FORAGE CONSERVATION FOR DRY SEASON FEEDING OF LIVESTOCK

EXTENSION BULLETIN NO.
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Assistant Extension Specialist
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FORAGE CONSERVATION

INTRODUCTION

Surplus forage or forage in special purpose pastures can be conserved as hay or silage. Either or both of these grassland products assume a great significance particularly during the dry season when stock live weights decline due to feed shortage. Forage conservation basically aims to produce, at low cost, a stable product suitable for animal feeding with minimum loss of nutritive value. Deterioration due to internal chemical changes and external microbial action of cut herbage are prevented either by dehydration or acidification.

Forage conservation hence provides more efficient animal production by making use of wasted pasture surpluses in the growing season. This reduces the decrease in body weight or production which may occur in the dry season and can prevent animal mortality in draught years.

ADVANTAGES OF CONSERVATION

It permits harvesting at optimum growth stages for best quality feed and assures uniform quality in feeding.

It avoids wastage from bush fires

It prevents grazing wastage by reducing losses from excessive trampling and fouling especially on tall-growing, high yielding forages such as gamba, elephant grass etc.

It permits mechanization of feeding and eases the burden of Management.

METHODS OF FORAGE CONSERVATION

Modes of forage conservation include silage, haylage, field or artificially dried hay, husklage, foggage and fodderbank.

(A) Silage

Silage is a fermented animal feed made by allowing green forages or other plants having sufficient moisture to undergo fermentation when stored in silo in the absence of air. It can be made from a great variety
of forage but the most common ones are maize and sorghum. Silage may also be made from other feeds such as green grass forage, guinea grass, Gamba, elephant grass, legumes or even weeds (forbs). These may require addition of preservatives (e.g. cereal grains, liquid molasses) since they do not contain or possess adequate soluble carbohydrates.

STAGE OF GROWTH TO CUT FOR SILAGE

For milk and meat production: cut before or at flowering when green, succulent and highly nutritious.

ii. For growing or store stock, or for dry season live weight maintenance; cut at maturity, since the bulk is more important than the quality.

SILAGE CROPS

Elephant grass - Early flowering or at about 2m tall
Gamba grass - Early flowering
Rhodegrass - Early A
Guinea grass - Early A
Guinea corn - Dough stage
Millet - Dough stage
Maize - When cob first reaches the dent or glazing stage
Cowpea - Early podding stage
Mucuna - A @ A
Soyabean - A @ A
Lablab - A @ A

In general, grasses and cereals for silage purposes should receive ample applications of nitrogenous fertilizers. In many instances mixtures of legumes and grasses are recommended the later provides the sugar necessary for the fermentation process.

PROPERTIES OF GOOD SILAGE.

1. Good silage must have good smell (A clean @ odour, not putrid).
2. Pleasing taste (palatability)
3. Good colour (greenish yellow
4. It must be without mould
5. Must neither be slimy nor rotten
6. High dry matter (DM) content (35%) to lower seepage
7. Low PH value - usually 4.1 or 4.2
Lactic acid predominating - 8.5% of DM
Little acetic acid - 2.5% of DM
No butyric acid
Limited amount of ammonia e.g. ammonia nitrogen
should not exceed 5-8% of total nitrogen.
8. High digestibility
9. Temperature of 85-95°F should be maintained in the
pit.

1. REQUIREMENT FOR GOOD SILAGE MAKING

1. Harvest at the proper stage of maturity: This suggest
cutting when grains are at the milk or soft dough stage
and the forage is at 60-70% moisture content.
2. Cut to proper length: - The fodder should be chopped
into particles of less than or equal to 3cm lengths.
3. Control the moisture content: The recommended
moisture content for ensiling is 60-70%. If higher the
cut forage should be wilted for 2 hours on a good sunny
day or by adding dry hay or dry preservative such as
ground grain, corn-cob, dried molasses. If cut forage
has below the recommended moisture content, add
water or very green freshly cut material to raise the
moisture level.
4. Add a preservative only when needed.
5. Fill rapidly, distribute and tramp the forage in the silo.
This is accomplished by driving tractor to and fro into
the silo while filling. It should be filled in two days or
less to prevent spoilage. See table I.
6. Seal or top off the silo: - This may be accomplished by
covering with plastic sheets to ensure exclusion of air
and rain. It may also be followed by putting a heavy
layer of dirt or straw.

TABLE I:
Some silage preservatives, rates of application (kg per 1000kg of green chop) and their uses.

