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Best Management Practices for Corn Production in South Dakota: Useful Calculations: Corn Yields and Storage Requirements

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CHAPTER 14
Useful Calculations: Corn Yields and Storage Requirements

Table 14.1. Distance conversion multipliers

		Unit Converting To (UT)								
		Mile (Mi)	Rod (Rd)	Yard (yd)	Foot (ft)	Inch (in)	Kilometer (Km)	Meter (m)	Centimeter (cm)	Millimeter (mm)
Unit Converting From (UF)	Mile	-	320	1,760	5,280	63,360	1.609	1,609	160,934	*
	Rod	0.003125	-	5.5	16.5	198	0.00503	5.03	502.9	*
	Yard	0.000568	0.1818	-	3	36	0.00091	0.914	91.44	914.4
	Foot	0.000189	0.0606	0.333	-	12	0.00031	0.3048	30.48	304.8
	Inch	*	0.0051	0.028	0.083	-	*	0.0254	2.54	25.4
	Kilometer	0.6214	198.84	1,093.6	3,280.8	39,370	-	1,000	100,000	*
	Meter	0.00062	0.1988	1.0936	3.28	39.370	0.001	-	100	1,000
	Centimeter	*	*	0.0109	0.0328	0.3937	*	0.01	-	10
	Millimeter	*	*	*	0.00328	0.0394	*	0.001	0.1	-

Example: To convert miles to rods, multiply the number of miles by 320.
* Values are either too large or small to be useful for conversion. If it is necessary to convert to these units, convert to a larger or smaller unit and then convert that result to the desired unit. Conversion multiplier values have been rounded but will provide accurate results in most situations.

Table 14.2. Area conversion multipliers

		Unit Converting To (UT)								
		Square Mile (Mi^2)	Acre (Ac)	Square Yard (yd^2)	Square Foot (ft^2)	Square Inch (in^2)	Square Kilometer (Km^2)	Hectare (ha)	Square Meter (m^2)	Square Centimeter (cm^2)
Unit Converting From (UF)	Square Mile	-	640	*	*	*	2.59	259	*	*
	Acre	0.0015625	-	4,840	43,560	*	0.00405	0.4047	4,047	*
	Square Yard	*	*	-	9.0	1,296	*	*	0.8361	8,361
	Square Foot	*	*	0.1111	-	144	*	*	0.0929	929
	Square Inch	*	*	*	0.0069	-	*	*	0.0006	6.4516
	Square Kilometer	0.3861	247	*	*	*	-	100	1,000,000	*
	Hectare	0.003861	2.47	*	*	*	0.01	-	10,000	*
	Square Meter	*	*	1.196	10.764	1,550	*	*	-	10,000
	Square Centimeter	*	*	*	0.00108	0.155	*	*	*	-

* Values are either too large or small to be useful for conversion. If it is necessary to convert to these units, convert to a larger or smaller unit and then convert that result to the desired unit. Conversion multiplier values have been rounded but are appropriate in most situations.

Table 14.3. Liquid volume measure conversion multipliers

Unit Converting From (UF)	Unit Converting To (UT): Acre Inch (Ac*In)	Cubic Foot (ft³)	Gallon (Gal.)	Quart (Qt.)	Pint (Pt.)	Cup (C)	Fluid Ounces (Fl. Oz)	Table-spoon (Tbsp)	Tea-spoon (Tsp)	Cubic Meter (m³)	Liter (L)
Acre Inch	-	3,630	27,154	*	*	*	*	*	*	102.79	*
Cubic Foot	0.000275	-	7.48	29.92	59.84	*	*	*	*	0.0283	28.32
Gallon	*	0.1337	-	4	8	16	128	256	768	0.003785	3.785
Quart	*	0.0334	0.25	-	2	4	32	64	192	0.000946	0.946
Pint	*	0.0167	0.125	0.5	-	2	16	32	96	0.000473	0.473
Cup	*	0.0084	0.0625	0.25	0.5	-	8	16	48	0.000237	0.236
Fluid Ounces	*	0.0011	0.0078	0.03125	0.0625	0.125	-	2	6	0.000029	0.029
Table-spoon	*	*	0.0039	0.01562	0.03125	0.0625	0.5	-	3	*	*
Teaspoon	*	*	0.0013	0.00521	0.01042	0.0208	0.167	0.334	-	*	*
Cubic Meter	*	35.31	264.17	1056.7	2113.38	4226.75	33,814	*	*	-	1000
Liter	*	0.0353	0.2642	1.05669	2.11337	4.2268	33.814	67.628	202.884	0.001	-

