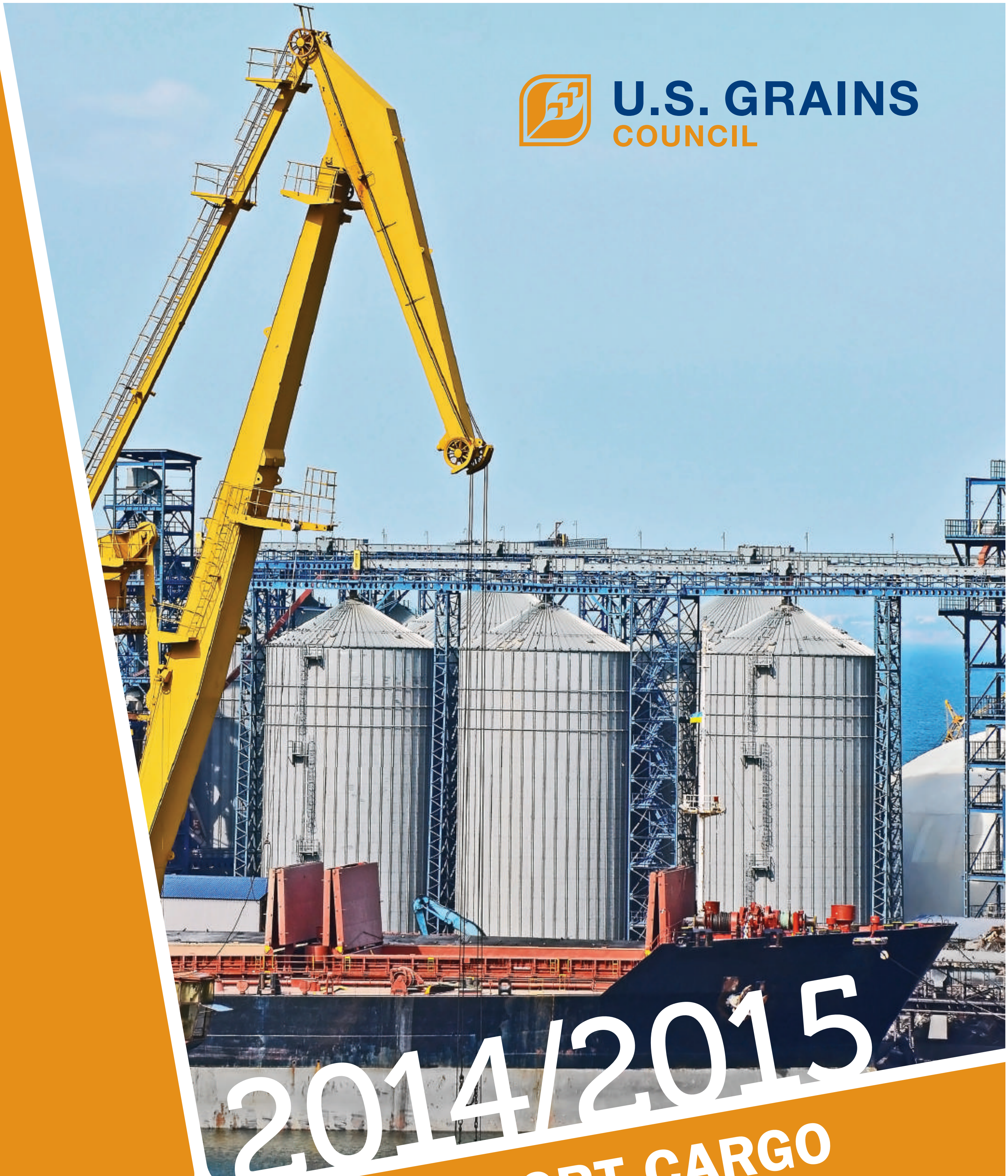
U.S. GRAINS COUNCIL



2014/2015

CORN EXPORT CARGO QUALITY REPORT

ACKNOWLEDGEMENTS

Developing a report of this scope and breadth in a timely manner requires participation by a number of individuals and organizations. The U.S. Grains Council is grateful to Dr. Sharon Bard and Mr. Chris Schroeder of Centrec Consulting Group, LLC for their oversight and coordination in developing this report. They were supported by internal staff along with a team of experts that helped in data gathering, analysis, and report writing. External team members include Drs. Lowell Hill, Marvin Paulsen, and Tom Whitaker. The Illinois Crop Improvement Association's Identity Preserved Grain Laboratory conducted analysis of the collected corn samples.

In particular, we acknowledge the irreplaceable services of the Federal Grain Inspection Service of the U.S. Department of Agriculture. FGIS provided samples from export cargoes along with their grading and aflatoxin test results. The FGIS Office of International Affairs coordinated the sampling process. FGIS field staff, the Washington State Department of Agriculture, and FGIS-designated domestic official service providers collected and submitted the samples that constitute the foundation of this report. We are grateful for the time they devoted during their busy season.

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GREETINGS FROM THE COUNCIL

The U.S. Grains Council is pleased to present its *Corn Export Cargo Quality Report 2014/2015* for use by international customers and other interested parties.

Quality is a vital concern for every stakeholder in the corn value chain: seed companies, growers, traders, handlers, shippers, processors and end-users. The *Corn Export Cargo Quality Report 2014/2015* is an objective survey of the quality of U.S. yellow commodity corn destined for export based on samples taken at the point of loading for international shipment.

This is the second of two reports released by the Council detailing the quality of the 2014/2015 corn crop, following the *Corn Harvest Quality Report 2014/2015* released by the Council late last year. Together, these two reports are intended to provide reliable information on U.S. corn quality from the farm to the customer based on a transparent and consistent methodology.

In addition to providing an early look at grade factors and moisture, which are tracked by the U.S. Federal Grain Inspection Service (FGIS), these reports provide information on additional quality characteristics that has not been reported elsewhere.

The *Corn Harvest Quality Report 2014/2015* and the *Corn Export Cargo Quality Report 2014/2015* are the fourth editions of an ongoing series produced annually. The value of these reports to all stakeholders is increasing over time as the information becomes more familiar and as year-to-year patterns in the U.S. corn marketing system are appearing.

The Council is committed to continuous export expansion based upon the principles of mutual benefit and increased food security through trade. We hope to serve as a trusted partner and a bridge between U.S. producers and international customers – an endeavor to which reliable and timely information is essential.

We trust that our international partners will find the *Corn Harvest Quality Report 2014/2015* and *Corn Export Cargo Quality Report 2014/2015* informative and useful, and we look forward to ongoing engagement based on the information they provide.

Sincerely,

Ron Gray

Ron Gray
Chairman, U.S. Grains Council
April 2015

I. EXPORT CARGO QUALITY HIGHLIGHTS

The average aggregate quality of the corn assembled for export early in the 2014/2015 marketing year was better than or equal to U.S. No. 2 on all grade factors, while moisture content was the same as last year. Chemical attributes indicated higher oil in 2014/2015 but protein and starch were similar to 2013/2014. Physical attributes of stress cracks were lower, kernel size was larger, and true density was higher than 2013/2014 export samples. In addition, the incidences of positive levels of aflatoxin and deoxynivalenol (DON) test results were low, suggesting, on average, low levels of aflatoxins and DON in export shipments. Notable U.S. Aggregate quality attributes of the early 2014/2015 export samples include:

GRADE FACTORS AND MOISTURE

- Average test weight of 57.5 lb/bu (74.0 kg/hl) indicates overall good quality. Although it was lower than 3YA[1], it was higher than 2013/2014. About 85% of all samples were above the limit for U.S. No. 1.
- BCFM (3.0%) was below the maximum limit for U.S. No. 2, but above 2013/2014, 2012/2013, and 3YA. BCFM predictably increased as the crop moved from harvest through the market channel to export, from 0.8% to 3.0%.
- Total damage (2.3%) increased during storage and transport as expected, but was higher than previous years and 3YA.
- Average moisture (14.5%) was the same as last year, but higher than 3YA.

CHEMICAL COMPOSITION

- Average protein content (8.6%) was the same as 2013/2014 (8.6%), and was lower than 2012/2013 (9.2%) and 3YA (8.8%).
- Starch content (73.7%) was the same as 2013/2014 (73.7%) and lower than 3YA (73.8%).
- Oil content (3.9%) was higher than 2013/2014 (3.7%) and 3YA (3.7%).
- Protein, starch and oil percentages all had narrower ranges and lower standard deviations at export than at harvest. This finding was expected, in part, because grains become more homogenous after aggregation from numerous harvest level sources.

PHYSICAL FACTORS

- Average stress cracks (14%) was lower than last year, yet higher than 3YA (12%). More samples had less than 20% stress cracks in 2014/2015 than 2013/2014, which should enable low rates of breakage during handling.
- Kernel volume and 100-kernel weight were higher than 2013/2014 and 3YA, indicating larger kernel sizes in 2014/2015 corn exports than in previous years.
- Average kernel volumes and 100-k weights for 2014/2015, the previous two years, and 3YA, indicate kernels from the Pacific Northwest ECA were smaller than those from the Gulf and Southern Rail ECAs.
- True density (1.295 g/cm^3) was higher than 2013/2014 (1.287 g/cm^3) and very close to 3YA.
- Whole kernels (88.4%) was close to 2013/2014 (88.6%) and 3YA (88.7%).
- Horneous endosperm (82%) was the same as 2013/2014 (82%) but lower than 3YA (84%). The true density and horneous endosperm tests indicate corn hardness will be unchanged or slightly higher than last year.

MYCOTOXINS

- All of the export samples tested below the FDA action level of 20 ppb for aflatoxins. A higher proportion of the export samples tested below 5 ppb aflatoxin than 2012/2013, but a lower proportion tested below 5 ppb aflatoxin than 2013/2014.
- 100% of the corn export samples tested below the FDA advisory levels for DON (5 ppm for hogs and other animals and 10 ppm for chicken and cattle). About 95% of the samples tested below 0.5 ppm DON, which was about the same as 2013/2014 and lower than 2011/2012.

[1] 3YA represents the simple average of the quality factor's average or standard deviation from the Export Cargo Reports 2011/2012, 2012/2013, and 2013/2014.

II. INTRODUCTION

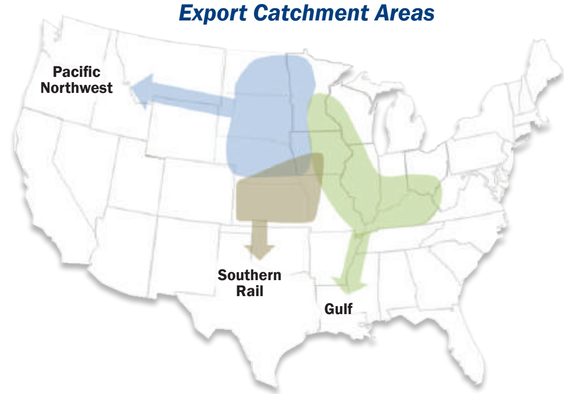
Corn quality information is important to foreign buyers and other industry stakeholders as they make decisions about purchase contracts and processing needs for corn for feed, food or industrial use. The *U.S. Grains Council Corn Export Cargo Quality Report 2014/2015* provides accurate, unbiased information about the quality of U.S. yellow commodity corn as it is assembled for export early in the marketing year. This report provides test results for corn samples collected during the U.S. government-licensed sampling and inspection process for U.S. corn waterborne and rail export shipments.

This *Export Cargo Report* is based on 411 yellow commodity corn samples collected from corn export shipments as they underwent the federal inspection and grading process performed by the U.S. Department of Agriculture's (USDA) Federal Grain Inspection Service or licensed inspectors at interior offices. The sample test results are reported at the U.S. aggregate level (U.S. Aggregate) and by export points associated with three general groupings that are labeled Export Catchment Areas (ECAs). These three ECAs are identified by the three major pathways to export markets:

1. The Gulf ECA consists of areas that typically export corn through U.S. Gulf ports;
2. The Pacific Northwest ECA includes areas exporting corn through Pacific Northwest and California ports; and
3. The Southern Rail ECA comprises areas generally exporting corn to Mexico by rail from inland subterminals.

The sample test results are also summarized by "contract grade" categories ("U.S. No. 2 or better" and "U.S. No. 3 or better") to illustrate the practical quality differences between these two contract specifications.

Export Catchment Areas



This report provides detailed information on each of the quality factors tested, including average, standard deviation and distribution for the aggregate of all samples and for each of the three ECAs. The "Quality Test Results" section summarizes the following quality factors:

- Grade Factors: test weight, broken corn and foreign material (BCFM), total damage and heat damage
- Moisture
- Chemical Composition: protein, starch and oil
- Physical Factors: stress cracks, stress crack index, 100-kernel weight, kernel volume, kernel true density, whole kernels, and horneous (hard) endosperm
- Mycotoxins: aflatoxins and DON

Details about the testing analysis methods used for this report are provided in the "Testing Analysis Methods" section.

New to this *Export Cargo Report 2014/2015* is a simple average of the quality factors' averages and standard deviations of the previous three *Export Cargo Reports* (*2011/2012, 2012/2013* and *2013/2014*). These simple averages are calculated for the U.S. Aggregate and each of the three ECAs, and are referred to as "3YA" in the report.

II. INTRODUCTION (continued)

For the *Export Cargo Report 2014/2015,* FGIS and interior offices collected samples during January through March 2015 to generate statistically valid results for the U.S. Aggregate and by ECA. The objective was to obtain enough samples to estimate quality factor averages of the corn exports with a relative margin of error (Relative ME) less than ± 10%, a reasonable target for biological data such as these factors. Details of the statistical sampling and analysis methods are presented in the "Survey and Statistical Analysis Methods" section.

This *Export Cargo Report 2014/2015* is the fourth in a series of annual surveys of the quality of the U.S. corn exports early in the marketing year. In addition to the Council reporting the quality of corn exports early in the current marketing year, the cumulative *Export Cargo Report* surveys will provide increasing value to stakeholders. The four years of data are enabling export buyers and other stakeholders to begin making year-to-year comparisons and assessing patterns in corn quality based on growing, drying, handling, storage and transport conditions.

The *Export Cargo Report* does not predict the actual quality of any cargo or lot of corn after loading or at destination, and it is important for all players in the value chain to understand their own contract needs and obligations. Many of the quality attributes, in addition to grade, can be specified in the buyer-seller contract. In addition, this report does not explain the reasons for changes in quality factors from the *Harvest Report* to the *Export Cargo Report*. Many factors including weather, genetics, commingling, and grain drying and handling, affect changes in quality in complex ways. Sample test results can vary significantly depending on the ways in which a corn lot was loaded onto a conveyance and the method of sampling used.

A companion report, the *U.S. Grains Council Corn Harvest Quality Report 2014/2015*, was released in December 2014 and reported on the quality of the corn as it entered the U.S. marketing system. The *Harvest Report 2014/2015* and the *Export Cargo Report 2014/2015* should be studied together so changes in corn quality that occur between harvest and export can be understood. A review of how corn quality evolves from the field to the ocean vessel or rail car is provided in the "U.S. Corn Export System" section.

III. QUALITY TEST RESULTS

A. Grade Factors

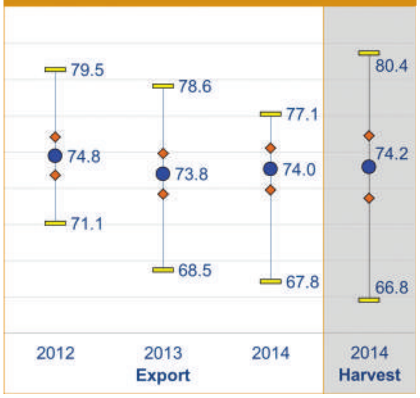
The USDA's Federal Grain Inspection Service (FGIS) has established numerical grades, definitions and standards for grains. The attributes which determine the numerical grades for corn are test weight, broken corn and foreign material (BCFM), total damage and heat damage. The table for "U.S. Corn Grades and Grade Requirements" is provided on page 49 of this report.

SUMMARY: GRADE FACTORS AND MOISTURE

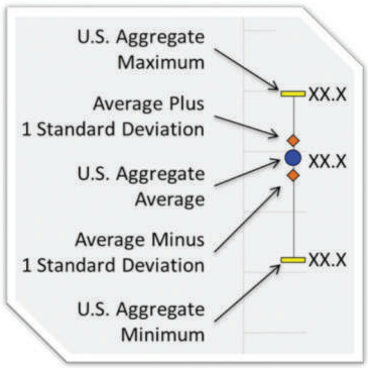
- *Average U.S. Aggregate test weight (57.5 lb/bu) was higher than 2013/2014 (57.3 lb/bu), lower than 3YA (57.7 lb/bu), and above the limit for U.S. No. 1 grade corn (56 lb/bu).*
- *Average U.S. Aggregate BCFM (3.0%) was higher than in previous years. However, approximately 45% of the export samples contained levels at or below the maximum allowed for U.S. No. 2 grade (3%).*
- *Average U.S. Aggregate total damage (2.3%) and heat damage (0.0%) were well below the limits for U.S. No. 1 grade.*
- *Test weight, total damage, and heat damage averages for the corn loaded for U.S. No. 2 o/b or U.S. No. 3 o/b contracts were better than U.S. No. 1 grade.*
- *BCFM averages were below the grade limits of the U.S. No. 2 o/b and U.S. No. 3 o/b contracts.*
- *Average U.S. Aggregate moisture content (14.5%) was the same as 2013/2014 but higher than 3YA (14.3%).*
- *Fewer 2014/2015 export samples had moistures above 14.5% than 2013/2014, indicating a higher proportion of export samples with satisfactory levels for safe transport to international markets than last year.*

III. QUALITY TEST RESULTS (continued)

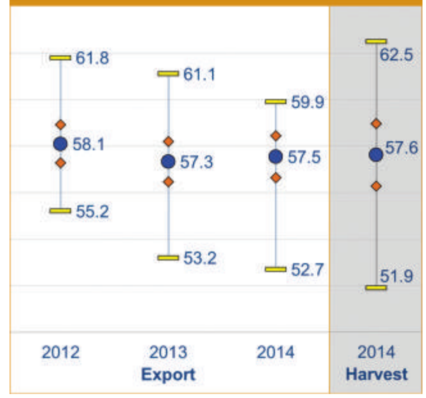
Test Weight (kg/hl)



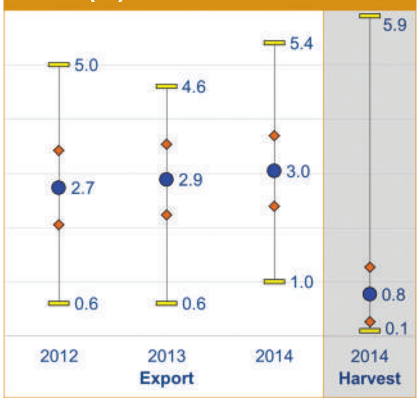
How to Read the Charts



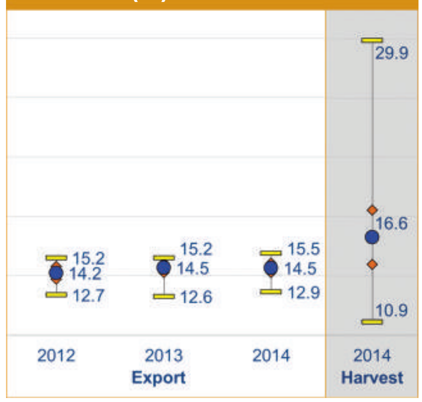
Test Weight (lb/bu)



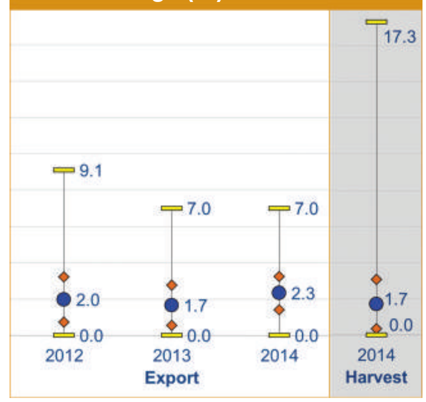
BCFM (%)



Moisture (%)



Total Damage (%)



1. Test Weight

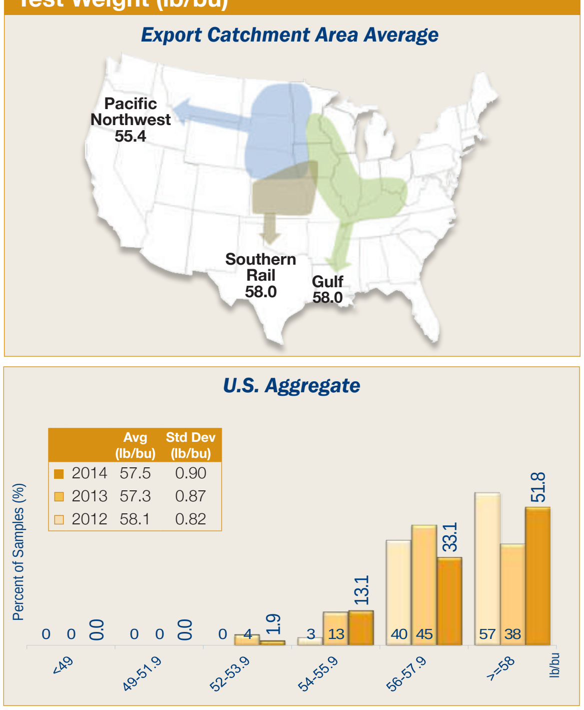
Test weight (weight per volume) is a measure of bulk density and is often used as a general indicator of overall quality and as a gauge of endosperm hardness to alkaline cookers and dry millers. It reflects kernel hardness and kernel maturity. Test weight is initially impacted by genetic differences in the structure of the kernel. However, it is also affected by moisture content, method of drying, physical damage to the kernel (broken kernels and scuffed surfaces), foreign material in the sample, kernel size, stress during the growing season, and microbiological damage. High test weight at the export point generally indicates high quality, high percent of horneous (or hard) endosperm, and sound, clean corn.

