

12-2006

Disaster Recovery—Managing immature crops for grain or silage

Stephen K. Barnhart

Iowa State University, sbarnhar@iastate.edu

Roger W. Elmore

Iowa State University, relmore@iastate.edu

Palle Pedersen

Iowa State University

H. Mark Hanna

Iowa State University, hmhanna@iastate.edu

Follow this and additional works at: http://lib.dr.iastate.edu/extension_ag_pubs



Part of the [Agricultural Science Commons](#), [Agriculture Commons](#), [Agronomy and Crop Sciences Commons](#), and the [Bioresource and Agricultural Engineering Commons](#)

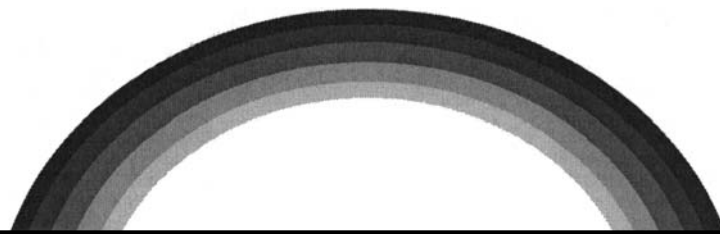
Recommended Citation

Barnhart, Stephen K.; Elmore, Roger W.; Pedersen, Palle; and Hanna, H. Mark, "Disaster Recovery—Managing immature crops for grain or silage" (2006). *Agriculture and Environment Extension Publications*. 204.

http://lib.dr.iastate.edu/extension_ag_pubs/204

Iowa State University Extension and Outreach publications in the Iowa State University Digital Repository are made available for historical purposes only. Users are hereby notified that the content may be inaccurate, out of date, incomplete and/or may not meet the needs and requirements of the user. Users should make their own assessment of the information and whether it is suitable for their intended purpose. For current publications and information from Iowa State University Extension and Outreach, please visit <http://www.extension.iastate.edu>.

Disaster Recovery



Managing immature crops for grain or silage

Cool weather and excessive precipitation, wind and hail can all lead to late planting, replanting, or slow crop development. As a result, a significant number of corn, sorghum, and soybean fields, and areas within fields, may not mature before the first killing freeze of fall. Producers who have livestock or have arranged for a local use for their silage can harvest these otherwise lost crop acres. Harvesting a silage crop with no definite plans for feeding or local sale can be costly.

Determining if it has reached maturity for a harvestable grain crop

Corn

Most of the Iowa corn crop is intended for harvest as dry grain. If it will reach physiological maturity, it will be more valuable as harvested grain, but may require supplemental drying. If the field or parts of the field fall short of physiological maturity some producers can harvest immature corn for silage or use it in grazing programs.

As the corn crop matures, harvestable grain yield will be highest at physiological maturity of the plant. However, highest yield of digestible nutrients as whole plant silage is greatest several days before plant maturity, when the stalk and leaf material remain more digestible. Since the optimum silage harvest comes before grain crop maturity, it is important to

have an accurate estimate of the developmental stage of the corn crop.

Visual Indicators of Corn Maturity

As the corn plant is nearing maturity, one of the best means of determining the developmental stage is an occasional look at the developing grain. As kernels mature, the milky, sugary endosperm gradually changes to a solid, starchy consistency. Soon after the grain reaches the "dent" stage, you can usually see the 'milk line' or the boundary between the liquid and solid endosperm consistency on the 'back side' of the kernel. The milk line is easiest to see on the 'back side' of the kernel; the side opposite the embryo or "germ." It is detectable as a relatively distinct line between two shades of yellow. Very soon after dent the milk line is nearest to the dented end of the kernel. As the grain develops the milk line can be seen nearer and nearer to the pointed tip of the kernel. At physiological maturity of the grain, the milk line has reached the tip of the kernel and a "black layer" forms at the tip indicating that all movement of nutrients from the stalk to the kernel has ceased. The grain and stalk continue to dry from that point on.

Table 1 summarizes several characteristics of the developing corn plant. As you review this table note that the greatest harvestable yield of whole plant digestible nutrients is at a stage when the milk line has advanced about 3/4 of the distance from the dent to the kernel tip. If you have significant acreage of corn to chop, begin when the most advanced fields or parts

of fields are at 1/2 milk line and try to harvest all the silage when between 1/2 milk line and maturity. Fortunately, the moisture of the whole plant is about 65-70 percent moisture at this stage; ideal moisture for direct chopping of corn for silage.

