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ID-205

Drought-Stressed Corn Silage Valuation—2012 Guide

Greg Halich and Kenny Burdine, Agricultural Economics, and Jeff Lehmkuhler, Animal and Food Sciences

Extended dry conditions have impacted the corn crop severely in many areas of the state this year. As the condition of the corn crop deteriorates, many have been forced to look at salvage options such as cutting corn for silage and possibly hay for some fields. Due to the extreme weather conditions this year, this publication will focus on valuing drought-stressed corn silage.

Before Harvesting

The investments in the corn crop this year are not to be taken lightly. With the crop looking to be in severe risk of failure, many are seeking options to recover some of these expenses. Cutting this crop for silage is a viable option.

One of the first steps producers should take when considering cutting a field for silage is to check with their crop-insurance agent. The agent will help them understand the various choices and rules associated with silage within the context of their insurance policy. Producers have two primary options: They can leave the field alone, harvest their crop, and collect payments on the difference between harvested bushels (or revenue) and their guarantee, or they can harvest their crop as silage. In order to harvest the crop as silage, they must contact their insurance agent and have an adjuster come out and determine the yield. To help determine yield, the adjuster may ask for test strips to be left that will be used to determine final yield.

Once the method to measure yield has been determined, the adjuster can release the field to be harvested for silage. Insurance indemnity payments will work much like option one, as if the crop had been left standing until harvest. If a second crop (i.e. soybeans) is going to be planted on corn-silage ground, it will impact corn indemnity payments. In the case where a second crop is planted, crop insurance would pay 35 percent of the corn indemnity payment. If no loss is found in the second crop, the remaining 65 percent corn indemnity payment would be paid. If an indemnity exists on the second crop, producers must decide whether to accept the remaining 65 percent corn indemnity payment or the second crop indemnity payment. Regardless of the specific situation, producers looking to chop corn for silage need to contact their insurance agent.

Nitrate testing is another crucial step the producer should take before chopping. High nitrate levels in forages can be toxic to ruminants. Because corn can accumulate nitrates under drought conditions, it is not recommended that it be grazed or fed as green chop unless it has been tested for nitrates and found to be safe. The ensiling process can reduce nitrates by 30 percent to 60 percent. Sampling prior to chopping will provide information on the relative risk of the forage for livestock feed. Samples should be obtained and analyzed after the ensiling process as well to determine at what levels it can be fed safely to livestock as the nitrate concentration will have been reduced through the ensiling process. (For more information on nitrates and testing, see **www.uky.edu/Ag/GrainCrops/Briefs/nitrate_testing2012.html.**)

Moisture testing is an essential decision-making tool when making silage. Corn usually should be 60 percent to 70 percent moisture when harvesting with the intent of ensiling. Silage that is excessively wet may not ferment well, spoilage losses will be greater, and excessive seepage will occur. Silage that is too dry will not pack well, causing poor fermentation and spoilage. Using a moisture tester (i.e. Koster moisture tester) is the best method for determining the moisture content. However, if a tester is not available, one can use the microwave method for determining moisture content (Figure 1). Corn that is already too dry may not be able to be harvested as silage and may have to be harvested as stover or hay. Attempting to add water at the bagger or blower may not be feasible. In general, if it requires 4-5 gallons of water per ton for each percentage point change in moisture, the rate of water addition may not be feasible. For example, an average fill rate in a bagger of 15 tons per hour with the need to raise the moisture content by 10 percent would require a flow rate of approximately 15 gallons per minute. A three-quarter inch garden hose with 40 psi at the source and ran 200 feet to the bagger would only supply 9 gallons per minute. Small increases in moisture may be feasible with a water hose at the bagger or blower, but it is difficult to get large volumes of water under normal situations to raise the moisture in silage by large degrees.

Figure 1. Microwave Moisture Test for Silage.

1. Collect a representative sample of fresh plants.
2. Chop plants into 1-2 inch pieces, and place in a container large enough to mix thoroughly. Mix pieces well.
3. Weigh a 3-4 ounce (or 100-gram) sample on a kitchen scale. A digital scale works best.
4. Spread the sample over a microwave-safe dish, and place in the oven. In the back corner of the oven place a coffee cup or glass with a small amount of water in it. Adding the cup of water ensures the silage does not ignite.
5. Heat for 1-2 minutes on high. Weigh the sample, and record the weight.
6. Heat for another 30 seconds and reweigh. Repeat until there is no change in weight.
7. Calculate the moisture:

$$\% \text{ Moisture} = \frac{(\text{Starting Wt} - \text{Final Wt}) \times 100}{(\text{Start Wt})}$$

