



U.S. Wheat Classes & Flour Quality Characteristics

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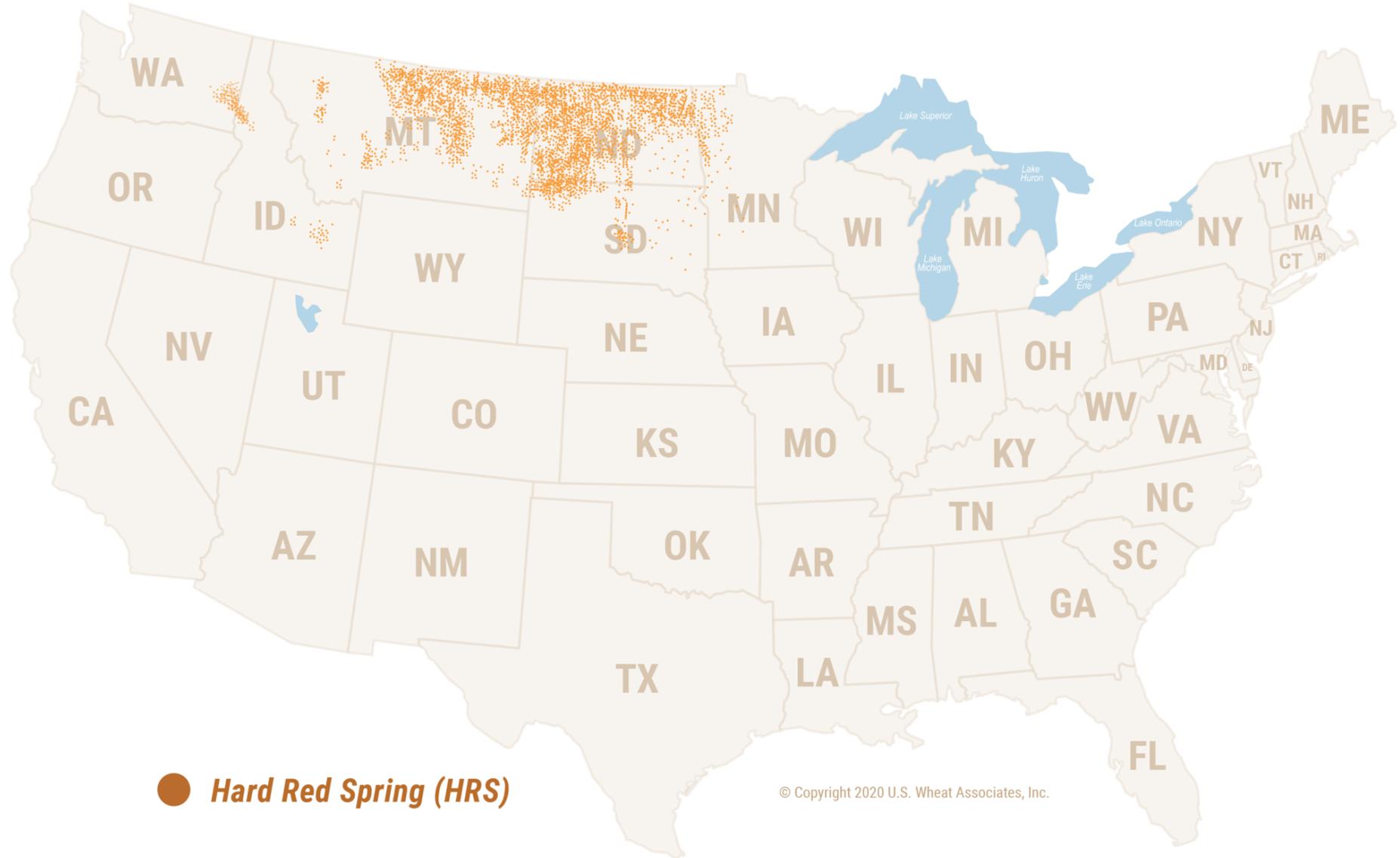
U. S. Hard Wheat: **Hard Red Spring (HRS)**





