE” IS ALWAYS OPEN.

U.S. farmers overcome significant risk every year to meet domestic wheat demand and still provide half their crop for export markets. Farmers and commercial warehouses can store and efficiently transport wheat in top condition to meet overseas demand when needed and throughout the marketing year.

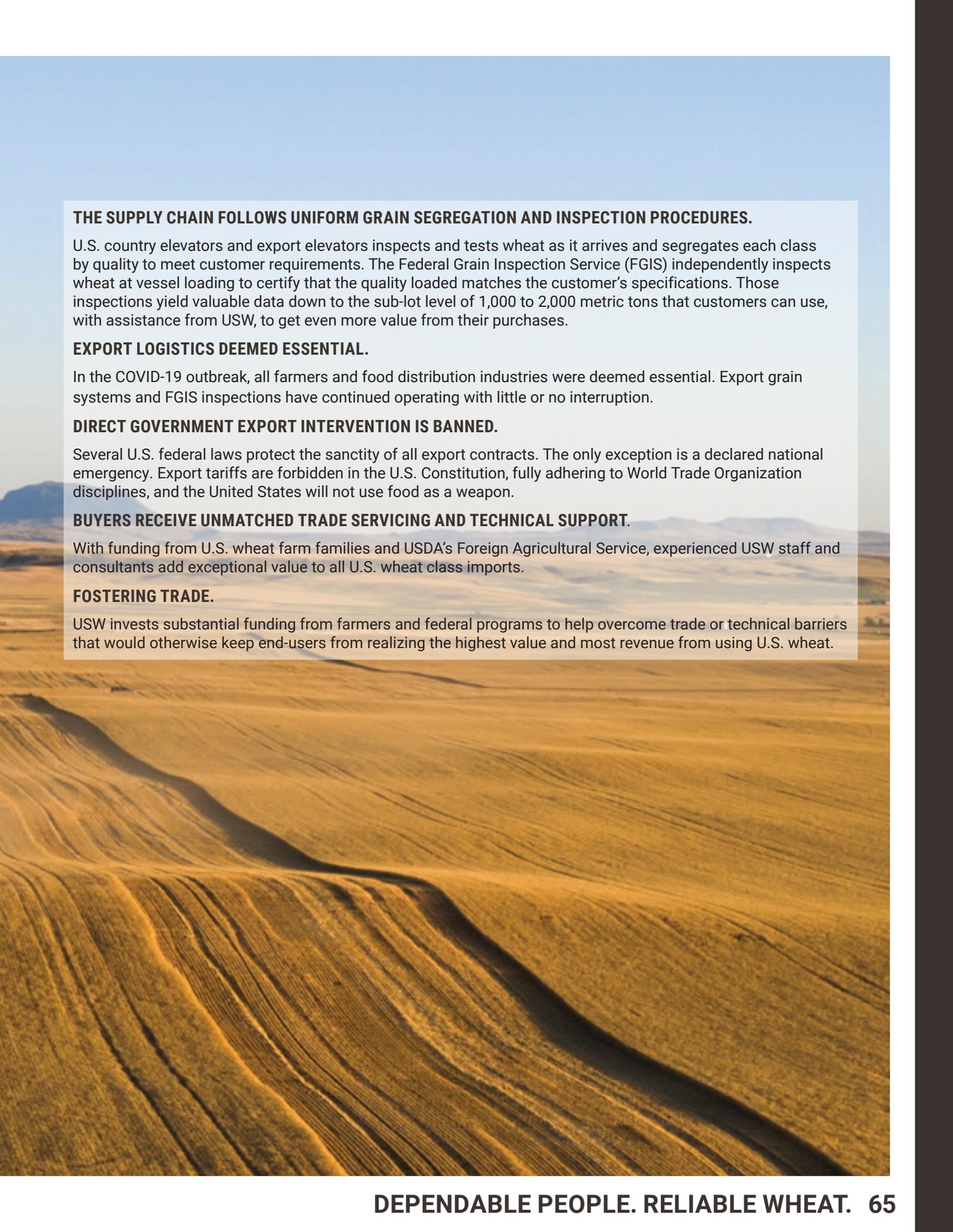
PRICES ARE TRANSPARENT AND HONORED.

U.S. wheat export prices are discovered openly through futures exchanges and basis costs and are always available to customers. Private exporters use risk management tools to honor sales contract prices often made months in advance of vessel loading.

QUALITY IS ASSURED.

USW publishes weekly reports during harvest that summarize initial wheat quality findings. USW works with several organizations and laboratories to analyze hundreds of wheat samples for all six U.S. wheat classes and publishes all results in the annual Crop Quality Report. Our staff, farmers and industry experts then travel the world to present the results to our customers and end users.





THE SUPPLY CHAIN FOLLOWS UNIFORM GRAIN SEGREGATION AND INSPECTION PROCEDURES.

