CHAPTER-4

Hay and silage making

Objectives:

1. To prepare hay from green fodders.
2. To prepare silage for fodder conservation.

Introduction

The green roughages can be preserved in form or hay or silage which can be used during the period of scarcity. Hay refers to grasses or legumes that are harvested, dried and stored at 85-90% DM. Fresh fodder when packed in a container and allowed to ferment under anaerobic conditions producing volatile fatty acids which preserve the material for a long time with minimum loss of nutrients is called as silage. When hay making is not possible because of high rainfall and less of sun shine available during the period when the green plant material is available in abundance, silage making is a very good option to conserve the green roughages.

A. Hay making

It is the process of preservation of green fodder by drying process. Hay refers to grasses or legumes that are harvested, dried and stored at 85-90% DM. Fodder crop is harvested before maturity (50% flowering stage) when it is still green. The crop is spread over a place in rows and then put on hay racks for further drying under sun. The fodder has to be given turning from time to time and should not be exposed to severe sunshine to avoid decarotinisation. Non-leguminous fodders like oats, jowar and Anjan grass and leguminous fodders like berseem and Lucerne can be converted into hay. Maize and barley are not suitable for hay making. The non-leguminous crops should be harvested after flowering stage and when 50% florescence is there. For leguminous crops, the harvesting should be done just when the flowering starts.

Characteristics of a good hay

- Hay must keep the characteristic green colour of the crop.
- It should be soft and pliable.
- It should be prepared in such a way that there is less loss of leaves due to shattering and maximum amount of green colour is retained by the hay.

- The hay should be free from dust, mould and bad odour.
- The aroma of the finished product should be such that it is relished by the animals.
- It should not have more than 15% of moisture so that it can be safely stored without risk of fermentation and combustion.

Crops suitable for hay making

The fodder crops having soft and pliable stems are more suitable for hay making. Green oats is the best crop for hay making. However, green berseem, lucerne, cowpea, guar, natural grasses, etc. can also be used for hay making if proper care is taken in curing whereby shattering of leaves is avoided. Annual and perennial grasses like *dub,* anjan, etc. can also form good hay. Maize, sorghum, bajra, etc. are more suitable for silage making than for hay making. To prepare hay of thick stemmed crop, it is advantageous to crush the stem or chop the fodder itself, Early cut graminacious crops are most suitable for making good quality hay which are very nutritious and sometimes may be compared with the crop for second cutting.

Fig. 4.1. Oat hay prepared at NDRI, Karnal

Method

The aim of hay making is to reduce the water content of the green crop to a level low enough so that the plant and bacterial enzymes do not act on the plant nutrients. The moisture content in the green crop is reduced to 20% and for bailing and storage it should range between 15-20%. In no case more than 20% of moisture should be allowed in Indian conditions, otherwise, due to fermentation the hay gets very hot and nutrients are lost. Sometimes, there is spontaneous combustion. A practical method of determining the safe limit for hay storage is to twist a wisp of hay in the hands. If the stems are twisted and there is no indication of moisture it can be stored.

In tropical countries like India there is, however, greater prospect of making good quality hay both in the sun as well as on the farm. During the *kharif* season (wet and hot), the crops may be harvested in the early September when the monsoons are at decline and during *rabi* (dry and cold) season the crop may be harvested during February-March for hay making.

For the efficient production of good quality hay, the crop should be harvested early in the morning when the dew has dried. However, some experiments have shown that there is no advantage in delaying the cutting grasses. After cutting, the grasses are left as such for few hours for the curing. After about 4 to 5 hours, if there is a good sunshine, the fodder may be turned upside down with the hay rack. If it is September and October by afternoon, the moisture may come down from 75 to 40%. In the evening, small loose heaps (windows) can be formed with the hay rack and fodder is left. On the next day one or two turnings are given and by afternoon the moisture level will come down to 25%. At this stage it can be baled and kept in baled form or if it is heavy rainfall area it can be stored on tripod stand. The tripod system of hay making has an advantage that if there is rain the water will pass down and there is proper aeration from below which inhibits the fermentation.

Various methods of drying the forages have been tried in India like drying the crops on fencing, wires, roofs tops, tree tops, galvanized tin sheets, tripod stand, etc. Care should be taken to avoid shattering of leaves in leguminous crops like berseem, lucerne, cowpea, etc. For heavy rainfall areas hay curing sheds have been developed where monsoon grasses are dried.