What is HRS Wheat? – The Market Class

- Hard red spring (HRS) is one of the six major U.S. wheat classes
 - 3 subclasses:
 - **Dark Northern Spring:** $\geq 75\%$ dark, hard, and vitreous kernels (DHV)
 - **Northern spring:** $< 75\%$ and $\geq 25\%$ DHV
 - **Red spring:** $< 25\%$ DHV
- Grade requirements for U.S. No. 1 HRS :
 - ≥ 58 lb/bu test weight
 - $\leq 3\%$ total defects
 - $\leq 3\%$ wheat of other classes





Cultivating HRS Wheat

Best performance observed in northern growing regions

- Northern U.S. (MT, ND, SD, MN, ID, WA, and OR)
- Canada

Nitrogen required to maintain high protein levels

- Requires ~3 lbs N/bu to maintain 14% protein
- Premiums for > 14% protein HRS incentivize the use of N

HRS yield is lower than HRW

- Further incentivizes good N management to offset yield losses

16 MMT currently grown annually in the northern U.S.

- Accounts for 20% of all wheat grown in the U.S.



HRS Wheat Characteristics

The U.S. wheat class system is designed to clearly separate wheat for different end uses

- Specific quality characteristics must be met in order to be included in a given class
- As a result, each class has specific end uses

HRS wheats have quality characteristics that are especially suitable for hearth breads, rolls, bagels, and pizza crusts

- High protein, strong gluten, high water absorption
- Superior performance in frozen dough products



HRS Flour Quality: Table 1. 2018 DNS Flour Quality Data

	DNS by Protein			
	Low	Medium	High	Overall
Farinograph				
Peak Time (min)	6.3	7.2	8.6	7.7
Water Absorption (%)	62.6	63.8	64.8	64.1
Stability (min)	8.9	9.7	12.3	10.8
Extensograph				
Energy at 45/135 min (cm ²)	130 / 132	115 / 146	112 / 154	116 / 147
Extensibility at 45/135 min (cm)	15.6 / 13.2	15.8 / 13.9	16.3 / 12.9	16.0 / 13.2
Rmax at 45/135 min (BU)	504 / 746	538 / 813	523 / 922	523 / 855
Alveograph				
P (mm)	104	101	92	97
L (mm)	109	124	150	134
P/L ratio	0.96	0.81	0.61	0.72
W (10 ⁻⁴ J)	377	411	432	415
Protein ranges: Low, <13.5%; Med, 13.5 - 14.5%; High, >14.5% *From: U.S. Wheat Associates. 2018 Crop Quality Report				



HRS Flour Quality Characteristics:

Table 2. DNS and CWRS Flour Quality Data

Farinograph	DNS	CWRS
Water Absorption (%)	64.3	64.5
Stability (min)	18.6	10.6
Extensograph		
Energy at 135 min (cm ²)	207	157
Extensibility at 135 min (cm)	182	213
Rmax at 135 min (BU)	891	574
*From: Dr. Soon-Bin Neoh. Presentation. Mar 24-26, 2018.		



HRS End Product Quality

HRS wheat is selected for:

- Higher protein
 - About 2 – 3% higher average protein than HRW
- More strong high molecular weight glutenin subunit combinations (e.g. 5 + 10)
 - Results in stronger gluten profile

