

U.S. DURUM
WHEAT

REGIONAL QUALITY REPORT

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U.S. DURUM WHEAT

MONTANA • NORTH DAKOTA

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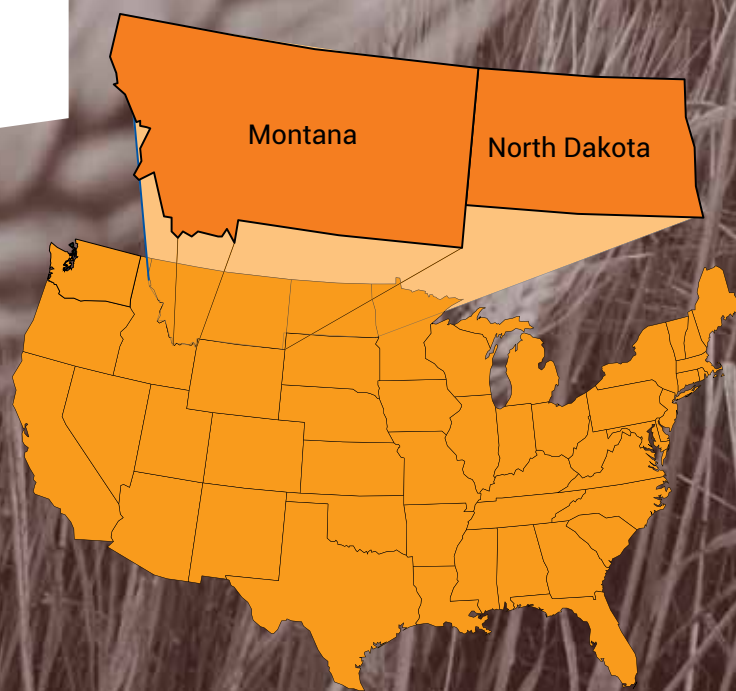
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MAKING PREMIUM PASTA

DURUM—is the hardest of all wheats. Its density, combined with its high protein content and gluten strength, make durum the wheat of choice for producing premium pasta and couscous products. Pasta made from durum is firm with consistent cooking quality. Durum kernels are amber-colored and larger than those of other wheat

classes. Also unique to durum is its yellow endosperm, which gives pasta its golden hue and the best color for couscous.

When durum is milled, the endosperm is ground into a granular product called semolina. A mixture of water and semolina forms a stiff dough. Pasta dough is then forced through dies, or metal discs with

holes, to create hundreds of different shapes.

Durum production is geographically concentrated to the Northern Plains because it demands a special agonomic environment. In most years, the states of North Dakota and Montana produce 80 percent of the U.S. durum crop.

2016 OVERVIEW

The 2016 durum crop in Montana and North Dakota is the largest since 2000 and nearly 50 percent larger than 2015 due to record yields and a one-third increase in planted area. The crop averages No. 1 Hard Amber Durum with grade parameters that are very similar to 2015. The crop benefited from mostly dry conditions for the bulk of the harvest, although significant differences in moisture and disease pressure during the last half of the growing season resulted in a big difference in DON levels in some of the northern growing regions. Functional performance is very similar to the 2015 crop for milling and pasta processing qualities.

Eighty-six percent of the crop is #2 grade or higher, compared to ninety percent in 2015. Specific kernel factors that are strong features in 2016 include an above average test weight of 61.2 lbs/bu (79.7 kg/hl), average damaged kernels of just 0.4 percent and an average vitreous kernel level of 90 percent. The portion of the crop with greater than 90 percent vitreous kernels, is lower than 2015 however, due to sporadic late harvest rains, and pockets of lower protein. Contrasting classes

are higher than average in portions of the crop, averaging 0.9 percent, compared to zero for a five-year average, as part of the increased durum acres in 2016 came from ground previously planted to hard red spring wheat.

The mostly dry harvest secured a low moisture crop, just 11.4 percent, and a sound crop with an average falling number of 423 seconds. Sixty percent of the crop is above 400 seconds, and only two percent below 300 seconds. Protein levels are slightly lower, as expected with a record yield, averaging 13.4 percent (12% moisture basis). This compares to 13.9 percent last year and 13.6 percent for a five-year average. A wider than normal difference in protein exists across the region due to vast differences in growing season moisture. Still, distributions show seventy percent of the crop exceeds the industry standard specification level of 13 percent.

Fusarium Head Blight disease pressures were prevalent across northern North Dakota into north-east Montana, but non-existent in other regions. The crop aver-

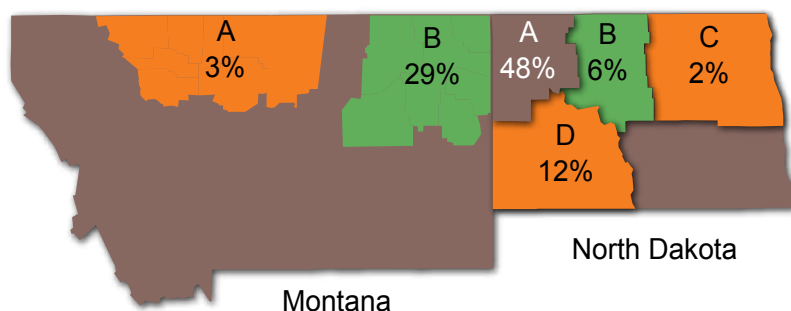
PRODUCTION DATA	2016	2015	2011-15 AVERAGE
MILLION BUSHELS			
Montana	31.4	18.8	14.7
North Dakota	58.3	42.5	32.2
U.S. Total	104	84.0	65.0
MILLION METRIC TON			
Montana	0.85	0.51	0.40
North Dakota	1.59	1.16	0.88
U.S. Total	2.83	2.29	1.77

Source: USDA 2016 Small Grains Summary

age DON is 1.0 ppm, based on samples collected in the survey, up from 2015 levels, but below the five-year average of 1.2 ppm. In the most impacted regions, DON is a significant marketing challenge and may be higher than this survey reflects in some areas. Although many producers applied fungicides to control Fusarium disease at flowering time, preserving yield potential and kernel development, ongoing high humidity levels during kernel fill favored late DON development. On a positive note, lab testing of semolina from the survey samples shows very minimal levels of DON, indicating much of the DON in the 2016 crop may be on the outside of the kernel.

Milling performance, based on a Buhler laboratory mill, reveals a significant jump in total extraction, averaging 73.6 percent, and semolina extraction, averaging 67.9 percent. These are both three percentage points above the five-year average. Part of the increase can be attributed to the replacement of all purifier screens on the lab mill. The milled product is reflecting higher ash levels, 0.71 percent compared to 0.64 percent in 2015, and a higher speck count. Wet gluten values for the crop are at 32.4 percent, well below 37 per-

Approximate Share of Regional Production by Crop Reporting Area



cent last year and 35.4 percent for the five-year average. The average gluten index of 60.8 percent is up from 2015 and the five-year level.

Semolina properties show very high color scores with a 'b' value of 30.3. Mixing properties are similar to 2015 and slightly weaker than the five-year average. Evaluation of the cooked spaghetti, reflects some impact from the

lower protein crop with lower color scores, a slight increase in cooking loss and slightly lower cooked firmness values compared to last year and the five-year average.

Buyers will find larger supplies but a somewhat diverse quality mix in the 2016 crop. Grade factors remain high across a broad part of the region, but protein content, vitreous kernel levels and DON are factors that vary and will have a

significant impact on price values. End-use performance of the crop is strong for milling yields and semolina color, but somewhat lower than the five-year average for cooking qualities. Good supplies of high milling quality durum are available, but buyers are encouraged to use diligent contract specifications, especially for DON, as levels do not always correlate with grade parameters.

SEASONAL CONDITIONS



Planting of the northern durum crop got off to a slow start in April, but was in full force by May and finished well ahead of average by the end of the month. Producers experienced mostly favorable conditions with little to no rain delays. Soil moisture was generally adequate although some areas became short on moisture by early June.

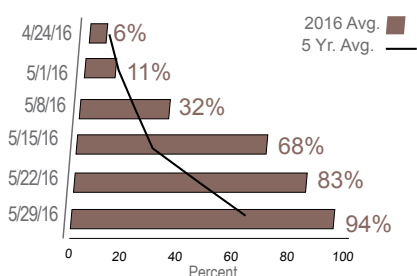


Emergence and crop development were well ahead of the average pace. Timely precipitation was received in northern producing areas of North Dakota and Montana, promoting yield potential. Disease pressures were greater than normal in this part of the region. Producers applied fungicides at flowering but high humidity in July kept disease threats high through kernel development. Producers in southern North Dakota struggled with below average moisture for a large portion of the growing season, impacting yield potential but eliminating disease threats and accelerating crop maturity.

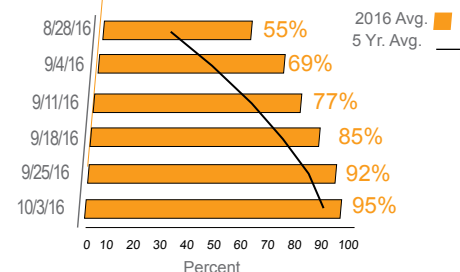


Harvest began in mid August with the bulk of the crop harvested by the end of September. Sporadic rains delayed harvest at times, primarily in the north, but progress remained ahead of the average. The first half of the harvest came off under dry conditions with little to no quality impacts. The second half of the harvest was hit with rain delays and increased quality concerns due to disease pressures during the growing season.

DURUM PLANTING PROGRESS



DURUM HARVEST PROGRESS



WHEAT CHARACTERISTICS

WHEAT GRADES as defined by the Federal Grain Inspection Service (FGIS) of the USDA Grain Inspection, Packers and Stockyards Administration (GIPSA), reflect the general quality and condition of a representative sample. U.S. grades are based on test weight and include limits on damaged kernels, foreign material, shrunken and broken kernels, and wheat of contrasting classes. Each determination is made on the basis of the grain when free from dockage and shrunken and broken kernels.