Quality

Drought-stressed corn silage will be variable in quality depending on when the silage experiences the stress. In some situations, the plant may be slightly shorter and have normal grain yield, raising the starch content. However in silage with stress-impacted ear development and barren corn, the feeding value may range from 65 percent to 100 percent of normal corn silage (Table 1). The feeding value remains high even without ears because the carbohydrates produced by the plant that would normally be used to build starch in the ear remain in green leaves and stalks. In most cases, the feeding value is expected to be around 75 percent to 85 percent that of normal silage for drought-stressed corn silage, but it is recommended that silage be sampled and a representative sample be submitted for nutritive analyses to aid in formulating a feeding program. The drier the plant becomes the lower the feeding value will be, as the sugar content will decline. Harvesting drought-stressed corn silage must be done at the appropriate moisture content to capture the highest quality and ensure good fermentation.

The protein content is often slightly higher than normal corn silage and may contain excessive levels of non-protein nitrogen in the form of nitrate nitrogen. For this reason, silage harvested from drought-stressed fields should be tested for nitrates prior to feeding. In addition, it is not generally recommended to use nitrogen supplements such as urea when feeding drought-stressed corn silage. Plant-derived protein supplements including soybean meal, cottonseed meal, distillers grains, and corn-gluten feed are preferred. Research has shown steers consuming drought-stressed corn silage and supplemented with soybean meal had daily gains approximately 35 percent higher than those receiving urea.

Table 1. Feeding Value of Drought-stressed Corn Silage.

Description	Feeding Value (Estimated % of Normal Silage)
Stressed (no ears, stunted)	65-80
Severely stressed (5-20 bu/acre grain yield)	80-90
Stressed during pollination only (3½ bu/acre grain yield) or moderately stressed (40-60 bu/acre grain yield)	90-100

(Adapted from *Feeding Drought Corn Silage to Beef Cows*, Drs. Daryl Strohbehn and Dan Loy)

Yield

Drought conditions have a greater impact on both grain and silage yield than on quality. Yields may be as low as 2½ tons per acre in severely stunted corn. In general, the grain portion represents approximately 45 percent to 50 percent of the volume in normal corn silage. Thus, for corn silage with 20 bushels of corn or less, the yield reduction will be approximately 40 percent to 50 percent —or roughly 10 tons to the acre—less silage yield per acre for 160-170 bushels of corn.

Yield will be quite variable, even within a field. If an ear is present, an approximate grain yield can be determined by counting the number of kernel rows on the ear. Then count the number of kernels per row. Next, estimate the number of ears per acre, which can be derived from the projected stand density. The next step is to multiply the kernel rows per ear times kernels per row times ears per acre. Divide this value by 90,000 to get an estimate of bushels per acre. For example, an ear with 12 kernel rows x 22 kernels per row x 18,000 ears per acre = 4,752,000/90,000 = 53 bushel/acre. This estimate should be done in multiple areas of the field to obtain a representative sampling of the field. A rule of thumb for estimating corn-silage yield without ears or poorly pollinated ears is 1 ton per foot of height of the corn. Thus, corn that is 7 feet tall would be estimated to yield 7 tons of corn silage at 70 percent moisture. Note that this will not work for corn that is less than three feet tall. The most important thing to remember is to weigh silage carts or trucks to get an actual yield from the field when selling or buying silage.

Drought-Stressed Corn Valuation: How Much is it Worth?

This section provides a framework to evaluate the most economical use of drought-stressed corn stands. For the most part, the two options are continuing with grain harvest as planned or chopping the corn to be fed or sold for feed. Clearly, many factors are unknown at this point, including the yield of the corn if harvested for grain, the price of hay if purchased this fall, and other key factors. Therefore, results are shown in a sensitivity format so users can make their own assumptions about important factors.

Several assumptions inherent in the decision-making process are worth discussing. The first has to do with the quick screening nitrate test described in the previous section. When analyzing the following economic scenarios, it was assumed that silage was safe to be fed at any level. Generally, this assumption implies the corn either passed the quick screening test or was chopped and allowed to ferment for a minimum of four weeks.

Secondly, it is important that producers be aware of which perspective the decision is being viewed from, the grain operation or the livestock operation. To a grain producer, they must receive more from the silage than they would from selling the grain (net of additional expenses), or potentially leaving the crop standing (avoided nutrient removal). From the perspective of the cattle producer, they must be able to purchase silage (including all production costs) for less than they could purchase the cheapest alternative feed on a nutrient basis. For an opportunity to cut the corn for silage to exist, the maximum feed value of the silage must exceed the minimum value of the grain. If opportunity exists, the agreed upon price between the two parties should fall somewhere between these two thresholds.