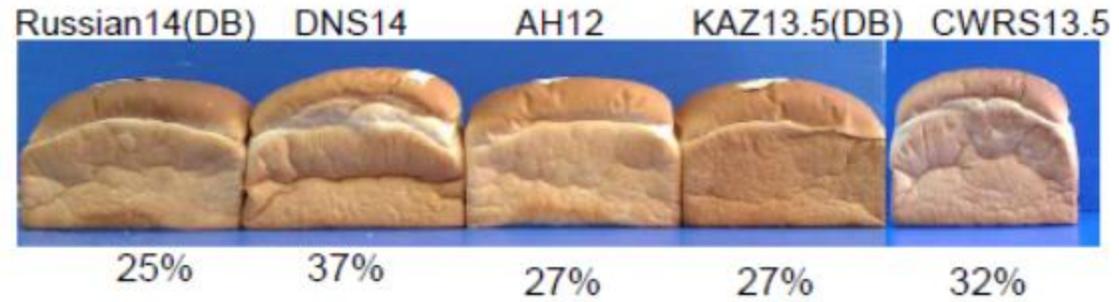
As a result, HRS has:

- Higher water absorption
- More strength for intensive processing

This makes HRS more suitable for products that require strength and processing tolerance

HRS Competitors

A : % of Oven spring



B : Crumbs structure



From: Dr. Soon-Bin Neoh. Presentation. Feb 24 2014.