SUBCLASS is a separate marketing factor based on the weight percentage of kernels with a complete, hard and vitreous endosperm, the portion that makes semolina. For durum wheat the subclasses are:

- Hard Amber Durum (HAD)—at least 75 percent or more hard, vitreous kernels;
- Amber Durum (AD)—between 60 and 74 percent hard, vitreous kernels;
- Durum (D)—less than 60 percent hard, vitreous kernels.



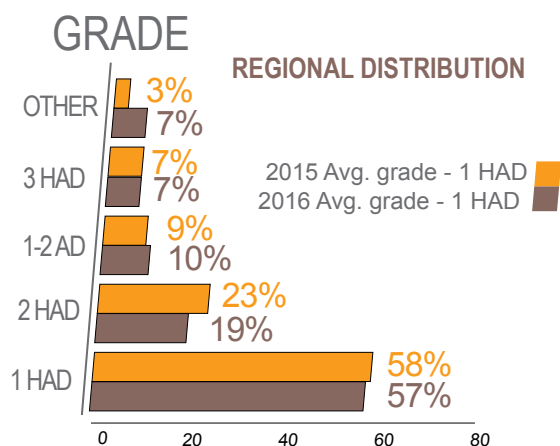
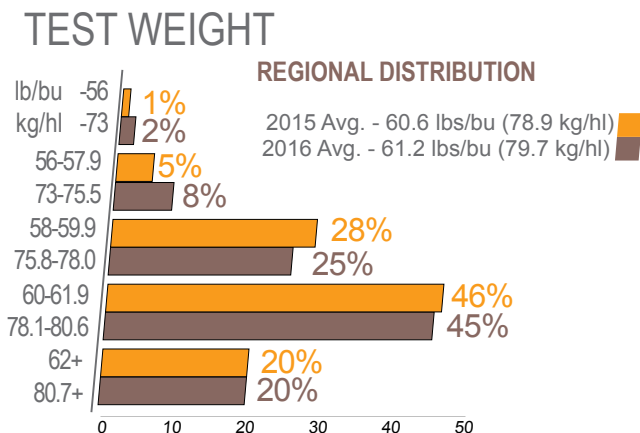
GRADING FACTORS	U.S. Grades				
	1	2	3	4	5
DURUM - MINIMUM TEST WEIGHTS					
Pounds per bushel	60.0	58.0	56.0	54.1	51.0
Kilograms per hectoliter	78.2	75.6	73.0	70.4	66.5
MAXIMUM PERCENT LIMITS OF:					
Damaged kernels					
Heat (part of total)	0.2	0.2	0.5	1.0	3.0
Total	2.0	4.0	7.0	10.0	15.0
Foreign material	0.4	0.7	1.3	3.0	5.0
Shrunken/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 classes ²					
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 OF:					
Other material					
Animal filth	1	1	1	1	1
Castor beans	1	1	1	1	1
Crotalaria seeds	2	2	2	2	2
Glass	0	0	0	0	0
Stones	3	3	3	3	3
Unknown foreign material	3	3	3	3	3
Total ⁴	4	4	4	4	4
Insect-damaged kernels	31	31	31	31	31

U.S. sample grade is wheat that:

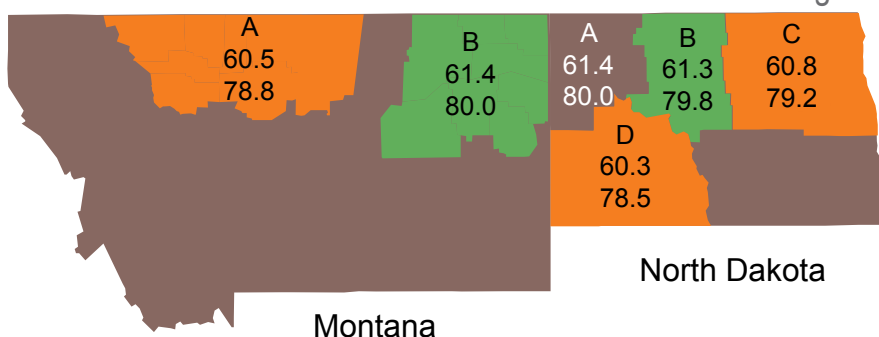
- Does not meet the requirements for U.S. Nos. 1, 2, 3, 4, or 5; or
- Has a musty, sour, or commercially objectionable foreign odor (except smut or garlic odor); or
- is heating or of distinctly low quality.
  - Includes damaged kernels (total), foreign material, and shrunken and broken kernels.
  - Unclassed wheat of any grade may contain not more than 10.0 percent of wheat of other classes.
  - Includes contrasting classes.
  - Includes any combination of animal filth, castor beans, crotalaria seeds, glass, stones, or unknown foreign substance.

WHEAT GRADING DATA

STATE AND CROP REPORTING AREA	TEST WEIGHT		DAMAGE	FOREIGN	SHRUNKEN/ BROKEN	TOTAL	CONTRASTING	U.S.	VITREOUS
	LBS/BU	KG/HL	%	MATERIAL	KERNELS	DEFECTS	CLASSES	GRADE	KERNELS
				%	%	%	%		%
MONTANA									
Area A	60.5	78.8	0.1	0.0	0.3	0.4	0.5	1 HAD	96
Area B	61.4	80.0	0.2	0.0	0.8	1.0	1.0	1 HAD	93
State Avg. 2016	61.3	79.8	0.2	0.0	0.7	0.9	0.9	1 HAD	93
State Avg. 2015	60.5	78.8	0.1	0.0	1.2	1.3	0.1	1 HAD	95
NORTH DAKOTA									
Area A	61.4	80.0	0.5	0.0	0.7	1.2	1.1	2 HAD	89
Area B	61.3	79.8	0.6	0.0	0.6	1.2	0.8	1 HAD	84
Area C	60.8	79.2	0.7	0.0	0.6	1.3	1.0	1 HAD	87
Area D	60.3	78.5	0.5	0.0	1.3	1.8	0.5	1 HAD	90
State Avg. 2016	61.2	79.7	0.5	0.0	0.8	1.3	1.0	1 HAD	88
State Avg. 2015	60.7	79.0	0.4	0.0	0.9	1.3	0.0	1 HAD	88
TWO-STATE REGION AVG									
Avg. 2016	61.2	79.7	0.4	0.0	0.8	1.2	0.9	1 HAD	90
Avg. 2015	60.6	78.9	0.3	0.0	1.0	1.3	0.0	1 HAD	91
Five-Year Avg	60.2	78.3	0.4	0.0	1.1	1.5	0.0	1 HAD	85



AVERAGE TEST WEIGHT BY AREA



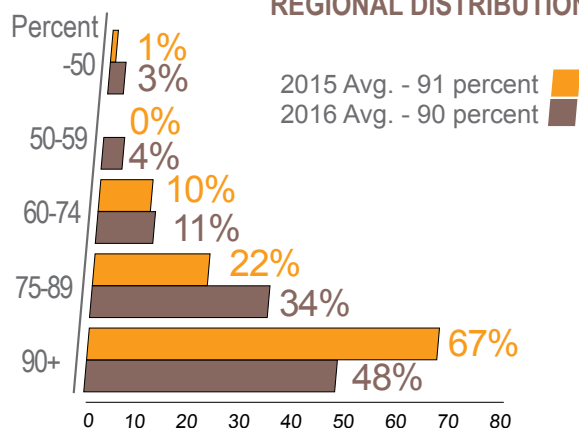
U.S. DURUM WHEAT

MONTANA • NORTH DAKOTA

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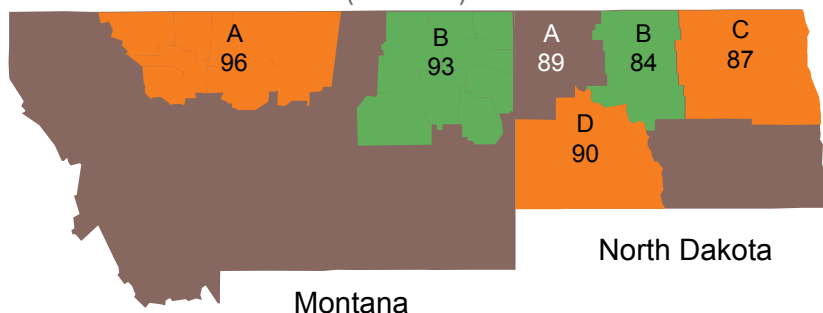
VITREOUS KERNEL

REGIONAL DISTRIBUTION



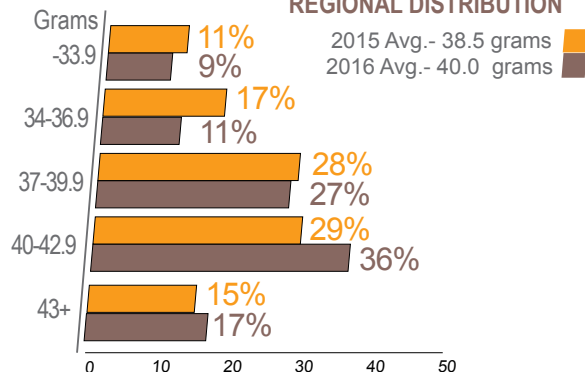
AVERAGE VITREOUS KERNEL BY AREA

(Percent)