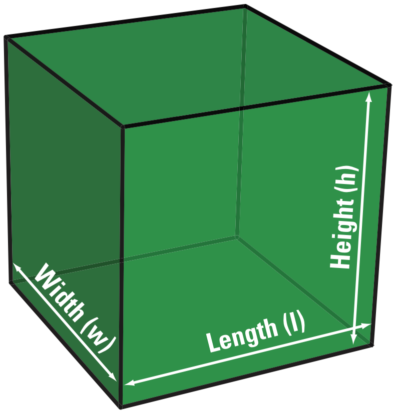
* Values are either too large or small to be useful for conversion. If it is necessary to convert to these units, convert to a larger or smaller unit and then convert that result to the desired unit. Conversion multiplier values have been rounded but are appropriate in most situations.

Table 14.4. Dry volume measure conversion multipliers

Unit Converting From (UF)	Unit Converting To (UT): Bushel (Bu)	Peck (Pk)	Dry Quart (qt-d)	Cubic Yard (yd³)	Cubic Foot (ft³)	Cubic Meter (m³)	Cubic Centimeter (cc)	Liter (L)	Milliliter (mL)
Bushel	-	4	32	0.0461	1.244	0.0352	35,239	35.24	35,239
Peck	0.25	-	8	0.0115	0.311	0.0088	8,810	8.81	8,810
Dry Quart	0.03125	0.125	-	*	0.039	*	1,101	1.101	*
Cubic Yard	21.7	86.785	*	-	27.0	0.7646	764,555	764.555	764,555
Cubic Feet	0.804	3.214	25.71	0.037	-	0.0283	28,317	28.317	28,317
Cubic Meter	28.378	113.51	908	1.308	35.315	-	1,000,000	1,000	1,000,000
Cubic Centimeter	*	*	*	*	*	*	-	0.0001	1.0
Liter	0.0284	0.1135	0.908	0.00131	0.0353	0.001	1,000	-	1,000
Milliliter	*	*	*	*	*	0.000001	1.0	0.001	-

* Values are either too large or small to be useful for conversion. If it is necessary to convert to these units, convert to a larger or smaller unit and then convert that result to the desired unit. Conversion multiplier values have been rounded but are appropriate in most situations.

Figure 14.1. Perimeter, area, and volume of a square, rectangle, or cube



Square or Rectangle

Perimeter = $(l \times 2) + (w \times 2)$

Area = $l \times w$

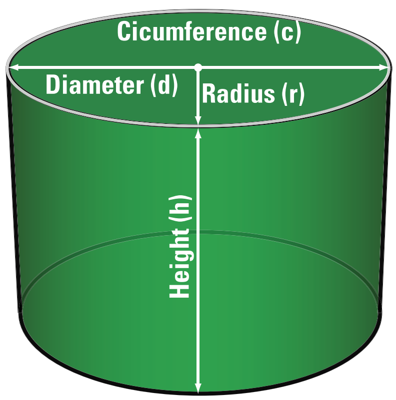
Cube or 3-Dimensional Rectangle

Perimeter = $(l \times 4) + (w \times 4) + (h \times 4)$

Surface Area = $(l \times w) \times 6$

Volume = $l \times w \times h$

Figure 14.2. Circumference, area, and volume of circles and cylinders



Pi **(π) = 3.14159**

Area of a Circle (A)

$A = \pi \times r^2$

Circumference (c)

$c = 2 \times r \times \pi$

Volume of Cylinder (v)

$v = \pi \times r^2 \times h$

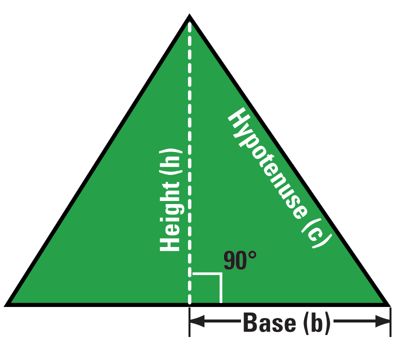
Volume of a Cone

$v = \frac{1}{3} \times r^2 \times \pi \times h$

Volume of Sphere

$v = \frac{4}{3} \times \pi \times r^2$

Figure 14.3. Measurements for triangular objects



Length of any Side of a Right Triangle

Pythagorean Theorem: $A^2 + B^2 = C^2$

Where:

- A = Height (h)
- B = Base (b)
- C = Hypotenuse (c)

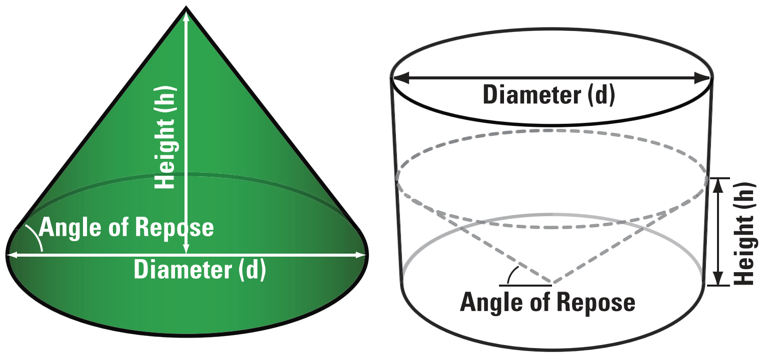
Area of a Triangle

Area = $(b \times h) \div 2$

Volume of a Pyramid (v)

$v = \left(\frac{1}{3}\right) \times ((b \times 2) \times h)$

Figure 14.4. Estimating the volume of a cone



$$v = \frac{1}{3} \times r^2 \times \pi \times h$$

Where:
- v= Volume
- r= radius
- π= Pi = 3.14159
- h= height

(Courtesy of Wilke & Wyatt 2002)

Estimating the Amount of Grain in a Pile

Corn is often piled on the ground when covered storage is not available. The amount of corn in a cone-shaped pile can be estimated by finding the volume using the equation in figure 14.4. The radius (r) of the pile is estimated by measuring the diameter (d) and dividing by two. The height of the pile can be estimated by measuring it or by finding the pile's angle of repose (AR). AR can be measured using a clinometer, or estimated using standard values provided in Table 14.5. Friction, cohesion, the shape of the grain, grain moisture, fine and foreign material content, spoilage, and the method for filling or emptying will influence AR. For dry corn, AR values range from 15 to 26 degrees (0.40 to 0.49 radians). Representative values of AR for selected crops in degrees and radians are provided in Table 14.5.

For the example below, consider a pile of corn with a diameter of 120 feet and an assumed AR of 23 degrees (Table 14.5). An estimate of the amount of grain is found using the following steps:

1) Find the radius of the pile from measured diameter (d):

$$r = \left(\frac{d}{2}\right) = \left(\frac{120\text{ ft}}{2}\right) = 60\text{ ft}$$

2) Estimate the height (h) of the pile using the AR.

$$h = (\mathit{Tan}\ \text{AR}) \times (r\text{ ft}) = (0.42) \times (60\text{ ft}) = 25.2\text{ ft}$$

3) Find the volume (v) of the cone:

$$v = \left[\frac{1}{3} \times r^2\right] \times \pi \times h = \left[\frac{1}{3} \times (60)^2\right] \times 3.14159 \times 25.2 = 95{,}001\text{ ft}^3$$

4) Convert cubic feet (ft^3) to bushel:

$$v_{bushel} = 95{,}001_{ft3} \times 0.803 = 76{,}286_{bushel}$$

The amount of corn is found by multiplying the volume in ft^3 by 0.803 (Table 14.4).

Table 14.5. Angle of repose (AR) for selected commodity grains

Crop	[1]Angle (AR°)		Tangent (tan(AR°))
	Deg.	Rad.	
Barley	28	0.49	0.53
Corn (Shelled)	23	0.40	0.42
Oats	28	0.49	0.53
Soybeans	25	0.44	0.47
Sunflowers	27	0.47	0.51
Wheat	25	0.44	0.47

(Adapted from Wilke & Wyatt 2002 and Grain Drying, Storage, and Handling Handbook, MWPS-13)