Table 1. Effect of harvest stage on yield and quality of corn silage.

Maturity	Whole Plant Moisture	Dry Matter Crude Protein	Digestibility of Whole Plant		Yield of Digestible Dry Matter
			Dry Matter	Dry Matter Yield	
	%	%	%	Tons/Ac	Tons/Ac
Early Dent	73	9.9	79.0	5.6	4.4
1/2 milk line	66	9.2	80.0	6.3	5.0
3/4 milk line	63	8.9	79.6	6.4	5.1
No milk line (mature)	60	8.4	78.6	6.3	4.9

Adapted from Wiersma, et.al. 1993. (Wisconsin, 1988-90 seasons).
¹ Authors note: Whole plant yields at 'silage moisture' will be considerably higher than these dry matter yields. Silage yields are dependent on many production and harvest factors.

So, in a 'normal' maturity and dry-down season, the decision to chop whole plant corn silage has to be made fairly early. With late planted corn and late maturity risks, frost may force the decision to harvest as silage. If frost comes during the 'target' milk line period, whole plant moisture content should be appropriate for normal ensiling.

There are some ensiling considerations if frost comes when the crop has only reached early dent, or is less developed. Whole plant silage chopped and stored at higher than 70 percent moisture may undergo abnormal or incomplete fermentation and will begin to lose dry matter as seepage (effluent) losses. Use caution when locating a site for silage storage with potential for seepage losses, because off-site movement of silage effluent can become an environmental hazard as a ground or surface water contamination source.

Soybean

The Iowa soybean crop also is intended for harvest as dry beans. The beans harvested from immature soybeans are often small, misshapen, off color, and sometimes diseased.

The normal grain markets generally do not want immature soybean and will pay greatly reduced prices for them. The harvest or use alternatives for immature soybean are usually livestock grain or forage. It also is useful then to closely follow the development of the soybean crop.

The normal development and maturation of a soybean plant also can be tracked reasonably by several identifiable plant characteristics. The key characteristics and plant parts are the development of the pods and the beans in the pods, particularly those near the top of the plant.

Is your soybean crop safe from frost?

Most soybean will have developed to R5 or greater by mid-September. Stage R5 gives the first indication of bean seed development in the upper part of the plant. At stage R5 small beans (1/8 inches long) can be found in a pod attached to one of the four uppermost attachment points (nodes) of a fully developed leaf. Substantial bean yield losses are likely from a killing frost of soy-bean in early stage R5. A University of Wisconsin study showed that there was about a 75 percent yield reduction when soybean was killed at R5 and a freeze then may cause bean quality problems (green, odd shaped beans, etc.).

To escape significant bean quality problems, soybean must reach developmental stage R6 before a hard killing freeze. Stage R6 is called the "full green bean" stage. A plant has reached this stage when you can find full sized green beans filling the pod cavity of at least one pod at one of the four uppermost leaf attachment points (nodes) supporting a fully developed leaf. Even at stage R6 a freeze will cause some yield loss. In the Wisconsin study, soybean yield losses were 20 to 25 percent when the crop received a killing freeze at stage R6.

A critical time for a late developing soybean crop is the two week period required for the plant to develop completely through the R5 stage. If a killing freeze comes early in the R5 period, yield losses can be significant, but if

the killing freeze comes late in the R5 period, yield loss risk is expected to be much reduced.

If one normal pod has attained its mature pod color (brown or tan) then the plant as a whole is considered to have reached complete pod fill and is the growth stage called physiological maturity (R7). At this stage, it is common to have green, yellow and brown or tan (depending on variety) pods on the same plant. This describes the beginning of developmental stage R7. At stage R7 the plant is considered to be near enough to maturity that a hard freeze will have little influence on its yield.

Soybean as a forage crop

When is it appropriate to abandon the little hope of much bean yield from the soybean crop and look to it as a possible forage source? The critical decision should be based on what developmental stage the majority of plants will reach by the time of a killing freeze. If the soybean plants will reach developmental stage R6 (full green bean stage) before a freeze, their value is far greater as a bean crop. If the freeze occurs when only small pods have formed near the top of the plant (pre stage R5) or there are only very small developing beans in upper pods (early stage R5), then harvest of the crop for forage is more appropriate. By the time beans in the upper pods are about 1/2 to 3/4 full size (late stage R5), the advantage swings to harvest for beans but at a significantly reduced yield and the possibility that bean quality will be adversely affected.

