Staff Paper

PRICING AND USE OF DROUGHT-STRESSED AND IMMATURE CORN AS SILAGE FOR DAIRY CATTLE

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Staff Paper 96-83 August, 1996

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Agricultural Economics
Staff Paper #96-83
August 30, 1996

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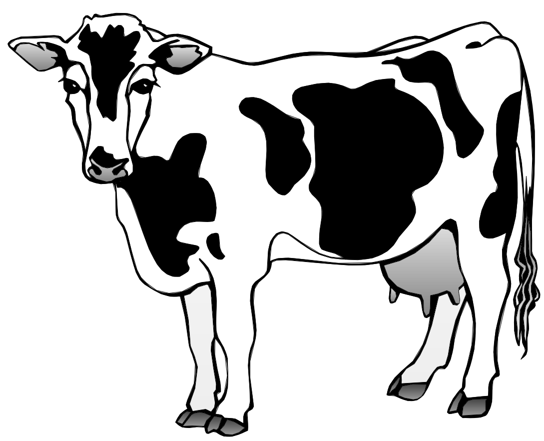

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PRICING AND USE OF DROUGHT-STRESSED AND IMMATURE CORN AS SILAGE FOR DAIRY CATTLE

INTRODUCTION

How best to use immature corn is the question being addressed in this paper. Immature corn was a problem in 1988, 1992, and again in 1996. In 1988, corn in many parts of Michigan was under considerable drought stress and grain content was well below normal. In 1992, many farmers had immature corn at harvest due to abnormally low "heat units" over the course of the summer. In 1996, many corn producers experienced late planting due to wet soil conditions, followed by cooler than normal temperatures which has now resulted in concern for timing of the first killing frost before the corn kernel reaches physiological maturity. Other corn growers have suffered droughty growing conditions resulting in potentially low grain yields.

Immature corn is defined as corn that fails to reach adequate maturity and can not be sold at normal, prevailing market values without steep price discounts. Corn that is drought-stressed, heat unit deficient, water logged, or frosted meets our definition. This fact sheet discusses factors to consider in *pricing* and determining how to *use* immature corn.

Part I outlines *alternatives* available to farmers with drought-stressed or immature corn standing in the field. Part II focuses on potential *problems* related to nitrate accumulations in corn plant forage and silage when the plant has faced drought stress. This discussion is particularly relevant for growers who are considering green-chopping. Part III discusses temporary *storage* of corn silage, particularly by farmers who don't ordinarily harvest corn as silage. Part IV discusses *feeding* management. Part V discusses *economic valuation* — both at the feedbunk and in the field. Part VI discusses whether you should harvest your corn as grain or as silage — assuming it's worth harvesting.

I. ALTERNATIVE USES FOR IMMATURE CORN

Farmers with cattle can harvest their immature corn for silage. Feeding trials over the last two decades have shown that corn silage made from plants that are in *good* condition, but poorly pollinated, will contain 85-90% of the energy per pound of dry matter that's contained in normal corn silage. The crude protein content of the whole corn plant is an indicator of the energy concentration of immature corn plants. Immature corn plants in good quality will have crude protein (CP) that is 10% to 15% higher than that of normal corn silage, depending upon the timing of the stress that limited pollination and when the plant is harvested. That typically places CP in the 8.8% to 9.2% of plant dry matter (DM). If the CP value is substantially greater — 11% to 12% of plant DM — the plant likely has a much lower energy value.

Cash corn growers alternatives include:

- Plow down the field early to permit timely planting of fall-seeded crops.

- Allow corn to mature as grain and harvest if you expect the value of the corn grain harvested to exceed harvest costs.
- Sell the whole corn plant to a cattle feeder, cow-calf operator, or dairy farmer — either as a standing crop in the field (“on the stump”) or as silage harvested and delivered to the feeder’s silage storage facility.
- Hire someone to custom harvest the corn as silage and purchase feeder cattle to grow-out for sale as heavier feeders or finished weight cattle. This alternative requires livestock facilities and knowledge of feeding cattle. Silage storage facilities will probably be temporary and storage losses would exceed those experienced by livestock producers with permanent storage. This option will also require a willing lender.
- Hire someone to custom harvest the corn for use as silage and feed dairy or beef heifers on a contractual basis. This will require feeding facilities or fenced lots and a working relationship with a dairy or beef farmer.