U.S. Grade Minimum Test Weight
No. 1: 56.0 lbs
No. 2: 54.0 lbs
No. 3: 52.0 lbs

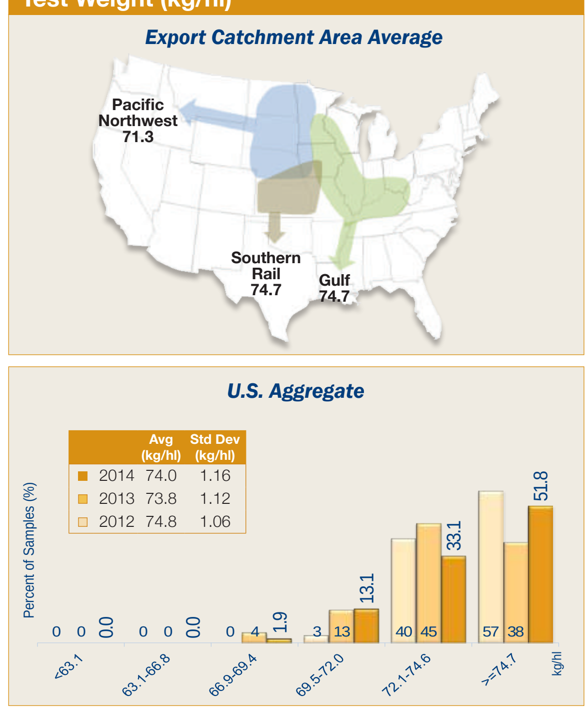
RESULTS

- Average U.S. Aggregate test weight (57.5 lb/bu or 74.0 kg/hl) was higher than 2013/2014 (57.3 lb/bu), but lower than 2012/2013 (58.1 lb/bu) and 3YA (57.7 lb/bu). However, the average U.S. aggregate test weight was above the limit for U.S. No. 1 grade (56.0 lb/bu).
- Variation in the 2014/2015 export samples was more than in previous years, as indicated by the higher standard deviation (0.90%) compared to 2013/2014 (0.87%) and 3YA (0.75%). The range in values was also greater than 2012/2013 but less than 2013/2014.
- Nearly 85% of all samples' test weights were at or above the minimum for U.S. No. 1 grade (56 lb/bu) and 98.0% were above the limit for U.S. No. 2 grade (54 lb/bu).
- Test weight at export was nearly the same as at harvest (57.6 lb/bu or 74.2 kg/hl). Changes in test weight between harvest and export usually have been very small.
- The 2014/2015 export samples' variability (0.90%) was less than the 2014 harvest samples (1.34%). As corn is commingled moving through the market channel, test weight may change somewhat, but it becomes more uniform with lower standard deviation and smaller range between maximum and minimum values than at harvest.
- Test weight was higher in samples from the Gulf (58.0 lb/bu) and Southern Rail (58.0 lb/bu) ECAs, with lower variability, compared to samples from the Pacific Northwest ECA (55.4 lb/bu).
- Average test weight of corn for contracts loaded as U.S. No. 2 o/b (57.5 lb/bu) was slightly higher than for contracts loaded as U.S. No. 3 o/b (57.4 lb/bu). Averages for both of these contracts were above the limit for U.S. No. 1.

Test Weight (lb/bu)



Test Weight (kg/hl)



2. Broken Corn and Foreign Material (BCFM)

Broken corn and foreign material (BCFM) is an indicator of the amount of clean, sound corn available for feeding and processing. As corn moves from farm deliveries through the market channel, each impact on the grain during handling and transporting increases the amount of broken corn. As a result, the average BCFM in most shipments of corn will be higher at the export point than in deliveries to the local elevator.

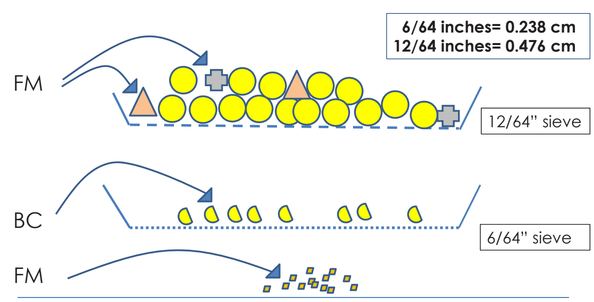
U.S. Grade BCFM Maximum Limits
No. 1: 2.0%
No. 2: 3.0%
No. 3: 4.0%

Broken corn (BC) is defined as corn and any other material (such as weed seeds) small enough to pass through a 12/64th inch round-hole sieve, but too large to pass through a 6/64th inch round-hole sieve.

Foreign material (FM) is defined as any non-corn pieces too large to pass through a 12/64th inch round-hole sieve, as well as all fine material small enough to pass through a 6/64th inch round-hole sieve.

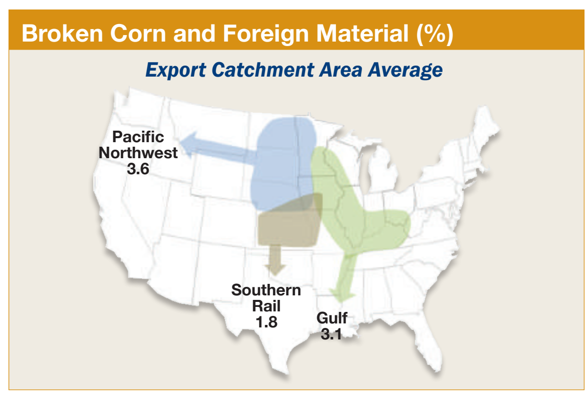
The diagram to the right illustrates the measurement of broken corn and foreign material for the U.S. corn grades.

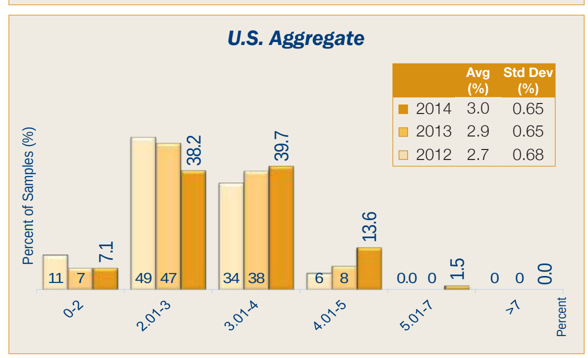
BCFM (Measured as Percent by Weight)



RESULTS

- Average U.S. Aggregate BCFM in export samples (3.0%) was at the maximum for U.S. No. 2 grade. It was higher than 2013/2014 (2.9%), 2012/2013 (2.7%), and 3YA (2.9%).
- The variability of the 2014/2015 export samples (with a standard deviation of 0.65%) was approximately the same as 2013/2014 (0.65%) but lower than 2012/2013 (0.68%) and 3YA (0.66%).
- BCFM in export samples was distributed with 45.3% of the samples at or below the limit for U.S. No. 2 grade (3%) and 85.0% at or below the limit for U.S. No. 3 grade (4%).
- Average BCFM at export (3.0%) was higher than at harvest (0.8%), as expected. This increase is consistent with previous years and is likely a result of increased breakage and stress cracks created by drying and handling impacts.
- BCFM at export was lower in the Southern Rail ECA (1.8%) than in either the Gulf (3.1%) or Pacific Northwest (3.6%) ECAs.





- Average BCFM for contracts loaded as U.S. No. 2 o/b was 2.7% compared to the average BCFM of 3.6% for contracts loaded as U.S. No. 3 o/b. Corn arriving at the export point is normally commingled from many origins to meet the limits for the contracted grade. Cleaning and loading procedures at the export point are designed to bring each factor close to but within the limits of each factor limit for grades U.S. No. 2 and U.S. No. 3. Thus, BCFM would be expected to be lower for No. 2 o/b than No. 3 o/b corn contracts, because the contracts specify 3.0% and 4.0% for U.S. No. 2 and U.S. No. 3, respectively.

3. Total Damage

Total damage is the percentage of kernels and pieces of kernels that are visually damaged in some way, including damage from heat, frost, insects, sprouting, disease, weather, ground, germ and mold. Most of these types of damage result in some sort of discoloration or change in kernel texture. Damage does not include broken pieces of grain that are otherwise normal in appearance. Mold damage and the associated potential for mycotoxins is the damage factor of greatest concern. Mold damage is usually associated with higher moisture content and high temperature during growing and/or storage conditions.

U.S. Grade Total Damage Maximum Limits
No. 1: 3.0%
No. 2: 5.0%
No. 3: 7.0%

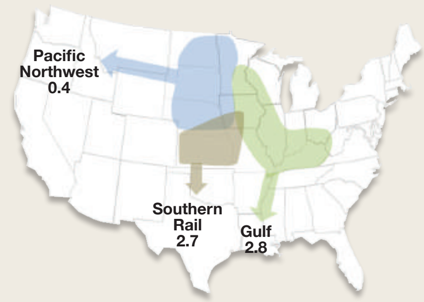
Corn with low levels of total damage is more likely to arrive at destination in good condition than corn with high levels of total damage. High levels of total damage have the potential of increasing moisture and microbiological activity during transport.

RESULTS

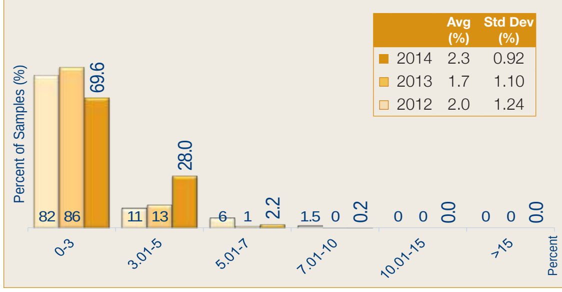
- Average U.S. Aggregate total damage (2.3%) was higher than 2013/2014 (1.7%), 2012/2013 (2.0%), and 3YA (1.8%), but still below the 3.0% limit for U.S. No. 1 grade.
- Variability in the 2014/2015 export samples was lower than 2013/2014 and 2012/2013 as indicated by the lower standard deviation (0.92% compared to 1.10% and 1.24%, respectively) and the similar or tighter range (7.0% compared to 7.0% and 9.1%, respectively).
- Of the export samples, 69.6% had 3.0% or less damaged kernels, meeting the requirement for U.S. No. 1 grade. Nearly 98% of the samples were below the limit for U.S. No. 2 grade (5.0%).
- The average level of total damage increased in the market channel, from 1.7% at local elevators to 2.3% at export. This increase leaves the corn well within the grade limits despite the original moisture content and the time in storage and transport. This indicates good management practices in the market channel.

Total Damage (%)

Export Catchment Area Average



U.S. Aggregate



	Avg (%)	Std Dev (%)
2014	2.3	0.92
2013	1.7	1.10
2012	2.0	1.24

- The Pacific Northwest had lower total damage (0.4%) compared with the Gulf (2.8%) and the Southern Rail (2.7%) ECAs.
- The Southern Rail ECA had a greater increase in total damage (1.3% to 2.7%) between harvest and export than the other ECAs. The Pacific Northwest ECA had the smallest change in total damage (0.0%), which has been the pattern in previous years. Lower moisture and cooler temperatures at harvest may be a partial explanation for the consistent pattern of the smaller increase in total damage in this ECA.
- Total damage for contracts being loaded as U.S. No. 2 o/b and U.S. No. 3 o/b were both 2.3%.

III. QUALITY TEST RESULTS (continued)

4. Heat Damage

Heat damage is a subset of total damage in corn grades and has separate allowances in the U.S. Grade standards. Heat damage can be caused by microbiological activity in warm, moist grain or by high heat applied during drying. Low levels of heat damage may indicate the corn has been stored at appropriate moisture and temperatures prior to delivery to the export point.

U.S. Grade Heat Damage Maximum Limits
No. 1: 0.1%
No. 2: 0.2%
No. 3: 0.5%

RESULTS

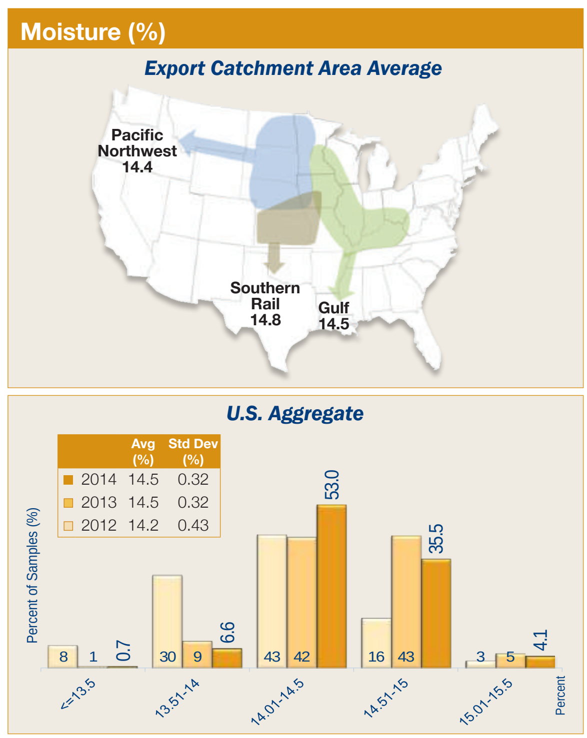
- Only two samples in the entire sample set showed any heat damage in export samples in 2014/2015. This number has also been well below the limit for U.S. No. 1 grade in previous years, indicating good management of drying and storage of the corn through the market channel.

B. Moisture

Moisture content is reported on all official grade certificates, but does not determine which numerical grade will be assigned to the sample. Moisture content is usually specified in the contract by the buyer, independent of the grade. Moisture content is important because it affects the amount of dry matter being sold and purchased. In addition, the average moisture level and variability in a shipment of corn affect its quality arriving at destination. Corn is typically transported in railcars or in closed, nearly airtight holds during the ocean voyage, and few bulk carriers or railcars have the ability to aerate the grain mass during transit. This lack of aeration can create an ideal environment for pockets of high moisture to initiate microbiological activity. In addition, temperature variations in the grain mass can cause moisture migration, resulting in warm, moist air condensing on colder surfaces of grain, near sidewalls or on the underside of hatch covers, which can lead to development of spoilage or hot spots. Hot spots are small pockets of corn where the moisture content and temperature become abnormally higher than the average for the cargo. Thus, uniformity of moisture content among sublots and average moisture values below 14.5% are important for minimizing the risk of hot spots developing during transit.

RESULTS

- Average U.S. Aggregate moisture content averaged 14.5%, the same as 2013/2014 but higher than 2012/2013 (14.2%) and 3YA (14.3%).
- Moisture content variability was similar among samples for 2014/2015 (standard deviation of 0.32%) and 2013/2014 (0.32%), but lower than 2012/2013 (0.43%) and 3YA (0.35%).
- Of the 2014/2015 export samples, 39.6% had moisture contents above 14.5%, compared to 48% in 2013/2014 and 19% in 2012/2013. The majority of the export samples (60.3%) had moisture contents of 14.5% or below.
- Average moisture content decreased between harvest and export (from 16.6% to 14.5%) and uniformity among samples increased, as indicated by the lower standard deviations at export (0.32%) compared to harvest (1.84%) as a result of drying, conditioning, and commingling in the market channel following harvest.



- Average moisture in the 2014/2015 export samples from the Southern Rail ECA (14.8%) was higher than from the Gulf (14.5%) and the Pacific Northwest (14.4%) ECAs.
- Moisture content is not a grade-determining factor. However, it was slightly lower for contracts loaded as U.S. No. 2 o/b (14.4%) than for contracts loaded as U.S. No. 3 o/b (14.6%). Moisture standard deviation was also lower for U.S. No. 2 o/b (0.27%) than for U.S. No. 3 o/b (0.32%) contracts, indicating slightly more uniformity and less potential for pockets of higher moisture in the contracts loaded as U.S. No. 2 o/b than for contracts loaded as U.S. No. 3 o/b.