What is the quality of soybean forage?

When in its vegetative and early bean development stages, the soybean plant is very similar in feeding value and harvestable yield to that of more familiar forage legumes such as alfalfa or red clover. As with other forage plants, the developing stem becomes less digestible while the leaves, and in the case of the soybean, the pods and developing seed remain highly digestible. Data presented in Table 2 shows relative yields and nutritive characteristics of whole plant soybean forage at increasing stages of development. Note that while the protein and digestibility remain surprisingly constant over this range of harvest periods, the harvestable dry matter increases

with maturity. Beyond R6, however, the leaf material will quickly be lost, leaving a forage material with a high proportion of high quality pods with beans and the remainder being very low quality, high fiber stems. The risk of pod and bean shatter loss also increases if soybean is harvested much past R6.

Table 2. Yield and quality of soybean forage as affected by harvest maturity. (Univ. of Wisconsin)

Maturity Stage ¹	Dry Matter Yield (T/Ac)	Moisture %	% Crude Protein	Relative Feed ² Value Index
R1	1.1	81.1	20.1	160
R3	1.7	80.7	18.1	138
R5	2.5	79.7	18.2	128

¹ R1 - Any open flower at any leaf attachment point (node) on the main stem.

R3 - At least one pod is 3/16 inches long at one of the four uppermost leaf attachment points (nodes) on the main stem with a fully developed leaf.

R5 - Seed is 1/8 inches long in at least one pod at one of the four uppermost leaf attachment points (nodes) on the main stem with a fully developed leaf.

² Relative Feed Value (RFV) index. An RFV of 150 approximates the feeding value of mid-bud alfalfa. An RFV of 100 approximates the feeding value of full bloom alfalfa.

Managing soybean for silage

More soybean plant dry matter will be retained if soybean can be stored as silage. The target moisture content for ensiling is 55 to 65 percent, so green soybean plants cut for silage may require some field wilting before chopping. Drying conditions will dictate how long the wilt period should be. If wilted too long, the silage will be more difficult to pack, and you increase the risk of dry matter loss from leaf shatter, excessive respiration, and heating during ensiling.

A few additional cautions about using soybean for forage

Review your herbicide labels for any restrictions regarding residues on the crop and feeding limitations. Soybean forage being stored as silage may respond favorably with lower pH if it is inoculated with lactic acid bacteria inoculant. Several animal nutritionists say that very immature, green soybean, with only small pods and no appreciable bean formation, can be fed as you would feed other legume forage. However, as the whole plant

fat content increases with bean development, these nutritionists caution producers to limit the amounts fed daily to livestock. Check with a nutritionist when formulating rations containing soybean forage.

Managing crops for silage

To be suitable forage for ensiling, crops should have sufficient levels of fermentable carbohydrates for good fermentation. Corn and sorghum generally have sufficient fermentable carbohydrate concentrations. However, immature soybean, overly mature forage legumes and grasses, and sudangrass may be more likely to have relatively low levels of fermentable sugars.

Moisture is another problem. Immature corn and forage sorghum may be too wet (greater than 65-70 percent whole plant moisture) for direct chopping. To avoid seepage losses and the risk of an undesirable fermentation, it may be necessary to allow the immature crop to stand in the field for several days to several weeks following a frost or freeze for further drying.

There are no good methods for estimating the whole-plant moisture content of standing corn or silage crop. Experienced silage makers may be able to estimate moisture contents for normal maturity crops, but will likely underestimate the moisture content of an immature crop.

The only sure method is to chop a small amount of the crop with the chopper to be used for harvest and obtain a moisture determination to know whether or when the crop is nearing the desired 65 to 70 percent moisture range. Immature soybean for silage, sudangrass, sorghum X sudangrass hybrids, and forage grasses and legumes should be cut and wilted to the desired moisture content before chopping.

Plant material of 70 percent or slightly higher can be more effectively stored in a horizontal bunker or covered silage pile without excessive seepage losses than in an upright silo structure. Plant material at 55 to 65 percent moisture content will pack more efficiently in an upright silo structure or silage bag.

Although some producers attempt to add water to relatively dry chopped material, it is impractical to add the large volumes necessary at a rate that the crop can absorb uniformly when the time constraint is so great for rapid filling and packing. Likewise, while it is possible to blend dry plant material with excessively wet chopped forage, it is difficult to uniformly blend these materials under the constraints of rapid filling.