For guidelines on making corn silage, see North Central Regional Publication NCR 574, *Corn Silage Production, Management and Feeding* and National Corn Handbook Fact Sheet NCH-49, *Corn Silage Harvest Techniques*, distributed by Michigan State University.

II. NITRATES AND GASES

Accumulation in the Corn Plant in Drought-Stressed Plants

Nitrate can accumulate in drought-stressed corn plants. Highest levels of nitrate accumulation occur where drought occurs during the period of most active nitrate uptake by the plant. Occurrence of drought during or immediately after pollination has been associated with the highest nitrate accumulations.

Extended drought before pollination is less likely to result in high accumulations of nitrate. Resumption of normal plant growth from heavy rainfall will reduce nitrate accumulation in the plant, but harvesting should be delayed for the first few days after heavy rainfall.

The nitrates taken up by plants are normally reduced and incorporated into amino acids which are used to build protein. The primary site of nitrate reduction in the corn plant is green leaves. The highest concentrations of nitrates are normally found in the stalks and other conductive tissues. A summary of nitrate levels in different parts of the plant, from drought-stressed corn in Wisconsin, is presented in Table 1.

Table 1. Nitrate-Nitrogen Levels in Drought-Stressed Corn Plants

Plant Part	Parts/Million Nitrate Nitrogen
Leaves	64
Ears	17
Upper 1/3 stalk	153
Middle 1/3 stalk	803
Lower 1/3 stalk	5524
Whole plant	978

Nitrate and nitrite are contained in different forms within plants and may be reported differently among laboratories. Table 2 contains a list of nitrate and nitrite forms and conversion factors to place them on a nitrate equivalent. Percent nitrate can be converted to parts per million by multiplying the percentage by 10,000 (e.g. 2% Nitrate × 10,000 = 20,000 ppm Nitrate).

Table 2. Methods of Expressing Nitrate and Nitrite Contents of Feeds, and Multiplication Factors for Conversion to Nitrate

Nitrogenous Substances	Chemical Formula or Designation	Multiplication Factor
Nitrate	NO_3	1
Nitrite	NO_2	1.35
Nitrate nitrogen	NO_3-N	4.43
Nitrite nitrogen	NO_2-N	4.43
Sodium nitrate	$NaNO_3$	.73
Potassium nitrate	KNO_3	.61

Table 3 places nitrate concentrations in a cattle feeding context.

Table 3. Toxicity of Nitrate-Nitrogen

Nitrate Nitrogen (NO_3-N) Content		Nitrate (NO_3) Content		Feeding Guide
PPM	**Percent**	**PPM**	**Percent**	
less than ≤1,000	≤0.1	less than ≤4,400	≤0.44	Not toxic
1,000-2,000	0.1 - 0.2	4,400-8,800	0.44 - 0.88	Limit feed to less than 50% or ration *dry matter*
2,000-4,000	0.2 - 0.4	8,800-17,600	0.88 - 1.76	Limit feed to less than 25% of ration *dry matter*, do not feed to pregnant animals
more than ≥4,000	≥0.4	more than ≥17,600	≥1.76	Do not feed

Ensiling Reduces Nitrate Concentration

Typically, drought-stressed corn ensiled at the proper dry matter content and packed well should not require testing for nitrates. Cutting drought-stressed corn for silage is a preferred method of utilization because ⅓ to ½ of the nitrate accumulated in the plant material can be reduced to ammonia during fermentation. Because fermentation takes 2 to 3 weeks for completion, drought-stressed corn silage should not be fed for at least 3 weeks after the silo has been filled. Drought-stressed corn plants should not be green chopped and fed directly to cattle without first testing for nitrates.