U.S. country elevators and export elevators inspect and test wheat as it arrives and segregate each class by quality to meet customer requirements. The Federal Grain Inspection Service (FGIS) independently inspects wheat at vessel loading to certify that the quality loaded matches the customer's specifications. Those inspections yield valuable data down to the sub-lot level of 1,000 to 2,000 metric tons that customers can use, with assistance from USW, to get even more value from their purchases.

EXPORT LOGISTICS DEEMED ESSENTIAL.

In the COVID-19 outbreak, all farmers and food distribution industries were deemed essential. Export grain systems and FGIS inspections have continued operating with little or no interruption.

DIRECT GOVERNMENT EXPORT INTERVENTION IS BANNED.

Several U.S. federal laws protect the sanctity of all export contracts. The only exception is a declared national emergency. Export tariffs are forbidden in the U.S. Constitution, fully adhering to World Trade Organization disciplines, and the United States will not use food as a weapon.

BUYERS RECEIVE UNMATCHED TRADE SERVICING AND TECHNICAL SUPPORT.

With funding from U.S. wheat farm families and USDA's Foreign Agricultural Service, experienced USW staff and consultants add exceptional value to all U.S. wheat class imports.

FOSTERING TRADE.

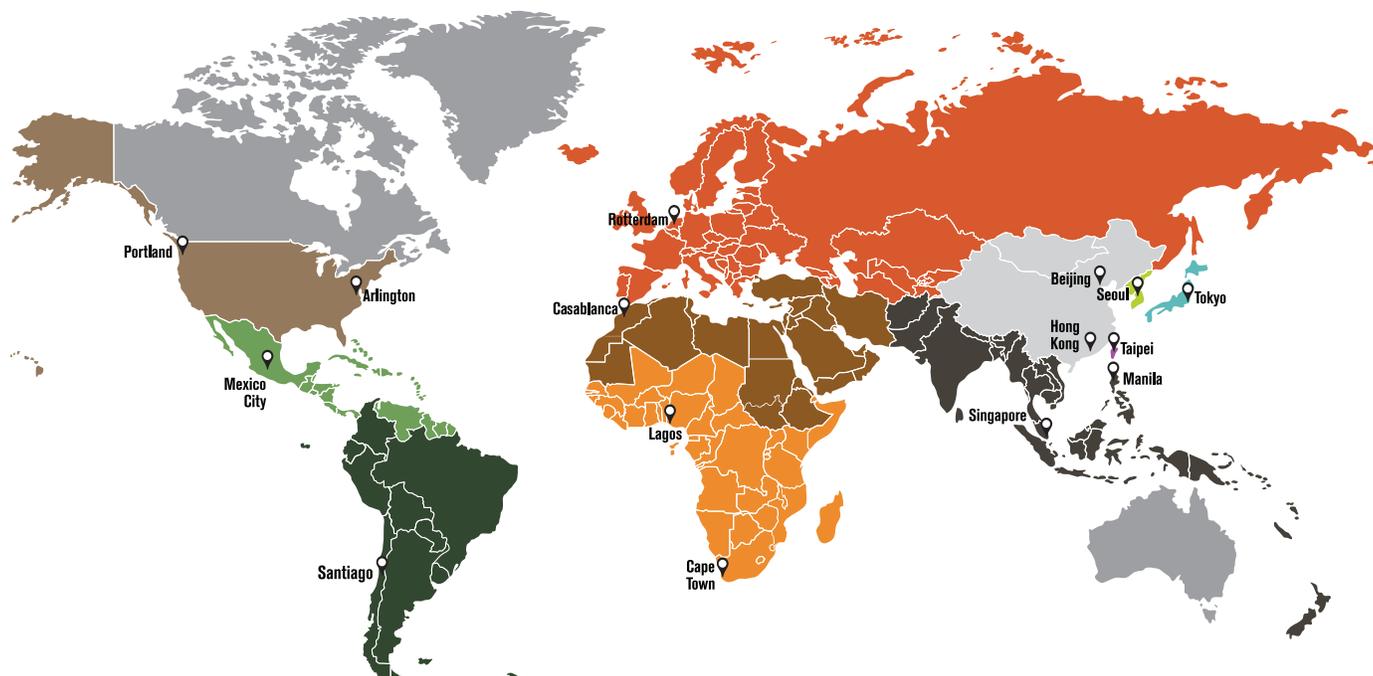
USW invests substantial funding from farmers and federal programs to help overcome trade or technical barriers that would otherwise keep end-users from realizing the highest value and most revenue from using U.S. wheat.



U.S. WHEAT ASSOCIATES

Dependable People. Reliable Wheat.

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U.S. Wheat Associates (USW) is the industry's market development organization working in more than 100 countries. Its mission is to "develop, maintain and expand international markets to enhance wheat's profitability for U.S. wheat producers and its value for their customers." USW activities are funded by producer checkoff dollars managed by 17 state wheat commissions and USDA Foreign Agricultural Service cost-share programs. For more information, visit www.uswheat.org or contact your state wheat commission.

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