<table>
<thead>
<tr>
<th>PRESERVATIVE</th>
<th>RATE</th>
<th>COMMENTS</th>
</tr>
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<tbody>
<tr>
<td>Cereal grains or liquid molasses</td>
<td>40-50</td>
<td>Added to low sugar legume and certain grass, to supply soluble sugars and promote fermentation.</td>
</tr>
<tr>
<td>Ground limestone or calcium carbonate</td>
<td>10</td>
<td>Allows the lactic acid bacteria to perform longer and produce more acids.</td>
</tr>
<tr>
<td>Urea</td>
<td>5</td>
<td>Added to low protein forages to increase protein content of silage.</td>
</tr>
<tr>
<td>Mineral acids e.g. 16% con. Phosphoric acid</td>
<td>8</td>
<td>To reduce PH of silage and promote fermentation.</td>
</tr>
</tbody>
</table>

(Adopted from Matsushima, 1979).

PROCESS OF SILAGE MAKING
The ensiling process refers to the changes that take place when forage or feed with sufficient moisture to cause fermentation is stored in a silo in the absence of air. The entire ensiling process requires 2-3 weeks, during which time the following aerobic (with air) and anaerobic (without air) activities predominate.

(a) **Aerobic activities**: The living plant cells of the forage continue to respire, or breathe, consuming the oxygen of the silage - entrapped air, producing carbon dioxide and water and releasing energy or heat. Aerobic yeasts and mold thrive and multiply. During the period the temperature rises to 100°F (35 °C) provided.

(i.) The materials are well prepared

(ii.) The right step for high quality silage making are followed.

(b) **Anaerobic activity**: When the available oxygen of
entraped air has been consumed, anaerobic bacteria chiefly acid forming and proteolytic, multiply at a prodigious rate. Simultaneously, the molds and the yeast die but continue in a minor way to functions as enzyme systems which produce an other end products. 

**Changes produced by the combined anaerobic activity:**

(i) The carbohydrates and sugars are broken down into lactic acid (acid in sourmilk), some acetic acid (acid in vengear) and a small amount of other acids and alcohol

(ii) Small quantities of protein are broken down into ammonia, amino acids, amines and amide.

(iii) The acidity finally reaches a point where the bacteria themselves are killed; and the silage making process is completed.

**Note:** Silage in good silo will remain unchanged for a period of 10-15 years. However yeasts, followed by molds will again become active if silage is exposed to air with the opening of the silo, or through air leaks or air pockets.

**STEPS FOR MAKING HIGH QUALITY SILAGE**

1. Partial witting before ensiling increases percentage dry matter and reduces bacteria activities.

2. Chopping, lacerating or crushing of stemmy or coarse materials assist consolidation.

3. Consolidation creates an air-tight condition which promotes fermentation.

4. When young grasses and legumes are used, additives such as molasses (3-4% by weight as spray) or dried, ground cereal grain at 40-140 kg/ton (to absorb excess moisture, provide fermentable carbohydrates which promotes useful bacteria growth and lactic acid production, reduce or eliminate seepage, and improve palatability.
5. Addition of sterilizing agents e.g. sulphur dioxide ($S_2O_2$) at the rate of 5 kg/ton of silage is capable of preserving silage for 2-3 years or sodium metabisulphite ($Na_2S_2O_3$) at the rate of 8 kg/ton of silage to kill unwanted bacteria (clostridia) flora.

6. Replacement of entrapped air with $CO_2$ immediately after ensiling to eliminate plant cell respiration and aerobic bacteria activity.

7. Addition of sodium chloride to improve fermentation and palatability of an inferior silage.

TYPES OF SILO

1. Pit silo (trench silo) - a trench or pit is dug in the ground on sloppy land. One end of the pit is at ground level to allow drainage and access by machinery. The side-wall, if soil structure is firm, should be smooth and sloped. If soil structure is not firm or if silo is to be used for many years should be lined with concrete. A trench silo is most popular in areas where there is a good drainage. A trench silo should be wider at the top than at the bottom and the bottom should slope away from one end such that excess juices will drain off if material with too high moisture content is ensiled.

2. **Bunker Silo**:—

   1. Built usually on fairly level ground with most of the floor at ground level and open at both ends. Side walls should be of concrete if it is to be used for several years (or wood, wire plus matting for short-time use) and require side support of concrete braces, post or other bracing. The floor should be sloped sufficiently to assure drainage.

3. Stack silo:—

   Suited for short time only, as spoilage percentage is high, unless plastic sheeting is used inside slated walls and cover. Location is the same as bunker silo.
4. Gas tight tower silo:--
   This silo is made of steel, unloads from the bottom, although expensive, it takes some of the risk out of silage making. Silage compression is assured.