The percent dry matter of the corn plant at harvest influences the time required for fermentation. The optimum dry matter for adequate fermentation is 30-35%. The maximum dry matter percentage for ensiling corn suspected of high nitrate is 45 percent. Corn ensiled at more than 45 percent dry matter results in reduced fermentation activity, and less breakdown of nitrate. Dry matter levels below 30 percent will result in seepage losses and can result in the production of a sour smelling silage which will not be consumed as readily by livestock as normal silage.

Nitrate Toxicity

Nitrate toxicity is actually caused by nitrite (NO_2), rather than nitrate (NO_3). After forage is eaten, rumen bacteria rapidly reduce nitrates to nitrites. Normally, the nitrites are converted to ammonia and used by rumen microorganisms as a nitrogen source. If nitrate intake is faster than its breakdown to ammonia, nitrate levels will increase. Nitrite is rapidly absorbed into the blood stream, where it oxidizes hemoglobin to methemoglobin. Red blood cells containing methemoglobin cannot transport oxygen, and the animal dies from asphyxiation.

Symptoms of nitrate toxicity in animals are increased pulse rate, quickened respiration, heavy breathing, muscle tremble, weakness, staggered gait, and blindness. If these symptoms occur, change feed source.

Testing for nitrate content of drought-stressed corn should be done before green chopping or grazing. If drought-stressed corn is ensiled at the proper moisture content and other steps are followed to provide good quality silage, testing should not be necessary. Forage can be tested for nitrates at most commercial forage testing laboratories or at the Soil and Plant Nutrient Laboratory at Michigan State University. The Michigan State University laboratory's address is:

Soil and Plant Nutrient Laboratory
Room A81, Plant and Soil Science Building
Michigan State University
East Lansing, MI 48824
Phone: 517/355-0218

Care must be taken in sampling to ensure a representative sample. Grab samples should be taken from chopped forage from various locations in the field which represent all levels of plant stress. Mix these samples in a bucket, air dry briefly, and place approximately one pint of material in a paper bag. Time between sampling and arrival at the laboratory must be as short as possible. Refrigeration of samples is beneficial, especially when the lag extends beyond one day. Green or wet samples allowed to stand at room temperature or higher temperatures may lose nitrate through action of denitrifying bacteria and enzyme action.

Silo Gases

Forage containing nitrate results in production of various forms of nitrogen oxide gas during fermentation. These gases, which are poisonous to humans and livestock may occur within 12 to 60 hours after silo filling begins. These gases are heavier than air and will accumulate above the silage in a tower silo, in the chute of a tower silo, in the silo room, and flow out with the silo effluent.

The first lethal gas to form is nitric oxide which is colorless and odorless. Nitric oxide is then converted to nitrogen dioxide which is yellowish-green in color and smells like some laundry bleaches. Further oxidation of nitrogen oxide forms nitrogen tetroxide which has a reddish-brown color and carries an odor characteristic of some laundry bleaches. These gases will leave a characteristic yellowish-brown stain on wood, silage or any other material it contacts. *It is important to inform your family and workers of this potentially hazardous situation*.

No one should enter a tower silo without first running the blower for 10 to 15 minutes to completely ventilate the silo, chute, and silo room. It is wise to do this during filling, and whenever anyone enters the silo for 2 to 3 weeks after completion of filling. Also, leave the chute door open at the surface of the silage to prevent accumulation in the silo.

Call a doctor immediately if anyone is exposed to nitrogen oxide gases from silage. Medical treatment may prevent death and minimize injury.

III. HARVESTING AND STORAGE OF SILAGE

Much of the corn harvested for silage in Michigan this year may be immature at harvest because of delayed planting and a cooler growing season. Although silage from immature corn can be an excellent forage, certain factors related to harvesting and feeding should be considered.