[1]Angles reported in degrees (Deg.) and radians (Rad.). To convert from degrees to radians:

$$\text{radians} = \text{degrees} \times \left(\frac{180}{\pi}\right)$$

Estimating Corn Yields

Estimates of pre-harvest yield can be helpful for planning purposes. One method for calculating a pre-harvest yield estimate is to sample a number of ears in a known area, calculate the number of kernels per ear, and convert kernels per ear to bushels per acre. Pre-harvest yield can be estimated by following the steps below:

Table 14.6. Length of row equal to 1⁄1000 acre at selected row spacing

Row Spacing (inches)	Length equal to 1⁄1000 acre
7	74 feet, 8½ inches
15	34 feet, 10 inches
22	23 feet, 8 inches
30	17 feet, 5 inches
38	13 feet – 9 inches

1) Measure the length of row required for 1⁄1000 acre. For fields with 30-inch row spacing, 1⁄1000 is equal to the area of a rectangle that is 30-inches wide and 17-feet-and-5-inches long (Table 14.6).
2) Determine the average number of kernels on a representative ear by counting the number of rows and the number of kernels in a row. IMPORTANT: Select an average-looking ear; if the largest ear is selected, yield is overestimated; if the ear is too small, yield is underestimated. Averaging the number of kernels per ear from several ears improves accuracy. Calculate the kernels per ear as shown below:

$$\frac{\text{kernels}}{\text{ear}} = \left[\left(\frac{\text{kernels}}{\text{rows}}\right)\times\left(\frac{\text{rows}}{\text{ear}}\right)\right] = \left[\left(\frac{35\text{ kernels}}{\text{rows}}\right)\times\left(\frac{16\text{ rows}}{\text{ear}}\right)\right] = \frac{560\text{ kernels}}{\text{ear}}$$

3) Count the number of plants in the length of row or sample area (SA). In the example below, 27 plants were counted in a 17-feet-5-inch row. The average number of ears per plant can be used, but in most cases it is recommended to assume 1 ear per plant.

$$\frac{\text{kernels}}{\text{SA}} = \left(\frac{\text{kernels}}{\text{ear}}\right)\times\left(\frac{\text{ear}}{\text{plant}}\right)\times\left(\frac{\text{plant}}{\text{ear}}\right) = \left(\frac{560\text{ kernels}}{\text{ear}}\right)\times\left(\frac{1\text{ ear}}{\text{plant}}\right)\times\left(\frac{27\text{ plants}}{\text{SA}}\right) = \frac{15{,}120\text{ kernels}}{\text{SA}}$$

4) An estimate of yield (bu/acre) is calculated by converting the value of kernels/sampling area (SA) to bu/acre. For this calculation it will be assumed that a bushel contains approximately 80,000 kernels.

$$\text{Yield }\frac{\text{bu}}{\text{acre}} = \left(\frac{\text{kernels}}{\text{SA}}\right)\times\left(\frac{\text{bu}}{\text{kernels}}\right) = \left(\frac{15{,}120\text{ kernels}}{0.001\text{ acre}}\right)\times\left(\frac{1\text{ bu}}{80{,}000\text{ kernels}}\right) = \frac{189\text{ bu}}{\text{acre}}$$

Estimating Yield Loss During Harvest

Measure the number of kernels in a 1ft^2 area behind the combine and convert units to bu/acre. The example below shows that if 13 kernels are collected, the yield loss is 7.1 bu/acre.

$$\text{Yield loss} = \left(\frac{13\text{ kernels}}{\text{ft}^2}\right)\left(\frac{43{,}560\text{ ft}^2}{\text{acre}}\right)\left(\frac{1\text{ bu}}{80{,}000\text{ kernels}}\right) = \frac{7.1\text{ bu}}{\text{acre}}$$

Note: This calculation assumes that a bushel of corn contains 80,000 kernels.