III. QUALITY TEST RESULTS (continued)

SUMMARY: GRADE FACTORS AND MOISTURE

	2014/2015 Export Cargo					2013/2014 Export Cargo			2012/2013 Export Cargo			3 Year Avg. (2011-2013)	
	No. of Samples	Avg.	Std. Dev.	Min.	Max.	No. of Samples	Avg.	Std. Dev.	No. of Samples	Avg.	Std. Dev.	Avg.	Std. Dev.
U.S. Aggregate													
Test Weight (lb/bu)	411	57.5	0.90	52.7	59.9	412	57.3*	0.87	397	58.1*	0.82	57.7	0.75
Test Weight (kg/hl)	411	74.0	1.16	67.8	77.1	412	73.8*	1.12	397	74.8*	1.06	74.3	0.97
BCFM (%)	411	3.0	0.65	1.0	5.4	412	2.9*	0.65	397	2.7*	0.68	2.9	0.66
Total Damage (%)	411	2.3	0.92	0.0	7.0	412	1.7*	1.10	397	2.0*	1.24	1.8	1.08
Heat Damage (%)	411	0.0	0.01	0.0	0.2	412	0.0	0.01	397	0.0	0.02	0.0	0.02
Moisture (%)	411	14.5	0.32	12.9	15.5	412	14.5	0.32	397	14.2*	0.43	14.3	0.35
Gulf													
Test Weight (lb/bu)	292	58.0	0.81	54.7	59.9	295	57.9*	0.72	284	58.4*	0.72	58.1	0.65
Test Weight (kg/hl)	292	74.7	1.04	70.4	77.1	295	74.5*	0.93	284	75.2*	0.93	74.8	0.84
BCFM (%)	292	3.1	0.68	1.0	5.4	295	2.9*	0.71	284	2.8*	0.71	2.9	0.71
Total Damage (%)	292	2.8	1.04	0.8	7.0	295	1.9*	1.08	284	2.4*	1.63	2.1	1.26
Heat Damage (%)	292	0.0	0.01	0.0	0.2	295	0.0	0.01	284	0.0	0.03	0.0	0.02
Moisture (%)	292	14.5	0.33	12.9	15.4	295	14.5	0.34	284	14.2*	0.46	14.4	0.35
Pacific Northwest													
Test Weight (lb/bu)	84	55.4	1.28	52.7	58.3	82	55.0	1.37	106	57.0*	0.84	56.2	1.01
Test Weight (kg/hl)	84	71.3	1.65	67.8	75.0	82	70.8	1.77	106	73.4*	1.08	72.4	1.30
BCFM (%)	84	3.6	0.65	1.2	5.0	82	2.9*	0.58	106	2.9*	0.74	2.9	0.63
Total Damage (%)[1]	84	0.4	0.34	0.0	1.8	82	0.9*	1.56	106	0.6*	0.40	0.7	0.83
Heat Damage (%)	84	0.0	0.00	0.0	0.0	82	0.0	0.00	106	0.0	0.02	0.0	0.01
Moisture (%)	84	14.4	0.22	13.7	15.0	82	14.4	0.25	106	14.1*	0.42	14.2	0.33
Southern Rail													
Test Weight (lb/bu)	35	58.0	0.79	55.8	59.6	35	57.8	0.89	7	58.2	1.33	58.2	0.91
Test Weight (kg/hl)	35	74.7	1.02	71.8	76.7	35	74.4	1.14	7	74.9	1.71	74.9	1.17
BCFM (%)	35	1.8	0.47	1.0	2.8	35	2.7*	0.41	7	2.1	0.46	2.5	0.39
Total Damage (%)[1]	35	2.7	1.15	0.6	4.8	35	1.6*	0.52	7	2.0*	0.57	1.5	0.53
Heat Damage (%)	35	0.0	0.00	0.0	0.0	35	0.0	0.02	7	0.0	0.00	0.0	0.02
Moisture (%)	35	14.8	0.40	13.9	15.5	35	14.9	0.31	7	14.2*	0.33	14.4	0.36

** Indicates that the 2013/2014 Export Cargo averages were significantly different from the 2014/2015 Export Cargo averages, and the 2012/2013 Export Cargo averages were significantly different from the 2014/2015 Export Cargo averages, based on a 2-tailed t-test at the 95% level of significance.*

[1] The Relative margin of Error (ME) for predicting the 2014/2015 Export Cargo population average exceeded ±10%.

SUMMARY: GRADE FACTORS AND MOISTURE

	Export Cargo Samples for Contract Loaded as U.S. No. 2 o/b					Export Cargo Samples for Contract Loaded as U.S. No. 3 o/b					2014 Harvest				
	No. of Samples	Avg.	Std. Dev.	Min.	Max.	No. of Samples	Avg.	Std. Dev.	Min.	Max.	No. of Samples[1]	Avg.	Std. Dev.	Min.	Max.
U.S. Aggregate															
Test Weight (lb/bu)	236	57.5	0.79	53.7	59.9	173	57.4	1.03	52.7	59.3	629	57.6	1.34	51.9	62.5
Test Weight (kg/hl)	236	74.0	1.01	69.1	77.1	173	73.8	1.33	67.8	76.3	629	74.2	1.72	66.8	80.4
BCFM (%)	236	2.7	0.40	1.0	4.4	173	3.6	0.76	1.0	5.4	629	0.8*	0.50	0.1	5.9
Total Damage (%)	236	2.3	0.91	0.1	7.0	173	2.3	0.89	0.0	5.6	629	1.7*	1.36	0.0	17.3
Heat Damage (%)	236	0.0	0.01	0.0	0.1	173	0.0	0.02	0.0	0.2	629	0.0	0.00	0.0	0.0
Moisture (%)	236	14.4	0.27	13.3	15.5	173	14.6	0.32	12.9	15.3	629	16.6*	1.84	10.9	29.9
Gulf															
Test Weight (lb/bu)	191	58.1	0.72	54.7	59.9	99	57.9	0.96	54.7	59.3	583	57.8*	1.34	51.9	62.5
Test Weight (kg/hl)	191	74.8	0.92	70.4	77.1	99	74.5	1.23	70.4	76.3	583	74.5*	1.73	66.8	80.4
BCFM (%)	191	2.8	0.39	1.2	4.4	99	3.6	0.81	1.0	5.4	583	0.8*	0.48	0.1	5.9
Total Damage (%)	191	2.8	1.03	0.8	7.0	99	2.8	1.05	1.1	5.6	583	2.2*	1.72	0.0	17.3
Heat Damage (%)	191	0.0	0.01	0.0	0.1	99	0.0	0.02	0.0	0.2	583	0.0	0.00	0.0	0.0
Moisture (%)	191	14.4	0.29	13.3	15.4	99	14.7	0.34	12.9	15.3	583	16.9*	1.93	10.9	29.9
Pacific Northwest															
Test Weight (lb/bu)	10	54.9	1.03	53.7	56.5	74	55.5	1.30	52.7	58.3	262	56.6*	1.36	51.9	62.5
Test Weight (kg/hl)	10	70.6	1.32	69.1	72.7	74	71.4	1.67	67.8	75.0	262	72.9*	1.75	66.8	80.4
BCFM (%)	10	2.8	0.41	2.2	3.4	74	3.7	0.59	1.2	5.0	262	0.9*	0.62	0.1	5.9
Total Damage (%)	10	0.5	0.33	0.1	1.2	74	0.4	0.34	0.0	1.8	262	0.4	0.39	0.0	7.4
Heat Damage (%)	10	0.0	0.00	0.0	0.0	74	0.0	0.00	0.0	0.0	262	0.0	0.00	0.0	0.0
Moisture (%)	10	14.3	0.13	14.1	14.5	74	14.4	0.23	13.7	15.0	262	16.1*	1.75	10.9	25.0
Southern Rail															
Test Weight (lb/bu)	35	58.0	0.79	55.8	59.6	0	0.0	0.00	0.0	0.0	371	58.0	1.30	52.0	62.5
Test Weight (kg/hl)	35	74.7	1.02	71.8	76.7	0	0.0	0.00	0.0	0.0	371	74.7	1.67	66.9	80.4
BCFM (%)	35	1.8	0.47	1.0	2.8	0	0.0	0.00	0.0	0.0	371	0.7*	0.45	0.1	5.9
Total Damage (%)	35	2.7	1.15	0.6	4.8	0	0.0	0.00	0.0	0.0	371	1.3*	1.00	0.0	14.6
Heat Damage (%)	35	0.0	0.00	0.0	0.0	0	0.0	0.00	0.0	0.0	371	0.0	0.00	0.0	0.0
Moisture (%)	35	14.8	0.40	13.9	15.5	0	0.0	0.00	0.0	0.0	371	16.0*	1.54	10.9	25.0

** Indicates that the 2014 Harvest averages were significantly different from the 2014/2015 Export Cargo averages, based on a 2-tailed t-test at the 95% level of significance.*

[1] Due to the Harvest ECA results being composite statistics, the sum of the sample numbers from the three ECAs is greater than the U.S. Aggregate.

III. QUALITY TEST RESULTS (continued)

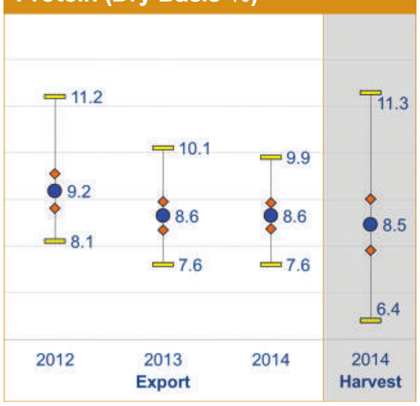
C. Chemical Composition

The chemical composition of corn consists primarily of protein, starch, and oil. These attributes are not grade factors but are of significant interest to end users. They provide information related to nutritional value for livestock and poultry feeding, for wet milling uses, and other processing uses of corn. Unlike many physical attributes, chemical composition values are not expected to change significantly during storage or transit.

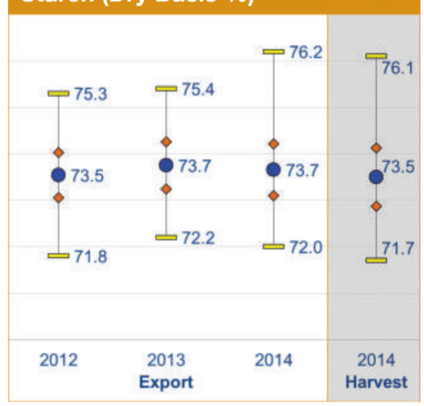
SUMMARY: CHEMICAL COMPOSITION

- *Average protein concentration for the 2014/2015 U.S. Aggregate export samples (8.6%) was the same as 2013/2014, lower than 3YA (8.8%), but higher than 2014 harvest samples (8.5%).*
- *U.S. Aggregate starch concentration was 73.7%, same as 2013/2014 (73.7%), below 3YA (73.8%) and higher than 2014 harvest samples (73.5%).*
- *U.S. Aggregate oil concentration was 3.9%, higher than 2013/2014 and 3YA (both 3.7%), and 2014 harvest samples (3.8%).*
- *Between ECAs, average oil concentrations for 2014/2015 export and 2014 harvest samples were lower for the Pacific Northwest ECA than the other two ECAs.*
- *Protein, starch, and oil all had narrower ranges and lower standard deviations at export than at harvest. This finding is, in part, due to grains becoming more homogenous after aggregation from numerous harvest level sources.*

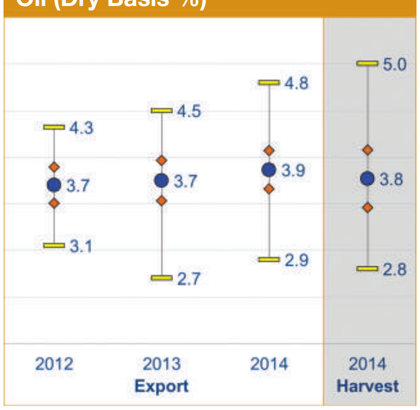
Protein (Dry Basis %)



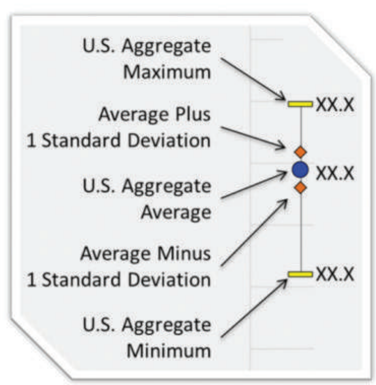
Starch (Dry Basis %)



Oil (Dry Basis %)



How to Read the Charts



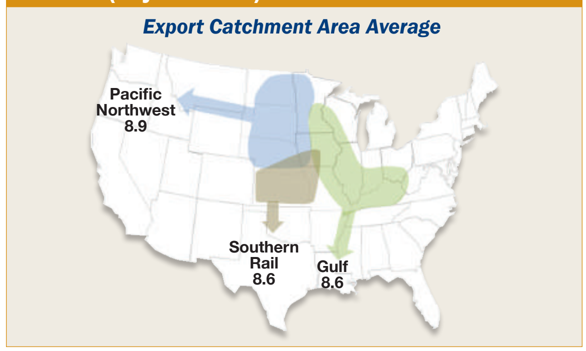
1. Protein

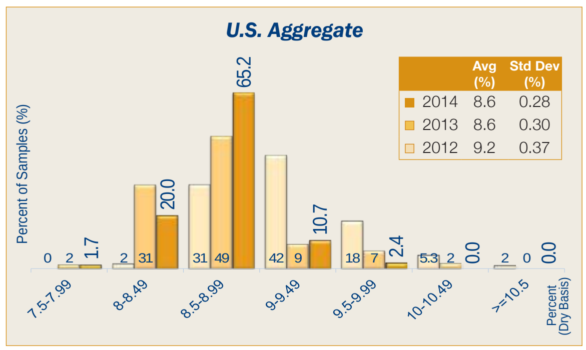
Protein is very important for poultry and livestock feeding. It supplies essential sulfur-containing amino acids and helps to improve feed conversion efficiency. Protein is usually inversely related to starch concentration. Results are reported on a dry basis.

RESULTS

- Average U.S. Aggregate protein concentration (8.6%) was the same as 2013/2014 (8.6%), lower than 2012/2013 (9.2%), and lower than 3YA (8.8%).
- Average protein concentration at export was higher than at harvest (8.5%), and the export samples (standard deviation of 0.28%) were more uniform than the harvest samples (standard deviation of 0.55%).
- Protein concentrations were distributed with 13.1% at or above 9%, compared to 18% of the 2013/2014 export samples at or above 9%.
- The Pacific Northwest ECA had higher average protein concentration (8.9%) than the Gulf (8.6%) and Southern Rail (8.6%) ECAs. Average protein concentrations have consistently been higher for the Pacific Northwest than the other two ECAs for each of the last two years and 3YA.
- Protein concentration averages were higher for contracts loaded as U.S. No. 2 o/b (8.7%) than for contracts loaded as U.S. No. 3 o/b (8.6%). However, all three ECAs had contracts loaded as U.S. No. 2 o/b, whereas only the Gulf and Pacific Northwest ECAs had contracts loaded as U.S. No. 3 o/b.

Protein (Dry Basis %)





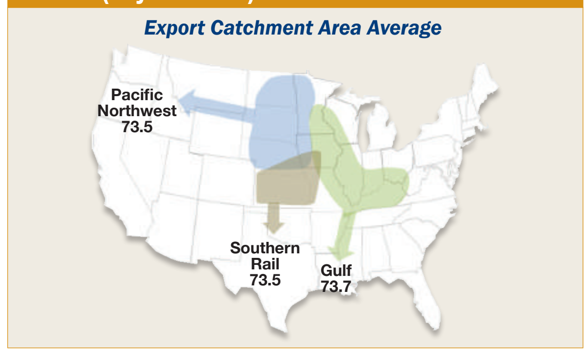
III. QUALITY TEST RESULTS (continued)

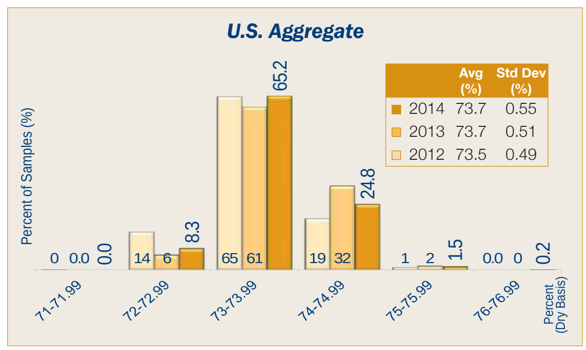
2. Starch

Starch is an important factor for corn used by wet millers and dry-grind ethanol manufacturers. High starch concentration is often indicative of good kernel maturation/filling conditions and reasonably high kernel densities. Starch is usually inversely related to protein concentration. Results are reported on a dry basis.

RESULTS

Starch (Dry Basis %)





- Average U.S. Aggregate starch concentration was 73.7%, same as 2013/2014 (73.7%) and lower than 3YA (73.8%).
- Average starch concentration at export (73.7%) was higher than at harvest (73.5%).
- Due to commingling, the 2014/2015 export samples (standard deviation of 0.55%) were more uniform than the 2014 harvest samples (standard deviation of 0.63%).
- Starch concentrations were distributed with 26.5% at or above 74.0% compared with 2013/2014 (34%) and 2012/2013 (20%).
- The Gulf ECA (73.7%) was higher in starch than the Pacific Northwest (73.5%) and Southern Rail (73.5%) ECAs.
- Average starch concentration for the contracts loaded as U.S. No. 2 o/b (73.6%) was lower than for contracts loaded as U.S. No. 3 o/b (73.8%). It should be noted that contracts loaded as U.S. No. 2 o/b had higher protein than contracts loaded as U.S. No. 3 o/b, which again shows an inverse relationship between starch and protein.

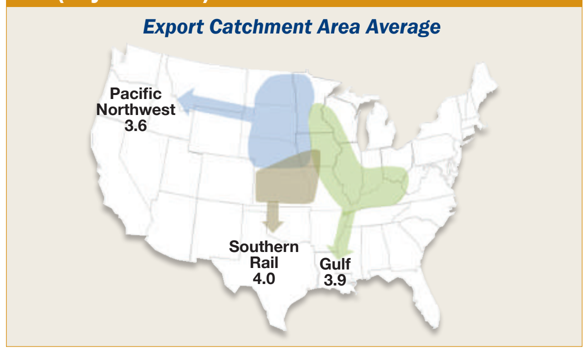
3. Oil

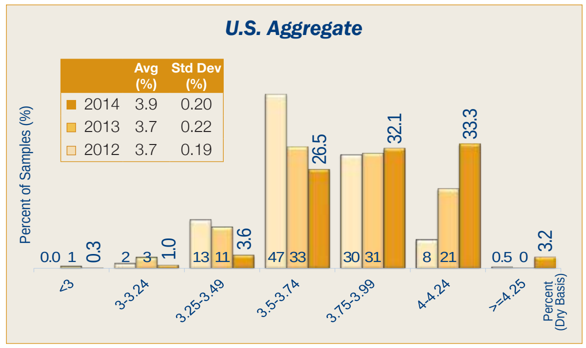
Oil is an essential component of poultry and livestock rations. It serves as an energy source, enables fat-soluble vitamins to be utilized, and provides certain essential fatty acids. Oil is also an important co-product of corn wet and dry milling. Results are reported on a dry basis.