When to Harvest

Immature corn is considerably wetter than normal and seepage from the silo will be extensive if harvested too wet. In addition, very wet corn silage may reduce dry matter intake if it is included in the diet at high levels. Moisture content should be less than 72% when stored in bunker silos and less than 65% when stored in upright silos. Corn planted in late June or early July will likely require harvesting after a frost and have moisture concerns. The best way to determine when to harvest is to harvest a representative sample of each field (not border rows) and determine the moisture content using a microwave or forced air drier. Do not decide when to harvest by just looking at the corn; leaves dry quickly and turn brown following a frost and the corn appears to be drier than it really is. Leaves are only about 7% of the entire plant and the plant may still be too wet when the leaves are brown and dry.

Length of Cut

Chopping coarsely will increase the effectiveness of fiber at stimulating chewing and salivary buffer flow into the rumen. Immature corn forage can be chopped more coarsely than mature corn for silage because the ears are much less developed and kernels, if present, are soft and do not need to be ruptured during harvest to be digested. Cob disks will also be less of a problem with immature ears.

Silage Additives

Immature corn should ensile well if harvested at the appropriate moisture content. There will be a more than adequate supply of sugars for the microbes to ferment because less sugar has been translocated to the ear and converted to starch. Avoid treating corn forage that is greater than 70% moisture with anhydrous ammonia as it might encourage growth of undesirable organisms resulting in a poor fermentation. Inoculants shouldn't be necessary if the corn is harvested during warm weather but should be considered for corn forage harvested during cool weather late in the season. If the daily high temperature is less than 55 to 60° F for several days prior to harvest, inoculants should be considered because the naturally occurring microbes which are desirable may be low in number.

Storing the Silage

Upright silos in good condition that are designed for storing high moisture crops can be used in the normal way. Temporary storage facilities can be utilized if more permanent structures are unavailable. As temporary storage, the above ground stack, plastic bags, and the below ground unlined trench are suitable alternatives. Select a well-drained site for a stack, plastic bags or trench to exclude surface water and provide best access under wet weather conditions. The stack should be 20-25 feet wide, 6-7 feet high and 80-90 feet long. A cubic foot of silage in a stack or trench will average about 40 pounds. With stacks or trenches, continuous packing with a weighted wheel tractor is necessary to exclude oxygen and ensure a favorable fermentation. Good compaction will reduce storage losses. Better compaction can be obtained with a wheel tractor than with a crawler type. Because of the greater exposed surface, the shallow depth, and the difficulty of packing; losses of dry matter during storage of corn silage will be greater for stacks (20%-30%) and trenches (15%-25%) than conventional storage facilities (10%-20%). A tight cover of polyethylene plastic sealed with soil around the edges and held down with dirt or old automobile tires is effective in minimizing losses.

IV. FEEDING

Feeding Value

The feeding value of silage from immature corn depends partly on the degree of maturity at harvest. In general it will have higher fiber, slightly higher protein, and slightly lower energy content than normal corn silage. The fiber content may exceed 55% NDF for very immature corn silage or for wet corn silage that has had extensive seepage. Digestibility might be 10 to 15% lower for very immature corn silage because of the higher fiber content and diets based on these forages must be adjusted with higher concentrate levels.

Silage from corn that is only slightly immature may have fiber levels that are close to normal even though the grain content may be considerably lower. This is because grain filling occurs by translocating sugars from the stover and the total sugar plus starch content of the plant may change little during grain filling. *Slightly immature corn silage has similar or even higher digestibility than mature corn silage.* This is because digestibility of starch and fiber decreases as the corn plant matures.

Although the grain content increases, the grain becomes harder and more kernels pass through the cow undigested. The non-structural carbohydrates of immature corn are highly digestible sugars and starch. The digestibility of fiber decreases as the corn plant matures giving an advantage to immature silage. Although silage from immature corn may require more grain in the diet than normal, if it is harvested at the appropriate moisture content, it might improve milk production because of higher starch and fiber digestibility.

