Making Grass and Legume Silage without Preservatives

While corn has been very popular as a silage crop for almost three-quarters of a century, it is only in comparatively recent years that grasses and legumes have been extensively used for this purpose. Previous to 1935 little grass silage was made on this continent. About that time considerable publicity was given to the results of experimental work, in which it had been found that the treatment of these high-protein crops with preservatives such as molasses or dilute acids assisted in making them into good-quality silage. During the last six or seven years the practice of treating legumes and grasses with molasses for silage purposes has become popular on many farms.

The war has changed many things and it has been found recently that molasses is necessary for the production of certain war materials. This means that it will be difficult, if not impossible, to obtain it for agricultural purposes. This should not prevent the use of grasses and legumes for silage; for molasses, although a valuable aid in improving the quality of legume silage, is not essential. Good silage can be made from legume crops without the use of preservatives if proper methods are followed in ensiling.

The Ensilage Process

In order to understand why certain precautions are necessary in ensiling legumes it is useful to know just how the ensilage process functions. When green crops are placed in an air-tight silo under ideal conditions for ensiling, the plants continue to live for a certain length of time. They therefore continue to breathe or respire. This results in the generation of heat and uses up some of the oxygen which is left in the silage mass. Later while there is still some air left the activities of lower forms of life such as moulds, yeasts and bacteria increase. In good silage moulds and yeasts function only for a few hours because the oxygen supply is soon exhausted. In very dry crops more air is present and moulds develop to a greater extent.

Bacteria play an important part in the ensilage process. The desirable types which are found in good silage are capable of living in a limited supply of air. They act on the sugars found in crops and convert them into organic acids such as lactic acid and acetic acid. As these acids develop in sufficient quantity they in turn destroy the bacteria which produce them or set up conditions in which the bacteria cannot develop. A state of equilibrium is thus reached and the silage will keep in this pickled or preserved state for a considerable length of time. Corn is an ideal medium for the development of the ensilage

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process since it contains relatively large amounts of sugar for the formation of organic acids. This is why corn has become such a popular silage crop. It can be made into good silage with ordinary care in ensiling.

Legumes and young grass are more difficult to ensile because they contain relatively little sugar and are comparatively high in protein. Bacteria and enzymes act on protein breaking it down into simpler and more soluble forms, the process being somewhat similar to that which takes place in the digestive tract of an animal. Often these proteins break down into butyric acid which is the foul smelling acid found in sour and spoiled silage. It may readily be seen that any method of handling which promotes or provides for the breakdown of sugar into desirable acids and discourages the breakdown of protein would be very useful in the production of good silage.

Several rather simple but important rules must be observed in making grass and legume silage.

1. The crop must be ensiled with the proper amount of moisture.
2. Most of the air must be excluded from the silage mass.
3. The crop should be cut at the proper stage of maturity.
4. Provision must be made for sugars or carbohydrates in the material to be converted into desirable acids to act as a preservative.

Moisture in the Silage Crop

Over a period of 18 years experiments have been conducted by the Field Husbandry Division, Central Experimental Farm, Ottawa, in experimental silos of one-half-ton capacity. Many of the results have been repeated in larger, standard size, farm silos. During this period more than 500 different tests have been made with 20 different crops. It has been found in these tests that having the right amount of moisture in crops is probably the most important factor to consider. Workers in the United States Department of Agriculture at the Ohio State Experiment Station and other institutions have obtained similar results.

The most suitable moisture content is around 65 per cent, but it is possible to make reasonably good silage if the moisture ranges 5 per cent above or below this amount. Unfortunately it is rather difficult to correctly estimate when this desirable moisture level is reached in the growing plant. It is a matter which requires considerable experience and judgment. The crop should be cut at the proper stage of maturity and this is discussed in a later section of this pamphlet. Little or no outside moisture from rain or dew should be in evidence. When a good sized handful of the crop is squeezed or twisted in the hand it should feel damp but not too soft or watery. If juice commences to exude freely from the silo under the pressure of partial filling it may indicate too much moisture.

If the crop contains too much moisture there are a number of methods of reducing it. One method is to allow the crop to stand for a few days until it becomes more mature, or the crop should be left until it may be harvested in drier weather. It is possible to make good silage under climatic conditions which would be much too humid or damp for hay making but "making hay in the rain" as has become the slogan of some silage enthusiasts is likely to result in failure even when molasses is used. Failure is almost certain if no preservative is available. If neither of the above suggestions can be followed the immature grasses or legumes may be cut and allowed to wilt for two to five hours, depending on whether drying conditions are good or poor. Care must be taken, however, not to wilt too much, since pockets of mould are likely to form if the crop is too dry or unevenly dried. Another method is to mix moist immature crops with chopped dry hay at the rate of 100 to 200 pounds of hay to each ton of silage. This will reduce the percentage of moisture considerably.

