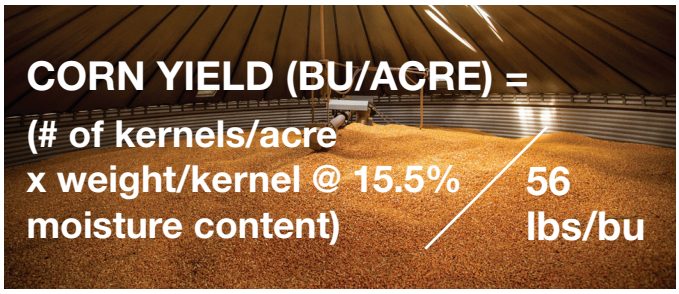
Relationship of Corn Test Weight and Drydown Rates

// Drydown starts when physiological maturity occurs and its rate depends on air temperature and moisture conditions.

// Test weight is a measurement of bulk density or weight of a unit volume of grain, which for corn is pounds/bushel.



Drydown

Once physiological maturity or black layer for corn occurs, which is around 30% moisture content, kernel drydown begins. How quickly the kernels lose moisture depends on environmental and other factors. Warm, dry weather can speed up the drying rate and cool, wet weather can slow the rate down. Other factors include late-planting, full-season products, influence of foliar or stalk rot diseases, insect damage to shanks and stalks, and inadequate or unavailable fertility issues. Typical loss of moisture content per day may range from 0.4 to 0.8% depending on environmental temperature and moisture and can be as low as 0.3% or greater than 1%.[1]

As day length becomes shorter and average temperatures decrease, the rate of moisture content loss generally decreases. Corn maturing at the beginning of September should dry faster than corn that matures a month later. Along with atmospheric moisture, physical characteristics of the ear, husk, and kernel can influence how quickly moisture "flows" (or returns) from the kernel.

Physical characteristics that can hasten the loss of kernel moisture content include:

- Fewer and thinner husk leaves.
- Quick death (natural or by disease) of husk leaves.
- Husks that are open at the ear tip.
- Overall husk looseness.
- Ears that droop from an upright position (Upright ears can capture rainfall).
- Thinner kernel pericarps or outer layer.

The optimum harvest moisture content for corn is about 23 to 25%.[3] At this moisture content range, kernels generally shell from the cob easily. During harvest time, kernel moisture content loss averages about 1 to 2% per day.[2] Waiting to harvest until moisture content is about 17 to 19% can save on artificial drying costs; however, there is a greater potential for stalk lodging, ear drop, and mechanical loss of kernels prior to reaching the combine harvesting throat.

Test Weight

There is no true relationship between drydown and grain test weight (TW) except that TW usually increases as is always discussed at harvest. Test weight is a measurement of bulk density or weight of a unit volume of grain (lb/bu). Corn test weight can range from 45 lb/bu to over 60 lb/bu.[3] The United States Department of Agriculture established 56 lb/bu as the standard TW for corn based on 15.5% moisture content (Table 1).

Table 1. Test weight needed to equal one bushel of No. 2 shelled corn (at 15.5% moisture) when corn is harvested at various moisture levels.[9]

% Moisture in corn	Test Weight (lb)
14.0	55.02
15.0	56.67
15.5	**56.00**
16.0	56.33
17.0	57.01
18.0	57.71

Source: Corn Field Guide, 2nd edition. 2013. Iowa State University.

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Some specialty food corn products use TW as an indicator of favorable grain characteristics for processing. In the United States today, grain yield is still referenced in bu/acre; however, it is actually marketed on a weight basis.

Test weight is measured when grain is sold and can affect the price offered in certain areas, such as those that offer premiums for high TW or when selling in the whole food grade market. However, in most cases, only TWs below the minimum for No. 2 yellow corn (less than 54 lb/bu) would be discounted.[5]

Any stress that prematurely stops or reduces grain fill and/or interferes with photosynthesis could lower yield potential and TW. Grain yield is determined by the number of kernels/acre along with the weight of each kernel, which is represented by the equation:

Corn Yield (bu/acre) = (# of kernels/acre x weight/kernel @ 15.5% moisture content) ÷ 56 lb/bu

In comparison, TW measures the weight of corn in pounds that can fit into a bushel. Yield is a direct measure of kernel weight and kernel number. However, TW is not a direct factor of grain yield. Test weight is only partially related to kernel weight because there is the volume component associated with the measurement.