Nutrient Characteristics

Corn silage made from plants that are in good condition, but poorly pollinated with no ears or partially filled ears, has 85-90% of the energy value of normal corn silage. Table 4 supports the concepts outlined. It's a summary of the results from six trials where normal and drought-stressed corn silage was fed to growing steers. The corn plants comprising the drought-stressed corn silage would have yielded less than 20 bu of corn/acre in all trials. The diets were supplemented with protein.

Table 4. Impact of Drought-Stressed vs Normal Corn Silage on Feedlot Performance

Measure	Corn Silage	
	Normal	**Drought- Stressed**
No. of cattle	170	262
Daily gain, lb	2.17	1.97
Dry matter intake, lb/day	16.1	15.5
Feed/gain	7.41	7.86

The steers receiving drought-stressed silage required 6.1% more feed per lb gain than steers receiving normal corn silage. Gain/day (ADG) was less for cattle receiving drought-stressed silage, partly because dry matter intake (DMI) was about 4% less. The information are directly applicable to growing heifers and provide support for the hypothesis that the energy value of good quality immature silage approaches that of normal corn silage.

To accommodate the altered nutrient characteristics of drought-stressed or immature corn silage, consider the following changes in feeding systems:

- Feed poorer quality silage to cattle on medium energy diets.
- Corn silage that has been through significant drought stress should not be supplemented with NPN since the NPN component of crude protein will be significantly higher than normal.
- Balance rations to minimize stress on animals.

Nitrate Toxicity

To avoid nitrate toxicity:

- Test the forage for nitrates.
- Limit corn plant forage initially if it is green chopped or pastured to avoid the risk of animals going off-feed or nitrate toxicity. Provide other feeds before pasturing or limit pasturing time.
- Make silage from corn that experienced drought-stress near silking time.
- Supplement with other forages to avoid excess intake and dilute potentially dangerous silage.
- Feed a small number of animals and observe carefully before feeding a large number of animals.

V. ECONOMIC VALUE OF DROUGHT–STRESSED AND IMMATURE CORN SILAGE

Concept

There is no clear-cut “right” economic value / price for drought-stressed and immature corn silage. However, we can establish the *maximum price* that a dairy operator can afford to pay for immature stressed corn silage delivered to the cattle *feedbunk* in comparison to prices for substitute feeds that can be used to accomplish the same feeding objectives. We can also establish the price the corn grower needs to have to warrant harvesting the corn for use as silage or as grain — call that the seller's *minimum price*. The range between the minimum and maximum price give the *price range for negotiation* between potential buyers and sellers. Supply–demand conditions in local areas will determine whether the price is closer to the seller's minimum or the buyer's maximum.

The purpose of this section is to develop a method for estimating: (1) the dairy farmer’s maximum bid price for immature corn silage and (2) how to get from the price of corn silage in the feedbunk to the price of the corn plant standing in the field.

Economic Value At The Feedbunk: Establishing a Maximum Bid Price

One approach to economic valuation at the feedbunk is for the livestock-producer to ask "If I didn't feed immature corn silage, what would it cost me using an alternative ration to get the same performance from my animals?" If immature corn silage is priced so high that it costs more to feed the animal with it than it would with the alternative diet, then corn silage is priced too high! There is no economic advantage to feed it.

If we accept the framework just described, we must start thinking about what feedstuffs immature corn silage can substitute for in dairy cattle diets. A bit of reflection leads us to the conclusion that its value will be dependent upon the type of animals (for example, growing heifer cattle versus lactating cows) being fed and the alternative feedstuffs that are available.

Feedstuff Nutrient Values Used in Budgeting

The feedstuff nutrient value assumptions used in our case example are presented in Table 5.