RESULTS

- U.S. Aggregate oil concentration was 3.9%, higher than 2013/2014 (3.7%) and higher than 3YA (3.7%).
- The average oil concentration at export was higher than the 2014 harvest samples (3.8%), while the oil concentration standard deviation at export (0.20%) was lower than found at harvest (0.31%).
- Average oil concentration for the Gulf, Pacific Northwest, and Southern Rail ECA export samples were 3.9%, 3.6%, and 4.0%, respectively. The Pacific Northwest ECA had the lowest average oil concentration of the three ECAs for the 2014/2015 and 2013/2014 export samples and the 2014 harvest samples.
- Approximately 69% of the samples contained at least 3.75% oil, in contrast to 52% in 2013/2014 and 38.5% in 2012/2013.
- Average U.S. Aggregate and Gulf ECA oil concentrations for contracts loaded as U.S. No. 2 o/b (3.9%) were higher than for the contracts loaded as U.S. No. 3 o/b (3.8%).

Oil (Dry Basis %)





III. QUALITY TEST RESULTS (continued)

SUMMARY: CHEMICAL COMPOSITION

	2014/2015 Export Cargo					2013/2014 Export Cargo			2012/2013 Export Cargo			3 Year Avg. (2011-2013)	
	No. of Samples	Avg.	Std. Dev.	Min.	Max.	No. of Samples	Avg.	Std. Dev.	No. of Samples	Avg.	Std. Dev.	Avg.	Std. Dev.
U.S. Aggregate													
Protein (Dry Basis %)	411	8.6	0.28	7.6	9.9	412	8.6	0.30	397	9.2*	0.37	8.8	0.31
Starch (Dry Basis %)	411	73.7	0.55	72.0	76.2	412	73.7*	0.51	397	73.5*	0.49	73.8	0.52
Oil (Dry Basis %)	411	3.9	0.20	2.9	4.8	412	3.7*	0.22	397	3.7*	0.19	3.7	0.21
Gulf													
Protein (Dry Basis %)	292	8.6	0.22	7.6	9.2	295	8.5*	0.23	284	9.0*	0.32	8.7	0.25
Starch (Dry Basis %)	292	73.7	0.56	72.4	76.2	295	73.8*	0.52	284	73.6*	0.51	73.9	0.53
Oil (Dry Basis %)	292	3.9	0.20	3.4	4.8	295	3.8*	0.21	284	3.7*	0.21	3.7	0.22
Pacific Northwest													
Protein (Dry Basis %)	84	8.9	0.46	7.8	9.9	82	9.3*	0.46	106	9.7*	0.50	9.1	0.46
Starch (Dry Basis %)	84	73.5	0.55	72.0	74.9	82	73.4	0.44	106	73.3*	0.62	73.6	0.55
Oil (Dry Basis %)	84	3.6	0.24	2.9	4.4	82	3.5*	0.24	106	3.7*	0.22	3.6	0.22
Southern Rail													
Protein (Dry Basis %)	35	8.6	0.28	8.0	9.5	35	8.4*	0.44	7	9.3*	0.42	8.9	0.38
Starch (Dry Basis %)	35	73.5	0.51	72.4	74.6	35	73.8*	0.55	7	73.6	0.16	73.7	0.39
Oil (Dry Basis %)	35	4.0	0.17	3.6	4.3	35	3.9*	0.20	7	3.7*	0.09	3.8	0.18

** Indicates that the 2013/2014 Export Cargo averages were significantly different from the 2014/2015 Export Cargo averages, and the 2012/2013 Export Cargo averages were significantly different from the 2014/2015 Export Cargo averages, based on a 2-tailed t-test at the 95% level of significance.*

SUMMARY: CHEMICAL COMPOSITION

	Export Cargo Samples for Contract Loaded as U.S. No. 2 o/b					Export Cargo Samples for Contract Loaded as U.S. No. 3 o/b					2014 Harvest				
	No. of Samples	Avg.	Std. Dev.	Min.	Max.	No. of Samples	Avg.	Std. Dev.	Min.	Max.	No. of Samples[1]	Avg.	Std. Dev.	Min.	Max.
U.S. Aggregate															
Protein (Dry Basis %)	236	8.7	0.28	7.6	9.6	173	8.6*	0.28	7.6	9.9	629	8.5**	0.55	6.4	11.3
Starch (Dry Basis %)	236	73.6	0.49	72.4	76.2	173	73.8*	0.59	72.0	75.5	629	73.5**	0.63	71.7	76.1
Oil (Dry Basis %)	236	3.9	0.18	3.4	4.4	173	3.8*	0.23	2.9	4.8	629	3.8**	0.31	2.8	5.0
Gulf															
Protein (Dry Basis %)	191	8.6	0.22	7.6	9.2	99	8.6	0.23	7.6	9.0	583	8.4**	0.55	6.4	11.3
Starch (Dry Basis %)	191	73.7	0.53	72.5	76.2	99	73.8*	0.60	72.4	75.5	583	73.6**	0.64	71.7	76.1
Oil (Dry Basis %)	191	3.9	0.19	3.4	4.4	99	3.8*	0.22	3.4	4.8	583	3.8**	0.32	2.8	5.0
Pacific Northwest															
Protein (Dry Basis %)	10	9.0	0.48	7.9	9.6	74	8.6*	0.46	7.8	9.9	262	8.7**	0.56	6.4	11.3
Starch (Dry Basis %)	10	73.3	0.36	72.9	73.7	74	73.8*	0.56	72.0	74.9	262	73.4	0.60	71.7	75.4
Oil (Dry Basis %)	10	3.6	0.15	3.4	3.9	74	3.8*	0.25	2.9	4.4	262	3.6	0.29	2.8	4.6
Southern Rail															
Protein (Dry Basis %)	35	8.6	0.28	8.0	9.5	0	0.00	0.00	0.0	0.0	371	8.6	0.57	6.9	11.0
Starch (Dry Basis %)	35	73.5	0.51	72.4	74.6	0	0.00	0.00	0.0	0.0	371	73.4	0.60	71.7	76.1
Oil (Dry Basis %)	35	4.0	0.17	3.6	4.3	0	0.00	0.00	0.0	0.0	371	3.7**	0.28	2.8	4.6

** Indicates the averages for samples with Grade "3" or "3 or better" were significantly different from the averages for the samples with Grade "2" or "2 or better," based on a 2-tailed t-test at the 95% level of significance.*

*** Indicates that the 2014 Harvest averages were significantly different from the 2014/2015 Export Cargo averages, based on a 2-tailed t-test at the 95% level of significance.*

[1] Due to the Harvest ECA results being composite statistics, the sum of the sample numbers from the three ECAs is greater than the U.S. Aggregate.

D. Physical Factors

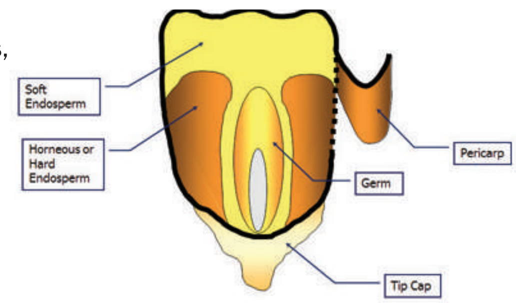


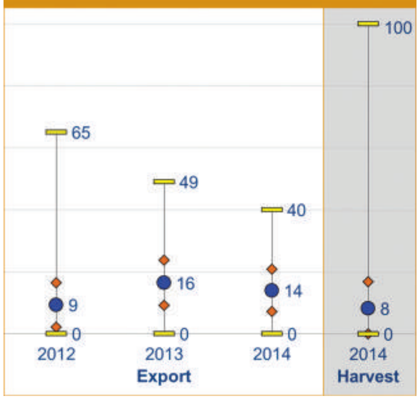
Illustration courtesy of K. D. Rausch University of Illinois

Physical factors are other quality attributes that are neither grading factors nor chemical composition. Physical factors include stress cracks, kernel weight, volume and density, percent whole kernels, and percent horneous (hard) endosperm. Tests for these physical factors provide additional information about the processing characteristics of corn for various uses, as well as corn's storability and potential for breakage in handling. These quality attributes are influenced by the physical composition of the corn kernel, which is in turn affected by genetics and growing and handling conditions. Corn kernels are made up of four parts: the germ or embryo, the tip cap, the pericarp or outer covering, and the endosperm. The endosperm represents about 82% of the kernel, and consists of soft (also referred to as floury or opaque) endosperm and of horneous (also called hard or vitreous) endosperm, as shown above. The endosperm contains primarily starch and protein, the germ contains oil and some proteins, and the pericarp and tip cap are mostly fiber.

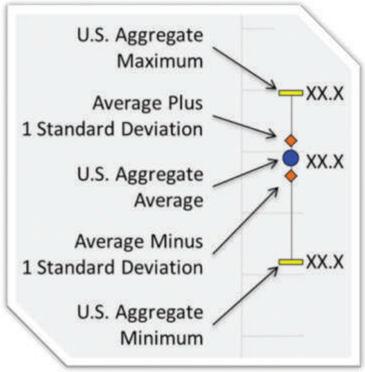
SUMMARY: PHYSICAL FACTORS

- *Average stress cracks (14%) was lower than 2013/2014 (16%) but above 3YA (12%); however, the majority of the export samples (79.1%) had less than 20% stress cracks, and should have low rates of breakage during handling.*
- *At export, 67.1% of the 2014/2015 samples had a Stress Crack Index (SCI) of less than 40, compared to 43% in 2013/2014. This would indicate that fewer kernels had double or multiple stress cracks in 2014/2015 than in 2013/2014.*
- *Whole kernels at export (88.4%) was similar to 2013/2014 (88.6%) and 3YA (88.7%).*
- *Both true densities and test weights were higher for 2014/2015 than for 2013/2014.*
- *Horneous endosperm (82%) was the same as 2013/2014 (82%) but lower than 3YA (84%).*
- *The true density (1.295 g/cm^3) is higher than 2013/2014 (1.287 g/cm^3) and 3YA (1.291 g/cm^3). The true density and horneous endosperm tests indicate hardness will be unchanged or slightly higher than last year.*
- *Kernel volume and 100-k weight were higher than 2013/2014 and 3YA, indicating larger kernel sizes in 2014/2015 corn exports than the previous year and 3YA.*
- *Average 100-k weight, kernel volume and true density were lower for the Pacific Northwest ECA than for the other ECAs, indicating smaller kernel sizes and lower true densities for the Pacific Northwest ECA than for the Gulf and Southern Rail ECAs.*

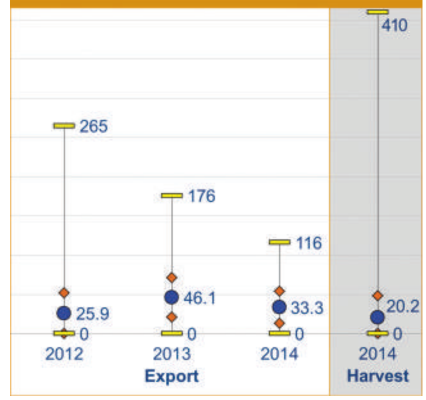
Stress Cracks (%)



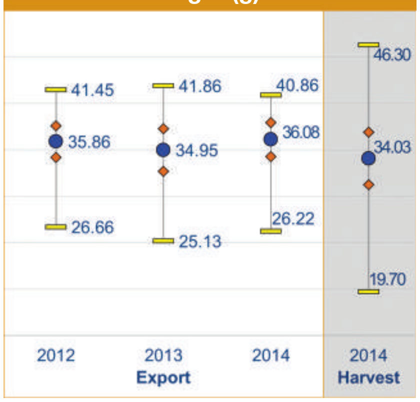
How to Read the Charts



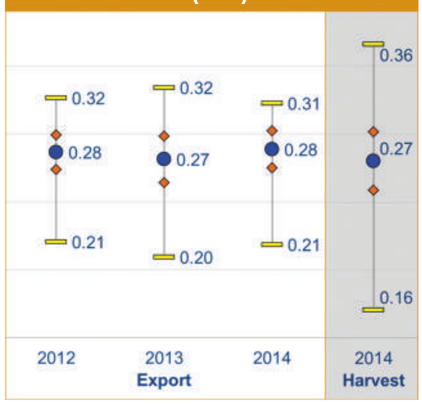
Stress Crack Index



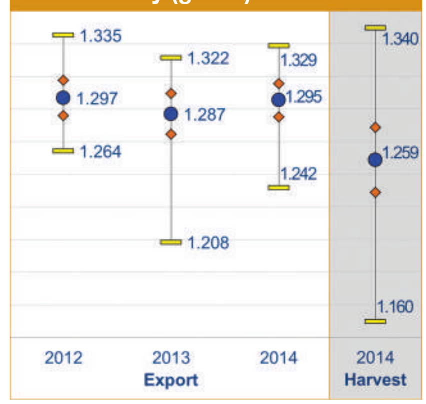
100-Kernel Weight (g)



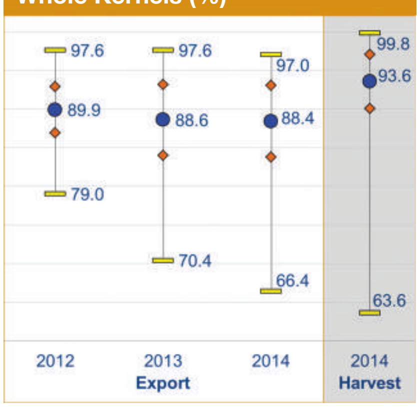
Kernel Volume (cm³)



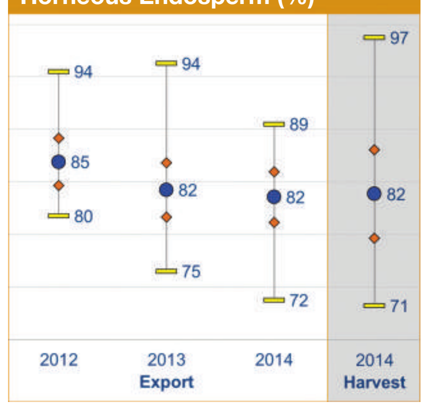
True Density (g/cm³)



Whole Kernels (%)



Horneous Endosperm (%)



4. Stress Cracks and Stress Crack Index (SCI)

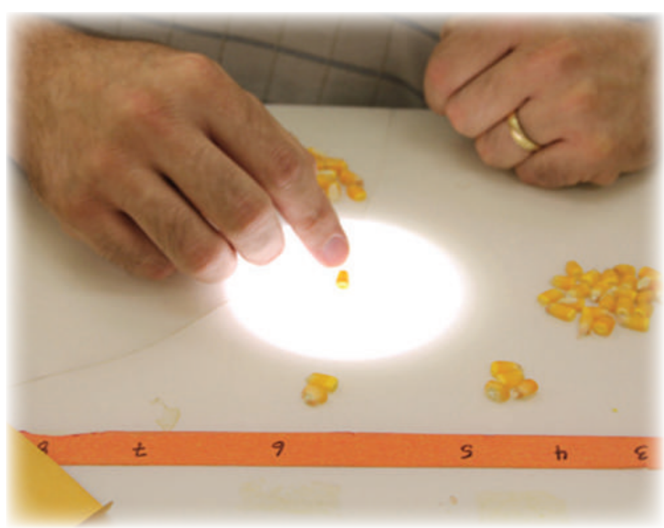
Stress cracks are internal fissures in the horneous (hard) endosperm of a corn kernel. The pericarp (or outer covering) of a stress-cracked kernel is typically not damaged, so the kernel may appear unaffected at first glance even if stress cracks are present.

The cause of stress cracks is pressure buildup due to moisture and temperature differences within the kernel's horneous endosperm. This can be likened to the internal cracks that appear when an ice cube is dropped into a lukewarm beverage. The internal stresses do not build up as much in the soft, floury endosperm as in the horneous endosperm; therefore, corn with higher percentages of horneous endosperm is more susceptible to stress cracking than softer grain. A kernel may have one, two or multiple stress cracks. The impact of high levels of stress cracks on various uses include:

- General: Increased susceptibility to breakage during handling, leading to increased broken corn needing to be removed during cleaning operations for processors and possible reduced grade/value.
- Wet Milling: Lower starch yield because the starch and protein are more difficult to separate. Stress cracks may also alter steeping requirements.
- Dry Milling: Lower yield of large flaking grits (the prime product of many dry milling operations).
- Alkaline Cooking: Non-uniform water absorption leading to overcooking or undercooking, which affects the process balance.

High-temperature drying is the most common cause of stress cracks. Growing conditions will affect crop maturity, timeliness of harvest and the need for artificial drying, which will influence the degree of stress cracking found from region to region. Then, as corn moves through the market channel, some stress-cracked kernels break, increasing the proportion of broken corn. Concurrently, impacts of kernels on other kernels or on metal surfaces during handling may cause new cracks in kernels. As a result, the percentage of kernels with stress cracks may not remain constant through the merchandising channel.

Stress crack measurements include "stress cracks" (the percent of kernels with at least one crack) and stress crack index (SCI), which is the weighted average of single, double and multiple stress cracks. "Stress cracks" measures only the number of kernels with stress cracks, whereas SCI shows the severity of cracking. For example, if half the kernels have only single stress cracks, "stress cracks" is 50% and the SCI is 50 (50 x 1). However, if half of the kernels have multiple stress cracks (more than 2 cracks), indicating a higher potential for handling issues, "stress cracks" remain at 50% but the SCI becomes 250 (50 x 5). Lower values for "stress cracks" and the SCI are always more desirable. In years with high levels of stress cracks, the SCI is valuable because high SCI numbers (perhaps 300 to 500) indicate the sample had a very high percentage of multiple stress cracks. Multiple stress cracks are generally more detrimental to quality changes than single stress cracks.



RESULTS: STRESS CRACKS

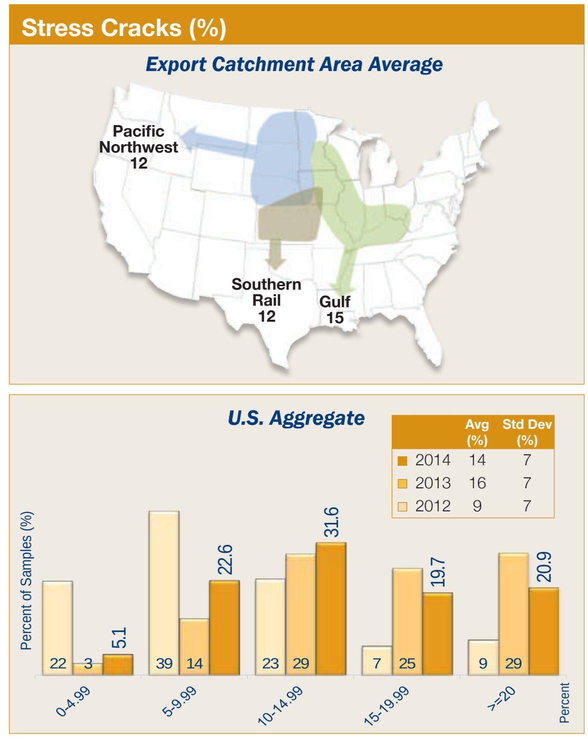
- Average U.S. Aggregate stress cracks were 14%, lower than 2013/2014 (16%), but higher than 3YA (12%).

- Stress crack percentages (14%) were higher than found at the 2014 harvest (8%). Stress cracks ranged from 0 to 40% with a standard deviation of 7%, indicating more uniformity than 2014 harvest samples with a range of 0 to 100% and a standard deviation of 9%.

- Of the export samples, 79.1% had less than 20% stress cracks, compared to 71% in 2013/2014. These samples (79.1%) with less than 20% stress cracks should have relatively low rates of breakage during handling.