Insert (Upright Silo) Diagram here

Insert (Stack Silo) Diagram here
ADVANTAGES OF SILAGE
1. It retains a higher proportion of the nutrients of plants than can be accomplished by hay making because shattering and bleaching are held to a minimum.
2. It is feasible to produce a top-quality feed during wet weather when it would be impossible to cure the forage crop for hay.
3. It is the most economical form in which the whole stalk of stout-growing plants such as maize, sorghum, elephant grass etc; can be processed and stored.
4. It eliminates the danger of feed loss by fire if stored within the recommended moisture range.
5. It is the most satisfactory and economical method for preserving a number of by-product feeds e.g. cull vegetables, fruits, weeds etc.
6. It is a better source of protein and certain vitamins especially carotene than dried forage.
7. It is a very palatable feed and slightly laxative in nature.

DISADVANTAGES
1. It requires a silo or storage structure and other special equipment for best results.
2. It contains considerably less vitamin D than sun cured hay.
3. It incurs an added expenditure when preservatives are necessary.

2. HAY
1. Hay is a forage harvested preferably during the growing period and preserved by drying for subsequent use. It is primarily a cattle, sheep, goat and horse feed, although some high quality legumes (as dehydrated meal) may be added in swine and poultry rations. Apart from supplementing the pasture during periods of extreme drought, hay, in small quantities are often fed toward off bloat. In many advanced countries, good hay is regarded as the most important harvested livestock feed.
Hay is the most common form of preserving forage for storage because it is relatively easy to handle.

1. **When to cut for Hay:**

   The time of harvest for optimum feeding value and yield varies with the species. For the grasses, cutting is done at heading but before blooming, weather permitting. It is desirable to cut the legumes before or at flowering.

   (b) **Characteristics of materials cut at the right time:**

   1. The materials have high protein content
   2. Higher digestibility
   3. More intense green colour, which gives the hay a higher vitamin A value.

   As the plants mature some of the proteins, carbohydrates and other food nutrients are transferred from the leaves and stems to the roots and seeds; thus increasing the crude fibre content of the hay. Chemical analysis have shown that with the advancement in the time of harvest there is a decrease in protein, calcium, cobalt, green colour, carotene and grade of hay and an increase in lignin since rapid drying with minimum exposure to sun and rain is essential to avoid excessive loss of nutrients, good hay making requires dry weather.

   (c) **Hay Crops:**

   Hays are made from legumes, grasses or cereal crops. Important hay crops include, signal grass, Rhode grass, woolly finger grass molasses grass, green parne, Gamba grass, centro siratro, cowpea and soyabean. Average quality hay runs 25-35% crude fibre (Cf) and 45-55%TDN (total digestible nutrients) on, an as feed basis, where as such concentrates as corn and wheat contain around 2-3% fibre and 80% TDN.

2. **When to make Hay**

   Hay making is dependent on sun curing. Therefore, hays are cut at or toward the end of the rains when the possibilities of rain damage is minimal. The hay making season is roughly between the months
of September to December. The cutting date for a given area will vary from North to South of the country. The farther north the area from the coast the earlier the cutting date.

Curing Hay

Hay must first be cut before it can be dried. The afternoon has been proposed as the most suitable time for harvesting since stem and leaf carbohydrate content reaches a peak then. When the hay cures, certain chemical changes occur e.g. loss of moisture, dry matter, crude protein and other nutrients. Losses have been estimated as follows:

<table>
<thead>
<tr>
<th>Loss Type</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>DM - about</td>
<td>25%</td>
</tr>
<tr>
<td>Nutritive value</td>
<td>7.5-20%</td>
</tr>
<tr>
<td>A @</td>
<td>50-60% in bad season</td>
</tr>
<tr>
<td>Respiration after cutting</td>
<td>10%</td>
</tr>
<tr>
<td>Mechanical damage</td>
<td>5-10%</td>
</tr>
<tr>
<td>Imperfectly dried hay (effect of bacteria and enzymic activities)</td>
<td>5-10%</td>
</tr>
</tbody>
</table>

Hay may be cured by:

(a) Placing the cut forage on wire strung between poles
(b) Using pikes or haycocks built on tripods.
(c) Dropping the forage over an upright stake with several horizontal crossbars.

The major disadvantages of the processes (a) - (c) is the high requirement for hand labour. Curing is best done by allowing the cut grass to wilt in the swath and raking with a side delivery rake. Curing is completed in the windrow. The side delivery rake rolls the forage off the ground such that the leaves are mostly on the inside of the window. The windrow can be inverted the next day if it rains overnight. In all cases, raking should be done before the leaves start shattering. Hay thus cured is baled with pickup balers e.g.
(i) Ram balers which produce rectangular bale
(ii) Roll balers which produce cylindrical bales.

HAYING EQUIPMENT

In order to save labour, modern forage harvesting equipment which improves the quality of hay have been developed. Among the new machines that have been developed for handling hay are as follows:-

1. Mowers: simplicity, high speeds, and its greater width have kept the cutter bar mower popular.
2. Mower conditioners: These combine cutting and conditioning in one operation.
3. Windrowers: Multipurpose, self propelled windrowers provide up to 4.8m of cutting capacity.
4. Rakes: Side delivery rakes are still widely used to make hay crop windrows
5. Stack machines: These are hydraulically operated field machines that compress long hay, into stacks weighing from 1 - 6 tones.
6. Balers: Conventional square balers are still the most popular method of packaging. They come in either twine or wire-tic models.