Table 5. Nutrient Characteristics used in Budgeting

Nutrient	Drought-Stressed Corn Silage	Normal Corn Silage	Soybean Meal 49	Corn Grain	18% CP Alfalfa
Dry matter, %	32	32	90	85	88
NE_ℓ, Mcal/lb DM	.65	.71	.88	.90	.61
Crude protein, % of DM	8.8	8.0	53.0	10.0	18.0

Substituting Drought-Stressed Silage for Corn Grain and Alfalfa

Drought-stressed silage, in the condition described in Tables 4 and 5, has a higher energy content but a lower protein content than most alfalfa hays. Thus, let's consider economic valuation based upon *substituting* immature corn silage (CS) and soybean meal (SBM) for corn grain (C) and alfalfa hay (A). SBM is used to compensate for corn silage's lower protein content vs. alfalfa hay; corn grain is used to compensate for alfalfa hay's lower energy content vs. corn silage. We will calculate the proportion of a pound of the drought-stressed CS:SBM mixture, on a dry matter basis, that is equal in energy and crude protein to a pound of a C:A mixture

The first step will be to calculate the respective proportions that yield equal energy and crude protein. The second step will be to work backwards and find out how much we can afford to pay for drought-stressed corn silage before the CS:SBM combination starts to cost more than the C:A combination.

Worksheet 1 provides a method for calculating the *maximum bid price* for immature corn silage, given the information we have just presented and projected prices for corn grain, alfalfa and soybean meal.

Let's consider an example: we'll use prices that reflect a sufficiently widespread drought for corn and soybean meal as well as alfalfa prices to be influenced. For $3.50/bu corn, $290/ton soybean meal and $100/ton alfalfa, the maximum bid price for drought-stressed corn silage that has 90% of the energy value of normal corn silage is $26.97/ton. A price that reflects the value at the *feedbunk*. Worksheet 1 can be used to calculate the equivalent silage price in the field for your relevant price relationships. Table 6 depicts the maximum bid price for drought-stressed corn silage delivered to the feedbunk for alternative prices of corn grain, alfalfa, and soybean meal. The objective is to provide equivalent feed value from either corn and alfalfa or from silage supplemented with soybean meal.

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Worksheet 1. Calculation of the Maximum Bid Price for Immature Corn Silage: Based Upon Substitution of Immature Corn Silage and Soybean Meal 49 for Alfalfa and Corn

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Description of the shares of each feedstuff, on a dry matter basis, in the drought-stressed corn silage: soybean meal and corn: alfalfa combinations:

		Example	Your Farm
Corn grain: Alfalfa combination (dry matter basis):			
(1)	Corn grain's share, %	26.5	______
(2)	Alfalfa's share, %	73.5	______
	Total	100.0	100.0
Drought-stressed corn silage: soybean meal combination (dry matter basis):			
(3)	Soybean meal 49 share, %	16.0	______
(4)	Immature corn silage's share, %	84.0	______
	Total	100.00	100.00
Prices:			
(5)	Corn grain, $/bu	3.50	______
(6)	Alfalfa, $/ton	100	______
(7)	Soybean meal 49, $/ton	290	______

Calculation of the maximum bid price for immature corn silage, $/ton at 32% dry matter:

Intermediate calculations:

		Example	Your Farm
(8)	Corn: (Line 1 ÷ % DM Corn) × (Line 5 ÷ 56) **(26.5 ÷.85) × (3.50 ÷ 56)**	$1.94	______
(9)	Alfalfa: (Line 2 ÷ % DM Alfalfa) × (Line 6 ÷ 2000) **(73.5 ÷ .88) × (100 ÷ 2000)**	$4.18	______
(10)	Soybean meal 49: (Line 3 ÷ % DM SMB) × (Line 7 ÷ 2000) **(16.0 ÷ .90) × (290 ÷ 2000)**	$2.58	______

Price of immature corn silage, $/ton:

		Example	Your Farm
(11)	[(Line 8 + line 9 - line 10) ÷ (Line 4 ÷ % DM Silage)] × 2000 **[(1.94 + 4.18 - 2.58) ÷ (84.0 ÷ 0.32)] × 2000**	$26.97	______