This matter of moisture in the crop cannot be too strongly emphasized. Material ensiled when too wet is liable to rot and when too dry it will become mouldy and musty. Both conditions will render the crop unfit for feed.

Excluding the Air from Silage

Next in importance to the moisture content of the ensiled crop, and very closely associated with it, is the control of the air in the silage mass. These two factors are so closely related that it is almost impossible to determine which is cause and which effect. It is impossible and undesirable to force all of the air from the interspaces in the cut crop. A small amount of air is necessary for the proper functioning of the ensilage process. To provide the proper amount of air in the silage the following precautions should be observed:—

1. The walls and doors of the silo should be air-tight. Inspect carefully before filling to see that there are no small holes or cracks.
2. The moisture content of the crop should be approximately 65 per cent.
3. The silage cutter should be set to cut in $\frac{1}{4}$ inch lengths.
4. The silo should be filled as quickly as possible. Hold-ups of over 24 or 36 hours should be avoided if possible, otherwise it may be necessary to throw mouldy and spoiled silage off the top before commencing to fill again. An exception to this would be in refilling a silo after settling is completed after a first filling.
5. The heaviest and wettest material should be placed at the top to provide pressure on the entire mass.
6. A limited amount of drainage should be provided at the bottom of the silo to prevent an accumulation of moisture or water logging.
7. The top of the silage should be tramped thoroughly during the filling of the silo and every few days for several weeks after ensiling, taking special care to fill in and tramp well, any pockets which occur near the walls. Even after settling has apparently ceased it is well to examine the top of the silage frequently to see if there is any shrinkage away from the walls of the silo. If shrinkage occurs, the openings should be filled and packed solidly.

Cutting at the Proper Stage of Maturity

The stage of maturity at which a crop is cut has an important bearing on the quality of the silage. For best results, alfalfa, red clover and alsike should be cut when nearly in full bloom. Grasses such as timothy, orchard grass, western rye grass, meadow fescue and others will give best results when ensiled immediately after heading. Oats, barley, rye and millet should be cut when the seeds are forming or in the milk stage and soybeans and peas when the seeds are well formed.

It is true that in some cases crops cut at an earlier stage than that suggested above will contain a higher percentage of protein. However, this disadvantage of cutting at a more mature stage is more than offset by the advantages of better preserving qualities in the silage, a higher total yield, greater ease of handling the crop and a lower percentage of spoiled silage.

Mixing Farm Crops to Provide Preservative Materials in the Silage

As mentioned above, grasses and legumes are relatively high in protein and low in sugars, a factor which adds to the difficulties of making them into good silage. The above suggested methods of handling the crops ensure the utmost utilization of the limited amount of sugar found naturally in the plant. By following these methods it is quite possible to convert enough of the sugars into acid to preserve the ensiled crop. The addition of molasses to the crop was

developed because it was a convenient way of adding a concentrated sugar in a form which was readily convertible into acid. Molasses is essentially about 50 per cent sugar, weighs about 12 pounds per gallon and the addition of about 60 pounds per ton of grass or legume silage gives added assurance that the silage will keep well, but it is not essential to making good silage and it may or may not be economical.

In the present emergency, while it may be impossible to purchase molasses, the mixing of home-grown crops high in carbohydrates with the high-protein crops is still possible and serves the same purpose. It is often possible to mix two such crops so that the resulting silage is of a lighter quality than either of the crops ensiled alone. The following are some suggested mixtures:—

1. Corn silage three parts and soybean silage one part mixed at the silo.
2. Equal parts of corn silage and third-cut alfalfa.
3. Millet or Sudan grass and soybeans equal parts.
4. Alfalfa three parts and any species of grass one part.
5. Red clover three parts and any species of grass one part.
6. Oats and peas grown in a mixture seeded at the rate of 2 bushels of oats and 1 bushel of peas.
7. Mixing 80 to 100 pounds of barley meal or corn meal with each ton of grass or legume silage.

If the above precautions are taken in ensiling grass and legume crops the resulting silage should be high in quality and feeding value. During the past 5 years 40 to 200 tons annually of alfalfa or mixed alfalfa and grass silage have been ensiled at the Central Experimental Farm, Ottawa, in standard farm silos without the use of preservatives of any kind. The silage has been of excellent quality and milk production has been well maintained.

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