AGRONOMIC Spotlight

Technology Development by MONSANTO

Understanding Corn Test Weight

Test weight is a term that is often misunderstood. Confusion arises from the belief there is an economic benefit to high test weight grain and that high test weights contribute to yield. In reality neither of these perceptions is true.

History

Hundreds of years ago grain was sold by the bushel (32 quarts or 1.2445 ft3 of grain). This was because it was easier to see a volumetric measurement than it was to weigh grain accurately and consistently. Then in 1916, the United States Grain Standards Act was passed. It included the concept of measuring grain test weight to account for differences in grain density.

Test weight is a measurement of bulk density, or weight of a unit volume, of grain (bu/lb). Iowa State University reports that corn test weight values can range from 45 lbs/bu to over 60 lbs/bu. The USDA established the standard test weight of a bushel of corn as 56 lb/bu based on 15.5% moisture content. For some specialty food corn, test weight is used as an indicator of grain characteristics which are favorable for processing.

Today in the United States, grain yield is still referenced in bushels per acre but it is actually traded and sold on a weight basis. Test weight is still measured when grain is sold today. However, it has no effect on the price the grower will be paid, unless the test weight is below the standard for #2 yellow corn (<54 lbs/bu) in which case there could be quality docks.

Is yield influenced by test weight?

Any stress that prematurely stops or reduces grain fill and/or interferes with photosynthesis has the potential to lower yield potential as well as test weight. Grain yield is determined by the number of kernels per acre along with the weight per kernel, which is shown in the equation below:

In comparison, test weight measures the weight of corn in pounds that will fit into a bushel. Yield is a direct measure of kernel weight and kernel number. However, test weight is not a direct factor of grain yield. Test weight is only partially related to kernel weight because there is also the volume component associated with the measurement. Factors that affect test weight but not corn yield are those that influence how kernels fit or pack together. These may include slipperiness of the seed coat as well as kernel shape or size. Due to its volume component, test weight will influence how many bushels a grower can fit into a bin, wagon or truck, but not yield per acre.

Is there a correlation between yield and test weight?

Many think yield will always be lower if test weight is lower and vice versa. If this were true, hybrids with high test weight grain would regularly outyield hybrids with average test weight grain. Yield can be high and test weight can be low. For example, if the time for grain fill is shortened the seed size may be smaller but the density of the individual seeds remains unchanged.

Conversely, yield can be low and test weight can be high. Popcorn is a good example of this as it is more dense than field corn and has a relatively high standard test weight of 65 lb/bu compared to 56 lb/bu for field corn. Yet, average popcorn yields are half as much as field corn.

$$\text{Corn yield (bu/acre)} = \frac{\text{\# of kernels per acre X weight per kernel at 15.5\% moisture content}}{\text{56 lb/bu (standard weight of a bushel)}}$$

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In some instances, corn test weights may be lower than expected due to changes in kernel weight from stresses during kernel fill. Lower kernel weights can also result in lower yield and therefore, the test weight can be low as well. It is important to remember that changes in yield and test weight are not always proportional or correlated.

Corn yield is about the accumulation of dry matter in the kernel and the number of kernels produced per acre. Controlled by the limitations of the environment and hybrid potential, the maximum amount of dry matter possible will be accumulated within that acre. If corn is grown in an environment that will support the production of 12,320 lbs of dry matter (220 bu) per acre and two different hybrids yield similarly but one has higher test weight than the other, the higher test weight hybrid has produced the same amount of dry matter but with less volume per unit of grain. However, the end result of equivalent yields is reached.

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Table 1. Example calculations of corn value, with varying test weight.

	Load #1	Load #2	Load #3
Weight (lbs)	20,000	20,000	20,000
# of bushels to be sold (=weight/56)[a]	357.14	357.14	357.14
Moisture content[b]	14.50%	14.50%	14.50%
Test weight (lb/bu)	54	59	51
Volume (ft^3)	461	422	488
Price ($/bu)	$4.25	$4.25	$4.25-.04 = $4.21[c]
Calculation of value	357.14 bu X 4.25/bu	357.14 bu X 4.25/bu	357.14 bu X 4.21/bu
Value ($)	$1,517.85	$1,517.85	$1,503.56

[a] = 56 lb/bu is the standard weight of a bushel established by the USDA.
[b] = Moisture discounts and drying charges usually apply when the moisture content exceeds 15%. There are no moisture discounts or drying charges in this example.
[c] = Includes a test weight discount of $0.04 per bu due to a test weight below 54 lbs/bu.

Source: Iowa State University