Table 6. Maximum Bid Price for Corn Silage Delivered to the Feedbunk

Corn $/bu	SB Meal 49 $/ton	18 % CP Alfalfa Hay, $/Ton 50.00	75.00	100.00	125.00	150.00	175.00
		Maximum Bid Price, $/Ton					
2.00	128.57	15.68	23.64	31.59	39.55	--	--
2.00	164.29	13.27	21.22	29.18	37.13	--	--
2.00	192.86	11.33	19.29	27.24	35.19	--	--
2.25	144.64	15.66	23.61	31.57	39.52	--	--
2.25	184.82	12.94	20.89	28.84	36.80	--	--
2.25	216.96	10.76	18.71	26.67	34.62	--	--
2.50	160.71	15.63	23.58	31.54	39.49	--	--
2.50	205.36	12.61	20.56	28.51	36.47	--	--
2.50	241.07	10.19	18.14	26.10	34.05	--	--
2.75	176.79	15.60	23.56	31.51	39.46	47.42	--
2.75	225.89	12.27	20.23	28.18	36.14	44.09	--
2.75	265.18	9.61	17.57	25.52	33.48	41.43	--
3.00	192.86	15.57	23.53	31.48	39.44	47.39	--
3.00	246.43	11.94	19.90	27.85	35.81	43.76	--
3.00	289.29	9.04	17.00	24.95	32.91	40.86	48.81
3.25	208.93	15.54	23.50	31.45	39.41	47.36	55.32
3.25	266.96	11.61	19.57	27.52	35.48	43.43	51.39
3.25	313.39	8.47	16.42	24.38	32.33	40.29	48.24
3.50	225.00	15.52	23.47	31.43	39.38	47.33	55.29
3.50	287.50	11.28	19.24	27.19	35.15	43.10	51.06
3.50	337.50	7.90	15.85	23.81	31.76	39.72	47.67
3.75	241.07	--	23.44	31.40	39.35	47.31	55.26
3.75	308.04	--	18.91	26.86	34.82	42.77	50.73
3.75	361.61	--	15.28	23.23	31.19	39.14	47.10
4.00	257.14	--	23.41	31.37	39.32	47.28	55.23
4.00	328.57	--	18.58	26.53	34.49	42.44	50.40
4.00	385.71	--	14.71	22.66	30.62	38.57	46.53
4.25	273.21	--	--	31.34	39.30	47.25	55.21
4.25	349.11	--	--	26.20	34.16	42.11	50.07
4.25	409.82	--	--	22.09	30.04	38.00	45.95
4.50	289.29	--	--	31.31	39.27	47.22	55.18
4.50	369.64	--	--	25.87	33.83	41.78	49.73
4.50	433.93	--	--	21.52	29.47	37.43	45.38

Economic Value the Field

Let's continue with our examples on maximum bid price. We projected the maximum bid price for drought-stressed corn silage supplemented with $290/ton SBM to someone valuing it as a substitute for $3.50/bu corn and $100/ton alfalfa. For purposes of discussion, lets say that the negotiated price delivered to the feedbunk is $26.50/ton. What is $26.50/ton corn silage at the feedbunk worth standing in the field?

Worksheet 1 was developed to answer that question. The costs of storage, including storage losses, must be subtracted along with the costs of harvesting, hauling and packing.

For our example, $9.50/ton silage harvesting and storage costs are projected to be incurred. That leaves $17.00/ton for corn in the field. The harvesting, hauling, etc., costs were adapted from S.B. Nott, et. al., 1995 *Crop and Livestock Budgets*, Michigan State University, Agricultural Economics Report 508; and G. Schwab and Marcelo E. Siles, Custom Work Rates in Michigan, Cooperative Extension Service Bulletin, E-2131, September 1994.