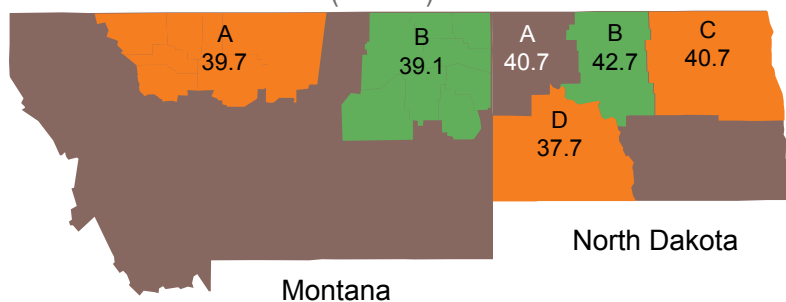
1000 KERNEL WEIGHT

REGIONAL DISTRIBUTION



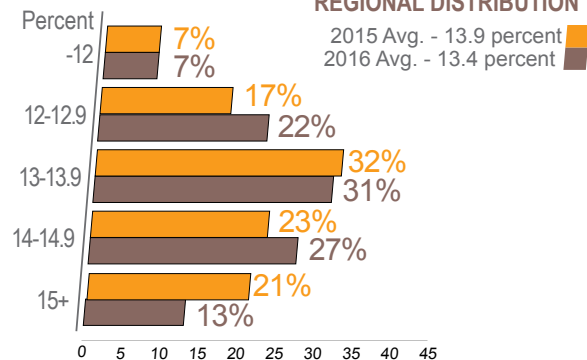
AVERAGE 1000 KERNEL WEIGHT BY AREA

(Grams)



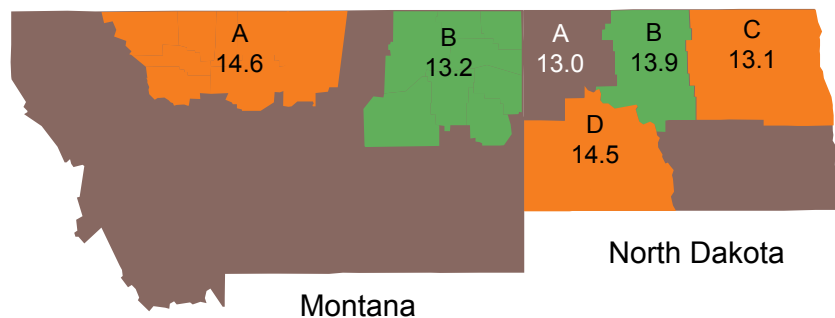
PROTEIN - 12% MOISTURE

REGIONAL DISTRIBUTION



AVERAGE PROTEIN BY AREA

12% Moisture Basis-Percent



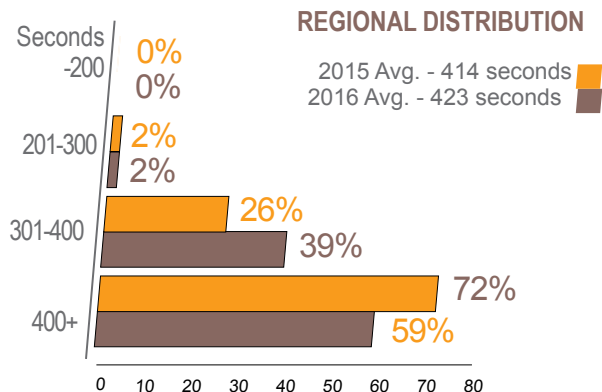
OTHER KERNEL QUALITY DATA

STATE AND CROP REPORTING AREA	Dockage %	Moisture %	1000 Kernel Weight G	Kernel Dist. Medium %	Kernel Dist. Large %	Protein (12% moisture) %	Protein (0% moisture) %	DON (ppm)	Wheat Ash %	Falling Number (sec)	Micro Sed (cc)
MONTANA											
Area A	0.4	10.9	39.7	40	58	14.6	16.6	<0.25	1.64	499	65
Area B	0.3	11.1	39.1	49	47	13.2	15.0	<0.25	1.60	428	53
State Avg. 2016	0.3	11.1	29.2	48	49	13.4	15.2	<0.25	1.60	438	54
State Avg. 2015	1.0	10.4	36.3	59	37	14.6	16.6	<0.25	1.47	426	70

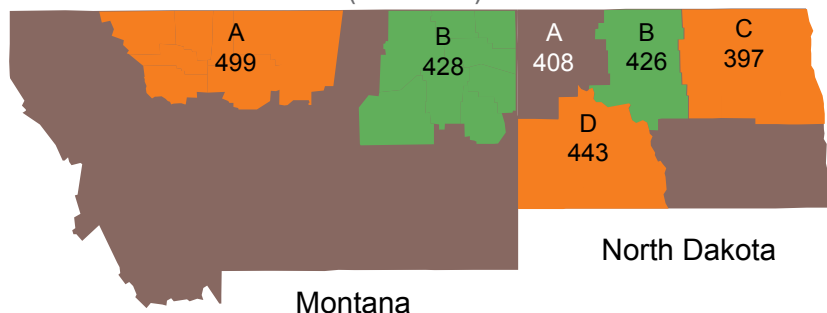
NORTH DAKOTA											
Area A	0.2	11.6	40.7	43	53	13.0	14.8	1.3	1.62	408	54
Area B	0.1	11.8	42.7	33	64	13.9	15.8	1.8	1.67	426	56
Area C	0.1	12.4	40.7	36	62	13.1	14.9	4.5	1.68	397	42
Area D	0.1	10.8	37.7	52	44	14.5	16.5	<0.25	1.54	443	58
State Avg. 2016	0.2	11.6	40.5	43	54	13.4	15.2	1.5	1.62	415	54
State Avg. 2015	0.9	11.6	39.7	46	51	13.6	15.4	1.2	1.62	407	58

TWO STATE REGION											
Avg. 2016	0.2	11.4	40.0	44	52	13.4	15.2	1.0	1.61	423	54
Avg. 2015	0.9	11.2	38.5	51	46	13.9	15.8	0.8	1.57	414	62
Five-Year Avg	1.0	11.6	38.9	44	51	13.6	15.5	1.2	1.61	370	52

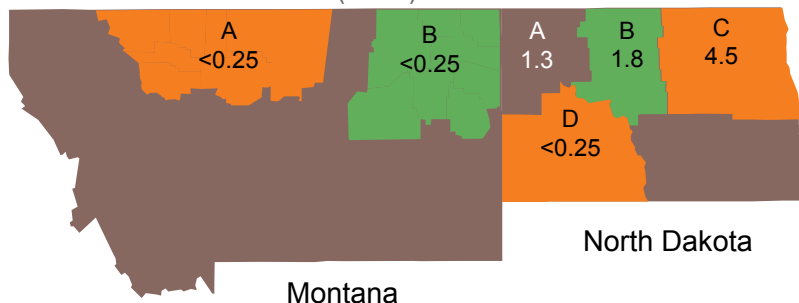
FALLING NUMBER



AVERAGE FALLING NUMBER BY AREA (Seconds)



AVERAGE DON BY AREA (PPM)



MILLING CHARACTERISTICS

TOTAL EXTRACTION represents the portion of the kernel that can be milled into flour and semolina.

SEMOLINA extraction is the portion milled into semolina only.

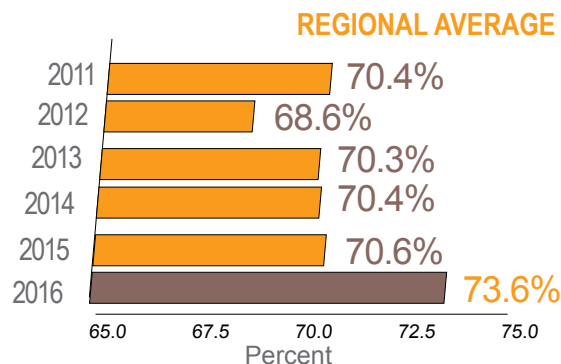
ASH CONTENT in the endosperm of durum is inherently higher than in the endosperm of other hard wheats, but can still be used as a relative measure of bran or mineral content in the flour and semolina.

SPECKS appear in semolina when small particles of bran or other material escape the cleaning and purifying process. Millers can control speck count by selecting durum that is free of disease and foreign material, thoroughly cleaning the durum, properly tempering and conditioning the wheat before milling, and by using purifiers to remove small bran particles from the semolina.

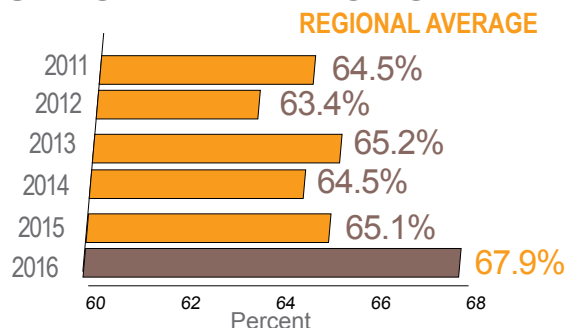
PROTEIN CONTENT in semolina has a high correlation with gluten content and, in turn, mechanical strength and cooking quality. Wet gluten is a quantitative measure of the gluten forming proteins in semolina that are primarily responsible for its mechanical strength and pasta quality.

MIXOGRAM curves reveal important information about the dough quality of semolina and ultimately about the potential cooked firmness of pasta. Mixograms are rated on a scale of 1 to 8, with the higher values indicating stronger mixing characteristics.