Grain Producer Perspective

The first thing that grain producers need to acknowledge is that money already spent on the corn crop is sunk. The desire to recoup investments is natural. However, the money that has been spent on land rent, seed, fertilizer, and other expenses is gone and has no bearing on the decision at this point. Furthermore, the amount spent thus far by the grain farmer has no impact on the value for feeding purposes, as will be seen in the next section.

From the perspective of the grain producer, the starting point of the analysis is the value of the grain. Producers need to make their best estimate of grain yield and multiply by the price of corn for fall delivery. For the purpose of this analysis, fall corn price is assumed to be $7.00 in tables 2 and 3 and grain yield is permitted to range from 0 to 120 bushels per acre.

The second step is to subtract harvesting and delivery cost if selling grain in the fall. If the corn were combined and delivered, these expenses would have to be subtracted from revenue. If chopped for silage, they are not incurred at all. In this analysis, harvesting costs are assumed to be $20 per acre plus 75 cents per bushel; trucking costs to the elevator are set at 25 cents per bushel (high for much of Western Kentucky and low for much of south-central Kentucky).

Finally, the grain producer must consider nutrient loss if the corn is chopped for silage. When harvested for grain, the stover left in the field supplies nutrients, particularly phosphorous (P) and potassium (K), back to the soil. If chopped, this material is removed and these nutrients would need to be replaced in the long term. In other words, drought stressed corn left in the field still has nutrient value and should be accounted for when considering chopping it. Additional nutrient removal (silage minus grain) is accounted for by valuing P and potash at 55 cents per pound on an elemental basis.

Results from the grain perspective are shown in tables 2 and 3 below. In both tables it is assumed the grain farmer does not pay any of the chopping, hauling, or other handling costs. Table 2 reports the minimum price per ton of corn silage for grain producers to be as well off as they would be harvesting and delivering the corn, given the assumptions made. Table 3 reports the same, but expresses it on a per-acre basis for the standing corn. Again, the assumptions made are critical to the final value, so sensitivity tables are used. Producers need to make their best estimate of both silage and grain yield, consider the other assumptions discussed earlier, and use these estimates as a guide.

Table 2. Minimum Selling Price of Corn Silage Per Ton Basis Grain Farmer ($7 Per Bushel of Corn).

Silage Yield (tons)	Corn Yield (bu)							
	0	**10**	**20**	**40**	**60**	**80**	**100**	**120**
2.5	$2	$23	-	-	-	-	-	-
5.0	$4	$15	$27	$52	-	-	-	-
7.5	$5	$12	$20	$37	$54	$70	-	-
10.0	$5	$11	$17	$29	$42	$54	$67	$79
12.5	$5	$10	$15	$25	$35	$45	$55	$65
15.0	$6	$9	$13	$22	$30	$38	$47	$55

Assumptions: Net P and K removal, calculated by stover removal less grain removal; $.55/lb P_2O_5; $.55/lb K_2O. Harvest cost = $20 + $.075/bu; Trucking cost = $.25/bu.

Table 3. Minimum Selling Price of Corn Silage Per Acre Basis Grain Farmer ($7 Per Bushel of Corn).

Silage Yield (tons)	Corn Yield (bu)							
	0	**10**	**20**	**40**	**60**	**80**	**100**	**120**
2.5	$4	$58	-	-	-	-	-	-
5.0	$20	$74	$137	$262	-	-	-	-
7.5	$35	$90	$153	$278	$403	$528	-	-
10.0	$51	$106	$169	$294	$419	$544	$670	$795
12.5	$67	$122	$184	$310	$435	$560	$685	$811
15.0	$83	$138	$200	$325	$451	$576	$701	$826

Assumptions: Net P and K removal, calculated by stover removal less grain removal; $.55/lb P_2O_5; $.55/lb K_2O. Harvest cost = $20 + $.075/bu; trucking cost = $.25/bu.

Table 4. Silage Harvest and Haul/Fill Costs.