Worksheet 2. Maximum Bid Price for Corn Standing in the Field for Use As Corn Silage

	Item	Example $/Ton	Your Farm
(1)	Corn silage @ feedbunk	$26.50[a]	________
(2)	- Storage losses (10% to 30%) (**Example** @ 23%)	$6.00	________
(3)	- Storage cost (zero for existing storage; Amortized cost if new facilities added)	0.00	________
(4)	- Harvesting (chopping)	$2.00	________
(5)	- Hauling and packing (depends upon distance)	$1.50	________
(6)	Total (Line 2, 3, 4, and 5)	$9.50	________
(7)	Maximum bid price/ton for corn standing in field (line 1 minus line 6)	$17.00	________

[a] Adapted from Worksheet 1 or Table 6.

VI. SHOULD YOU HARVEST YOUR CORN AS SILAGE OR AS GRAIN—ASSUMING IT IS WORTH HARVESTING?

Worksheet 3 asks the question, “Will you generate more net income harvesting corn as grain or as silage?” Your pre-harvest expenses are sunk costs — they have already been committed and are irrelevant to the decision.

Let's consider Example I in Worksheet 3. Suppose a corn field will yield 25 bu/acre if harvested for corn grain and 9 ton/acre if harvested for corn silage. For those *relative* yields, corn silage wins hands down. Corn silage *returns $140.06/acre above unallocated costs* as compared to $57.50 for corn for grain.

We can also explore *break-even relationships.* For example, what are the corn grain and corn silage yields at which returns above unallocated costs are equivalent? Consider Example II. If corn grain yields were projected at 50 bu/acre, not 25 bu/acre as in the example I, then the returns per acre above unallocated costs would be $135.00. For our case example, net returns to unallocated costs are “toss-up” at 50 bu harvested as grain versus 9 ton harvested as silage. You can increase the corn grain yield until returns are equivalent, but also consider whether silage yield changes as corn yield increases.

The *relative* prices for corn and corn silage are critical. Typically, the corn grain price will be better established; the corn silage price may offer significant opportunities, but will require more work to achieve.

Worksheet 3. Partial Budget for Comparing Net Returns[a] to Unallocated Costs From Corn Harvested As Grain vs. Corn Harvested as Silage

	Item	Unit	Example No. I	Example No. II	Your Farm
	Corn Grain				
	Revenue:		$/Acre		
(1)	Yield	bu/acre	25	50	________
(2)	Price, (no. 2 corn adjusted for test weight ...)	$/bu	3.50	3.50	________
(3)	Gross revenue (Line 1 × Line 2)	$/acre	87.50	175.00	________
	Harvest cost:				
(4)	Combining	$/acre	$20.00	20.00	________
(5)	Grain Hauling @ $0.15	$/bu	3.75	7.50	________
(6)	Drying @$0.25	$/bu	6.25	12.50	________
(7)	Total (Line 4 + Line 5 + Line 6)		$30.00	40.00	________
(8)	Net above harvesting costs from harvesting corn as grain (Line 3 - 7)		$57.50	$135.00	________
	Corn Silage				
(9)	Yield	ton/acre	9.0	9.0	________
(10)	Price in field (Value from Line 7, Worksheet 1)	$/ton	17.00	17.00	________
(11)	Gross from harvesting corn as silage (Line 9 × Line 10)	$/acre	153.00	153.00	________

(12) Additional fertilizer equivalent removed with corn plant above corn grain removal

	Lbs/ bu[b]	Lbs/ ton[b]	Added lb/ acre for silage (No. I)	No. I	Added lb/ acre for silage (No. II)	No. II
Phosphate @ .25/lb	.37	3.3	20.45	$5.11	11.2	$2.80
Potash @ .12/lb	.27	8.0	65.25	$7.83	58.5	$7.02

	Item	No. I	No. II
(13)	Net above harvesting and nutrient removal costs for harvesting corn as silage (Line 11 - Line 12)	$140.06	$143.18

[a] These are returns to all costs that have been committed up to the time of harvest.

[b] "Tri-State Fertilizer Recommendations for corn, soybeans, wheat and Alfalfa," E-2567, Michigan State University, The Ohio State University and Purdue University, May 1995.