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Adjusting Crop Yield to a Standard Moisture Content[1]

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Introduction

Reporting crop yield at a standardized moisture content is important for proper grain storage, standardization across buying points (buyers want to purchase grain, not water), and the comparison of results across research trials. Manuscripts and papers often report yield at a standardized moisture content, but do not describe the calculation used in the methods section because it is believed to be a trivial calculation (e.g., Halvorson et al. 2011; Jani et al. 2020; Lamb et al. 2004; Mulvaney et al. 2019; Mulvaney et al. 2014). It is also common to report yield without stating *if* yield was standardized for moisture content (e.g., Halevy et al. 1987; Killorn and Moore 2007; Mulvaney et al. 2017; Thomason et al. 2018).

Grain moisture is simply the weight of the water divided by the wet grain weight (Kraszewski et al. 1998). Since there are different ways to report moisture (as a decimal or as a percentage), and because the calculation seems intuitive, there is some confusion among agricultural professionals about how to adjust yield to a standardized moisture content. This publication aims to clarify the concept and the math.

The Common Mistake

Adjusting yield for a given moisture content seems, at first glance, to be an easy and intuitive calculation. After all, if we know the moisture content and weight, we should be able to simply subtract out the weight of the water to find dry mass and then add in the standardized moisture content. For example, suppose you harvested 10,000 lb corn/ac at a grain moisture content of 20% (10,000 x 0.2 = 2,000 lb water/ac). It would make sense to subtract that amount of water from the yield to get dry matter (10,000 lb/ac – 2,000 lb/ac = 8,000 lb/ac dry matter), and then multiply by the standardized moisture content (for corn, that is 15.5%) to find the amount of water that *should* be in the crop (8,000 lb/ac x 0.155 = 1,240 lb water/ac). Add that to your dry matter yield, and that would seem to be the yield at standardized moisture content (8,000 lb dry matter/ac + 1,240 lb water/ac = 9,240 lb corn/ac at 15.5% moisture content). The apparent simplicity of this reasoning has led many to report incorrect crop yields inadvertently.

The Correct Reasoning

The confusion stems from thinking about the amount of moisture instead of the amount of dry matter per acre. That is, instead of multiplying by a standard moisture content, one must divide by the standard *dry matter* content (Pask et al. 2012). In our example above, 8,000 lb dry matter/ac was incorrectly multiplied by the standard moisture content (0.155) to find the amount of moisture we needed to add back to the yield. Instead, we need to *divide* by the dry matter content as shown in the calculations below.

1. In this example, the standard dry matter content is 1 – 0.155 = 0.845 (or 84.5% dry matter).
2. Now if we take 8,000 lb dry matter/ac and divide by the standard dry matter content (8,000/0.845), we get 9,467 lb corn/ac at 15.5% moisture content.

One will note that the two methods differ by 227 lb/ac, or 4 bu/ac, or 2.4% in this example.

The Simple Math

The formula looks different depending on how moisture content is presented. That is, moisture content could be reported as a percentage (e.g., 20%) or as a decimal (e.g., 0.20). Even though these are the same number, this difference creates considerable confusion regarding how to apply the equation, even among experienced professionals.

To forego the math and use a spreadsheet that will automatically calculate yield at a standard moisture content, click here, use the QR code below, or copy and paste this link: https://wfrec.ifas.ufl.edu/media/wfrecifasufledu/docs/doc/Yield-Moisture-Adjustment.xlsx.

Using Decimal Form

The easiest formula uses the decimal form of moisture content (i.e., 0.20). In this case, the formula to determine yield at a standard moisture content is shown in Equation 1.

$$\frac{(Harvest\ yield) \times (1 - Harvest\ moisture)}{(1 - Standard\ moisture)}$$

Equation 1.

Continuing with the example above for shelled corn:

Given:

Harvest yield = 10,000 lb/ac

Harvest moisture = 0.20

Standard moisture = 0.155

Then:

Using Equation 1,

$$\frac{\left(10{,}000\ \frac{lb}{ac}\right) \times (1 - 0.20)}{(1 - 0.155)} = \frac{\left(10{,}000\ \frac{lb}{ac}\right) \times (0.80)}{0.845}$$

$$= \frac{8{,}000\ \frac{lb}{ac}}{0.845} = 9{,}467\ \frac{lb}{ac}\ at\ 15.5\%\ standard\ moisture\ content$$

Using Percent Form

The only difference here is that we must convert the percent moisture into a decimal. The formula, in essence, remains the same. In this case, the equation becomes:

$$\frac{(Harvest\ yield) \times \left[\frac{(100\% - Harvest\ moisture\ \%)}{100\%}\right]}{\left[\frac{100\% - Standard\ moisture\ \%}{100\%}\right]}$$

Equation 2.

Given:

Harvest yield = 10,000 lb/ac

Harvest moisture = 20%

Standard moisture = 15.5%

Then:

Using Equation 2,

$$\frac{\left(10{,}000\ \frac{lb}{ac}\right) \times \left[\frac{(100\% - 20\%)}{100\%}\right]}{\left[\frac{100\% - 15.5\%}{100\%}\right]} = \frac{\left(10{,}000\ \frac{lb}{ac}\right) \times (0.80)}{0.845}$$

$$= \frac{8{,}000\ \frac{lb}{ac}}{0.845} = 9{,}467\ \frac{lb}{ac}\ at\ 15.5\%\ standard\ moisture\ content$$

Standard Moisture Content and Bushel Weights

It is often useful to report yield in terms of bushels/ac. Since a bushel is a volume, not a weight, the weight per bushel varies by commodity. Standard moisture (%) and US bushel weights (in lb) for common crop commodities are shown in Table 1.

Conclusion

Do not rely on intuition when adjusting yield to a standard moisture content. Be conscientious about the differences between expressing moisture content as a decimal vs. a percentage. Although the calculation is simple, it continues to confuse laypeople and professionals alike. For a simple spreadsheet to calculate yield at a given moisture content, click here, follow the QR code provided above, or copy and paste this address: https://wfrec.ifas.ufl.edu/media/wfrecifasufledu/docs/doc/Yield-Moisture-Adjustment.xlsx.

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Table 1. Standard moisture (%) and US bushel weights for select crop commodities. Data compiled from Hellevang (1995); Kraszewski and Nelson (1993); Langham et al. (2008); Mulvaney et al. (2019); Murphy (1993); National Sunflower Association (2007); and USDA (1992, 2013).

Commodity	Standard Moisture (%)	US lb/bu at Standard Moisture
Canola	8.5	50
Carinata	8	50
Ear corn	15.5	70
Grain sorghum	13	56
Oat	13.5	32
Peanut, unshelled, Runner-type	10.5	21
Peanut, unshelled, Spanish-type	10.5	25
Peanut, unshelled, Virginia-type	10.5	17
Sesame	6	46
Shelled corn	15.5	56
Soybean	13	60
Sunflower, unshelled	10	25
Wheat	13.5	60

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