Tons per acre	$ Chop/ acre	$ Chop/ ton	$ Haul/ fill	Total cost/ acre	Total cost/ton
0.0	$30	-	$0	$30	-
2.5	$40	$16.00	$15	$55	$22.00
5.0	$50	$10.00	$30	$80	$16.00
7.5	$60	$8.00	$45	$105	$14.00
10.0	$70	$7.00	$60	$130	$13.00
12.5	$80	$6.40	$75	$155	$12.40
15.0	$90	$6.00	$90	$180	$12.00
17.5	$100	$5.71	$105	$205	$11.71
20.0	$110	$5.50	$120	$230	$11.50

As an example, if a grain farmer estimated a field yielded 20 bushels of grain and 7½ tons of silage, the minimum he would have to receive for the silage to make it worthwhile is $20 per ton, or $153 per acre. If he had to pay for any of the chopping cost, he would add these costs to this minimum.

Table 5. Maximum Feed Value of Corn Silage Per Ton Basis Very Low Silage Yields (2.5 tons/acre).

Hay Price (Ton)	Hay Waste Rate	TDN Silage								
		55%			60%			65%		
		Silage Waste Rate			Silage Waste Rate			Silage Waste Rate		
		10%	20%	30%	10%	20%	30%	10%	20%	30%
$60	15%	$3	$0	$0	$6	$2	$0	$10	$6	$1
	25%	$8	$4	$0	$12	$8	$3	$16	$11	$6
	35%	$15	$10	$5	$19	$14	$9	$24	$18	$12
$80	15%	$14	$9	$4	$18	$13	$8	$23	$17	$11
	25%	$20	$15	$9	$26	$20	$14	$31	$24	$18
	35%	$29	$23	$16	$35	$28	$21	$40	$33	$25
$100	15%	$25	$19	$12	$30	$24	$17	$36	$29	$21
	25%	$33	$26	$19	$39	$32	$24	$45	$37	$29
	35%	$43	$35	$27	$50	$42	$33	$57	$48	$39
$120	15%	$36	$28	$21	$42	$34	$26	$49	$40	$32
	25%	$45	$37	$29	$53	$44	$35	$60	$50	$40
	35%	$58	$48	$39	$66	$56	$45	$74	$63	$52

Assumptions: Dry matter silage 40%; TDN hay 50%; Weekly labor requirements are 5 hours for hay and 8.5 hours for silage. Silage chopping, hauling, handling costs paid by buyer.

Table 6. Maximum Feed Value of Corn Silage Per Ton Basis Low Silage Yields (5 tons/acre).

Hay Price (Ton)	Hay Waste Rate	TDN Silage								
		55%			60%			65%		
		Silage Waste Rate			Silage Waste Rate			Silage Waste Rate		
		10%	20%	30%	10%	20%	30%	10%	20%	30%
$60	15%	$9	$5	$1	$12	$8	$4	$16	$12	$7
	25%	$14	$10	$6	$18	$14	$9	$22	$17	$12
	35%	$21	$16	$11	$25	$20	$15	$30	$24	$18
$80	15%	$20	$15	$10	$24	$19	$14	$29	$23	$17
	25%	$26	$21	$15	$32	$26	$20	$37	$30	$24
	35%	$35	$29	$22	$41	$34	$27	$46	$39	$31
$100	15%	$31	$25	$18	$36	$30	$23	$42	$35	$27
	25%	$39	$32	$25	$45	$38	$30	$51	$43	$35
	35%	$49	$41	$33	$56	$48	$39	$63	$54	$45
$120	15%	$42	$34	$27	$48	$40	$32	$55	$46	$38
	25%	$51	$43	$35	$59	$50	$41	$66	$56	$46
	35%	$64	$54	$45	$72	$62	$51	$80	$69	$58

Assumptions: Dry matter silage 40%; TDN hay 50%; Weekly labor requirements are 5 hours for hay and 8.5 hours for silage. Silage chopping, hauling, handling costs paid by buyer.

Livestock Feeder's Perspective

From the livestock feeder's perspective, the cost to produce the corn or the value of the grain is not relevant. To a livestock producer, silage is one potential feed and its value is determined by the next cheapest alternative (adjusted for any differences in nutrient value and storage and labor costs). For the purposes of this discussion, we assume that the alternative feed is grass hay. As grass hay becomes more expensive, the value of the silage as a feed increases.

Tables 5-7 show the maximum value of corn silage delivered to the farm from the perspective of the livestock feeder given various silage yield assumptions. TDN of the hay is assumed to be 50 percent and dry matter is assumed to be 40 percent and 85 percent on the silage and hay respectively. Weekly labor requirements are assumed to be five hours for hay and 8½ hours for silage with labor valued at $12 per hour, and additional tractor cost valued at $15 per hour.

