

## Rain Damage to Forage During Hay and Silage Making

by Mike Rankin and Daniel Undersander

### Introduction

Rain that occurs between the time forage is cut and harvested causes both yield and quality losses that reduce the value of the crop as an animal feed and a marketable commodity. Weather-induced losses can be caused by:

- Increased and prolonged plant respiration that reduces soluble carbohydrates and the overall energy content of forage.
- Leaching of soluble carbohydrates, protein, and certain minerals.
- Leaf shattering and loss, removing the highly digestible and high protein portion of the forage.
- Microbial activity that metabolizes soluble carbohydrates, reduces forage energy content, and possibly produces harmful mycotoxins.
- Color bleaching.

### How much does rainfall reduce yield?

Several research studies have addressed the effects of rainfall on cut alfalfa. In Wisconsin, Collins measured dry matter losses of 22% when alfalfa was exposed to 1-inch of rain after 1 day of curing. Similar hay cured without rain damage lost only 6.3% of the initial potential yield. Losses appear to be greatest after partial drying of the forage has occurred. In this same study, alfalfa exposed to 1.6 inches of rain over several days suffered a 44% loss in dry matter.

In Michigan, Rotz and co-workers conducted several different studies to examine the effects of rainfall on field cured alfalfa. The first study reported maximum DM losses of 34%. In a second study, rainfall intensity was kept constant at 0.7-in but spread over periods of 1 to 7 hours. Dry matter losses ranged from 4 to 13 percent with highest losses occurring when the rain was spread over a

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longer duration. Overall, dry matter losses were much lower than those found in Wisconsin experiments although rainfall amounts (in some cases) were nearly 2 inches.

### How does rainfall reduce yield?

Three primary factors are involved: leaching, respiration, and leaf loss. Leaching is the movement of cell solubles out of the plant. Components of the plant that are very water-soluble are leached out of the forage and lost during a rain event. Unfortunately, most of these compounds are those highly digested by the animal. They include such things as readily available carbohydrates and soluble nitrogen, minerals, and lipids. About one-half of the dry matter leached by rain is soluble carbohydrate.

Excessive leaching of soluble carbohydrates by rainfall impacts its value to make good silage. Reduced soluble carbohydrates provide less substrate for bacteria involved in the fermentation process. In situations where soluble carbohydrates are in low concentrations, silage additives that provide fermentable substrate might provide some benefit to insure proper fermentation.

Respiration, the breakdown of soluble carbohydrates by plant enzymes, will cause dry matter losses regardless of whether wilted forage is subjected to rain or not. Respiration losses occur while crop moisture levels are above about 30 percent. These losses are reported to be about 3 to 4 percent of the potential DM harvest. Each time cut forages are wetted by rain, respiration is prolonged or begins again in cases where the cured forage is already below 30 percent moisture. In either situation, additional dry matter is lost.

Researchers disagree about the amount of leaf loss that occurs in cut alfalfa as a direct result of rainfall. In a Wisconsin study, leaf loss ranged from 8 to over 20 percent of the initial forage dry matter where rainfall amounts were from 1 to 2.5 inches. In a Michigan study, direct leaf loss was much lower ranging from 0.5 to 4.2%. For both of these experiments, the cut forage was physically picked-up and lost leaves underneath the swath

were weighed. In an Ontario study where forage was not hand-manipulated, rain-induced leaf loss was determined to be minimal (less than 0.5%).

Experience and common sense tell us that rain damaged alfalfa is more susceptible to leaf shatter after it dries. Rainfall often means additional raking or tedding to speed up drying; hence, more lost leaves.

### How does rainfall intensity and forage moisture affect losses?

Research is conclusive on these two points. Given the same amount of total rainfall, a low intensity rain will result in more leaching of soluble compounds than a high intensity rain. In addition, as forage moisture declines, it is more prone to DM loss from rain. In Wisconsin rainfall studies, the maximum loss in DM (54% DM loss) was a treatment where 2.5 inches of rain fell on hay that was nearly cured.

### Does rainfall affect forage quality?

Perhaps nothing is more frustrating than to see excellent quality alfalfa turn into cordwood with each passing rainstorm and subsequent raking. Most rainfall studies agree that wetting of field cured alfalfa has little impact on crude protein concentration. In fact, it is common to see relatively high protein values in comparison to fiber concentrations. However, because rain leaches soluble carbohydrates, structural fibers (acid and

neutral detergent fibers) comprise a greater percent of the forage dry matter. Depending on numerous factors previously discussed, the digestibility of rained-on hay may decline from 6 to 40 percent.

### My hay is ready to cut but there's rain in the forecast. Do I cut or not?

This dilemma has faced forage producers for years. Because the impact of rainfall on loss of forage yield and quality varies with timing, amount, and duration, there is no easy answer. The range in economic loss from rainfall for a particular hay crop can range from minimal to over 100 percent, if the forage has to be chopped back onto the field. However, based on previous research studies and applied management practices, we can categorize factors that increase our risk of cutting hay when the weather forecast is somewhat less than perfect. These are presented in **Table 1**.

Finally, computer technology and the Internet now make it feasible for producers to have home access to up-to-date weather radar images. There are many excellent weather information web sites with both multiple radar image selections and updated forecasts. These help to take some of the "guess work" out of forage harvesting decisions.

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**Table 1. Relative Risk of Cutting Hay with Rain in the Forecast**

<b>Relative Risk</b>		<b>Explanation</b>
<b>Lower</b>	<b>Higher</b>	
Forage can or will be ensiled	Forage will be baled	Fewer days needed for curing and swath is often narrower when forage is ensiled.
Small acreage of forage to harvest	Large acreage of forage to harvest	With many acres to harvest, delaying harvest puts more acres at risk of not being cut in a timely manner.
Rain is forecasted for early in the drying period	Rain is forecasted for late in the drying period	Quality losses are less if forage is rained-on while still relatively high in moisture. NOTE: weather forecasts are less reliable beyond two days.
Forecasted rain is short duration and/or scattered	Forecasted rain is “frontal” and/or long duration in nature	Less leaching of cell solubles occurs with short duration, high intensity rainfall than with long duration, low intensity rainfall.
Forage is pure grass or grass-legume mixture	Forage is a pure legume	Losses associated with leaf shattering are less of a concern with grass species.
Standing forage is beyond optimum maturity stage	Standing forage is still relatively high in quality	With advancing maturity, a smaller percentage of the plant is comprised of cell compounds that are most susceptible to leaching by rainfall.
A chemical drying agent and/or preservative is used	No chemical drying agent and/or preservative is used	Effective use of chemical hay drying agents and/or preservatives can speed drying time or allow for harvest at a slightly higher moisture level.
A market or feeding opportunity exists for lower quality forage	A market or feeding opportunity doesn’t exist for lower quality forage	In many situations there may actually be a need for a limited amount of lower quality forage
Lower quality forage can be stored (ensiled) separately from high quality forage	All forage must be stored (ensiled) in same structure	The ability to inventory forage by quality allows for more flexibility in ration formulation and doesn’t force the use of low quality forage for animals with high nutrient needs.