- Stress cracks averages were 15%, 12%, and 12% for the Gulf, Pacific Northwest, and Southern Rail ECAs, respectively. The Southern Rail ECA also had the lowest 3YA for stress cracks among all ECAs.

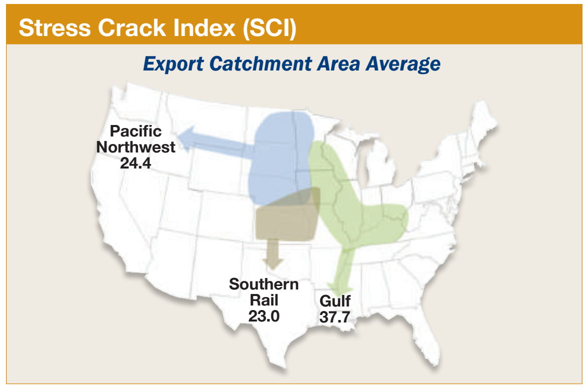
- The variability of stress cracks (standard deviation) was nearly the same (6 to 7%) across all ECAs.

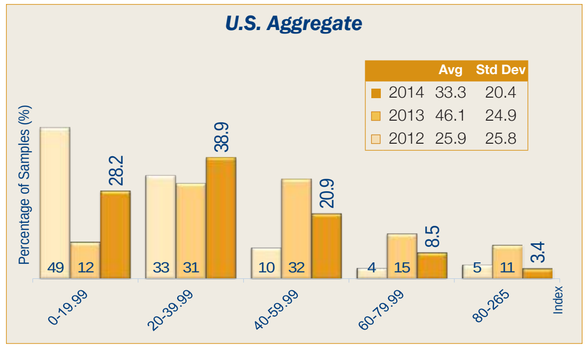


- Stress cracks for contracts loaded as U.S. No. 2 o/b was 13%, lower than the 15% for contracts loaded as U.S. No. 3 o/b. The lower stress cracks for contracts loaded as U.S. No. 2 o/b is consistent with their lower BCFM levels (2.7%) compared to the higher BCFM levels (3.6%) for contracts loaded as U.S. No. 3 o/b.

RESULTS: STRESS CRACK INDEX (SCI)

- Average U.S. Aggregate stress crack index (SCI) (33.3) is close to 3YA (34.3) but lower than 2013/2014 (46.1).
- SCI ranged from 0 to 116 with a standard deviation of 20.4.
- SCI at export was higher than the SCI found at harvest (20.2).
- The Southern Rail ECA (23.0) had the lowest SCI compared to the Gulf (37.7) and Pacific Northwest (24.4) ECAs. The Southern Rail ECA also had the lowest SCI for 3YA and the 2014 harvest samples. The lower SCI and stress crack percentages found for the Southern Rail ECA may, in part, be due to all of the corn contracted for the Southern Rail ECA being U.S. No. 2 o/b.
- SCI standard deviations across ECAs were 21.6, 16.2, and 20.2 for Gulf, Pacific Northwest, and Southern Rail ECAs, respectively.
- At export, 67.1% had SCI of less than 40, compared to 2013/2014 (43%). This would indicate fewer kernels in 2014/2015 had double or multiple stress cracks than in 2013/2014.
- SCI for contracts loaded as U.S. No. 2 o/b (31.4) was lower than for contracts loaded as U.S. No. 3 o/b (36.1).





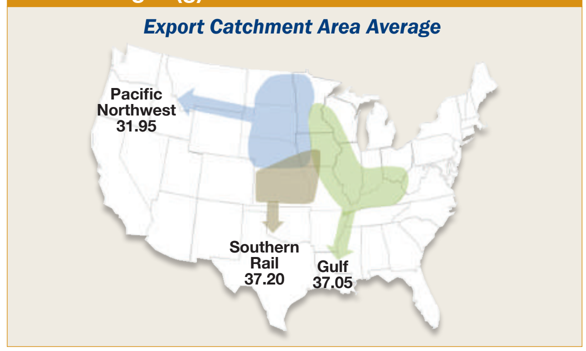
5. 100-Kernel Weight

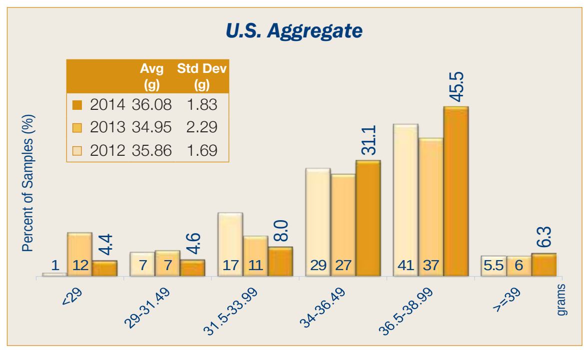
100-kernel (100-k) weight (reported in grams) indicates larger kernel size as 100-k weights increase. Kernel size affects drying rates. As kernel size increases, the volume-to-surface area ratio becomes higher, and as the ratio gets higher, drying becomes slower. In addition, large uniform-sized kernels often enable higher flaking grit yields in dry milling. Kernel weights tend to be higher for specialty varieties of corn that have high amounts of horneous (hard) endosperm.

RESULTS

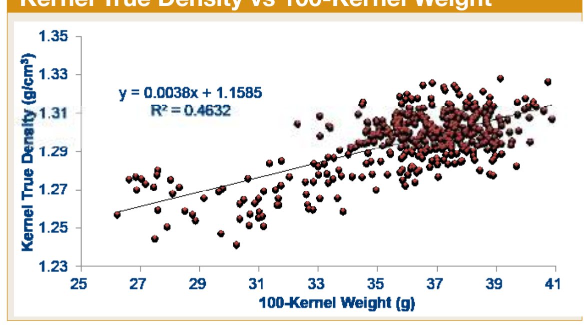
- U.S. aggregate 100-k weight averaged 36.08 g with a range of 26.22 to 40.86 g. This 100-k weight was higher than 2013/2014 (34.95 g) and 3YA (35.31 g).
- 100-k weight was higher than for the 2014 harvest corn (34.03 g). Higher average 100-k weight at export than at harvest has been seen in the past two years and for 3YA. Since the 100-k weights are based on 100 fully intact kernels, any breakage occurring in transit could have self-selected out smaller kernels that might have been soft or more prone to breakage.
- The 2014/2015 export samples had greater uniformity than the 2014 harvest samples as indicated by a tighter range and lower standard deviation.
- The average 100-k weight was lower for the Pacific Northwest ECA (31.95 g) than for the Gulf (37.05 g) or Southern Rail (37.20 g) ECAs. The Pacific Northwest had the lowest average 100-k weight of the three ECAs in the previous two years and 3YA.
- Of the 2014/2015 export samples, 82.9% had 100-k weight of 34.0 g or greater, indicating larger kernels in 2014/2015 than in previous years (70% in 2013/2014 and 75.5% in 2012/2013).
- There is a weak but positive relationship for the 2014/2015 export corn between 100-k weight and true density as shown in the graphic at the lower right (the correlation coefficient is 0.68).

100-k Weight (g)





Kernel True Density vs 100-Kernel Weight



III. QUALITY TEST RESULTS (continued)

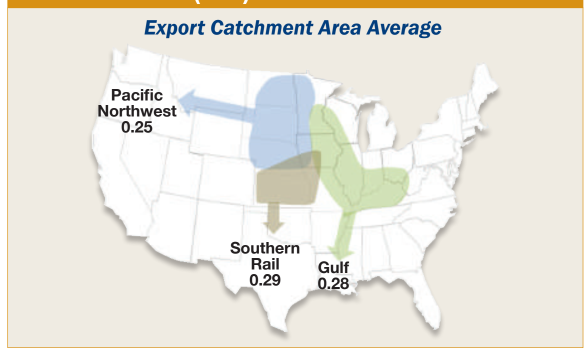
6. Kernel Volume

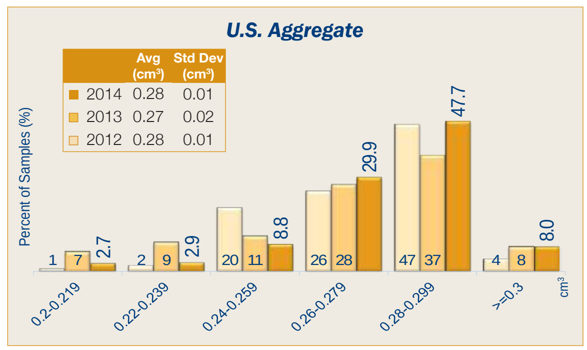
Kernel volume in cubic centimeters (cm^3) is often indicative of growing conditions. Small or round kernels are more difficult to degerm. Additionally, small kernels may lead to increased cleanout losses for processors and higher yields of fiber.

RESULTS

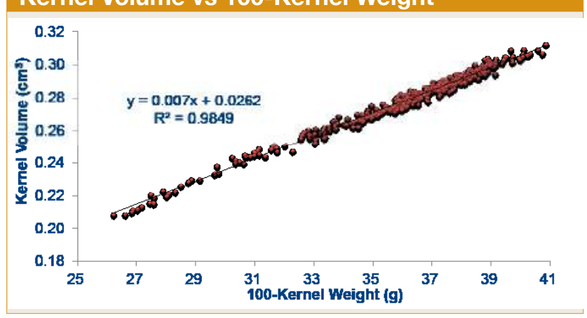
- Average kernel volume (0.28 cm^3) was higher than 2013/2014 (0.27 cm^3), 3YA (0.27 cm^3), and the 2014 harvest samples (0.27 cm^3).
- Kernel volume ranged from 0.21 to 0.31 cm^3, which is similar to the 2013/2014 range and to the 3YA range (0.20 to 0.32 cm^3).
- The standard deviation of 0.01 cm^3 was lower and the range was less in the 2014/2015 export samples than in the 2014 harvest samples.
- Average kernel volume was smaller for the Pacific Northwest ECA (0.25 cm^3) than for the Gulf (0.28 cm^3) and Southern Rail (0.29 cm^3) ECAs for 2014/2015 export samples. The Pacific Northwest ECA also had the lowest kernel volume for the previous two years, 3YA, and the 2014 harvest samples. Of the 2014/2015 export samples, 55.7% had kernel volumes equal to or greater than 0.28 cm^3, compared with 45% in 2013/2014.
- It can be seen that kernel volume is positively correlated to 100-k weight (the correlation coefficient is 0.99).

Kernel Volume (cm^3)





Kernel Volume vs 100-Kernel Weight



7. Kernel True Density

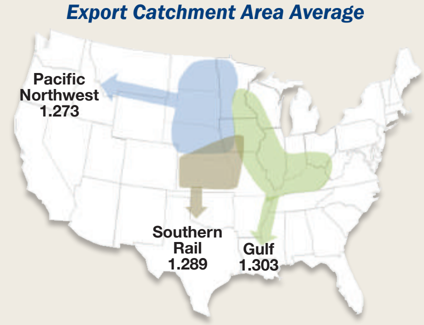
Kernel true density is calculated as the weight of a 100-k sample divided by the volume, or displacement, of those 100 kernels and is reported as g/cm³. True density is a relative indicator of kernel hardness, which is useful for alkaline processors and dry millers. True density may be affected by the genetics of the corn hybrid and the growing environment. Corn with higher density is typically less susceptible to breakage in handling than lower density corn, but it is also more at risk for the development of stress cracks if high-temperature drying is employed. True densities above 1.30 g/cm³ would indicate very hard corn desirable for dry milling and alkaline processing. True densities near the 1.275 g/cm³ level and below tend to be softer, but will process well for wet milling and feed use.

RESULTS

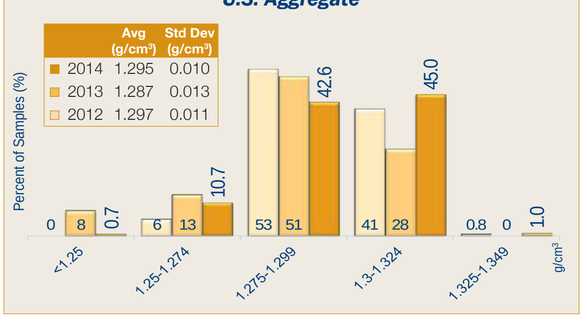
- Average kernel true density (1.295 g/cm³) was higher than 2013/2014 (1.287 g/cm³) and 3YA (1.291 g/cm³).
- Average kernel true density for the 2014/2015 export samples was higher than for the 2014 harvest samples (1.259 g/cm³). Average true density was also higher at export than at harvest in the previous two years. The 3YA true density (1.291 g/cm³) was also higher than the 3YA harvest true density (1.267 g/cm³). This higher true density at export is likely due, in part, to the higher 100-k weights that also occurred each year at export.
- For the export samples, 88.6% had kernel true densities equal to or above 1.275 g/cm³, compared with 79% found in 2013/2014.
- The Pacific Northwest had the lowest average true density (1.273 g/cm³) and 100-k weight (31.95 g) among ECAs in 2014/2015, in each of the past two years and for 3YA. The Pacific Northwest also consistently had the lowest test weight among all ECAs the past two years and 3YA. True density and test weight are also weakly but positively correlated with each other (the correlation coefficient is 0.69) as shown in the accompanying figure.

Kernel True Density (g/cm³)

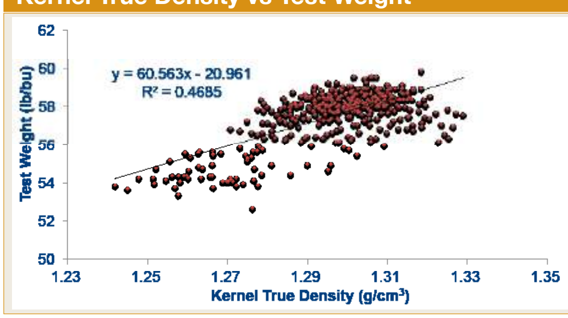
Export Catchment Area Average



U.S. Aggregate



Kernel True Density vs Test Weight



8. Whole Kernels

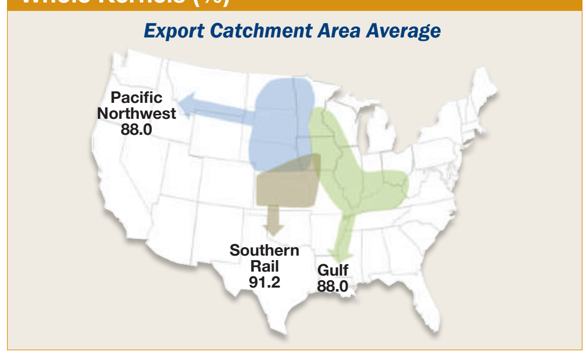
Though the name suggests some inverse relationship between whole kernels and BCFM, the whole kernels test conveys different information than the broken corn portion of the BCFM test. Broken corn is defined solely by weight percentage of material passing through a screen. Whole kernels, as the name implies, is the percent of fully intact kernels in the sample with no pericarp damage or kernel pieces chipped away.

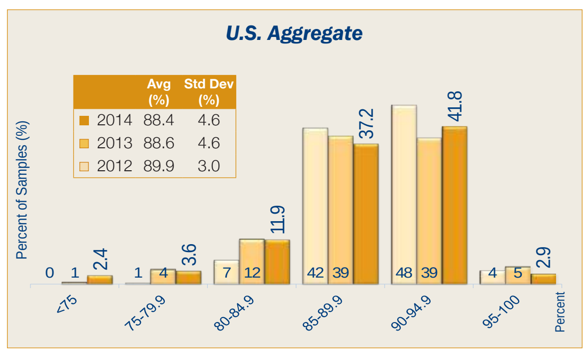
The exterior integrity of the corn kernel is very important for two key reasons. First, it affects water absorption for alkaline cooking and steeping operations. Kernel nicks or pericarp cracks allow water to enter the kernel faster than for fully intact or whole kernels. Too much water uptake during cooking can result in loss of solubles, non-uniform cooking, expensive shutdown time and/or products that do not meet specifications. Secondly, intact whole kernels are less susceptible to mold invasion during storage and to breakage during handling. Some companies pay contracted premiums for corn delivered above a specified level of whole kernels.

RESULTS

- Average U.S. Aggregate whole kernels (88.4%) was similar to 2013/2014 (88.6%) but somewhat lower than 3YA (88.7%).
- The average percent of whole kernels at export was lower than at harvest (93.6%). Whole kernels for the 3YA export samples (88.7%) was also lower than for the 3YA harvest samples (93.5%). The reduction in whole kernels from harvest to export is likely caused by the added handling in transport to export loading locations.
- The 2014/2015 export samples had a range of 66.4 to 97.0% (with a standard deviation of 4.6%), while the 2014 harvest samples had a wider range (63.6 to 99.8%) but a lower standard deviation (3.5%). The higher standard deviation at export than at harvest also occurred in 2013/2014, but not in 2012/2013.
- The Southern Rail ECA had a higher whole kernel average (91.2%) compared to the Gulf (88.0%) and Pacific Northwest (88.0%) ECAs. The 3YA places the Pacific Northwest ECA with the highest whole percentages even though 2014/2015 samples did not show this.

Whole Kernels (%)





- The percent of samples that had whole kernel percentages greater than or equal to 90% was 44.7%, compared to 44% for the 2013/2014 export samples, and to 85.7% for 2014 harvest samples. This comparison of export distribution to 2014 harvest distribution shows the large reduction of samples with over 95% whole kernels that occurs due to handling.
- The whole kernel percentages for contracts loaded as U.S. No. 2 o/b were 88.8%, somewhat higher than the 88.3% found for contracts loaded as U.S. No. 3 o/b. This result was consistent with the fact that contracts loaded as U.S. No. 2 o/b also had lower BCFM and lower stress cracks than corn loaded as U.S. No. 3 o/b.

9. Horneous (Hard) Endosperm

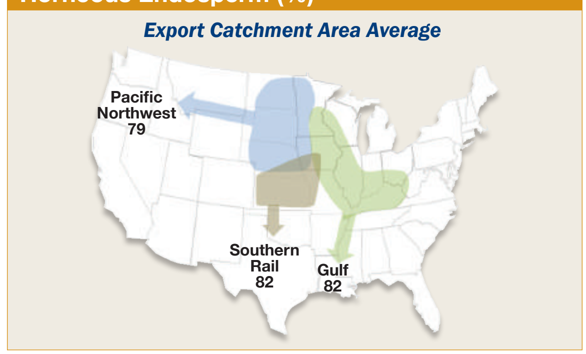
The horneous (hard) endosperm test measures the percent of horneous or hard endosperm out of the total endosperm in a kernel, with a potential value from 70 to 100%. The greater the amount of horneous endosperm relative to soft endosperm, the harder the corn kernel is said to be. The degree of hardness is important depending on the type of processing. Hard corn is needed to produce high yields of large flaking grits in dry milling. Medium-high to medium hardness is desired for alkaline cooking. Moderate to soft hardness is used for wet milling and livestock feeding.