U. S. Hard Wheat: **Hard Red Winter (HRW)**





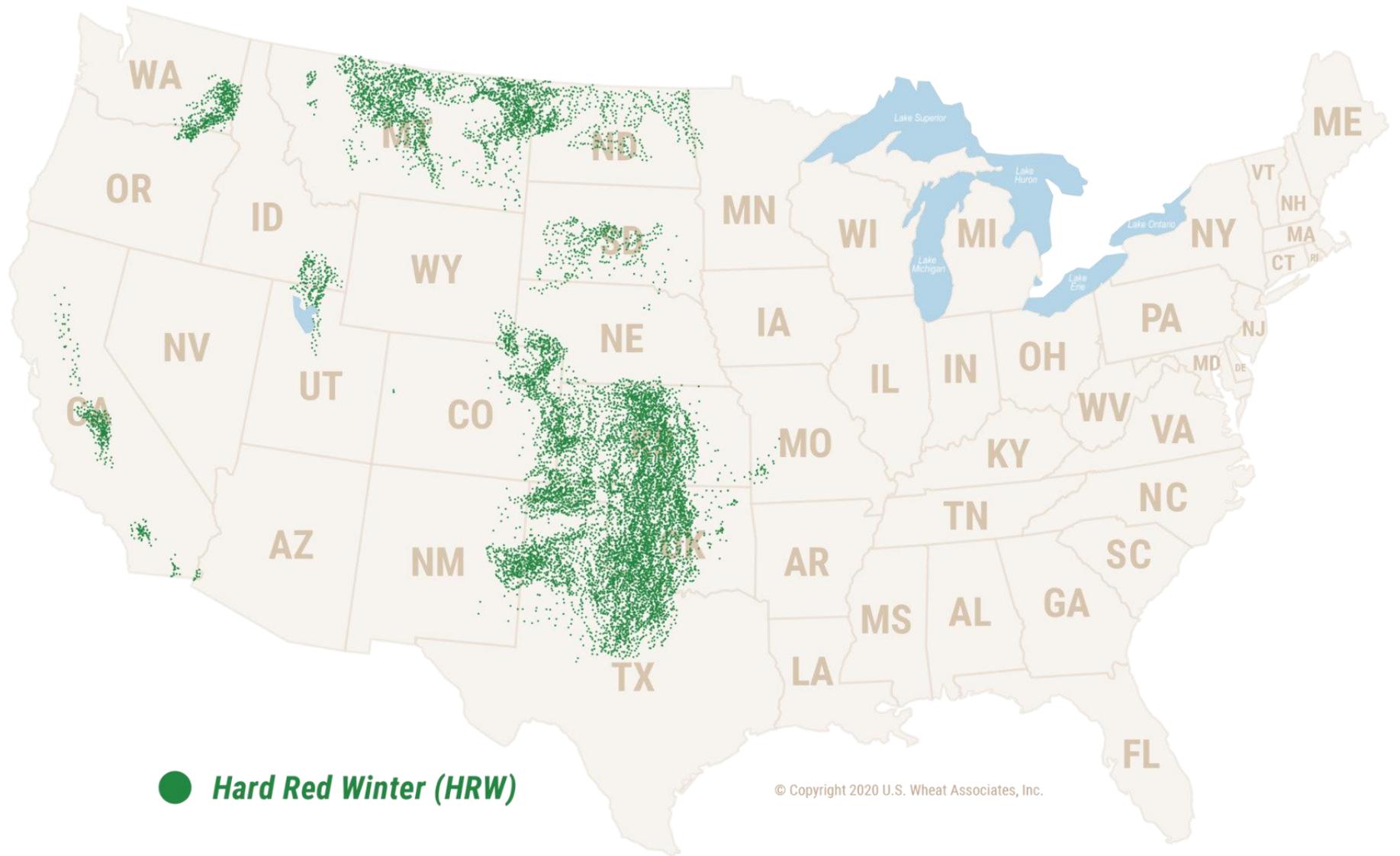
What is HRW Wheat? – The Market Class

Hard red winter (HRW) wheat is one of the six major U.S. wheat classes

- Most prevalent class grown in the U.S.
- No subclasses

Grade requirements for U.S. No. 1 HRW:

- ≥ 60 lb/bu test weight
- $\leq 3\%$ total defects
- $\leq 3\%$ wheat of other classes



● *Hard Red Winter (HRW)*

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Cultivating HRW Wheat

Best performance observed growing regions with moderate winters

- Southern U.S. Plains and PNW (KS, OK, NE, TX, WA, OR, and ID)
- Russia, Ukraine, Kazakhstan, and Argentina

Must ensure wheat survives the winter

- Most growers plant in stubble to protect from cold temperatures and retain moisture from snow
- Split nitrogen application required – at planting and early spring

HRW yield is higher than HRS

- Offers an economic advantage over HRS despite HRS protein premiums
- Increasingly loses out to corn due to low commodity prices for HRW

22 MMT currently grown annually in the U.S.

- Accounts for 40% of all wheat grown in the U.S.



HRW Wheat Characteristics

The U.S. wheat class system is designed to clearly separate wheat for different end uses

- Specific quality characteristics must be met in order to be included in a given class
- As a result, each class has specific end uses

HRW wheats have quality characteristics that are especially suitable for hearth and flat breads, croissants, some Asian noodles, and all-purpose flours

- Intermediate to high protein
- Intermediate gluten strength, moderate water absorption
- Adds strength to soft wheat flour blends, mellows HRS flour blends



HRW Flour Quality: Table 3. 2018 HRW Flour Quality Data

	HRW by Protein			
	Low	Medium	High	Overall
Farinograph				
Peak Time (min)	2.7	4.4	6.3	5.2
Water Absorption (%)	57.3	57.9	58.6	58.4
Stability (min)	7.0	11.7	13.5	12.2
Extensograph				
Energy at 45/135 min (cm ²)	107 / 130	98 / 119	115 / 162	107 / 145
Extensibility at 45/135 min (cm)	14.3 / 11.7	12.9 / 10.2	15.2 / 12.9	14.3 / 11.8
Rmax at 45/135 min (BU)	528 / 796	574 / 954	586 / 1047	570 / 991
Alveograph				
P (mm)	88	84	79	83
L (mm)	62	87	101	92
P/L ratio	1.42	0.97	0.78	0.90
W (10 ⁻⁴ J)	210	272	291	280
Protein ranges: Low, <11.5%; Med, 11.5 - 12.5%; High, >12.5%			<i>*From: U.S. Wheat Associates. 2018 Crop Quality Report</i>	



HRW End Product Quality

HRW wheat is selected for:

- Higher protein content
 - Necessary to remain competitive with HRS
- A more balanced glutenin/gliadin profile

As a result, HRW has:

- More mellow gluten properties than HRS
- Suitability for a wider range of flour blends than any other class

More suitable for products where excessive strength is undesirable and as a blend improver