STORAGE OF HAY

Hay can be stored in barns or sheds. Such barns or sheds need not be made with expensive materials. The maximum moisture content for safe hay storage are:

1. Loose stacked hay: 25% moisture
2. Baled hay = 20 - 22% moisture
3. Chopped hay = 18 - 20% moisture

CHARACTERISTICS OF GOOD HAY

The characteristics indicating hay of high palatability and nutrient content are:
1. It is made from plants cut at the early stage of maturing; thus assuring the maximum content of protein, minerals, vitamins and high digestibility
2. It is leafy, thus giving high protein content
3. It is fine stemmed and pliable not coarse, stiff and woody
4. It is bright green in colour, thus indicating proper curing, a high carotene or provitamin A content and palatability.
5. It is free from foreign materials such as weeds, stubble etc.
6. It is free from molds or dust
7. It has a pleasing, fragrant aroma

The characteristics are worth recognizing by those who grow or buy hay since they can give hint on the feeding value of the material.

ADVANTAGES OF SILAGE OVER HAY MAKING

1. High quality forage that might be harvested as hay or fodder of inferior quality or lost because of rain, can be preserved.
2. If harvested at the right stage and properly stored, most of the protein in the forage will be preserved, thus reducing the requirements for purchasing protein supplements.
3. A high proportion of the carotene is preserved as an insurance against vitamin A deficiency.
4. More dry matter is conserved by ensiling than by field curing the same crop.
5. Silage is well adapted to a system of saving surplus pastures in mid to later part of the rainy season.
6. Crops can be harvested earlier at their most nutritious stage.
7. It helps to control weeds, which are often spread through hay or fodder.
8. It practically eliminates the danger of loss by fire if stored within the recommended moisture range.
9. It is the most satisfactory and economical way in which a number of by product feeds can be preserved.
10. It is a very palatable feed and slightly laxative in nature
11. It makes for less waste, the entire plants being consumed which is an important consideration with coarse, stemmy forages.

ADVANTAGES OF HAY OVER SILAGE

1. It is the best form of long term storage of forages. Silage can be stored for extended periods, but once the silo is opened, the storage life of the feed decreases.
2. Once hay has been harvested and properly packed, it is easy to handle and feed.
3. It is an excellent source of certain vitamins and minerals.
4. Storing a ton of a crop as silage requires the handling of two to four times more weight than storing as hay.
5. Additional machinery is needed if harvesting and storage of silage is conducted mechanically e.g. need for two forage harvesters, dumping equipments etc.
6. Silage made from high-moisture crops that have received no wilting or preservative may have an offensive odour and not be too acceptable to livestock.
7. Silage should not replace good hay entirely with livestock on full feed but can very well replace a major portion. Silage, especially that with an unusual high moisture content, is low in dry matter and an animal cannot consume enough to fully meet daily drymatter requirements; thus supplemental hay feeding is also needed.
HUSKLAGE

It is a salvage feed consisting primarily of husks and cobs with limited grain which remain in the field following grain harvest. It is low in crude protein. The low quality (4-6% Cp) demands the use of supplements before feeding to livestock. E.g. protein, vitamins and minerals. Husklage can be grazed in stacks or ensile.

FOGGAGE

This is a roughage feed produced by delaying grazing during part of the growing season to a relatively mature stage to increase pasture vigour and root development by permitting adequate top growth. It also allow pasture regeneration by permitting seeding and to provide grazing during the dry season, when growth is normally at a stand still. In this regard, certain areas under rangeland conditions or certain paddocks under a notational grazing system, are set aside for grazing at a later date. Foggage can provide grazing right through dry season but will not meet maintenance requirement. Feeding foggage or standing hay requires sequence feeding of supplement.

CONCLUSION

Forage conservation as a practice and in which ever form is becoming increasingly necessary in Nigeria because of the diminishing ratio of grazing land to livestock units and the growing human demands for livestock products. Herbage availability during wet season often exceeds animal requirements. This becomes relatively scarce during the dry season especially in the northern part of the country where most of our stock are kept. The problem of inadequacy of roughage feed for our livestock during the dry season in the savanna areas can be tackled through forage conservation. Considerable research effort have been made at NAPRI, Shika in this regard. It is evident that forages in Nigeria are hardly harvested at the right stage of development for conservation purposes. Forms of forage conservation are highlighted. Option choices are dependent on the facilities available, the financial strength of the livestock farmer, and the type of livestock enterprise among other factors.
REFERENCES