Estimating Test Weight (TW)

Test weight (TW) is a measure of grain quality and is defined as the amount of weight the grain must have to make one bushel. Test weight increases as grain dries because dry kernels pack together more easily than wet ones. In addition, kernels shrink as they dry, allowing for more kernels to make up a bushel. Test weight is usually measured by weighing one dry quart of corn and converting that value to pound per bushel. When calculating test weight, it is important to remember that one dry quart is not equal to one liquid quart. One dry quart is equal to 4⅔ cups, and one bushel contains 32 dry quarts. For example, what is the test weight if 1 dry quart (4⅔ cups) of corn at 15.5% moisture weighs 28 ounces?

$$\text{Test weight }\left(\frac{\text{lbs}}{\text{bu}}\right) = \left(\frac{\text{oz}}{\text{DryQt}}\right)\times\left(\frac{32\text{ DryQt}}{1\text{ bushel}}\right)\times\left(\frac{1\text{ lbs}}{16\text{ oz}}\right)$$

$$\text{Test weight }\left(\frac{\text{lbs}}{\text{bu}}\right) = \left(\frac{28\text{ oz}}{1\text{ DryQt}}\right)\times\left(\frac{32\text{ DryQt}}{1\text{ bushel}}\right)\times\left(\frac{1\text{ lbs}}{16\text{ oz}}\right) = \frac{56\text{ lbs}}{\text{bu}}$$

Grain Moisture

The grain percent moisture is defined by the following equation:

$$\% \text{ moisture} = \left(\frac{\text{water weight}}{\text{water weight - dry grain}}\right) 100\%$$

If it is assumed that 1 bushel of corn at 15.5% moisture weighs 56 pounds, then 1 bushel of corn contains 47.32 pounds of dry corn. Based on the equation

$$\frac{\text{lb}}{\text{bu}} = \left(\frac{47.32 \text{ lbs/bu}}{100 - \% \text{ moisture}}\right) \times 100$$

the weight of corn required to produce 47.32 pounds of dry matter can be calculated (Table 14.7). These values should not be confused with either test weight or how bushels of corn are actually calculated at the elevator.

Table 14.7. Corn moisture conversions relative to a standard bushel

% moisture	lb/bu	% moisture	lb/bu
11.0	53.17	21.0	59.90
12.0	53.77	22.0	60.67
13.0	54.39	23.0	61.45
14.0	55.02	24.0	62.26
15.0	55.67	25.0	63.09
15.5	56.0	26.0	63.95
16.0	56.33	27.0	64.82
17.0	57.01	28.0	65.72
18.0	57.71	29.0	66.65
19.0	58.42	30.0	67.60
20.0	59.15	31.0	68.58

(Adapted from Evans et al. 1997)

Grain Marketing

Corn yield is measured either in bushels or in standard bushels (Table 14.8). Yield monitors generally calculate yields in standard bushels (56 lbs. at 15.5% moisture), while elevators often calculate yields in bushels (56 lbs., irrespective of moisture percentage). Corn yield is classified and graded according to standards outlined in rules administered by the Grain Inspection, Packers and Stockyards Administration, an agency of the United States Department of Agriculture. Most corn grown in South Dakota is marketed as yellow dent corn and carries a grade that ranges from 1 to 6. Factors influencing grade are broken kernels and foreign material; test weight; heat damage; damaged kernels (total); stones; heating; musty, sour, or other objectionable foreign odor; and distinct low quality (Evans et al. 1997). Grain moisture is not a grading factor, but it greatly influences quality and is important in dockage schedules.

Yield estimates and trading schedules are based on the "bushel" volume unit; however, grain is usually weighed at the point of sale. Standard test weight is used to convert the weight of grain to bushels and is also an indicator of grain quality. Most grain buyers will base dockage schedules on 56 lbs/bu at 15.5% moisture, which is the weight per bushel at the maximum permitted moisture content of U.S. No. 2 corn (Evans et al. 1997).

Table 14.8. Standard test weight values at selected grain moisture content

	Grain Moisture (%)					
	20%	18%	15.5%	13%	10%	0%
Commodity	----------Weight (lbs/bu.)----------					
Corn	59.15	57.71	*56.0	54.39	52.58	47.32
Soybeans	65.25	63.65	61.78	*60.0	58.0	52.2
Wheat	64.88	63.29	61.42	[1]*60.0	57.67	51.9

[1]Standard Test Weight Value Based on 13.5% Moisture
* Standard Test Weight (Stw) Values

Table 14.9. Theoretical moisture shrink factors for drying shelled corn to various final moisture levels

Final Moisture Content (FGM) (%)	Moisture Shrink Factor (MS)(% shrink per point)
15.5	1.183
15	1.176
14	1.163
13	1.149
12	1.136
11	1.126
10	1.111
9	1.099
8	1.087
0	1.000

$$MS = (IGM - FGM) \times MSF$$

Where:
MS = Moisture Shrink (%)
IGM = Initial Grain Moisture (%)
FGM = Final Grain Moisture (%)