HRW Competitors: Table 4. U.S. HRW Competitors

	By Protein Content	
	Low Protein	High Protein
Competitors by Country		
Australia	Hard CPSW	Premium White CWHWS
Canada	CPSR	CPSW CPSR
Argentina	X	
Kazakhstan	X	
Ukraine	X	
Germany	X	X
China	X	

Low Protein, <11.5%; High Protein, >11.5%



HRW Competitors

Most competitors will produce acceptable bread

- One key is understanding if a HRW competitor will work with your product and process – e.g., no time dough, straight dough, and sponge and dough processes all have different flour quality requirements

Primary differentiators tend to be price and the ability to deliver wheat that is safe and of consistent quality



U. S. Hard Wheat: **Hard White (HDWH)**





What is HDWH Wheat? – The Market Class

Hard white (HDWH) wheat is one of the six major U.S. wheat classes

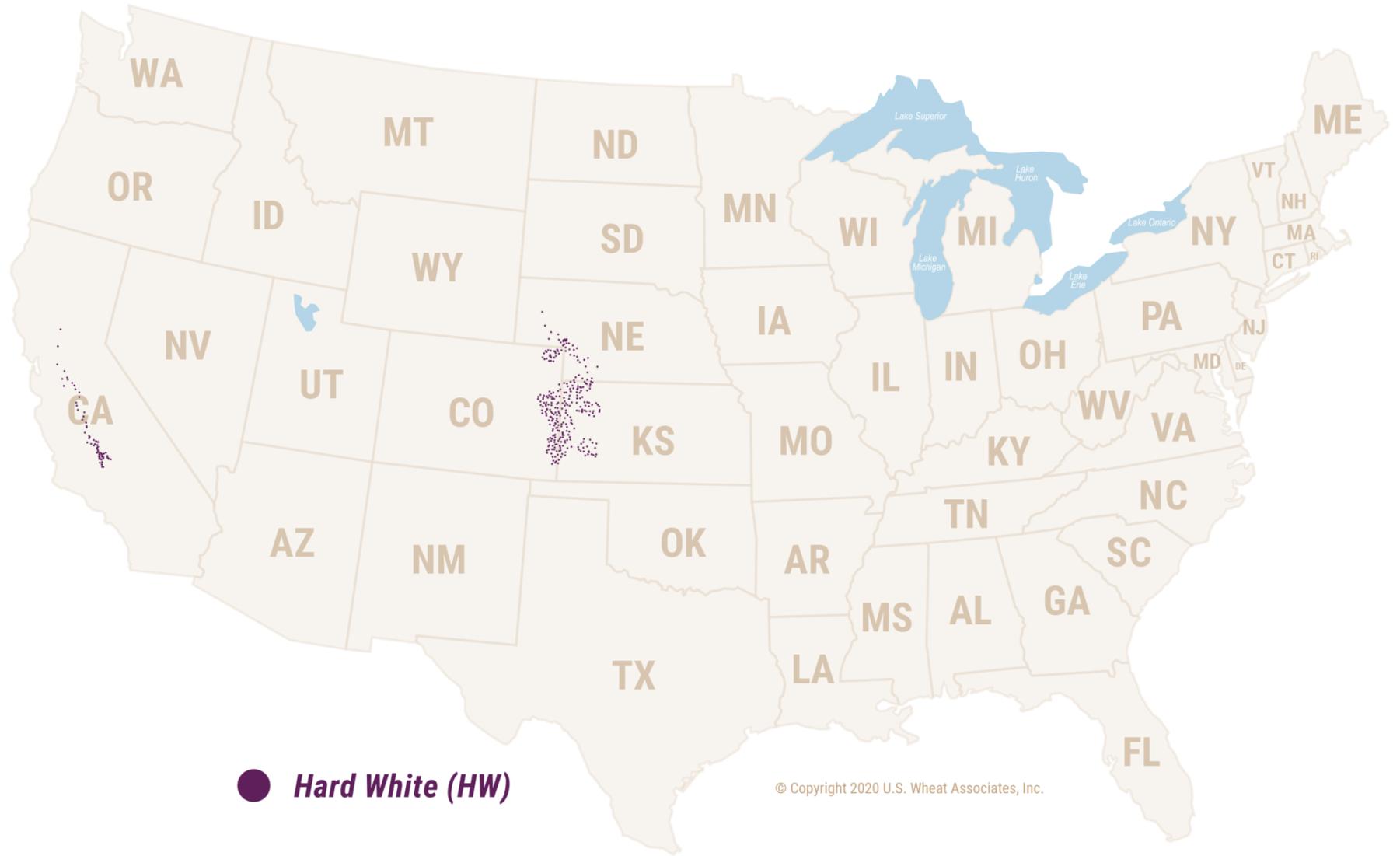
- No subclasses

Developed from hard red winter wheats

Sweeter taste due to reduced tannins in bran

Requires identity preservation and segregation

- Increases costs for producers and end-users





Cultivating HDWH Wheat

Best performance observed in drier growing regions

- U.S. Great Plains (CO, KS, OK, NE, MT, and ID)