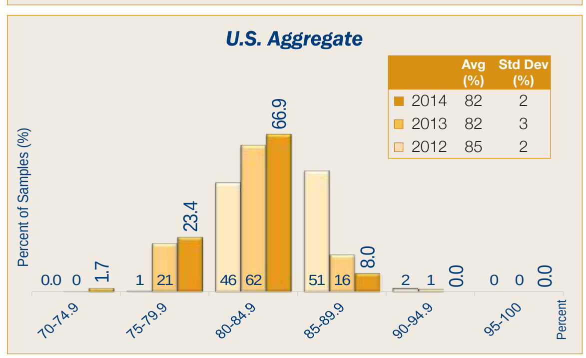
Hardness has been correlated to breakage susceptibility, feed utilization/efficiency and starch digestibility. As a test of overall hardness, there is no good or bad value for horneous endosperm; there is only a preference by different end users for particular ranges. Many dry millers and alkaline cookers would like greater than 90% horneous endosperm, while wet millers and feeders would typically like values between 70% and 85%. However, there are certainly exceptions in user preference.

RESULTS

- U.S. Aggregate horneous endosperm averaged 82%, the same as 2013/2014 (82%), unchanged from 2014 harvest samples (82%), but lower than 3YA (84%).
- The 2014/2015 export samples ranged from 72 to 89% and had a smaller range and standard deviation than the 2014 harvest samples. This same pattern of increased uniformity between export and harvest samples occurred in 2013/2014 and 2012/2013 export samples when compared to 2013 and 2012 harvest samples, respectively.
- The horneous endosperm for the Pacific Northwest ECA (79%) was lower than for the Gulf and Southern Rail ECAs (82% and 82%, respectively). The Pacific Northwest also had the lowest horneous endosperm in 2013/2014 and 3YA.
- Average horneous endosperm was slightly higher for contracts loaded as U.S. No. 2 o/b (82%) than for contracts loaded as U.S. No. 3 o/b (81%).

Horneous Endosperm (%)





- At export, 74.9% of the samples had greater than 80% horneous endosperm in contrast to 2013/2014 (79%) and 2012/2013 (99%), indicating many samples have a lower percentage of hard corn in 2014/2015 than in the two previous years.

III. QUALITY TEST RESULTS (continued)

SUMMARY: PHYSICAL FACTORS

	2014/2015 Export Cargo					2013/2014 Export Cargo			2012/2013 Export Cargo			3 Year Avg. (2011-2013)	
	No. of Samples	Avg.	Std. Dev.	Min.	Max.	No. of Samples	Avg.	Std. Dev.	No. of Samples	Avg.	Std. Dev.	Avg.	Std. Dev.
U.S. Aggregate													
Stress Cracks (%)	411	14	7	0	40	412	16*	7	397	9*	7	12	6
Stress Crack Index	411	33.3	20.4	0	116	412	46.1*	24.9	397	25.9*	25.8	34.3	22.6
100-Kernel Weight (g)	411	36.08	1.83	26.22	40.86	412	34.95*	2.29	397	35.86	1.69	35.31	1.78
Kernel Volume (cm^3)	411	0.28	0.01	0.21	0.31	412	0.27*	0.02	397	0.28*	0.01	0.27	0.01
True Density (g/cm^3)	411	1.295	0.010	1.242	1.329	412	1.287*	0.013	397	1.297	0.011	1.291	0.011
Whole Kernels (%)	411	88.4	4.6	66.4	97.0	412	88.6	4.6	397	89.9*	3.0	88.7	3.7
Horneous Endosperm (%)	411	82	2	72	89	412	82*	3	397	85*	2	84	2
Gulf													
Stress Cracks (%)	292	15	7	0	40	295	16	7	284	10*	8	13	7
Stress Crack Index	292	37.7	21.6	0	116	295	47.2*	26	284	30.2*	31.5	39.1	26.2
100-Kernel Weight (g)	292	37.05	1.57	32.29	40.86	295	36.26*	2.12	284	36.94	1.50	36.25	1.65
Kernel Volume (cm^3)	292	0.28	0.01	0.25	0.31	294	0.28*	0.02	284	0.28	0.01	0.28	0.01
True Density (g/cm^3)	292	1.303	0.010	1.260	1.329	295	1.297*	0.010	284	1.300*	0.011	1.297	0.010
Whole Kernels (%)	292	88.0	5.4	66.4	97.0	295	88.5	4.6	284	89.3*	3.0	88.4	3.8
Horneous Endosperm (%)	292	82	2	72	89	295	83*	3	284	85*	2	84	3
Pacific Northwest													
Stress Cracks (%)[1]	84	12	6	1	37	82	18*	7	106	9*	6	11	5
Stress Crack Index[1]	84	24.4	16.2	1	111	82	45.3*	22	106	20.1	18.5	25.9	16.2
100-Kernel Weight (g)	84	31.95	3.03	26.22	37.24	82	28.94*	2.81	106	32.31	1.92	31.42	2.08
Kernel Volume (cm^3)	84	0.25	0.02	0.21	0.29	82	0.23*	0.02	106	0.25	0.01	0.25	0.02
True Density (g/cm^3)	84	1.273	0.013	1.242	1.299	82	1.253*	0.020	106	1.285*	0.012	1.271	0.014
Whole Kernels (%)	84	88.0	3.3	78.2	94.2	82	89.3*	4.1	106	91.3*	3.1	89.8	3.4
Horneous Endosperm (%)	84	79	3	72	87	82	79	3	106	84*	2	83	2
Southern Rail													
Stress Cracks (%)[1]	35	12	7	1	37	35	16*	7	7	6*	4	9	5
Stress Crack Index[1]	35	23.0	20.2	1	113	35	41.3*	21	7	12.9*	8.3	21.3	13.3
100-Kernel Weight (g)	35	37.20	1.39	33.53	39.68	35	36.91	2.45	7	35.86	2.31	36.59	2.02
Kernel Volume (cm^3)	35	0.29	0.01	0.26	0.31	35	0.29	0.02	7	0.28	0.02	0.28	0.02
True Density (g/cm^3)	35	1.289	0.009	1.273	1.310	35	1.287	0.013	7	1.297*	0.010	1.293	0.010
Whole Kernels (%)	35	91.2	2.8	83.0	96.8	35	87.8*	5.2	7	90.9	2.8	88.0	4.1
Horneous Endosperm (%)	35	82	2	78	86	35	83*	2	7	84*	2	84	2

** Indicates that the 2013/2014 Export Cargo averages were significantly different from the 2014/2015 Export Cargo averages, and the 2012/2013 Export Cargo averages were significantly different from the 2014/2015 Export Cargo averages, based on a 2-tailed t-test at the 95% level of significance.*

[1] The Relative margin of Error (ME) for predicting the 2014/2015 Export Cargo population average exceeded ±10%.

SUMMARY: PHYSICAL FACTORS

	Export Cargo Samples for Contract Loaded as U.S. No. 2 o/b					Export Cargo Samples for Contract Loaded as U.S. No. 3 o/b					2014 Harvest				
	No. of Samples	Avg.	Std. Dev.	Min.	Max.	No. of Samples	Avg.	Std. Dev.	Min.	Max.	No. of Samples[1]	Avg.	Std. Dev.	Min.	Max.
U.S. Aggregate															
Stress Cracks (%)	236	13	6	0	37	173	15*	7	1	40	629	8**	9	0	100
Stress Crack Index	236	31.4	19.1	0	113	173	36.1*	20.7	1	116	629	20.2**	27.7	0	410
100-Kernel Weight (g)	236	35.96	1.82	27.49	40.86	173	35.84	1.82	26.22	39.98	629	34.03**	2.83	19.70	46.30
Kernel Volume (cm^3)	236	0.28	0.01	0.22	0.31	173	0.28	0.01	0.21	0.30	629	0.27**	0.02	0.16	0.36
True Density (g/cm^3)	236	1.296	0.011	1.245	1.329	173	1.293*	0.010	1.242	1.323	629	1.259**	0.020	1.160	1.340
Whole Kernels (%)	236	88.8	4.2	70.0	96.8	173	88.3	5.4	66.4	97.0	629	93.6**	3.5	63.6	99.8
Horneous Endosperm (%)	236	82	2	72	88	173	81	2	72	89	629	82	4	71	97
Gulf															
Stress Cracks (%)	191	14	7	0	34	99	15	7	3	40	583	9**	10	0	100
Stress Crack Index	191	36.6	21.1	0	108	99	36.2	21.9	7	116	583	24.1**	33.3	0	410
100-Kernel Weight (g)	191	37.11	1.64	32.29	40.86	99	35.87*	1.46	32.81	39.98	583	34.88**	2.90	25.16	46.30
Kernel Volume (cm^3)	191	0.28	0.01	0.25	0.31	99	0.28*	0.01	0.26	0.30	583	0.28**	0.02	0.20	0.36
True Density (g/cm^3)	191	1.305	0.009	1.281	1.329	99	1.293*	0.009	1.260	1.323	583	1.262**	0.020	1.160	1.340
Whole Kernels (%)	191	87.8	4.9	70.0	96.8	99	88.3	6.0	66.4	97.0	583	93.8**	3.3	63.6	99.8
Horneous Endosperm (%)	191	82	2	72	88	99	81*	2	75	89	583	82	4	71	97
Pacific Northwest															
Stress Cracks (%)	10	10	5	2	16	74	15*	6	1	37	262	6**	6	0	56
Stress Crack Index	10	18.4	11.2	2	34	74	36.2*	16.7	1	111	262	12.8**	17.1	0	204
100-Kernel Weight (g)	10	31.16	2.72	27.49	37.17	74	35.87*	3.07	26.22	37.24	262	30.92**	2.57	19.70	44.13
Kernel Volume (cm^3)	10	0.24	0.02	0.22	0.29	74	0.28*	0.02	0.21	0.29	262	0.25	0.02	0.16	0.34
True Density (g/cm^3)	10	1.271	0.017	1.245	1.299	74	1.293*	0.012	1.242	1.298	262	1.246**	0.021	1.160	1.339
Whole Kernels (%)	10	90.5	2.6	86.8	94.2	74	88.3*	3.3	78.2	94.0	262	92.5**	4.4	64.8	99.8
Horneous Endosperm (%)	10	79	3	75	84	74	81	3	72	87	262	81**	4	71	97
Southern Rail															
Stress Cracks (%)	35	12	7	1	37	0	0	0	0	0	371	6**	6	0	62
Stress Crack Index	35	23.0	20.2	1	113	0	0.0	0.0	0	0	371	11.4**	15.3	0	230
100-Kernel Weight (g)	35	37.20	1.39	33.53	39.68	0	0.00	0.00	0.00	0.00	371	34.47**	2.83	25.54	46.30
Kernel Volume (cm^3)	35	0.29	0.01	0.26	0.31	0	0.00	0.00	0.00	0.00	371	0.27**	0.02	0.21	0.36
True Density (g/cm^3)	35	1.289	0.009	1.273	1.310	0	0.000	0.000	0.000	0.000	371	1.263**	0.019	1.174	1.340
Whole Kernels (%)	35	91.2	2.8	83.0	96.8	0	0.0	0.0	0.0	0.0	371	93.9**	3.2	68.6	99.8
Horneous Endosperm (%)	35	82	2	78	86	0	0	0	0	0	371	82	4	72	97

** Indicates the averages for samples with Grade "3" or "3 or better" were significantly different from the averages for the samples with Grade "2" or "2 or better," based on a 2-tailed t-test at the 95% level of significance.*

*** Indicates that the 2014 Harvest averages were significantly different from the 2014/2015 Export Cargo averages, based on a 2-tailed t-test at the 95% level of significance.*

[1] Due to the Harvest ECA results being composite statistics, the sum of the sample numbers from the three ECAs is greater than the U.S. Aggregate.

E. Mycotoxins

Mycotoxins are toxic compounds produced by fungi that occur naturally in grains. When consumed at elevated levels, mycotoxins may cause sickness in humans and animals. While several mycotoxins have been found in corn grain, aflatoxins and deoxynivalenol (DON or vomitoxin) are considered to be two of the important mycotoxins.

The U.S. grain merchandising industry implements strict safeguards for handling and marketing any elevated levels of mycotoxins. All stakeholders in the corn value chain – seed companies, corn growers, grain marketers and handlers as well as U.S. corn export customers – are interested in understanding how mycotoxin infection is influenced by growing conditions and the subsequent storage, drying, handling and transport of the grain as it moves through the U.S. corn export system.

To assess the effect of these conditions on aflatoxins and DON development, this report summarizes the results from official USDA Federal Grain Inspection Service (FGIS) aflatoxin tests and from independent DON tests for all the export samples collected as part of this survey. Details on the testing methodology employed in this study for the mycotoxins are in the "Testing Analysis Methods" section.

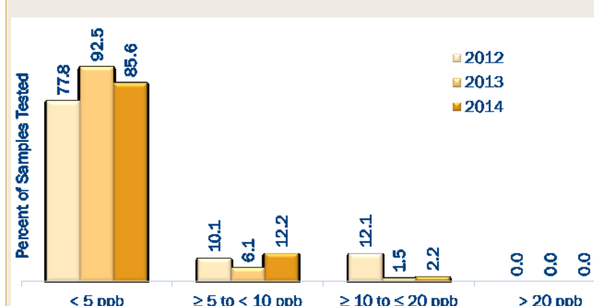
RESULTS: AFLATOXINS

FGIS tested 411 export samples for aflatoxins for the *Export Cargo Report 2014/2015*. Results of the 2014/2015 survey are as follows:

Aflatoxins

	Percent of Total Samples				
	< 5 ppb	≥ 5 to < 10 ppb	≥ 10 to ≤ 20 ppb	> 20 ppb	Total
U.S. Aggregate	85.6%	12.2%	2.2%	0.0%	100.0%
By ECA					
Gulf	80.1%	16.8%	3.1%	0.0%	100.0%
Pacific Northwest	100.0%	0.0%	0.0%	0.0%	100.0%
Southern Rail	97.1%	2.9%	0.0%	0.0%	100.0%

Aflatoxin Testing Results



- 352 samples or 85.6% of the 411 samples tested in 2014/2015 had no detectable levels of aflatoxins (defined as less than 5.0 parts per billion (ppb) or the FGIS lower reporting level). This 85.6% is greater than the 77.8% of the 2012/2013 export samples and less than the 92.5% of the 2013/2014 export samples.
- 84 samples or 12.2% of the 411 samples tested in 2014/2015 had aflatoxin levels greater than or equal to 5.0 ppb, but less than 10 ppb. This 12.2% is greater than the 10.1% of the 2012/2013 export samples and the 6.1% of the 2013/2014 export samples.
- 9 samples or 2.2% of the 411 samples tested in 2014/2015 had aflatoxin levels greater than or equal to 10.0 ppb, but less than or equal to the FDA action level of 20 ppb. This 2.2% is less than the 12.1% of the 2012/2013 export samples but about the same as the 1.5% of the 2013/2014 export samples.
- 100% of the samples tested in 2014/2015 were below or equal to the FDA action level of 20 ppb, which is the same as reported in the 2012/2013 and 2013/2014 export reports.

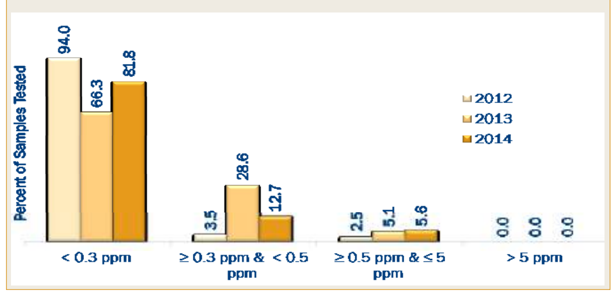
Comparing the 2014/2015 aflatoxin export survey results to the 2012/2013 and 2013/2014 export survey results suggests that there were fewer incidents of aflatoxins in 2014/2015 export samples than in 2012/2013 export samples, but slightly more than in 2013/2014 export samples. Also, the percentage of all samples below 10 ppb in 2014/2015 is about the same as 2013/2014 and greater than 2012/2013. The percentage of all samples below 10 ppb in 2014/2015 was similar to the aflatoxin results from the *Harvest Report 2014/2015.*

RESULTS: DON (DEOXYNIVALENOL OR VOMITOXIN)

A total of 411 export samples were tested for DON for the *Export Cargo Report 2014/2015*. Results of the testing are shown below:

DON					
	Percent of Total Samples				
	< 0.3 ppm	≥ 0.3 to <≤ 0.5 ppm	≥ 0.5 to ≤ 5.0 ppm	> 5.0 ppm	Total
U.S. Aggregate	81.8%	12.7%	5.6%	0.0%	100.0%
By ECA					
Gulf	76.4%	16.4%	7.2%	0.0%	100.0%
Pacific Northwest	100.0%	0.0%	0.0%	0.0%	100.0%
Southern Rail	82.9%	11.4%	5.7%	0.0%	100.0%

DON Testing Results



- 336 samples or 81.8% of the 411 samples tested had DON levels less than 0.3 parts per million (ppm). This 81.8% is less than the 94.0% of the 2012/2013 export samples and higher than the 66.3% of the 2013/2014 export samples.
- 52 samples or 12.7% of the 411 samples tested had DON levels greater than or equal to 0.3 ppm, but less than 0.5 ppm. This 12.7% is greater than the 3.5% of the 2012/2013 export samples and less than the 28.6% of the 2013/2014 export samples.
- 23 samples or 5.6% of the 411 samples tested had DON levels greater than or equal to 0.5 ppm, but less than or equal to the FDA advisory level of 5 ppm. This 5.6% is greater than the 2.5% of the 2012/2013 export samples and the 5.1% of the 2013/2014 export samples.
- 100% of the samples tested were below or equal to the FDA advisory level of 5 ppm, which is the same as that reported in the 2012/2013 and 2013/2014 export reports.

Comparing the 2014/2015 DON export survey results to the 2012/2013 and 2013/2014 DON export survey results indicates that there were fewer incidents of DON in the 2014/2015 export samples than in 2013/2014 export samples and more incidents of DON than in 2012/2013 export samples. All samples were below 5 ppm for all three marketing seasons. The percentage of samples less than 0.5 ppm in 2014/2015 (94.5%) was much higher than DON results reported for the *Harvest Report 2014/2015* (80.2%).

1. Background: General

The levels at which the fungi produce mycotoxins are influenced by the fungus type and the environmental conditions under which the corn is produced and stored. Because of these differences, mycotoxin production varies across the U.S. corn-producing areas and across years.

Humans and livestock are sensitive to mycotoxins at varying levels. As a result, the U.S. Food and Drug Administration (FDA) has issued action levels for aflatoxins and advisory levels for DON by intended use.

- **Action levels** specify precise limits of contamination above which the agency is prepared to take regulatory action. Action levels are a signal to the industry that FDA believes it has scientific data to support regulatory and/or court action if a toxin or contaminant is present at levels exceeding the action level, if the agency chooses to do so. If import or domestic feed supplements are analyzed in accordance with valid methods and found to exceed applicable action levels, they are considered adulterated and may be seized and removed from interstate commerce by FDA.

- **Advisory levels** provide guidance to the industry concerning levels of a substance present in food or feed that are believed by the agency to provide an adequate margin of safety to protect human and animal health. While FDA reserves the right to take regulatory enforcement action, enforcement is not the fundamental purpose of an advisory level.