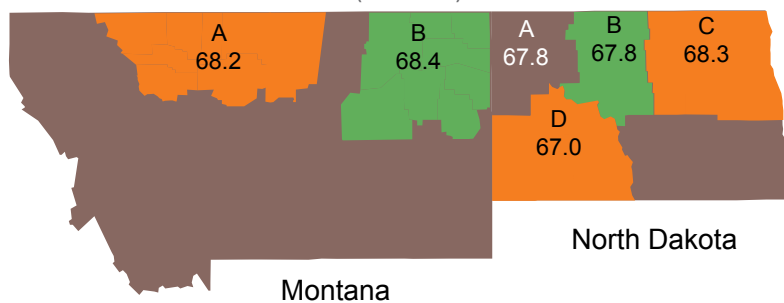
TOTAL EXTRACTION



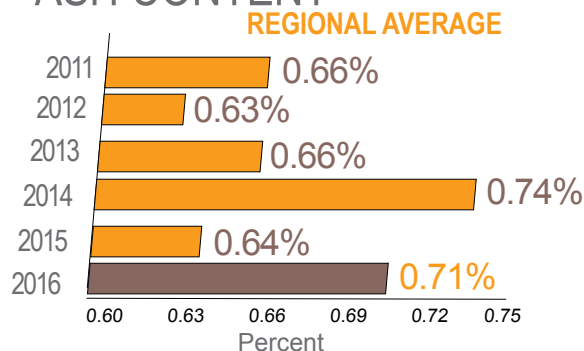
SEMOLINA EXTRACTION



AVERAGE SEMOLINA EXTRACTION BY AREA (Percent)



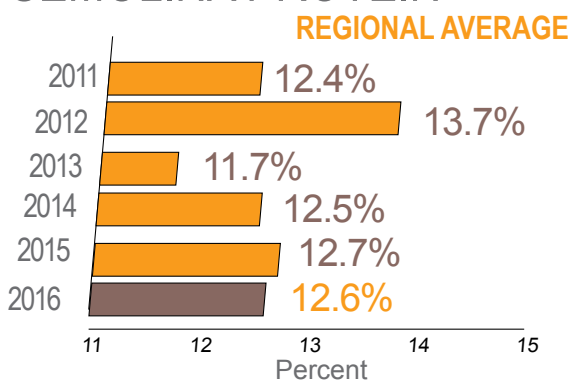
ASH CONTENT



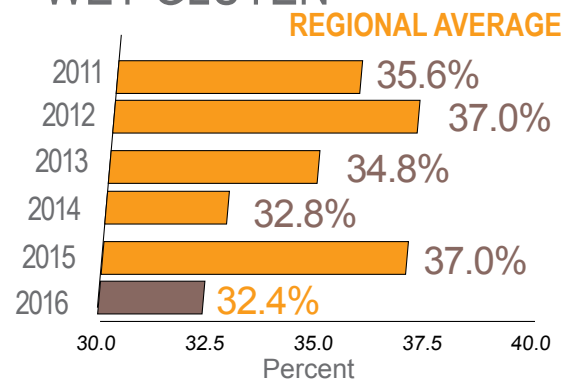
SEMOLINA QUALITY DATA

STATE AND CROP REPORTING AREA	TOTAL EXTRACTION %	SEMOLINA EXTRACTION %	ASH %	SPECKS NO/10 SQ IN %	PROTEIN (14% MOISTURE) %	WET GLUTEN %	GLUTEN INDEX %	MIXOGRAM CLASSIFICATION SCALE 1-8
MONTANA								
Area A	72.6	68.2	0.74	23	14.1	35.8	87.0	7.0
Area B	73.7	68.4	0.70	30	12.6	32.9	58.0	5.0
State Avg. 2016	73.5	68.4	0.70	29	12.8	33.3	62.4	5.3
State Avg. 2015	70.2	65.1	0.64	20	13.3	38.8	57.7	5.3
NORTH DAKOTA								
Area A	73.7	67.8	0.72	30	12.2	30.1	58.2	5.0
Area B	73.9	67.8	0.70	33	12.6	34.3	58.4	5.0
Area C	74.4	68.3	0.78	30	12.4	32.0	62.9	5.0
Area D	72.5	67.0	0.67	30	13.9	36.7	66.8	5.0
State Avg. 2016	73.6	67.7	0.71	30	12.5	31.9	59.9	5.0
State Avg. 2015	70.9	65.1	0.63	27	12.3	35.9	46.0	5.0
TWO-STATE REGION								
Avg. 2016	73.6	67.9	0.71	30	12.6	32.4	60.8	5.1
Avg. 2015	70.6	65.1	0.64	24	12.7	37.0	50.2	5.1
Five-Year Avg	70.1	64.5	0.67	26	12.6	35.4	53.3	5.4

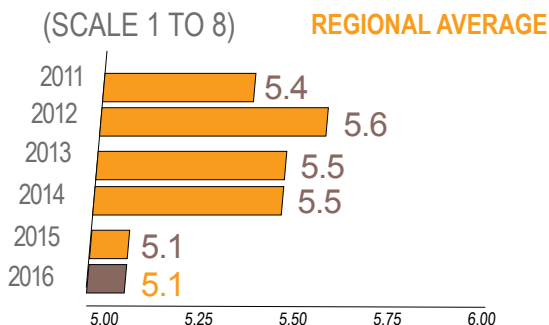
SEMOLINA PROTEIN



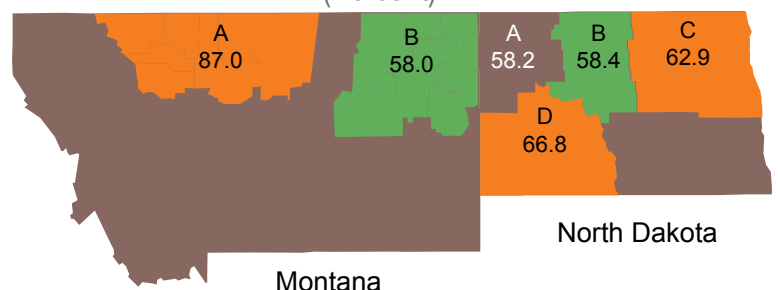
WET GLUTEN



MIXOGRAM CLASSIFICATION (SCALE 1 TO 8)



AVERAGE GLUTEN INDEX BY AREA (Percent)



PASTA CHARACTERISTICS

DRY PASTA PROCESSORS want a finished product that is visually appealing, elastic and strong enough to resist breakage during cutting, packaging, handling and shipping, able to withstand the rigors of cooking, and satisfying to the consumer palate.

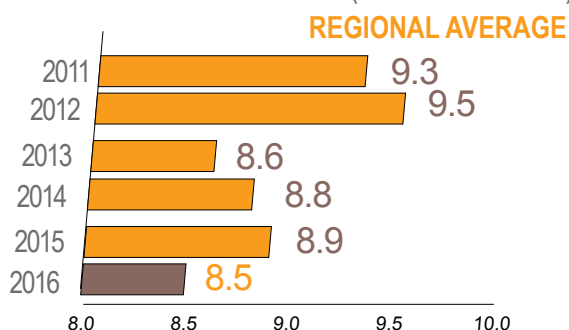
Yellow color in semolina and pasta is a traditional, rather than functional, mark of quality. In the early



days of the pasta industry, before sophisticated testing evolved, consumers assumed that a yellow pasta was made from durum wheat, which is known to make pasta with superior cooking quality compared to that made from other hard wheats.

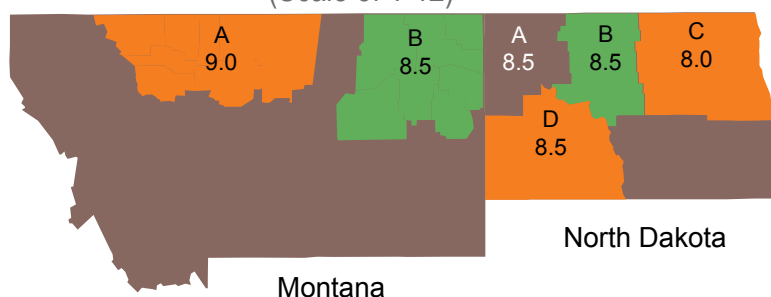
Most consumers prefer pasta that is “al dente,” meaning it has some firmness to the bite. Good quality pasta that is cooked according to package directions should not be sticky or mushy when eaten.

COLOR SCORE (SCALE 1 TO 12)

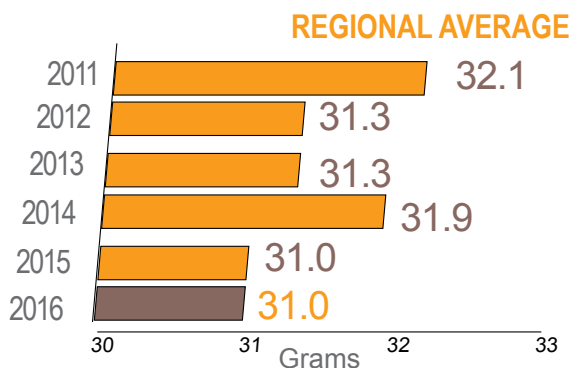


AVERAGE COLOR SCORE BY AREA

(Scale of 1-12)

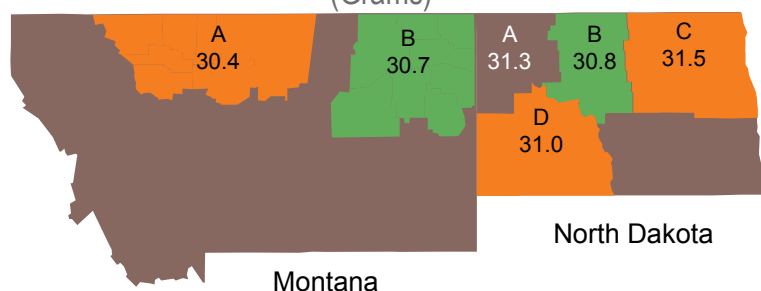


COOKED WEIGHT



AVERAGE COOKED WEIGHT BY AREA

(Grams)