- Australia

Most acres are contracted in the U.S.

- Requires certified seed to protect genetic purity
- Premiums average \$0.10/bu over hard red winter wheats

HDWH yield is similar to HRW

- More issues with PHS requiring drier growing conditions

~0.9 MMT currently grown annually in the U.S. Great Plains

- Account for ~2% of all wheat grown in the U.S.



HDWH Wheat Characteristics

The U.S. wheat class system is designed to clearly separate wheat for different end uses

- Specific quality characteristics must be met in order to be included in a given class
- As a result, each class has specific end uses

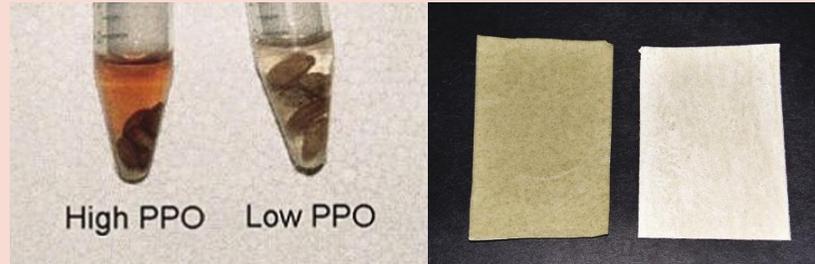
HDWH wheats have quality characteristics that are especially suitable for whole wheat products, pan breads, flat breads, and Asian noodles

- Intermediate to strong gluten profiles with good mixing stability
- Good starch pasting properties for noodle products
- Sweeter bran flavor in whole wheat/high extraction products

HDWH Wheat Characteristics

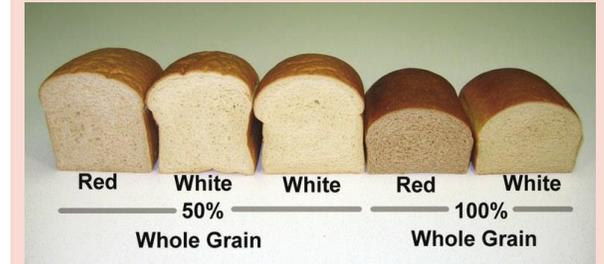


HDWH wheat kernels are similar to those of HRW with a white bran color



Lower PPO levels in many HDWH varieties grown in the U.S.