A source of additional information is the National Grain and Feed Association (NGFA) guidance document titled "FDA Mycotoxin Regulatory Guidance" found at *http://www.ngfa.org/wp-content/uploads/NGFAComplianceGuide-FDARegulatoryGuidanceforMycotoxins8-2011.pdf*.

2. Background: Aflatoxins

The most important type of mycotoxin associated with corn grain is aflatoxins. There are several types of aflatoxins produced by different species of the *Aspergillus* fungus, with the most prominent species being *A. flavus*. Growth of the fungus and aflatoxin contamination of grain can occur in the field prior to harvest or in storage. However, contamination prior to harvest is considered to cause most of the problems associated with aflatoxin. *A. flavus* grows well in hot, dry environmental conditions or where drought occurs over an extended period of time. It can be a serious problem in the southern United States, where hot and dry conditions are more common. The fungus usually attacks only a few kernels on the ear and often penetrates kernels through wounds produced by insects. Under drought conditions, it also grows down silks into individual kernels.

There are four types of aflatoxins naturally found in foods – aflatoxins B1, B2, G1 and G2. These four aflatoxins are commonly referred to as "aflatoxins" or "total aflatoxins." Aflatoxin B1 is the most commonly found type of aflatoxins in food and feed and is also the most toxic. Additionally, dairy cattle will metabolize aflatoxins to a different form of aflatoxins called aflatoxin M1, which may accumulate in milk.

Aflatoxins express toxicity in humans and animals primarily by attacking the liver. The toxicity can occur from short-term consumption of very high doses of aflatoxin-contaminated grain or long-term ingestion of low levels of aflatoxins, possibly resulting in death in poultry and ducks, the most sensitive of the animal species. Livestock may experience reduced feed efficiency or reproduction, and both humans' and animals' immune systems may be suppressed as a result of ingesting aflatoxins.

The FDA has established action levels for aflatoxin M1 in milk intended for human consumption and for total aflatoxins in human food, grain and livestock feed products (see table below).

Aflatoxins Action Level	Criteria
0.5 ppb (Aflatoxin M1)	Milk intended for human consumption
20 ppb	For corn and other grains intended for immature animals (including immature poultry) and for dairy animals, or when the animal's destination is not known
20 ppb	For animal feeds, other than corn or cottonseed meal
100 ppb	For corn and other grains intended for breeding beef cattle, breeding swine or mature poultry
200 ppb	For corn and other grains intended for finishing swine of 100 pounds or greater
300 ppb	For corn and other grains intended for finishing (i.e., feedlot) beef cattle and for cottonseed meal intended for beef cattle, swine or poultry

Source: FDA and USDA GIPSA, http://www.gipsa.usda.gov/Publications/fgis/broch/b-aflatox.pdf

FDA has established additional policies and legal provisions concerning the blending of corn with levels of aflatoxins exceeding these threshold levels. In general, FDA currently does not permit the blending of corn containing aflatoxins with uncontaminated corn to reduce the aflatoxin content of the resulting mixture to levels acceptable for use as human food or animal feed.

Corn exported from the United States must be tested for aflatoxins according to federal law. Unless the contract exempts this requirement, testing must be conducted by FGIS. Corn above the FDA action level of 20 ppb cannot be exported unless other strict conditions are met. These requirements result in relatively low levels of aflatoxins in exported grain.

3. Background: DON (Deoxynivalenol) or Vomitoxin

DON is another mycotoxin of concern to some importers of corn grain. It is produced by certain species of *Fusarium*, the most important of which is *F. graminearum* (*Gibberella zeae*), which also causes Gibberella ear rot (or red ear rot). *Gibberella zeae* can develop when cool or moderate and wet weather occurs at flowering. The fungus grows down the silks into the ear, and in addition to producing DON, it produces conspicuous red discoloration of kernels on the ear. The fungus can also continue to grow and rot ears when corn is left standing in the field. Mycotoxin contamination of corn caused by *Gibberella zeae* is often associated with excessive postponement of harvest and/or storage of high-moisture corn.

DON is mostly a concern with monogastric animals, where it may cause irritation of the mouth and throat. As a result, the animals may eventually refuse to eat the DON-contaminated corn and may have low weight gain, diarrhea, lethargy and intestinal hemorrhaging. It may cause suppression of the immune system, resulting in susceptibility to a number of infectious diseases.

The FDA has issued advisory levels for DON. For products containing corn, the advisory levels are:

- 5 ppm in grains and grain co-products for swine, not to exceed 20% of their diet;
- 10 ppm in grains and grain co-products for chickens and cattle, not to exceed 50% of their diet; and
- 5 ppm in grains and grain co-products for all other animals, not to exceed 40% of their diet.

FGIS is not required to test for DON on corn bound for export markets, but will perform either a qualitative or quantitative test for DON at the buyer's request.

IV. U.S. CORN EXPORT SYSTEM

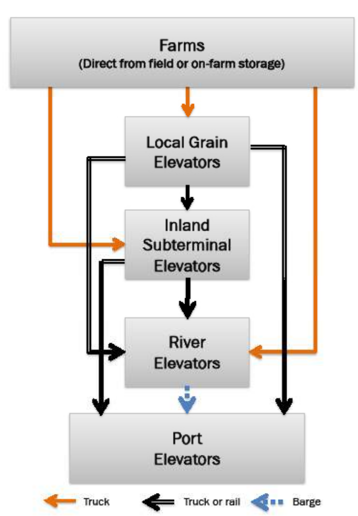
This *U.S. Grains Council Corn Export Cargo Quality Report 2014/2015* provides advance information about corn quality by evaluating and reporting quality attributes when the corn is ready to be loaded onto the vessel or rail car for export. Corn quality includes a range of attributes that can be categorized as:

- Intrinsic quality characteristics – Protein, oil and starch content, hardness and density are all intrinsic quality characteristics and are of critical importance to the end user. Since they are nonvisual, they can only be determined by analytical tests.
- Physical quality characteristics – These attributes are associated with outward visible appearance of the kernel or measurement of the kernel characteristics. Characteristics include kernel size, shape and color, moisture, test weight, total damaged and heat-damaged kernels, broken kernels, stress cracking and potential for breakage. Some of these characteristics are measured when corn receives an official USDA grade.
- Sanitary quality characteristics – These characteristics indicate the cleanliness of the grain. Attributes include presence of foreign material, odor, dust, rodent excreta, insects, residues, fungal infection and non-millable materials.

The intrinsic quality characteristics are impacted significantly by genetics and growing season conditions and typically do not change at the aggregate level as corn moves through the marketing system. On the other hand, the physical and sanitary characteristics can change as corn moves through the market channel. The parties involved in corn marketing and distribution use technologies (such as cleaning, drying and conditioning) at each step in the channel to increase uniformity and to prevent or minimize the loss of physical and sanitary quality. The *Harvest Report 2014/2015* assessed the quality of the 2014 corn crop as it entered the marketing system and reported the crop as good, with low incidences of aflatoxins and DON. This *Export Cargo Report* provides information on the impact of the subsequent practices including cleaning, drying, handling, blending, storing and transporting of the crop at the point where it is being loaded for export. To provide the backdrop for this assessment, the following sections describe the market channel from farm to export, the practices applied to corn as it moves through the market channel, and the implication of these practices on corn quality. Lastly, the inspection and grading services provided by the U.S. government are reviewed.

A. U.S. Export Corn Flow

As corn is harvested, farmers transport grain to on-farm storage, end users, or commercial grain facilities. While some producers feed their corn to their own livestock, the majority of the corn moves to other end users (feed mills or processors) or commercial grain handling facilities such as local grain elevators, inland subterminal or river elevators, and port elevators. Local grain elevators typically receive most of their grain directly from farmers. Inland subterminal or river elevators collect grains in quantities suitable for loading on unit trains and barge tows for further transport. These elevators receive more than half of their corn from other elevators (usually local grain elevators) and are often located where the transport of bulk grain can be easily accommodated by unit trains or barges. Local grain, inland subterminal and river elevators provide functions such as drying, cleaning, blending, storing and merchandising grain. River elevators and the larger inland subterminals supply most of the corn destined for export markets. The figure to the right conveys the flow of U.S. corn destined for export markets.



B. Impact of the Corn Market Channel on Quality

While the U.S. corn industry strives to minimize changes in the physical and sanitary quality attributes as corn moves from the farm to export, there are points in the system where quality changes inevitably occur due to the biological nature of the grain. The following sections provide some insight on why corn quality may change as corn moves from the field to the ocean vessel or rail car.

1. Drying and Conditioning

Farmers often harvest corn at moistures ranging from about 18 to 30%. This range of moisture contents exceeds safe storage levels, which are usually about 14 to 15%. Thus, wet corn at harvest must be dried to a lower moisture to become safe for storage and transport. Conditioning is the use of aeration fans to control temperatures and moisture, both of which are important to monitor for storage stability. Drying and conditioning may occur either on a farm or at a commercial facility. When corn is dried, it can be dried by systems using natural air, low-temperature or high-temperature drying methods. The high-temperature drying methods will often create more stress cracks in the corn and ultimately lead to more breakage during handling than natural air or low-temperature drying methods. However, high-temperature drying is often needed to facilitate timely harvesting of grain.

2. Storage and Handling

In the United States, corn storage structures can be broadly categorized as upright metal bins, concrete silos, flat storage inside buildings or flat storage in on-ground piles. Upright bins and concrete silos with fully perforated floors or in-floor ducts are the most easily managed storage types because they allow aeration with uniform airflow through the grain. Flat storage can be used for short-term storage. This occurs most often when corn production is higher than normal and surplus storage is needed. However, it is more difficult to install adequate aeration ducts in flat types of storage, and they often do not provide uniform aeration. In addition, on-ground piles are sometimes not covered and may be subjected to weather elements that can result in mold damage.

Handling equipment can involve vertical conveying by bucket elevators and/or horizontal conveying, usually by belt or en-masse conveyors. Regardless of how the corn is handled, some corn breakage will occur. The rate of breakage will vary by types of equipment used, severity of the grain impacts, grain temperature and moisture content, and by corn quality factors such as stress cracks or hardness of endosperm. As breakage levels increase, more fines (broken pieces of corn) are created, which leads to less uniformity in aeration and ultimately to higher risk for fungal invasion and insect infestation.

3. Cleaning

Cleaning corn involves scalping or removing large non-corn material and sieving to remove small, shriveled kernels, broken pieces of kernels and fine materials. This process reduces the amount of broken kernels and foreign material found in the corn. The potential for breakage and initial percentages of broken kernels, along with the desired grade factor, dictate the amount of cleaning needed to meet contract specifications. Cleaning can occur at any stage of the market channel where cleaning equipment is available.

4. Transporting Corn

The U.S. grain transportation system is arguably one of the most efficient in the world. It begins with farmers transporting their grain from the field to on-farm storage or local grain and river elevators using either large wagons or trucks. Corn is then transported by truck, rail or barge to its next destination. Once at export facilities, corn is loaded onto ocean-going vessels or rail cars. As a result of this complex yet flexible marketing system, corn may be loaded and unloaded several times, increasing the amount of broken kernels, stress cracks and breakage susceptibility.

Corn quality changes during shipment in much the same manner as it changes during storage. Causes of these changes include moisture variability (non-uniformity) and moisture migration due to temperature differences, high humidities and air temperatures, fungal invasion and insect infestation. However, there are some factors affecting grain transportation that make quality control during transport more difficult than in fixed storage facilities. First, there are few modes of transport equipped with aeration, and as a result, corrective actions for heating and moisture migration cannot take place during transport. Another factor is the accumulation of fine material (spout lines) beneath the loading spout when loading rail cars, barges and ocean vessels. This results in whole kernels tending to roll to the outer sides, while fine material segregates in the center. A similar segregation occurs during the unloading process at each step along the way to final destination.

5. Implications on Quality

The intrinsic quality attributes such as protein cannot be altered within a corn kernel. However, as corn moves through the U.S. corn market channel, corn from multiple sources is mixed together. As a result, the average for a given intrinsic quality characteristic is affected by the quality levels of the corn from the multiple sources. The above-described marketing and transportation activities inevitably alter the various physical and sanitary quality characteristics. The quality characteristics that can be directly affected include test weight, damaged kernels, broken kernels, kernel size, stress crack levels, moisture contents and variability, foreign material and mycotoxin levels.

C. U.S. Government Inspection and Grading

1. Purpose

Global corn supply chains need verifiable, predictable and consistent oversight measures that fit the diverse needs of all end users. Oversight measures, implemented through standardized inspection procedures and grading standards, are established to provide:

1. Information for buyers about grain quality prior to arrival at destination; and
2. Food and feed safety protection for the end users.

The United States is recognized globally as having a combination of official grades and standards that are typically used for exporting grains and referenced in export contracts. U.S. corn sold by grade and shipped in foreign commerce must be officially inspected and weighed by the USDA's Federal Grain Inspection Service (FGIS) or an official service provider delegated or designated by FGIS to do so (with a few exceptions). In addition, all corn exports must be tested for aflatoxins, unless the contract specifically waives this requirement. Qualified state and private inspection agencies are permitted to be designated by FGIS as official agents to inspect and weigh corn at specified interior locations. In addition, certain state inspection agencies can be delegated by FGIS to inspect and weigh grain officially at certain export facilities. Supervision of these agencies' operations and methodologies is performed by FGIS's field office personnel.

2. Inspection and Sampling

The loading export elevator provides FGIS or the delegated state inspection agency a load order specifying the quality of the corn to be loaded as designated in the export contract. The load order specifies the U.S. grade and all other requirements which have been agreed upon in the contract between the foreign buyer and the U.S. supplier, plus any special requirements requested by the buyer such as minimum protein content, maximum moisture content or other special requirements. The official inspection personnel determine and certify that the corn loaded in the vessel or rail car actually meets the requirements of the load order. Independent laboratories can be used to test for quality factors not mandated to be performed by FGIS or for which FGIS does not have the local ability to test.

Shipments or "lots" of corn are divided into "sublots." Representative samples for grading are obtained from these sublots using a diverter sampling device approved by FGIS. This device takes an incremental portion every 500 bushels (about 12.7 metric tons) from the moving grain stream just after the final elevation before loading into the ship or rail car. The incremental portions are combined by sublot and inspected by licensed inspectors. The results are entered into a log and, typically, a statistical loading plan is applied to assure not only that the average result for each factor meets the contract specifications, but also to assure the lot is reasonably uniform in quality. Any sublot that does not meet uniformity criteria on any factor must be returned to the elevator or certified separately. The average of all sublot results for each factor is reported on the final official certificate. The FGIS sampling method provides a truly representative sample, while other commonly used methods may yield non-representative samples of a lot due to the uneven distribution of corn in a truck, rail car or in the hold of a vessel.

3. Grading

Yellow corn is divided into five U.S. numerical grades and U.S. Sample Grade. Each grade has limits for test weight, broken corn and foreign material (BCFM), total damaged kernels and heat-damaged kernels as a subset of total damage. The limits for each grade are summarized in the table shown in the "U.S. Corn Grades and Conversions" section on page 49. In addition, FGIS provides certification of moisture content and other attributes, if requested, such as stress cracks, protein, oil and mycotoxins. Export contracts for corn specify many conditions related to the cargo, in addition to the contract grade. In some cases, independent labs are used to conduct tests not required by FGIS.

Since the limits on all official grade factors (such as test weight and total damage) cannot always be met simultaneously, some grade factors may be better than the limit for a specified grade, but they cannot be worse. For example, a lot may meet the requirements for U.S. No. 2 except for one factor which would cause it to grade U.S. No. 3. For that reason, most contracts are written as "U.S. No. 2 or better" or "U.S. No. 3 or better." This permits some grade factor results to be at or near the limit for that grade, while other factor results are "better than" that grade.

V. SURVEY AND STATISTICAL ANALYSIS METHODS

A. Overview

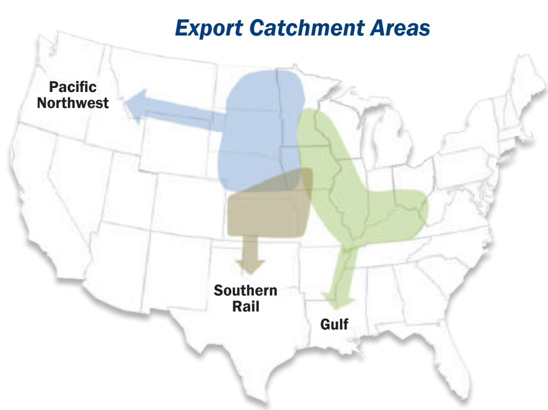
The key points for the survey design and sampling and statistical analysis for this *Export Cargo Report 2014/2015* are as follows:

- Following the process developed for the previous *Export Cargo Reports*, samples were stratified according to Export Catchment Areas (ECAs) – the Gulf, Pacific Northwest and Southern Rail.
- To achieve a maximum ± 10% relative margin of error (Relative ME) for the U.S. Aggregate level and to ensure proportional sampling from each ECA, the targeted number of total samples was 430 samples, to be collected from the ECAs as follows: 292 from the Gulf, 84 from the Pacific Northwest, and 54 from the Southern Rail.
- Southern Rail ECA samples were provided by any of several official agencies designated by USDA's Federal Grain Inspection Service (FGIS) that inspect and grade rail shipments of corn destined for export to Mexico. Gulf and Pacific Northwest samples were collected by FGIS field offices at ports in the respective ECAs.
- Export inspections of shipments from the Southern Rail ECA (interior) did not generate the targeted number of samples for this report because there were few interior shipments meeting the sampling criteria. As a result, 35 samples were collected for the Southern Rail ECA. Nonetheless, the U.S. Aggregate averages for the quality factors were weighted according to the targeted proportion by ECA.
- To evaluate the statistical validity of the number of samples surveyed, the Relative ME was calculated for each of the quality attributes at the U.S. Aggregate and the three ECA levels. The Relative MEs for the quality factor results were less than ± 10% except for three attributes from the Southern Rail and Pacific Northwest ECAs – total damage, stress cracks, and stress crack index.

B. Survey Design and Sampling

1. Survey Design

For this *Export Cargo Report*, the target population was yellow commodity corn from the 12 key U.S. corn-producing states representing about 99% of U.S. corn exports. A ***proportionate stratified sampling*** technique was used to ensure a sound statistical sampling of U.S. yellow corn exports. Two key characteristics define the sampling technique for this report: the ***stratification*** of the population to be sampled and the ***sampling proportion*** per subpopulation or stratum.



Stratification involves dividing the survey population of interest into subpopulations called strata. For the *Export Cargo Reports*, the key corn-exporting areas in the United States are divided into three geographical groupings which we refer to as Export Catchment Areas (ECAs). These three ECAs are identified by the three major pathways to export markets:

1. The Gulf ECA consists of areas that typically export corn through U.S. Gulf ports;
2. The Pacific Northwest ECA includes areas exporting corn through Pacific Northwest and California ports; and
3. The Southern Rail ECA comprises areas generally exporting corn by rail to Mexico.

Using data from the FGIS Export Grain Information System (EGIS), each ECA's proportion of the total annual yellow corn exports for the 2007/2008 through the 2013/2014 corn marketing years was calculated and averaged over the seven marketing years. This average share of exports was used to determine the ***sampling proportion*** (the percent of total samples per ECA) and, ultimately, the number of yellow corn samples to be collected from each ECA. The specified sampling proportions for the three ECAs are as shown in the table at the right.