Are additives or inoculants needed?

Sometimes supplemental sources of fermentable carbohydrates such as corn grain or molasses are blended at the site of storage to improve the likelihood of a normal fermentation. Plan ahead to secure these materials and perfect a method to uniformly meter it into the forage material being ensiled.

The protein value of silages is important. Nitrogen-containing materials such as urea or aqueous ammonia sometimes are added to chopped plant material to increase the non-protein nitrogen content for use by ruminant livestock. When considering the immature crops likely to be ensiled in fall, most are expected to have higher protein levels than those of a fully matured crop of the same type.

The exception, however, may be immature soybean nearing maturity, which have a very high protein value in the beans. Very immature soybean, either very late vegetative or with significant small bean fraction, forage grasses and legumes, sudangrass, and sorghum X sudangrass hybrids should all have sufficient protein content for most livestock rations. Therefore the need for nutrient additives for these crop materials is unnecessary.

A much debated silage "additive" is supplemental fermenting bacteria, commonly referred to as silage inoculants. The purpose of added bacteria is to supplement or override the action of naturally-occurring populations of fermenting bacteria in an effort to speed the fermentation process, reduce protein degradation in the ensiled mass, and to improve aerobic stability of the silage during the feeding phase.

Cultures containing several million live lactic acid-forming bacteria per ounce of forage are the most commonly used silage inoculant. Although opinions vary greatly on their effectiveness, some research results are favorable. Improvements in the rate of pH decline and increased lactic acid levels have been noted with legumes, grasses, and cereal silages at the higher end of the desirable moisture range.

Although differences in fermentation response have been less pronounced for corn and sorghum silage, they are frequently seen. The great variability in the characteristics of the harvested crop material and the natural bacterial populations make it difficult to show large consistent, positive responses to silage inoculants.

In few cases would a crop fail to ensile with natural bacterial populations. So added bacterial inoculants would not generally be required. However, by adding effective strains of lactic-acid forming bacteria in large numbers, fermentation often is faster with slightly less dry matter loss during ensiling and at feeding.

Silos and the possibility of great waste

Structures constructed for storing silage come in many shapes and sizes. The storage volumes, feedout capacities, permanency, and ultimately the cost per ton of silage stored vary greatly.

Permanent silage structures are designed for the specific supply needs and feeding method requirements of a site. Other types of silage storage are intended to be temporary and to provide flexibility for changeable livestock operations.

The upright, tubular, or tower silos are designed with oxygen exclusion in mind. They may be glass-lined steel; solid wall, poured concrete; or made of concrete staves with joints plastered or sealed. Before using these structures, they should be carefully inspected to ensure both structural stability and good seals.

Permanent and semi-permanent horizontal-type silos are common where very large volumes of silage and rapid feeding are required. These structures generally have walls ranging

from simple earthen walls of an elongated pit dug into a hillside to walls of reinforced concrete or wood constructed above ground.

Horizontal silos are sometimes called bunker, pit, or trench silos. In addition to capacity and location, the effectiveness of sidewalls in excluding oxygen, and drainage of seepage and rainwater away from the silo site are important design characteristics.

The "floors" of these may be earth, crushed stone, or concrete. Before using existing horizontal silos, inspect them for structural soundness and the effectiveness of the seal of sidewalls and floor. Plastic sheet liners are an effective method of sealing sidewalls.

Temporary silage structures frequently are used in years when demand is high for this type of storage. Temporary storage ranges from self-contained, horizontal, tubular plastic silage bags, through various configurations of horizontal silos using large round hay bales for sidewalls, to simply piles of chopped forage on the ground.

The greatest concern when using temporary silage storage is the safety factor when filling and packing, and of the excessive spoilage losses from insufficient packing and sealing.

Permanent silage structures and silage bags

For upright silos, the weight of the silage material provides the packing. In a well-sealed upright silo, the exposed top surface is relatively small and often is not covered. Some producers use a plastic sheet or very wet plant material on top for a seal.

For horizontal silos, chopped plant material is dumped and spread uniformly across the surface of the silo. The spreading tractor also is used to pack the silage mass. Slightly wetter chopped material (70 percent or slightly higher) can be used in horizontal silos.

The heavier weight of the plant material aids in packing. Pack with a heavy-wheeled, ROPS-equipped (rollover protective structure) tractor.