A crucial consideration for the livestock feeder is the cost of chopping the silage or having the silage chopped. Maximum values reported in tables 5-7 assume the farmer buying the silage is responsible for chopping, hauling, and handling costs. Chopping costs may be difficult to estimate this year in fields with very low silage yields. Therefore, it is unlikely that standard chopping rates on a per ton basis will be accurate, so chopping cost estimates are modified

Table 7. Maximum Feed Value of Corn Silage Per Ton Basis Fair Silage Yields (10 tons/acre).

Hay Price (Ton)	Hay Waste Rate	TDN Silage								
		55%			60%			65%		
		Silage Waste Rate			Silage Waste Rate			Silage Waste Rate		
		10%	20%	30%	10%	20%	30%	10%	20%	30%
$60	15%	$12	$8	$4	$15	$11	$7	$19	$15	$10
	25%	$17	$13	$9	$21	$17	$12	$25	$20	$15
	35%	$24	$19	$14	$28	$23	$18	$33	$27	$21
$80	15%	$23	$18	$13	$27	$22	$17	$32	$26	$20
	25%	$29	$24	$18	$35	$29	$23	$40	$33	$27
	35%	$38	$32	$25	$44	$37	$30	$49	$42	$34
$100	15%	$34	$28	$21	$39	$33	$26	$45	$38	$30
	25%	$42	$35	$28	$48	$41	$33	$54	$46	$38
	35%	$52	$44	$36	$59	$51	$42	$66	$57	$48
$120	15%	$45	$37	$30	$51	$43	$35	$58	$49	$41
	25%	$54	$46	$38	$62	$53	$44	$69	$59	$49
	35%	$67	$57	$48	$75	$65	$54	$83	$72	$61

Assumptions: Dry matter silage 40%; TDN hay 50%; Weekly labor requirements are 5 hours for hay and 8.5 hours for silage. Silage chopping, hauling, handling costs paid by buyer.

from previous years in Table 4. It is assumed that a fixed cost of $30 is incurred regardless of the amount of silage in the field and an added chopping cost of $4 per ton harvested. A $6 per ton charge is assumed for hauling and filling a bag or bunk. The effect of these assumptions is that chopping costs are considerably higher for low yields. Because of this, the feeding value is shown with silage yields of 2.5, 5, and 10 tons per acre in tables 5-7 respectively.

The remaining considerations including hay price, hay waste rate, silage TDN, and silage waste rate can be adjusted using the sensitivity ranges within the tables. Hay price varies from $60 to $120 per ton, hay waste rate ranges from 15 percent to 35 percent, silage TDN varies from 55 percent to 65 percent, and silage waste rate ranges from 10 percent to 30 percent. Any combination of these four factors can be considered using tables 5-7. Tables 5-7 report maximum feed values for silage at yields of 2½, 5, and 10 tons per acre, respectively. Producers should first select the table (5-7) that best describes their expected silage yield, make their best estimates for each of the remaining four factors and use the reported value as a guide.

Figure 2. How a Livestock Feeder Could Use Tables 5-7.

A livestock producer knows he will be short of hay this year and has been approached by a neighbor corn producer about purchasing drought-stressed corn to be chopped and fed for silage. The livestock producer looks at the standing corn and estimates it will likely yield about 10 tons of silage per acre. He is interested in purchasing the silage, but does not know how much it is worth as a feed. Since the estimated silage yield is 10 ton per acre, he uses Table 7 as a guide.

The livestock feeder thinks 50 percent TDN grass hay can be purchased from another producer for $80 per ton and is likely his cheapest alternative to the silage. So he goes to the left hand side of Table 7 and finds the non-shaded area, where the assumed hay price is $80 per ton. He has a limited amount of under-roof hay storage and an average hay feeding system, so he selects an estimated 25 percent hay-waste rate. The livestock farmer now focuses only on that single row of Table 7.

Next, he estimates that the drought stressed silage will have a TDN of about 60 percent and thinks his waste rate feeding the silage will be about 20 percent. Given those assumptions, he determines he can pay up to $29 per ton ($290 per acre) for the silage. This estimate assumes the livestock feeder also will be paying the chopping, filling, and delivery costs. If he was not responsible for any of these costs, he would add to the maximum feed value. The feeder also can use Table 7 to see how sensitive this value is to the assumptions made. For example, he will note that if the waste rate is 30 percent—rather than 20 percent—the silage would be worth $23 per ton.

Combining this estimate with the grain producer example we have the following potential scenario: The minimum selling price for the grain producer was $20 per ton and the maximum feed value for the livestock producer was $29 per ton. So the two could negotiate at a price in between these two values, and they would both benefit from cutting the corn for silage.

Issued 2-2013