Factors that affect TW, but not corn yield, are those that influence how kernels fit or pack together such as seed coat slipperiness, and kernel shape and size. Due to the volume component, TW influences how many bushels can fit into a bin, wagon, or truck, but not bu/acre. Grain yield and TW are not correlated. Yield can be high and TW low and vice versa. As examples, seed size may be small because of various reasons but density of the individual seeds remain unchanged. The TW of popcorn has a relatively high standard TW of 65 lb/bu; however, average popcorn yields are much less than field corn.[6,7,8]

Corn yield is the result of accumulated dry matter in the kernel and the number of kernels produced/acre. If two different corn products are grown in an environment to support the same produced amount of dry matter (12,320 lb of dry matter/acre or 220 bu/acre) but one has a higher TW, the higher TW product has less volume per unit of grain. In addition to environmental stresses impacting TW, individual corn products through genetics can have different TWs.

This results from the kind of endosperm within the kernels. Products with higher vitreous (hard or flinty) endosperm can have a higher density and TWs compared to products with floury (soft or dent) endosperms. However, endosperm content does not necessarily correlate to differences in genetic yield potential.

Sources (verified August 2018) and Legals

[1]Elmore, R. and Abendroth, L. 2007. How fast can corn drydown? Iowa State University Extension., [2]Thomison, P. Field drying and scheduling corn harvest. 2009. C.O.R.N. Newsletter. The Ohio State University., [3]Hicks, D. 2004. Corn test weight changes during drying. Minnesota Crop News.http://blog.lib.umn.edu/efans/cropnews/., [4]Hurburgh, C. and Elmore, R. 2008. Corn quality issues in 2008 – moisture and test weight. Integrated Crop News. Iowa State University Extension. www.extension.iastate.edu/., [5]Nafziger, E. 2003. Test weight and yield: A connection? The Bulletin. University of Illinois. http://bulletin.ipm.illinois.edu/., [6]Nielsen, R.L. 2012. Test weight issues in corn. Corny News Network. Purdue University. www.agry.purdue.edu/ext/., [7]Bern, C. and Brumm, T. 2009. Grain test weight deception. Iowa State University Extension. PMR 1005. http://lib.dr.iastate.edu/., [8]Rankin, M. 2009. Understanding corn test weight. University of Wisconsin Extension. Team Grains., [9]Lauer, J. 2002. Methods for calculating corn yield. University of Wisconsin. Field Crops 28.47-33. http://corn.agronomy.wisc.edu/.

Other Sources: Geyer, A. and Thomison, P. Corn drydown. C.O.R.N. Newsletter 2006-28. The Ohio State University., Coulter, J. 2008. Maturity, frost, and harvest moisture considerations for corn. Minnesota Crop eNews. University of Minnesota Extension, Hicks, D.R. 2004. The corn crop—frost and maturity. University of Minnesota., Nielsen, R.L. 2008. Field drydown of mature corn grain. Purdue University. Corny News Network. 130812080221

Table 2. Example calculation of corn value, with different test weights.[7]

	Load 1	Load 2	Load 3
Weight (lbs)	20,000	20,000	20,000
# of bushels to be sold	357.14	357.14	357.14
Moisture content (%)	14.5	14.5	14.5
Test weight (lb/bu)	54.0	59.0	51.0
Volume (ft^3)	461	422	488
Price ($/bu)	$4.00	$4.00	$4.00 - $0.04*= $3.96
Calculation of value (bu × price)	357.14 × $4.00	357.14 × $4.00	357 .14 × $3.96
Value ($)	$1,428.57	$1,428.57	$1,414.27
*discount charged for low test weight			