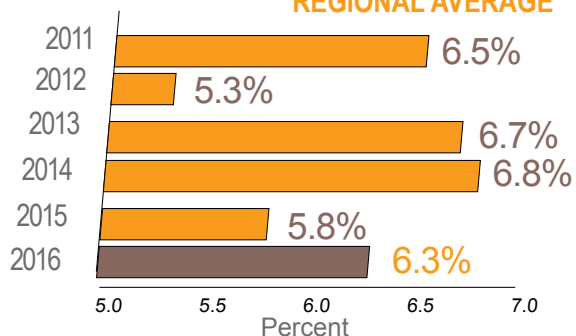


SEMOLINA & SPAGHETTI DATA

STATE AND CROP REPORTING AREA	SEMOLINA COLOR L (black-white)	SEMOLINA COLOR a (red-green)	SEMOLINA COLOR b (yellow-blue)	SPAGHETTI COLOR SCORE (1-12)	SPAGHETTI COOKED WEIGHT G	SPAGHETTI COOKING LOSS %	SPAGHETTI COOKED FIRMNESS G CM
MONTANA							
Area A	83.8	-2.8	32.2	9.0	30.4	5.9	4.6
Area B	84.2	-2.8	30.1	8.5	30.7	6.0	4.3
State Avg. 2016	84.1	-2.8	30.4	8.6	30.7	6.0	4.3
State Avg. 2015	84.5	-3.1	30.3	9.0	31.1	5.5	4.6
NORTH DAKOTA							
Area A	84.4	-2.9	30.4	8.5	31.3	6.5	4.0
Area B	84.5	-2.8	29.6	8.5	30.8	6.0	4.1
Area C	84.1	-2.5	28.1	8.0	31.5	6.5	4.0
Area D	84.5	-2.8	30.7	8.5	31.0	6.7	4.5
State Avg. 2016	84.4	-2.8	30.2	8.5	31.2	6.5	4.1
State Avg. 2015	84.3	-3.0	30.0	8.9	31.0	5.9	4.3
TWO-STATE REGION							
Avg. 2016	84.3	-2.8	30.3	8.5	31.0	6.3	4.2
Avg. 2015	84.4	-3.1	30.1	8.9	31.0	5.8	4.4
Five-Year Avg	84.6	-3.2	29.0	9.0	31.5	6.2	4.6

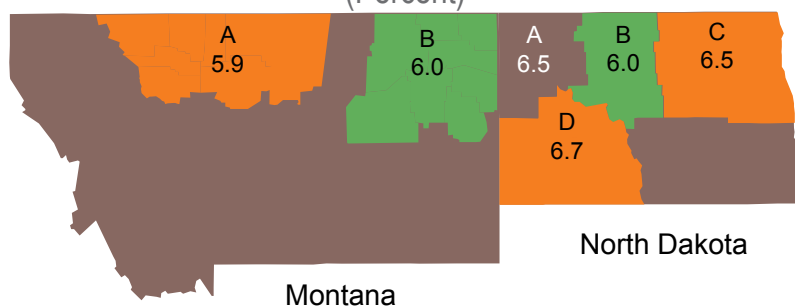
COOKING LOSS

REGIONAL AVERAGE



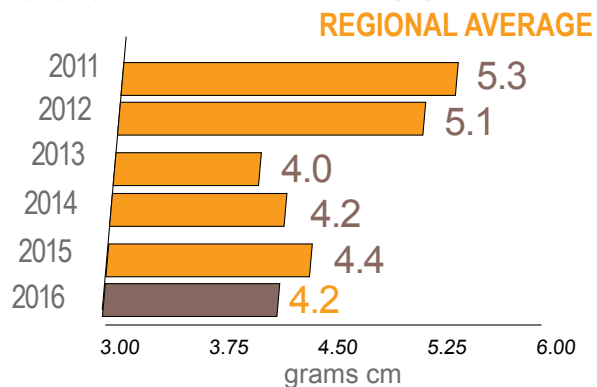
AVERAGE COOKING LOSS BY AREA

(Percent)

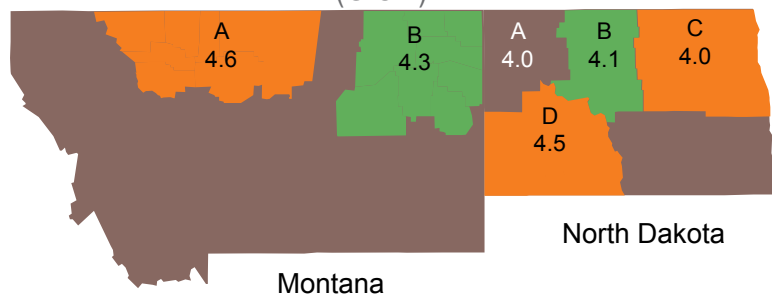




COOKED FIRMNESS



AVERAGE COOKED FIRMNESS BY AREA (G CM)



AVERAGE QUALITY FACTORS

	2016	2015	2014	2013	2012	2011	Five-Year Average
GRADING AND WHEAT DATA							
Test Weight (lbs/bu)	61.2	60.6	59.0	60.7	60.6	59.9	60.2
Test Weight (kg/hl)	79.7	78.9	76.8	79.0	78.9	78.0	78.3
Total Defects (%)	1.2	1.3	1.6	1.0	1.8	1.8	1.5
Vitreous Kernels (%)	90	91	74	85	89	88	85
Grade	1 HAD	1 HAD	2 AD	1 HAD	1 HAD	2 HAD	1 HAD
OTHER WHEAT DATA							
Dockage (%)	0.2	0.9	0.7	0.9	0.9	1.4	1.0
Protein: 12% moisture	13.4	13.9	13.2	12.8	14.6	13.6	13.6
1000 Kernel Weight (gm)	40.0	38.5	38.0	44.1	36.9	36.6	38.9
Moisture (%)	11.4	11.2	12.4	12.1	10.5	11.6	11.6
DON	1.0	0.8	2.1	1.0	1.0	1.0	1.2
Ash (%)	1.61	1.57	1.64	1.57	1.57	1.71	1.61
Falling Number (sec)	423	414	276	375	412	372	370
Sedimentation (cc)	54	62	60	46	49	43	52
SEMOLINA DATA							
Total Extraction (%)	73.6	70.6	70.4	70.3	68.6	70.4	70.1
Semolina Extraction (%)	67.9	65.1	64.5	65.2	63.4	64.5	64.5
Ash (%)	0.71	0.64	0.74	0.66	0.63	0.66	0.67
Wet Gluten (%)	32.4	37.0	32.8	34.8	37.0	35.6	35.4
Specks (no/10 sq in)	30	24	26	26	23	31	26
Protein (%)	12.6	12.7	12.5	11.7	13.7	12.4	12.6
Gluten Index (%)	60.8	50.2	45.1	55.1	60.6	55.5	53.3
Mixograph Classification	5.1	5.1	5.5	5.5	5.6	5.4	5.4
Color: L (black-white)	84.3	84.4	84.9	84.6	85.0	84.6	84.6
a (red-green)	-2.8	-3.1	-4.0	-3.2	-2.8	-2.7	-3.2
b (yellow-blue)	30.3	30.1	27.9	27.7	29.8	29.7	29.0
SPAGHETTI PROCESSING DATA							
Color Score (scale of 1-12)	8.5	8.9	8.8	8.6	9.5	9.3	9.0
L (black-white)	53.5	54.5	53.5	56.4	55.5	55.2	55.0
b (yellow-blue)	26.4	27.3	26.6	27.4	27.5	27.3	27.2
Cooked Weight (gm)	31.0	31.0	31.9	31.3	31.3	32.1	31.5
Cooking Loss (%)	6.3	5.8	6.8	6.7	5.3	6.4	6.2
Cooked Firmness (g cm)	4.2	4.4	4.2	4.0	5.1	5.3	4.6

Semolina color performed on CIE color scale. Granulation size is approximately 40 percent above 425 microns and 12 percent below 180 microns. Spaghetti color is performed on Hunter color scale.

EXPORT CARGO SAMPLING

SAMPLE COUNT	2015 (14)	2014 (36)
GRADING AND WHEAT DATA		
Test Weight (lbs/bu)	60.6	60.0
Test Weight (kg/hl)	78.9	78.1
Damaged Kernels (%)	3.2	4.3
Foreign Material (%)	0.1	0.1
Shrunken & Broken (%)	1.4	1.4
Total Defects (%)	4.7	5.7
Vitreous Kernels (%)	69	62
Grade	2 AD	3 AD
OTHER WHEAT DATA		
Dockage (%)	0.6	0.6
Moisture (%)	11.8	12.3
Protein: 12% moisture (%)	13.5	13.2
Protein: Dry (%)	15.3	15.0
Ash: 14% moisture (%)	1.64	1.63
Ash: Dry (%)	1.90	1.90
1000 Kernel Weight (gm)	39.1	40.0
Kernel Size (%) lg/md/sm	51/45/4	47/51/2
Falling Number (sec)	377	275
DON (ppm)	n/a	1.4
SEMOLINA DATA		
Total Extraction (%)	72.2	70.1
Semolina Extraction (%)	65.9	63.7
Ash: 14% moisture (%)	0.74	0.69
Ash: Dry (%)	0.86	0.81
Gluten Index	56	48
Specks (no/10 sq in)	29	28
Protein: 14% moisture (%)	12.3	12.0
Protein: Dry (%)	14.3	14.0
Mixograph Classification (scale of 1-8)	5.6	5.4
Color: L (black-white)	84.3	84.4
a (red-green)	-2.68	-2.81
b (yellow-blue)	27.8	26.8
SPAGHETTI PROCESSING DATA		
Color Score (scale of 1-12)	8.4	8.0
Cooked Weight (gm)	31.0	31.5
Cooking Loss (%)	6.4	6.3
Cooked Firmness (g cm)	3.9	3.9

Data contained in previous sections of this report are derived from the testing of samples gathered during harvest from origination points throughout the northern U.S. durum growing region. The results provide an assessment of the overall quality of the crop produced in a given year.