If sidewalls are not airtight, line the sidewalls and cover the top of the silage mass with 4 to 6 mil sheet plastic. Roll the sidewall and top plastic under on the edges and weight the edge roll and top to prevent billowing and air penetration. Most producers use old tires or a few feet of wet plant material for weighting. Where tires are used, plan on enough tires to cover 30 percent of the plastic surface.

For temporary storage when using tubular silo bags, manage the silage as you would for other silo structures, with attention to chop length and moisture condition. Avoid storing excessively wet material in sealed bags, because seepage will accumulate in the lower volume of the bag, inhibiting normal fermentation. Bag silos are vulnerable to tears and animal damage. Seal any damage immediately.

Temporary storage innovation

Many producers who unexpectedly find that they need to make silage from immature crops pile chopped crop material in a pile on the ground and pack it with a tractor. The relative surface area to volume of stored material often is very high and leads to very large surface spoilage losses.

If silage piles are made, attempt to make them as deep as possible to minimize surface area. Use the same filling and packing cautions described for horizontal silos.

It is best to select a site that drains away from all sides of the pile. Cover and seal the pile with plastic and weight edges and cover as described for horizontal silos.

A common consideration for temporary silage storage is the use of large round hay bales as sidewalls for a temporary bunker silo. It makes a difference how the bales are arranged. If bales are to be used, line the bales side by side such that the flat ends of the bales form the silo sidewall.

This bale orientation forces the bales to maintain maximum friction with the ground and minimizes the tendency to roll if oriented end-to-end the length of the silo. To improve stability of the bale sidewalls, anchor the bales on

the outside of the structure with wood posts, steel posts anchored in concrete, or large wood chock blocks such as logs or railroad ties anchored to the ground with steel rods.

Take particular caution when operating equipment near the edges of a deep silage pile. Engineers caution that for bale row silage bunkers where sidewall support is unknown, stay at least as far from the edge of the piles as the bottom of the wheels of the filling or packing tractor are from the ground surface.

Covering silage with plastic will reduce losses. Some producers have successfully used the bale retainer system with a plastic liner draped over the end of the bale to avoid spoilage at the bale/silage interface. In some situations, the same sheet of plastic can be anchored at the inside base of the bales, cover the bale ends and extend across the center peak of the silage pile. When done similarly on both sides and the top edges rolled, sealed and weighted satisfactorily, a well sealed pile can be produced.

Dry roughage

Moisture content is critical for forage crop harvesting. Suitable moisture falls into two major categories: (1) whole plant material with moisture content appropriate to complete the ensiling process (55 - 70 percent) and (2) material that is dry enough to be stored in bales or stacks without excess spoilage (25 percent maximum, preferably below 20 percent).

A potentially dangerous condition exists where material is too dry to properly ensile yet too wet to bale. Large volumes of forage stored between 25 percent and 50 percent moisture are potential candidates for a hay or silo fire due to spontaneous combustion.

Producers may elect to harvest the crop as dry roughage because either 1) the crop is too dry to ensile or 2) bales are more convenient to store and handle. Check moisture content to determine whether you are in the correct range to avoid excessive losses.

Immature soybean will have some of the same field curing challenges as would any other forage legume, with the stems drying more

slowly than the leaves. Soybean leaves are very brittle when dry and can shatter excessively during raking and baling. While the use of a mechanical conditioner will speed the drying of stems, producers have found that flail conditioners lead to more leaf and pod losses than do roll-type conditioners. Frost will lead to leaf death and leaf drop within a few days, so if you are planning to use soybeans for forage, be ready to cut, condition, and windrow the crop. Soybean hay bales are subject to more rain and weathering loss if stored outside than that of grass or alfalfa hay, so inside or covered storage is recommended.

Prepared by S. Barnhart, ISU Extension Forage Agronomist Roger W. Elmore ISU Extension Corn Specialist, Palle Pedersen, ISU Extension Soybean Specialist, and M. Hanna, ISU Extension Agricultural Engineer.

File: Agronomy 2, 3-4

... and justice for all

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, gender, religion, age, disability, political beliefs, sexual orientation, and marital or family status. (Not all prohibited bases apply to all programs.) Many materials can be made available in alternative formats for ADA clients. To file a complaint of discrimination, write USDA, Office of Civil Rights, Room 326-W, Whitten Building, 14th and Independence Avenue, SW, Washington, DC 20250-9410 or call 202-720-5964.

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Jack M. Payne, director, Cooperative Extension Service, Iowa State University of Science and Technology, Ames, Iowa.