Percent of Samples per ECA			
Gulf	Pacific Northwest	Southern Rail	Total
67.9%	19.5%	12.6%	100.0%

The ***number of samples*** collected within each ECA was established so the Council could estimate the true averages of the various quality factors with a certain level of precision. The level of precision chosen for the *Export Cargo Report* was a Relative ME of no greater than ± 10%. A Relative ME of ± 10% is a reasonable target for biological data such as these corn quality factors.

To determine the number of samples for the targeted Relative ME, ideally the population variance (i.e., variability of the quality factor in the corn exports) for each of the quality factors should be used. The more variation among the levels or values of a quality factor, the more samples needed to estimate the true mean with a given confidence limit. In addition, the variances of the quality factors typically differ from one another. As a result, different sample sizes for each of the quality factors would be needed for the same level of precision.

Since the population variances for the 15 quality factors evaluated for this year's corn exports were not known, the variance estimates from last year's *Export Cargo Report* were used as estimates of the population variance. The variances and ultimately the estimated number of samples needed for the Relative ME of ± 10% for 12 quality factors were calculated using the 2013/2014 results of 412 samples. Heat damage, 100-k weight, and kernel volume were not examined. Based on these data, a total sample size of 430 would allow the Council to estimate the true averages of the quality characteristics with the desired level of precision for the U.S. Aggregate. Applying the sampling proportions previously defined to the total of 430 samples resulted in the following number of targeted samples from each ECA (shown in table).

Number of Samples per ECA			
Gulf	Pacific Northwest	Southern Rail	Total
292	84	54	430

2. Sampling

The sampling was administered by FGIS and participating official service providers as part of their inspection services. Based on feedback from the FGIS field offices indicating that 2014 corn was reaching export points by November 2014, it was decided to start the sampling period by January 2015. FGIS sent instruction letters to the Gulf and Pacific Northwest field offices and to the domestic inspections office, and the sampling period began in January 2015 for the three ECAs. The FGIS field offices in the respective ECAs responsible for overseeing the sample collection within their region were as follows: Gulf – New Orleans, Louisiana; Pacific Northwest – Olympia, Washington (Washington State Department of Agriculture); and Southern Rail – FGIS Domestic Inspection Operations Office in Kansas City, Missouri.

Representative sublot samples from the ports in the Gulf and Pacific Northwest ECAs were collected as ships were loaded, and only lots for which quantitative aflatoxin testing was being performed were to be sampled. Samples for grading are obtained by a diverter sampling device approved by FGIS. The diverter sampler "cuts" (or diverts) a representative portion at periodic intervals from a moving stream of corn. A cut occurs every few seconds, or about every 500 bushels (about 12.7 metric tons) as the grain is being assembled for export. The frequency is regulated by an electric timer controlled by official inspection personnel, who periodically determine that the mechanical sampler is functioning properly.

While the sampling process is continuous throughout loading, a shipment or “lot” of corn is divided into “sublots” for the purpose of determining uniformity of quality. Sublot size is based on the hourly loading rate of the elevator and the capacity of the vessel being loaded. Sublot sizes range from 60,000 to 100,000 bushels. All sublot samples are inspected to ensure the entire shipment is uniform in quality.

The same sampling frequency for the Pacific Northwest and Gulf ECAs as last year’s export cargo survey was used for this year’s survey. Therefore, sublots ending in 0, 3, 5 and 7 from each lot during the survey period were sampled.

For the Southern Rail samples, a representative sample was taken at domestic interior elevators using a diverter sampler to ensure uniform sampling. A cut is taken about every 500 bushels. A composite sample was made from unit trains of yellow corn inspected for export to Mexico and for which quantitative aflatoxin testing was being performed.

For each sample, a minimum of 2700 grams was collected by the FGIS field staff, the Southern Rail ECA official service providers, and the Washington State Department of Agriculture. The samples were congregated at the field offices, and mailed to Illinois Crop Improvement Association’s Identity Preserved Grain Laboratory (IPG Lab). Refer to the “Testing Analysis Methods” section for the description of the testing methods employed for the study.

The sampling period ended March 9, 2015 for the Pacific Northwest ECA and March 13, 2015 for the Gulf ECA when the targeted number of samples per ECA was reached. As of March 30, 2015, no additional shipments from which samples could be collected were expected for the Southern Rail in the near future. Therefore, in order to publish the *Export Cargo Report* in a timely manner, the sampling period for the Southern Rail ECA concluded on March 30, 2015.

C. Statistical Analysis

The sample test results for the grade factors, moisture, chemical composition and physical factors were summarized as the U.S. Aggregate and also by the three ECAs (Gulf, Pacific Northwest and Southern Rail) and two “contract grade” categories. Contract grades are described in the “Corn Export System” section on page 39. The two contract grade categories in the *Export Cargo Report* are:

- “U.S. No. 2” or “U.S. No. 2 or better” contracts specify that the corn must at least meet U.S. No. 2 factor limits or be better than U.S. No. 2 factor limits. This category is designated as U.S. No. 2 o/b.
- “U.S. No. 3” or “U.S. No. 3 or better” contracts specify that the corn must at least meet U.S. No. 3 factor limits or be better than U.S. No. 3 factor limits. This category is designated as U.S. No. 3 o/b.

The sampling process resulted in less than the targeted number of samples in the Southern Rail ECA. However, the U.S. Aggregate averages and standard deviations were weighted by ECA using the original sampling proportions.

New to this *Export Cargo Report 2014/2015* is a simple average of the quality factors’ averages and standard deviations of the previous three *Export Cargo Reports (2011/2012, 2012/2013* and *2013/2014)*. These simple averages are calculated for the U.S. Aggregate and each of the three ECAs and are referred to as “3YA” in the text and summary tables of the report.

V. SURVEY AND STATISTICAL ANALYSIS METHODS (continued)

The Relative ME was calculated for each of the quality factors tested for this study at the U.S. Aggregate level and for each of the ECAs. The Relative ME was less than ± 10% for all the quality attributes at the U.S. Aggregate level and for the Gulf ECA. The Relative ME exceeded ± 10% for some quality factors (see table) in the Pacific Northwest and Southern Rail ECAs.

	Relative Margin of Error (ME)		
	Total Damage	Stress Cracks	Stress Crack Index
Pacific Northwest ECA	17%	10%	14%
Southern Rail ECA	14%	19%	29%

While the level of precision for these quality factors in the two ECAs is less than desired, the levels of Relative ME do not invalidate the estimates. The averages for the quality factors are the best possible unbiased estimates of the true population means. However, they are estimated with greater uncertainty than the quality factors with a Relative ME of less than ± 10%. Footnotes in the summary tables for "Grade Factors and Moisture" and "Physical Factors" indicate the attributes for which the Relative ME exceeds ± 10%. This allows the reader to keep in mind the greater degree of uncertainty of the sample average representing the true population mean.

References in the "Quality Test Results" section to statistical differences were validated by 2-tailed t-tests at the 95% confidence level. The t-tests were calculated:

- Between factors in the *Harvest Report 2014/2015* and *Export Cargo Report 2014/2015*;
- Between factors in the *Export Cargo Report 2014/2015* and *Export Cargo Report 2013/2014*, and the *Export Cargo Report 2014/2015* and *Export Cargo Report 2012/2013*;
- Among factors in the *Export Cargo Report 2014/2015* ECAs (Gulf, Pacific Northwest, Southern Rail); and
- Between chemical and physical factors in the *Export Cargo Report 2014/2015* contract grades (U.S. No. 2 o/b, U.S. No. 3 o/b).

VI. TESTING ANALYSIS METHODS

USDA's Federal Grain Inspection Service (FGIS) or FGIS-designated official service providers provided official grading and aflatoxin results from their normal inspection and testing procedures for each sublot corn sample collected. The corn samples (approximately 6 pounds/2700 grams) were sent directly from the FGIS field offices and the official service providers to the Illinois Crop Improvement Association's Identity Preserved Grain Laboratory (IPG Lab) in Champaign, Illinois, for the chemical composition, physical factors and DON testing. Upon arrival at IPG Lab, the samples were split into two subsamples using a Boerner divider while keeping the attributes of the grain sample evenly distributed between the two subsamples. One subsample was analyzed for DON. The other subsample was analyzed for the chemical composition and other physical factors following either industry norms or well-established procedures in practice for many years. IPG Lab has received accreditation under the ISO/IEC 17025:2005 International Standard for many of the tests. The full scope of accreditation is available at *http://www.pjview.com/clients/pjl/viewcert.cfm?certnumber=1752*.

A. Corn Grading Factors

1. Test Weight

Test weight is the weight of the volume of grain that is required to fill a Winchester bushel (2,150.42 cubic inches) to capacity. Test weight is a part of the FGIS Official United States Standards for Grain grading criteria.

The test involves filling a test cup of known volume through a funnel held at a specific height above the test cup to the point where grain begins to pour over the sides of the test cup. A strike-off stick is used to level the grain in the test cup, and the grain remaining in the cup is weighed. The weight is then converted to and reported in the traditional U.S. unit, pounds per bushel (lb/bu).

2. Broken Corn and Foreign Material (BCFM)

Broken corn and foreign material (BCFM) is part of the FGIS Official United States Standards for Grain grading criteria.

The BCFM test determines the amount of all matter that passes through a 12/64th inch round-hole sieve and all matter other than corn that remains on the top of the sieve. BCFM measurement can be separated into broken corn and foreign material. Broken corn is defined as all material passing through a 12/64th inch round-hole sieve and retained on a 6/64th inch round-hole sieve. Foreign material is defined as all material passing through a 6/64th inch round-hole sieve and the coarse non-corn material retained on the 12/64th inch round-hole sieve. While FGIS can report broken corn and foreign material separately if requested, BCFM is the default measurement and thus was provided for the *Export Cargo Report*. BCFM is reported as a percentage of the initial sample by weight.

3. Total Damage/Heat Damage

Total damage is part of the FGIS Official United States Standards for Grain grading criteria.

A representative working sample of 250 grams of BCFM-free corn is visually examined by a trained and licensed inspector for content of damaged kernels. Types of damage include blue-eye mold, cob rot, dryer-damaged kernels (different from heat-damaged kernels), germ-damaged kernels, heat-damaged kernels, insect-bored kernels, mold-damaged kernels, mold-like substance, silk-cut kernels, surface mold (blight), surface mold, mold (pink *Epicoccum*) and sprout-damaged kernels. Total damage is reported as the weight percentage of the working sample that is total damaged grain.

Heat damage is a subset of total damage and is kernels and pieces of corn kernels that are materially discolored and damaged by heat. Heat-damaged kernels are determined by a trained and licensed inspector visually inspecting a 250-gram sample of BCFM-free corn. Heat damage, if found, is reported separately from total damage.

B. Moisture

The moisture determined using an approved moisture meter at the time of inspection is reported. These meters are electronic moisture meters that sense an electrical property of grains called the dielectric constant that varies with moisture. The dielectric constant rises as moisture content rises. Moisture is reported as a percent of total wet weight.

C. Chemical Composition

The chemical composition (protein, oil and starch concentration) of corn is measured using Near-infrared transmission spectroscopy (NIRT). The NIRT uses unique interactions of specific wavelengths of light with each sample. It is calibrated to traditional chemistry methods, to predict the concentrations of oil, protein and starch in the sample. This procedure is nondestructive to the corn.

Chemical composition tests for protein, oil and starch were conducted using a 400- to 450-gram (g) sample in a whole-kernel Foss Infratec 1229 Near-Infrared Transmittance (NIRT) instrument. The NIRT was calibrated using reference wet chemistry methods, and the standard errors of predictions for protein, oil and starch were about 0.2%, 0.3% and 0.5%, respectively. Results are reported on a dry basis percentage (percent of non-water material).

D. Physical Factors

1. 100-Kernel Weight, Kernel Volume and Kernel True Density

The 100-kernel weight is determined from the average weight of two 100-kernel replicates using an analytical balance that measures to the nearest 0.1 mg. The averaged 100-kernel weight is reported in grams.

The kernel volume for each 100-kernel replicate is calculated using a helium pycnometer and is expressed in cubic centimeters (cm^3) per kernel. Kernel volumes usually range from 0.18-0.30 cm^3 per kernel for small and large kernels, respectively.

True density of each 100-kernel sample is calculated by dividing the mass (or weight) of the 100 externally sound kernels by the volume (displacement) of the same 100 kernels. The two replicate results are averaged. True density is reported in grams per cubic centimeter (g/cm^3). True densities typically range from 1.16 to 1.35 g/cm^3 at "as is" moistures of about 12 to 15%.

2. Stress Crack Analysis

Stress cracks are evaluated by using a backlit viewing board to accentuate the cracks. A sample of 100 intact kernels with no external damage is examined kernel by kernel. The light passes through the horneous or hard endosperm so the severity of the stress crack damage in each kernel can be evaluated. Kernels are sorted into four categories: (1) no cracks; (2) one crack; (3) two cracks; and (4) more than two cracks. Stress cracks, expressed as a percent, are all kernels containing one, two or more than two cracks divided by 100 kernels. Lower levels of stress cracks are always better since higher levels of stress cracks lead to more breakage in handling. If stress cracks are present, singles are better than doubles or multiples. Some corn end users will specify by contract the acceptable level of cracks based on the intended use.

Stress crack index (SCI) is a weighted average of the stress cracks. This measurement indicates the severity of stress cracking. SCI is calculated as

SCI = [SSC x 1] + [DSC x 3] + [MSC x 5];

Where

SSC is the percentage of kernels with only one crack;

DSC is the percentage of kernels with exactly two cracks; and

MSC is the percentage of kernels with more than two cracks.

The SCI can range from 0 to 500, with a high number indicating numerous multiple stress cracks in a sample, which is undesirable for most uses.

3. Whole Kernels

In the whole kernels test, 50 grams of cleaned (BCFM-free) corn are inspected kernel by kernel. Cracked, broken, or chipped grain, along with any kernels showing significant pericarp damage, are removed, the whole kernels are weighed, and the result is reported as a percentage of the original 50-gram sample. Some companies perform the same test, but report the "cracked & broken" percentage. A whole kernels score of 97% equates to a cracked & broken rating of 3%.

4. Horneous (Hard) Endosperm

The horneous (or hard) endosperm test is performed by visually rating 20 externally sound kernels, placed germ facing up, on a light table. Each kernel is rated for the estimated portion of the kernel's total endosperm that is horneous endosperm. Soft endosperm is opaque and will block light, while horneous endosperm is translucent. The rating is made from standard guidelines based on the degree to which the soft endosperm at the crown of the kernel extends down toward the germ. The average of horneous endosperm ratings for the 20 externally sound kernels is reported. Ratings of horneous endosperm are made on a scale of 70 to 100%, though most individual kernels fall in the 70 to 95% range.

E. Mycotoxin Testing

Official aflatoxin results are provided by FGIS for the *Export Cargo Report 2014/2015*. For the aflatoxin testing, a sample of at least 10 pounds of shelled corn was used according to FGIS official procedures. The 10-pound sample was ground using a FGIS-approved grinder. Following the grinding stage, two 500-gram ground portions are removed from the 10-pound comminuted sample using a riffle divider. From one of the 500-gram ground portions, a 50-gram test portion is randomly selected for testing. After adding the proper extraction solvent to the 50-gram test portion, aflatoxin is quantified. The following FGIS-approved quantitative test kits may have been used: VICAM AflaTest™, Beacon Analytical Plate Kit, Romer Labs FluoroQuant Afla or FluoroQuant Afla IAC, Envirologix QuickTox™ for QuickScan Aflatoxin (AQ 109 BG and AQ 209 BG), Neogen Reveal Q+ for Aflatoxin, Reveal Q+ for Aflatoxin Green, or Veratox® Aflatoxin Quantitative Test, Charm Sciences ROSA® FAST, WET™, WET™ XR Aflatoxin Quantitative Test, or R-Biopharm RIDASCREEN® FAST Aflatoxin SC test or RIDA QUICK Aflatoxin RQS.

For the DON testing, the FGIS-approved Envirologix QuickTox™/QuickScan method was used. A 1350-gram sample of shelled corn (obtained by dividing the original sample) was ground to a particle size which would pass through a number 20 wire mesh sieve and divided down to a 50-gram test portion using a Romer Model 2A sampling mill. The 50-gram test portion was then processed as the FGIS *DON (Vomitoxin) Handbook* requires. DON was extracted with distilled water (5:1), and the extract was tested using the Envirologix AQ 254 BG test kits. The DON was quantified by the QuickScan system.

The EnviroLogix quantitative test kits report specific concentration levels of the mycotoxin if the concentration level exceeds a specific level called a "Limit of Detection" (LOD). The LOD is defined as the lowest concentration level that can be measured with an analytical method that is statistically different from measuring an analytical blank (absence of a mycotoxin). The LOD will vary among different types of mycotoxins, test kits and commodity combinations. The LOD for the EnviroLogix AQ 254 BG is 0.3 parts per million (ppm) for DON.

A letter of performance has been issued by FGIS for the quantification of DON using the Envirologix AQ 254 BG kit.

VII. U.S. CORN GRADES AND CONVERSIONS

U.S. CORN GRADES AND GRADE REQUIREMENTS

Grade	Minimum Test Weight per Bushel (Pounds)	Maximum Limits of Damaged Kernels: Heat Damaged (Percent)	Maximum Limits of Damaged Kernels: Total (Percent)	Maximum Limits of Broken Corn and Foreign Material (Percent)
U.S. No. 1	56.0	0.1	3.0	2.0
U.S. No. 2	54.0	0.2	5.0	3.0
U.S. No. 3	52.0	0.5	7.0	4.0
U.S. No. 4	49.0	1.0	10.0	5.0
U.S. No. 5	46.0	3.0	15.0	7.0

U.S. Sample Grade is corn that: (a) Does not meet the requirements for the grades U.S. Nos. 1, 2, 3, 4 or 5; or (b) Contains stones with an aggregate weight in excess of 0.1 percent of the sample weight, two or more pieces of glass, three or more crotalaria seeds *(Crotalaria spp.)*, two or more castor beans *(Ricinus communis L.)*, four or more particles of an unknown foreign substance(s) or a commonly recognized harmful or toxic substance(s), eight or more cockleburs *(Xanthium spp.)*, or similar seeds singly or in combination, or animal filth in excess of 0.20 percent in 1,000 grams; or (c) Has a musty, sour or commercially objectionable foreign odor; or (d) Is heating or otherwise of distinctly low quality.

Source: Code of Federal Regulations, Title 7, Part 810, Subpart D, United States Standards for Corn

U.S. AND METRIC CONVERSIONS

Corn Equivalents		Metric Equivalents	
1 bushel =	56 pounds (25.40 kilograms)	1 pound =	0.4536 kg
39.368 bushels =	1 metric ton	1 hundredweight =	100 pounds or 45.36 kg
15.93 bushels/acre =	1 metric ton/hectare	1 metric ton =	2204.6 lbs
1 bushel/acre =	62.77 kilograms/hectare	1 metric ton =	1000 kg
1 bushel/acre =	0.6277 quintals/hectare	1 metric ton =	10 quintals
56 lbs/bushel =	72.08 kg/hectoliter	1 quintal =	100 kg
		1 hectare =	2.47 acres

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