1. For corn with a moisture content (IGM) of 20%, determine the moisture shrinkage if dried to 15.5%.
   5.32%=(20%-15.5%) × 1.183
2. For corn with a moisture content of 20%, determine the moisture shrinkage if dried to 13%.
   8.043%=(20%-13%) × 1.149

(Adapted from Hicks and Cloud 1992)

Evaluating Grain Sales

Growers should seek more than one quote when selling corn because grain buyers use different discounts. Grain buyers may use a "pencil shrinkage" method to calculate the total shrink factor (TS). TS is the sum of the moisture shrink factor (MS) and handling shrink factor (HS). TS is calculated with the following equation:

$$TS = MS + HS$$

Theoretical MS for grain are shown in Table 14.9. Handling shrink varies from buyer to buyer. The actual amount of handling shrink has extreme variations (Hoffbeck 2007). The example below is provided to demonstrate how shrinkage is used to determine selling price:

Problem: A seller has 100,000 lbs of corn with 20% initial grain moisture content (IGM). To get the best price for his corn, he obtains 2 bids.

Buyer #1 quotes a price of $5.00 per dry bushel, uses a TS of 1.25, and shrinks grain to a final grain moisture content (FGM) of 14%.

Buyer #2 quotes a price of $5.05 per dry bushel, uses a TS of 1.35, and shrinks grain to an FGM of 13%.

To whom should the seller sell the corn? Both buyers assume wet corn weighs 56.0 lbs/bu. The value of the corn is found using the following equation:

$$\text{Value of Corn} = \left[\frac{(100\text{-}(TS(IGM\text{-}FGM)))}{100}\right] \times \left[\left(\frac{\text{lbs wet corn}}{\text{Lot}}\right) \times \left(\frac{1\text{ bu}}{56.0\text{ lbs}}\right)\right] \times \left[\frac{\text{price (\$)}}{\text{bu}}\right]$$

Where:
TS = Total Shrink (%) = Moisture Shrink (MS) + Handling Shrink (HS)
IGM = Initial Grain Moisture (%)
FGM = Final Grain Moisture (%)

Buyer #1:

$$\$8{,}259.00 = \left[\frac{(100\text{-}(1.25(20\%\text{-}14\%)))}{100}\right] \times \left[\left(\frac{10{,}000\text{ lbs}}{\text{Lot}}\right) \times \left(\frac{1\text{ bu}}{56.0\text{ lbs}}\right)\right] \times \left[\frac{\$5.00}{\text{bu}}\right]$$

Buyer #2:

$$\$8{,}166.00 = \left[\frac{(100\text{-}(1.35(20\%\text{-}13\%)))}{100}\right] \times \left[\left(\frac{10{,}000\text{ lbs}}{\text{Lot}}\right) \times \left(\frac{1\text{ bu}}{56.0\text{ lbs}}\right)\right] \times \left[\frac{\$5.05}{\text{bu}}\right]$$

In the example, the seller receives $93.00 more for the lot of corn from buyer #1 than buyer #2.

Why use the term shrinkage?
Our forefathers developed the way corn is bought and sold. A clear understanding of the method is needed to maximize your payments. Before large-scale weighing was available at most country elevators, corn was sold by volume (thus the bushel became the basic unit of grain commerce). The inside dimensions of a grain wagon were measured to determine the wagon's width, length, and the height of the grain in the box. A bushel (United States dry measure) equals 2150.42 cubic inches (CRC handbook). When wet corn (greater than 15.5% moisture content) was bought, it was found that as the grain dried, it lost volume (test weight increased by .25 to .5 lb/bu point); thus the term "shrinkage" was used to describe the phenomena of loss of volume when there was a loss of moisture from a load of corn. Today, while we don't measure the volume and instead make most transactions based upon weight, we still use the word shrinkage to indicate moisture loss.