U.S. Wheat Associates, the export market development arm for American wheat growers, furthers this information by commissioning an export cargo sampling program. That data is shown in the table to the left. The program provides an accurate representation of the supplies moving through the grain marketing and transportation system and actually reaching export points. Results show the quality levels at which U.S. wheat is realistically traded and are useful to customers in developing reasonable purchase specifications.

The Federal Grain Inspection service oversees the program whereby all export inspection agencies at all ports collect every tenth sub lot sample from every vessel of U.S. wheat shipped during three two-month time periods annually.

The durum wheat samples are sent for analysis to the Durum Wheat Quality and Pasta Processing Laboratory in the North Dakota State University Plant Science Department. The samples represented here are based on samples collected from the fall of 2014 through the summer of 2015 for crop year 2014. For crop year 2015, samples tested were collected from the fall of 2015 through the spring of 2016. Grade data in the table is the actual official grade on individual sublots.

Semolina color performed on CIE color scale.

Granulation size is approximately 40 percent above 425 microns and 12 percent below 180 microns. Spaghetti color is performed on Hunter color scale.

LABORATORY ANALYSIS

All quality data contained in this report is the result of testing and analysis conducted by or under the supervision of Dr. Frank Manthey, professor, Hiroshi Ando and Yu Liu, food technologists of the Durum Wheat Quality and Pasta Processing Laboratory in the Department of Plant Science at North Dakota State University, Fargo, North Dakota, USA.

COLLECTION • The North Dakota and Montana state offices of the National Agricultural Statistics Service obtained durum wheat samples during harvest directly from growers, farm bins and local elevators. These samples reflect the condition of the grain at the point of origin. Collection began in mid August when approximately 20 percent of the regional durum crop had been harvested and continued until late September. A total of 210

samples were collected during harvest from Montana (55) and North Dakota (155).

ANALYSIS • Half of the total wheat samples collected were analyzed for grade and other physical kernel characteristics. The data obtained from the analyses was used to generate frequency distributions as a percentage of the harvested crop. Distribution results may differ from data presented in the various tables, because the latter are derived from production adjusted averages, rather than simple averages.

All samples received in the laboratory were sub-sampled to obtain one composite sample for each of the four areas in North Dakota and one composite each of two areas for Montana. These were analyzed for grade and physical characteristics as well as milling performance



and spaghetti processing qualities. Again, all state and regional averages have been adjusted to reflect production as opposed to simple averaging.

METHODS, TERMS, SYMBOLS

WHEAT

SAMPLE COLLECTION • Each sample contained approximately 2 to 3 pounds of wheat, stored in securely closed, moisture proof plastic bags.

MOISTURE • Official USDA procedure using Motomco Moisture Meter.

GRADE • Official United States Standards for Grain, as determined by a licensed grain inspector. North Dakota Grain Inspection Service, Fargo, ND, provided grades for composite wheat samples representing each crop reporting area.

VITREOUS KERNELS • Approximate percentage of kernels having vitreous endosperm, based on weights.

DOCKAGE • Official USDA procedure. All matter other than wheat which can be removed readily from a test portion of the original sample by use of an approved device (Carter Dockage Tester). Dockage may also include underdeveloped, shriveled and small pieces of wheat kernels removed in properly separating the material other than wheat and which cannot be recovered by properly rescreening or recleaning.

TEST WEIGHT • American Association of Cereal Chemists Method

55-10 approved April 1961, revised October 1999. Measured as pounds per bushel (lb/bu), kilograms per hectoliter (kg/hl) = (lbs/bu X 1.292) + 0.630. Approved Methods of the American Association of Cereal Chemists, Cereal Laboratory Methods (10th Edition), St. Paul, MN (2000).

THOUSAND KERNEL WEIGHT

• Based on 10 gram sample of cleaned wheat (free of foreign material and broken kernels) counted by electronic seed counter.

KERNEL SIZE DISTRIBUTION • Determinations made according to the procedure described in Cereal Science Today 5:(3), 71 (1960).

Kernels remaining over a Tyler No. 7 (2.92 mm opening) are classified as “large;” kernels passing through the top sieve but remaining on a Tyler No. 9 (2.24 mm opening) are classified as “medium” size kernels. Kernels passing through the second sieve are classed as “small.” Size is reported as percentage of large, medium, and small kernels.

PROTEIN • American Association of Cereal Chemists (AACC) Method: 46-30 (Combustion Method), expressed on dry basis and 12 percent moisture basis.

ASH • American Association of Cereal Chemists Method 08-01, approved April 1961, revised October 1999; expressed on a 14 percent moisture basis.

DON • Analysis was done on ground wheat using a gas chromatograph with an electron capture detector as described in J. Assoc. Official Anal. Chem 79,472 (1996)

FALLING NUMBER • American Association of Cereal Chemists Method 56-81B, approved November 1972, revised September 1999; units of seconds (14 percent moisture basis).

MICRO SEDIMENTATION • Determined as described by Dick, J.W. and Quick, J.S. Cereal Chem. 60(4):315-318, 1983.

WET GLUTEN • American Association of Cereal Chemists Method 38-12, approved October 1999; expressed on a 14 percent moisture basis determined with the glutomatic instrument.

GLUTEN INDEX • American Association of Cereal Chemists Method 38-12, approved October 1999; determined with the glutomatic in-

strument as an indication of gluten strength.

SEMOLINA

EXTRACTION • AACC Method 26-41 (modified for the Buhler Mill). Expressed on a total product basis.

ASH • AACC Method 08-01, approved April 1961, revised October 1999; expressed on a 14 percent moisture basis.

PROTEIN • AACC Method 46-30 (combustion method), approved September 1995, revised October 1999, N x 5.7, expressed on a 14 percent moisture basis.

SPECKS • The number of specks in semolina was determined on a flat surface under a constant light source, and counting the visible specks (brown and black particles) in three different one-inch square areas. The average of the three readings was converted to the number of specks per 10 square inches.

MIXOGRAPH • Mixograph evaluation of semolina was performed according to the AACC Method 54-40A with some modifications: Ten grams of semolina (weighed on 14 percent moisture basis) were mixed for 8 min at constant water absorption of 5.8 ml, using a spring setting of 8. The mixograms were scored by comparing them to reference mixograms. A scale of 1 to 8 is employed, higher values indicate strong mixing characteristics (see reference mixogram chart).

SPAGHETTI

PROCESSING • Pasta was made using the laboratory procedure described by Walsh, Ebeling, and

Dick, Cereal Sci. Today: 16(11) 385, 1971. A 1-Kg semolina was mixed with the appropriate amount of water that gave a dough consistency of 32 percent total water absorption. The other processing conditions used were: Water temperature, 40 C, extruder shaft speed, 25 rpm and vacuum, 18 in. Hg; the dough was pressed through an 84-strand teflon-coated spaghetti die with 0.157 cm openings. The extruded spaghetti samples were dried at high temperature for 12 hrs, using maximum temperature and relative humidity of 73 C and 83 percent, respectively.

COLOR • Color scores were determined by light reflectance (AACC Method 14-22, 1983), using a Minolta Color Difference Meter (Model CR 410, Minolta Camera Co., Japan). The scores were generated according to the new color map designed by Debbouz (Pasta J. vol 6, No 6, 1994). A spaghetti sample with a score of 8.0 or higher is considered to have good color.

COOKED WEIGHT • AACC Method 66-50 with some modifications: 10 g of dry spaghetti were placed in 300 ml boiling distilled water and cooked for 12 min. The cooked and drained spaghetti sample was weighed and the results were reported in grams.

COOKING LOSS • AACC Method 66-50. Solids lost to the cooking water. After drying the residue was weighed and reported as percentage of the original dry sample.

FIRMNESS • AACC Method 66-50 with a Plexiglas tooth attached to a Texture Analyzer (Model TA-XT2, Texture Technology Corp., Scarsdale, New York).

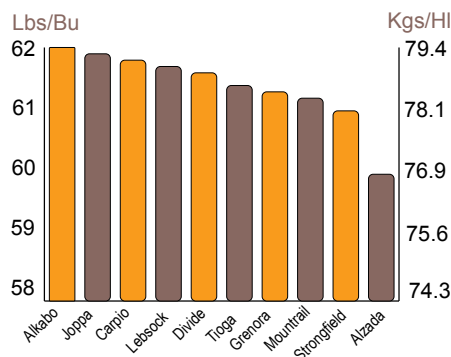
VARIETAL INFORMATION

Quality products begin with quality ingredients. In the case of wheat, quality begins with the varieties planted. Within the durum class of wheat, there are different varieties available—all with relatively uniform characteristics. The public plant breeding program at North Dakota State University in Fargo develops and releases most of the durum varieties grown in the northern region, although some private firms also have durum breeding programs. Before any durum variety is released to the public, breeders are encouraged to show that it meets or exceeds current standards for the class. Prospective releases are evaluated for milling and pasta characteristics as well as for yield, protein content, test weight, resistance to diseases and insects, and straw strength.

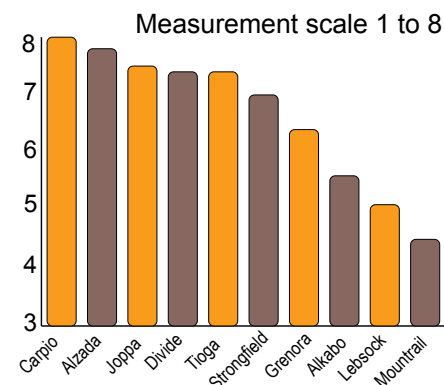
Environment influences the quality of varieties across growing areas and planting years. For this reason, wheat breeders use “check” or reference varieties to evaluate quality in experimental varieties. They test and analyze quality data from multiple years and growing locations before a variety is released.

Source: Yield trials 2013-15 crop years across multiple North Dakota locations.