- Better color in noodle and whole wheat products



Higher flour extraction rates possible due to lighter bran color

- Higher fiber content that can be marketed to consumers



HDWH Flour Quality: Table 5. 2018 HDWH Flour Quality Data (PNW)

HDWH by Protein		
	Low Protein	High Protein
Farinograph		
Peak Time (min)	7.2	11.4
Water Absorption (%)	60.1	61.4
Stability (min)	19.5	11.6
Extensograph		
Energy at 45/135 min (cm ²)	171 / 189	196 / 207
Extensibility at 45/135 min (cm)	20.7 / 15.3	23.4 / 14.6
Rmax at 45/135 min (BU)	697 / 1076	706 / 1237
Alveograph		
P (mm)	70	76
L (mm)	109	107
P/L ratio	0.64	0.71
W (10 ⁻⁴ J)	254	273
Protein ranges: Low, <11.5%; High, >12.6% <i>*From: U.S. Wheat Associates. 2018 Crop Quality Report</i>		



HDWH Baking Quality

HDWH wheat is selected for:

- Low PPO
- Improved bran color, especially the aleurone layer

As a result, HDWH has:

- Better color stability in fresh noodles
- Brighter color, especially in whole wheat/high extraction products
- More suitable for products requiring brighter color and whole wheat products



U. S. Soft Wheat: **Soft White (SWH)**





What is SWH Wheat? – The Market Class

Soft white wheat (SWH) is one of the six major U.S. wheat market classes

- 2 subclasses:
 - White club wheat is low protein soft textured white wheat
 - Western white wheat is a blend of SWH and white club wheats

Western white wheat usually contains 10 – 30% club wheat

- Higher percentages of club wheat (up to 90%) can be included in a western white wheat blend if contracted

Most common western white blend contains 20% white club wheat



Cultivating SWH Wheat

Best performance observed in low humidity growing regions

- U.S. Pacific Northwest (PNW)

Very susceptible to Fusarium and other pathogens

- Primary breeding focus is introducing disease resistance

SWH yield is better than white club yield

- Better return for growers compared to white club wheat

5.5 MMT currently grown annually in U.S. PNW

- Accounts for ~10% of all wheat grown in the U.S.



SWH Wheat Characteristics

Soft kernel texture with a white bran color

- Lower gluten strength and water absorption compared to hard wheat

Best suited for cookies, cakes, and pastries

- White color is highly desirable
- Lower protein better for light, delicate product texture
- Lower water absorption allows for more complete bake-off of water



SWH Flour Quality: Table 6. 2018 SWH Flour Quality Data

	SWH by Protein				
	Low	Medium	High	Overall	Club
Farinograph					
Peak Time (min)	1.5	2.0	2.4	2.7	1.5
Water Absorption (%)	50.8	51.9	52.8	52.2	49.9
Stability (min)	3.9	3.3	2.1	2.9	1.4
Extensograph					
Energy at 45 min (cm ²)	58	60	59	62	20
Extensibility at 45 min (cm)	16.4	18.2	20.9	18.9	14.2
Rmax at 45 min (BU)	232	214	183	221	118
Alveograph					
P (mm)	35	32	31	32	21
L (mm)	76	100	134	121	79
P/L ratio	0.46	0.32	0.23	0.26	0.27
W (10 ⁻⁴ J)	74	81	85	83	31
Protein ranges: Low, <9.0%; Med, 9.0 - 10.5%; High, >10.5%					
*From: U.S. Wheat Associates. 2018 Crop Quality Report					



SWH End Product Quality

SWH wheat is selected for:

- Lower protein
 - About 2-5% lower average protein than hard wheats
- Fewer high molecular weight glutenin subunits
 - Results in weaker gluten

As a result, SWH has:

- Lower water absorption
- Fewer quality differences over a wider range of proteins
- This makes SWH wheat more suitable for low moisture products and those requiring brighter color



SWH Partial Waxy

Lower levels of amylose

- Normal amylose level of ~25%
- Partial waxy wheat ~15 – 20%
- Waxy wheat <5%

As a result, partial waxy SWH has:

- Softer, more cohesiveness textures
- Potential freeze/thaw stability in frozen products

This makes SWH partial waxy wheat suitable as a component of flour blends for managing texture characteristics



Questions?

Thank you for your visit.

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