Mechanical Drying Costs

Whether corn is dried on-farm or at a commercial grain terminal, there is cost associated with drying. Typical on-farm gas-fired dryers use 0.015 to 0.025 gal. propane (LP)/(bushel per moisture percentage point). If 0.02 gal. of propane is used to reduce the moisture content 1% in one bushel of corn, then the cost per bushel per percent moisture is \$0.04 (assuming \$2.00/gal propane cost). The cost for dry-down of a bushel of grain 1 percentage point is calculated in the following manner:

$$\frac{\$0.04}{\text{bu}} = \left(\frac{0.02 \text{ gal}}{\text{bu}} \times \frac{\text{LP } \$2.00}{\text{gal LP}}\right)$$

Capital costs for drying vary widely. It is not unusual for capital cost to range from \$0.01 to \$0.02 per bushel per percentage point. Labor adds additional cost, ranging from \$0.01 to \$0.02 bushel per moisture percentage point. Based on these estimates, drying costs could be around \$0.08 per bushel per percent moisture. Based on these estimates, the drying cost of drying 23% moisture corn to 15.5% would be \$0.60 per bushel [\$0.08·(23% - 15.5%)]. Moisture shrinkage can be calculated in the following manner:

$$\left(\frac{(23\text{-}15.5) \times 1.183}{100}\right) = 8.875\% \text{ per bushel}$$

Total shrinkage and drying costs would be \$1.088/bushel (\$0.60 + [0.08875 × \$5.50/bu]). Propane cost varies considerably; current price estimates may be found at http://tonto.eia.doe.gov/dnav/pet/pet_pri_prop_dcu_nus_m.htm.

Bin Storage Requirements

As corn yields have increased, so has the on-farm storage of corn. Producers may store grain for livestock feed or simply to retain equity. Just like any other piece of equipment, storage bins are capital assets that depreciate and require maintenance. The right amount of storage considers production potential, but the proportion of that production stored on-farm will vary by operation. Determining bin capacity is a simple calculation of the volume of a cylinder. For example, a bin with a diameter of 30 feet and a height of 36 feet holds how much corn?

1) Calculate volume (fig. 14.2):

$$25{,}447 \text{ cubic ft} = 3.14159 \times \left(\frac{30 \text{ ft}}{2}\right)^2 \times 36 \text{ ft}$$

2) Convert cubic feet to bushel (Table 14.4):

$$v(\text{bu}) = x \text{ ft}^3 \times \left(\frac{0.804 \text{ bu}}{1 \text{ ft}^3}\right)$$

$$20{,}000 \text{ bu} \approx 25{,}447 \text{ ft}^3 \times \left(\frac{0.804 \text{ bu}}{1 \text{ ft}^3}\right)$$

Additional Information and References

Digital Dutch, 2004. WWW Unit Converter. Digital Dutch, Amsterdam. http://www.digitaldutch.com/unitconverter/.

Evans, M.G., R.L. Nielsen, and C.B. Southard. 1997. USDA Grading Standards and Moisture Conversion Table for Corn. Purdue University Cooperative Extension Service, West Lafayette. http://www.ces.purdue.edu/extmedia/ay/ay-225.pdf.

Hicks, D.R. and H.A. Cloud. 1991, Calculating grain weight shrinkage in corn due to mechanical drying. National Corn Handbook. NCH-61. Purdue University Cooperative Extension Service, West Lafayette. http://www.ces.purdue.edu.

Hoffbeck, C. 2007. How to determine corn moisture shrink and total shrink. Field Facts 7:11. 1–2. Pioneer HiBred International.

Rankin, M. 2007. Bushels, test weight, shrink, and storage. University of Wisconsin Extension Service. http://www.uwex.edu/ces/crops/bushelstestweight.htm.

Wilcke, W. 1999. Calculating bushels. University of Minnesota Extension Service. http://www.bbe.umn.edu/extens/postharvest/bushels.pdf.

Wilcke, W. and G. Wyatt. 2002. Grain storage tips. Factors and Formulas for Crop Drying, Storage and Handling. University of Minnesota Extension Service, St. Paul. http://www.extension.umn.edu/distribution/cropsystems/M1080-FS.pdf.

Reitsma, K.D., D.E. Clay, S.A. Clay, and C.G. Carlson. 2009. "Useful calculations: corn yields and storage requirements." Pp. 111–19. In Clay, D.E., K.D Reitsma, and S.A, Clay (eds). Best Management Practices for Corn Production in South Dakota. EC929. South Dakota State University, South Dakota Cooperative Extension Service, Brookings, SD.

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