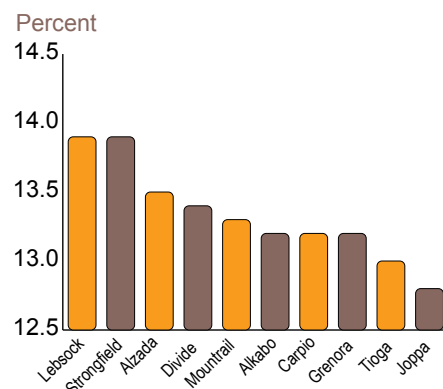
TEST WEIGHT



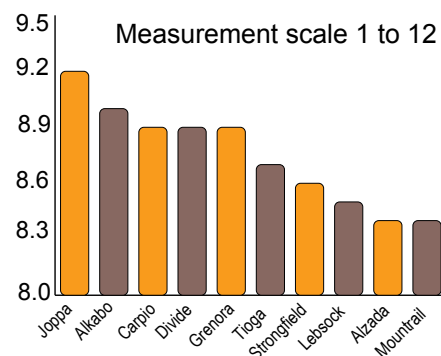
MIXOGRAPH



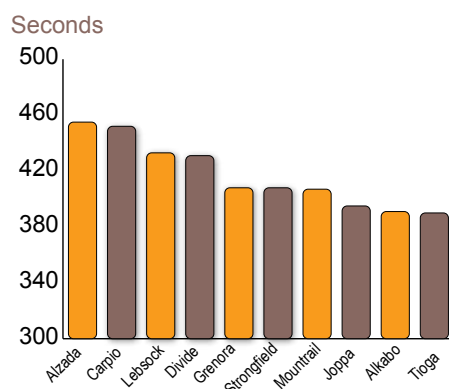
KERNEL PROTEIN



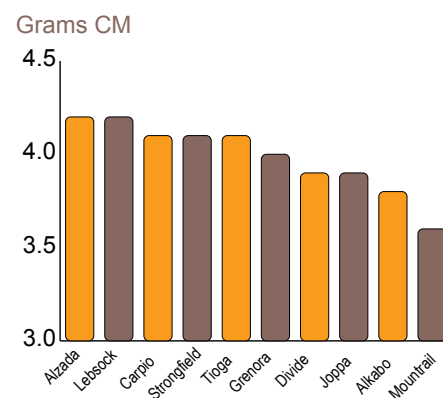
PASTA COLOR



FALLING NUMBER



COOKED FIRMNESS



VARIETAL INFORMATION

MAJOR VARIETIES PRODUCED IN REGION • AGRONOMIC FACTORS							
Variety	Agronomic Description			Reaction to Disease ²		Average Yield	
	Agent or Origin ¹	Year Released	Straw Strength	Leaf Rust	Foliar Disease	Western, North Dakota ³ BU/Acre	MT/Hect
Alkabo	ND	2005	strong	R	M	61.9	4.16
Alzada	WB	2004	med weak	R	S	47.2	3.17
Carpio	ND	2012	medium	R	M	60.7	4.08
Divide	ND	2005	medium	R	M	63.0	4.24
Grenora	ND	2005	medium	R	M	60.8	4.09
Joppa	ND	2013	medium	R	M	64.3	4.32
Lebsock	ND	1999	strong	R	M	57.7	3.88
Mountrail	ND	1998	medium	R	M	64.0	4.30
Strongfield	CAN	2004	med weak	R	MS	58.0	3.90
Tioga	ND	2010	med strong	R	M	64.6	4.34

GROWN AND TESTED ACROSS NORTH DAKOTA • QUALITY & END-USE FACTORS									
Variety	Quality Factors ⁴								
	Test Weight LB/BU	Test Wheat KG/HL	Wheat Protein %	Wheat Falling # Seconds	Mixogram Score (scale 1-12)	Pasta Color (Scale 1-12)	Gluten Index %	Cooked Firmness G CM	Overall Pasta Quality Rating ⁵
Alkabo	62.0	80.7	13.2	391	5.6	9.0	44	3.8	good
Alzada	60.0	78.2	13.5	455	7.8	8.4	86	4.2	good
Carpio	61.8	80.5	13.2	452	8.0	8.9	92	4.1	excellent
Divide	61.6	80.2	13.4	431	7.4	8.9	75	3.9	good
Grenora	61.3	79.8	13.2	408	6.4	8.9	64	4.0	good
Joppa	61.9	80.6	12.8	395	7.5	9.2	82	3.9	good
Lebsock	61.7	80.4	13.9	433	5.1	8.5	36	4.2	good
Mountrail	61.2	79.7	13.3	407	4.5	8.4	17	3.6	average
Strongfield	61.0	79.4	13.9	408	7.0	8.6	60	4.1	good
Tioga	61.4	80.0	13.0	390	7.4	8.7	75	4.1	good

Source: 2016 North Dakota Durum Wheat Variety Performance Descriptions

1. ND–North Dakota State University, WB–Westbred and CAN–Canada.
2. Reaction to Disease: resistant (R), moderately resistant (MR), intermediate (M), moderately susceptible (MS), susceptible (S), very susceptible (VS).
3. Three year average data 2013-15 from four locations across North Dakota.
4. Based on NDSU Durum Quality Lab testing of samples grown at multiple North Dakota locations during 2013-15.
5. Based on kernel attributes, milling and semolina processing, pasta color, and spaghetti cooking performance. Ratings can be excellent, good, average, fair and poor.

NORTH DAKOTA

The top five durum varieties planted in North Dakota in 2016 are Divide, Carpio, Alkabo, Joppa and Tioga. On a combined basis they account for two-thirds of the planted acres. Carpio and Joppa, both recent releases from NDSU, made the top five list for the first time, replacing long time popular varieties Mountrail and Lebsock.

DIVIDE is the top variety planted in North Dakota and Montana, accounting for 21.5 percent and 27 percent of the acreage, respectively. Compared to 2015, its share of acres fell in North Dakota but increased in Montana. It has been the leading variety in North Dakota for eight consecutive years. A 2005 release from North Dakota State University, Divide remains popular with producers for its high yield potential and tolerance to disease. It is rated as good for end-use quality.

CARPIO, a 2012 NDSU release, made the most significant acreage gains of any variety in 2016. It advanced into second in North Dakota with 17 percent of the acres, up from just 2 percent in 2015. Carpio has high yield potential and improved quality over other varieties. It is rated as excellent for end-use quality with strong gluten properties, and high color and cooked firmness scores.

ALKABO fell to third place in North Dakota with 11 percent of the acres, down from 21 percent in 2015. It is the sixth most popu-

lar variety in Montana with a 4.4 percent share of acres in 2016. Alkabo is the leading variety in the southwest district of North Dakota. It is a 2005 NDSU release with improved yield potential and relatively stronger straw properties when compared to other popular varieties. Alkabo possesses good end-use quality traits, especially for pasta color.

JOPPA is the fourth most popular variety in North Dakota in 2016 with 10 percent of the acres, up from just 1 percent last year. It also made marginal gains in Montana. Joppa was released from NDSU in 2013 and ranks near the top for yield potential of current varieties, although protein content is slightly lower. It possesses high end-use quality traits with especially high pasta color scores.

NORTH DAKOTA VARIETIES SHARE OF PLANTED ACRES³

Variety	2016% ¹	2015% ¹
Divide	21.5	29.5
Carpio	17.0	2.2
Alkabo	11.2	20.9
Joppa	10.3	0.9
Tioga	8.0	10.1
Lebsock	7.8	4.9
Mountrail	5.5	7.6
Grenora	3.8	4.3
VT Peak	1.9	0.6
Pierce	1.4	0.7
Other ²	11.6	18.3

1. Percentage may not add to 100 due to rounding.
2. Includes varieties with less than 1% of acreage in 2016 and unknown varieties.
3. 1,000 acres (1 acre = 0.405 hectares)
2016 - 1,460,000 acres
2015 - 1,090,000 acres





NORTH DAKOTA VARIETIES SHARE OF 2016 PLANTED ACRES BY CROP DISTRICT

Variety	North West	West Central	South West	Combined Districts ¹	Total State
percentage (%) ²					
Divide	21.5	32.0	11.3	23.9	21.5
Carpio	18.9	8.8	12.1	18.7	17.0
Alkabo	10.5	7.3	20.5	8.6	11.2
Joppa	10.0	4.1	10.1	16.3	10.3
Tioga	7.2	16.6	10.7	3.1	8.0
Lebsock	8.9	11.7	5.5	1.3	7.8
Mountrail	8.5	0	0	0	5.5
Grenora	4.7	1.7	1.0	3.3	3.8
VT Peak	0	0	9.2	6.2	1.9
Pierce	1.6	1.4	1.1	0.3	1.4
Other ³	8.2	16.6	18.6	18.6	11.6
1,000 acres (1 acre = 0.4 hectares)					
Total Acres ³	850	125	165	160	1,300 ⁴

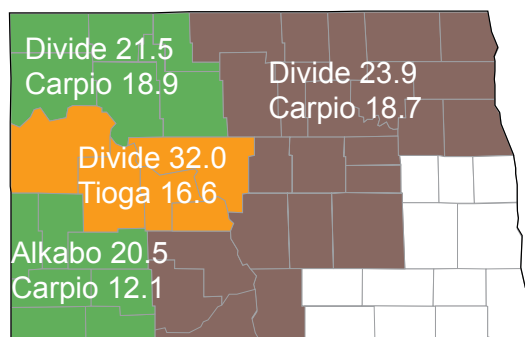
1. Data from North Central, Northeast, Central, East Central, South Central and Southeast districts are combined to avoid disclosure of individual operations.

2. Percentages may not add to 100 due to rounding.

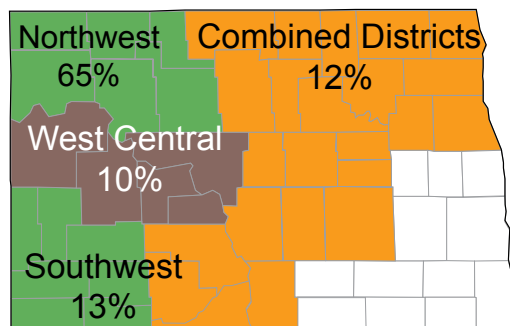
3. Includes varieties with less than 1% acreage in 2016 and unknown varieties.

4. September 30, 2016 small grain estimates was 1,460,000 acres.

NORTH DAKOTA 2016 TOP TWO VARIETIES BY DISTRICT (% OF ACRES)



NORTH DAKOTA 2016 SHARE OF PLANTED ACRES BY NASS DISTRICTS



MONTANA

The top five durum varieties planted across Montana in 2016 are Divide, Mountrail, Alzada, Tioga and Kyle, combining for three-fourths of the total durum acres. Compared to 2015, Divide, Alzada and Tioga made gains, while Mountrail and Kyle declined in share.

MOUNTRAIL is the second most popular variety in Montana in 2016 with 21 percent of the acres, down from 27 percent, and the top spot in 2015. In North Dakota, it ranks seventh with 5.5 percent. Released by NDSU in 1998, it remains one of the elite yielding varieties with positive agronomic traits, but ranks lower than other varieties for disease resistance. Mountrail is rated as average for end-use quality.

ALZADA remained the third most popular variety in Montana with a 15 percent share of acres, holding steady with the previous year. It is the dominant variety in the north central district of the state where nearly all of its production is contract produced for its uniquely strong gluten properties and excellent cooking properties. Alzada is a 2004 release from Westbred (Monsanto).

TIOGA moved into fourth place in Montana in 2016 with 8.6 percent of the acres, up from 5.5 percent last year. In North Dakota, it fell to fifth place with 8 percent of the acres, down from 10 percent. Tioga was released in 2010 and is popular for its balance of yield

potential, strong straw and very balanced end-use quality traits.

KYLE is the fifth most popular variety in Montana in 2016 with a 6 percent share, down from 9 percent in 2015. It tends to tolerate prolonged, wet harvest conditions better than other varieties, but is weaker in straw strength. Kyle is a 1984 release from Agriculture Canada.

MONTANA VARIETIES SHARE OF PLANTED ACRES³

Variety	2016% ¹	2015% ¹
Divide	27.1	21.3
Mountrail	20.7	27.0
Alzada	15.2	14.2
Tioga	8.6	5.5
Kyle	5.9	9.0
Alkabo	4.4	2.2
Joppa	1.8	0.0
Strongfield	1.7	4.6
Other ²	14.6	16.2

1. Percentage may not total 100 due to rounding.
2. Includes varieties with less than 1% of acreage in 2015 and unknown varieties.
3. 1,000 acres (1 acre = 0.405 hectares)
2016 - 780,000 planted acres
2015 - 620,000 planted acres

MONTANA VARIETIES SHARE OF 2016 PLANTED ACRES BY CROP DISTRICT

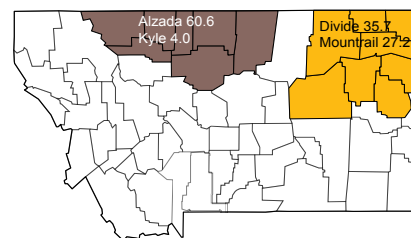
Variety	North Central	North East	Other Districts ¹	Total State
percentage (%) ²				
Divide	0.0	35.7	0.0	27.1
Mountrail	0.0	27.2	0.0	20.7
Alzada	60.6	0.0	2.0	15.2
Tioga	2.2	10.7	0.0	8.6
Kyle	4.0	6.6	0.0	5.9
Alkabo	0.0	5.4	0.0	4.4
Joppa	2.1	1.8	0.0	1.8
Strongfield	0.0	0.0	0.0	1.7
Other ³	31.1	10.6	98.0	14.6

1,000 acres (1 acre = 0.4 hectares)

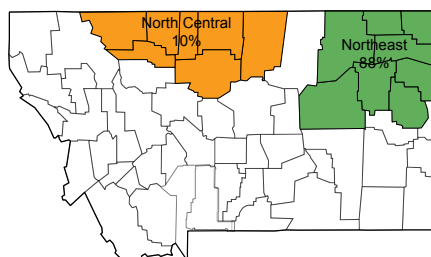
Total Acres³ 680⁴

1. Other district varieties were combined to avoid disclosure of individual information.
2. Percentages may not add to 100 due to rounding.
3. Includes varieties with less than 1% acreage in 2016 and unknown varieties.
4. September 30, 2016 small grain estimates was 780,000 acres.

MONTANA 2016 TOP TWO VARIETIES BY CROP DISTRICT (% OF ACRES)



MONTANA SHARE OF PLANTED ACRES BY NASS DISTRICT



HANDLING & TRANSPORTATION

The durum wheat growing region in the Northern Plains has a vast network of country elevators to facilitate efficient and precise movement to domestic and export markets. On average, nearly 80 percent of the region's wheat moves to markets by rail. Duluth is the only export market easily serviced by trucks. Shipments to the Pacific Northwest and Gulf export markets are almost entirely by rail, with some barge movement to the Gulf. The dominant railroad is the

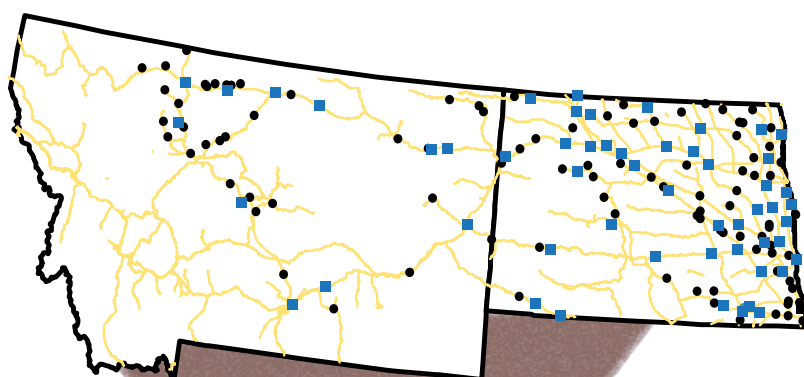
Burlington Northern Santa Fe, followed by the Canadian Pacific.

A growing number of elevators in the region are investing to ship 100-110 car units in "shuttle" trains. Each rail car holds approximately 3,500 bushels (95 metric tons) of wheat. Shuttle-equipped facilities receive the lowest rates, sharing volume and transaction efficiencies with the railroad.

The diverse rail shipping capacities and widespread network of elevators are strengths buyers

can capitalize on, especially as their demand heightens for more precise quality specifications and consistency between shipments. Buyers are encouraged to explore origin-specific shipments to optimize quality and value.

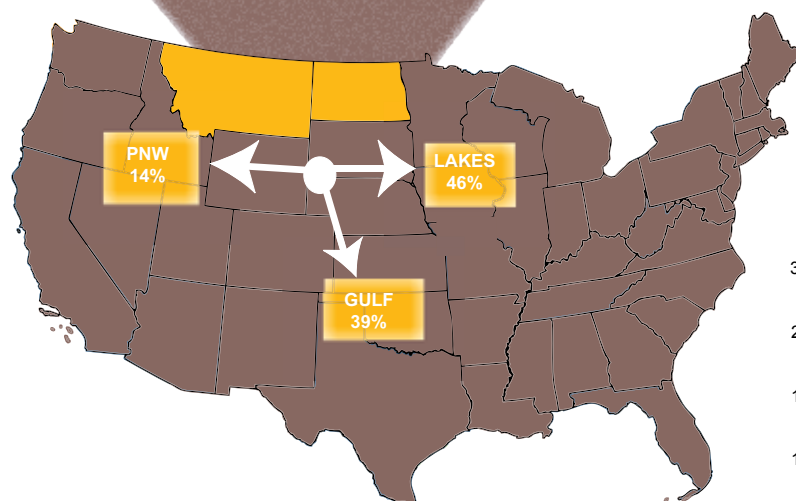
The rail and elevator network in the U.S. northern grown durum region is well suited for meeting the increasing quality demands of both domestic and international customers.



- Track for 50 to 99 rail cars
- Track for 100 or more cars

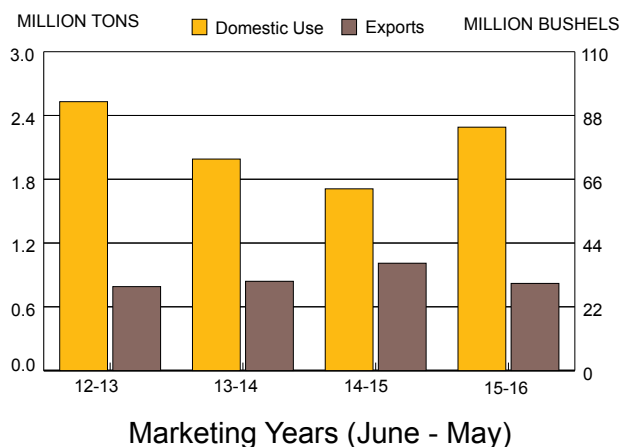
Source: Upper Great Plains Transportation Institute

Grain Handling and Transportation Facilities in the Two-State Region



AVERAGE SHARE OF U.S. DURUM EXPORTS BY PORT (2012-2015)

2012-15 U.S. DURUM DOMESTIC USE AND EXPORTS



U.S. DURUM
WHEAT
REGIONAL QUALITY REPORT

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FUNDING & SUPPORT PROVIDED BY

U.S. Wheat Associates

North Dakota Wheat Commission

Montana Wheat and Barley Committee

North Dakota State University Plant Sciences Department