Factors affecting the nutritive value of hay

1. Stage of harvesting

The nutritive value of the fodder goes down as the plant matures. At a very early stage the protein and energy contents of the fodder are very high but the dry matter yield of

the fodder per unit area is very low. At the later stages when the crop is full bloom, the protein value goes down and the digestibility of nutrients is also reduced. The total yield of dry matter is increased. In order to get more nutrients per hectare, the crop should be harvested just at preflowering stage or when about 10% of the crop is in bloom. This is the time when plenty of sunshine is also available for hay making. Under high moisture and temperature fungi and moulds may grow on the hays. Such infested hays are unpalatable and harmful to the farm animals and men. In later case, allergy to the farmer handling the infested hay has been reported. Common salt and fungicides like phosphoric acid have used to check the growth of moulds. Curing of hay under normal sunshine condition does not affect the nutritive value of the hay. However, if the crop is not quickly dried and left in the field unattended, then there are heavy losses.

2. Shattering of leaves

This loss is more common in leguminous crops like berseem, lucerne, cowpea, etc., where the leaves dry earlier than the stems. If drying is prolonged without proper turning, the leaves become brittle and shatter. Sometimes this loss becomes very serious since leaves are richer in proteins, vitamins, minerals, etc. than the stems. This loss can be reduced if the forages are-chaffed before curing them for hay. Leguminous hays should be transported from the field early in the morning so that with dew there is less shattering of leaves.

3. Fermentation

After the crop is harvested, the plant enzymes act on the soluble carbohydrates forming thereby carbon dioxide and water. Therefore, in a normal hay making process some of the nutrients are lost which results in the higher crude fibre content of dry matter of hay as compared to the green fodder analysed before hay making. Although major changes during hay making occur in the carbohydrate fraction but other nutrient like protein is also affected. Proteins are also hydrolysed to amino acids which may be lost if there is a rain on the hay due to leaching. In a normal curing there is a loss of about 5~9% of dry matter.

4. Oxidation

If the green fodder is exposed to the sun for a longer period without proper turnings, nearly all the carotene will be lost. In the green fodder, it is between 150-200 ppm of dry matter and due to bleaching it can be reduced to 5-10 ppm. Rapid drying of the crop on tripod system conserves the maximum amount of carotene. Sunlight has a beneficial effect vitamin D_2 formation.

5. Leaching

During hay making, if heavy rains prolong, severe losses due to leaching occur. Leaching causes loss of protein, NFE, soluble minerals and vitamins. The crude fibre content is increased.

B. Silage making

Silage: It is the green material produced by controlled fermentation of green fodder containing high moisture level. Fresh fodder when packed in a container and allowed to ferment under anaerobic conditions producing volatile fatty acids which preserve the material for a long time with minimum loss of nutrients is called as silage. The process of silage making is called ensiling.

Characteristics of a good silage

Among the physical characteristics, it should have acceptable aroma without mould growth. A good silge is greenish yellow and is highly palatable to the animals. A fermentation loss of 10-15% cent is acceptable. Chemically, its pH value should be between 4-5, in proportion to lactic acid, other volatile substances should be less, ammonia should not comprise more than 10-12% of total nitrogen. Concentration of butyric acid should be less than 0.2 %.

Suitable crops

Soluble carbohydrate rich crops like maize, sorghum, bajra, napier, oat etc. are suitable for ensiling. Cultivated and natural grasses are very good substrate for ensilage. The crops used for the purpose should have about 65%. Legumes may contain 60-65% moisture. The crop should have solid stem so that small amount of air is trapped. For hollow stemmed crops, trampling should be adequate. Stage of harvesting is also an important aspect. For silage, maize should be harvested at dough stage, sorghum and bajra at milk to dough stage and natural grasses at flowering stage. Leguminous crops may also be ensiled with cereal crops in different ratios (2-4: 1).

Method

There could be several methods, however, the principle is same that green crops harvested at 65-75% moisture level can be ensiled or better chopped/chaffed. The mass is packed in silos so that it contains no or vey less air after trampling down using tractor or bullocks. After proper packing, the material is packed/sealed with mud/straw/polythene sheets. The soluble carbohydrates in the fodders are converted mainly to lactate and other

organic acids by lactic acid bacteria. The resulting product is acidic in nature (pH=4.0). At this pH undesirable butyric acid production is inhibited and so also the degradation of proteins to ammonia and amines. This can be achieved by proper compaction of the chaffed fodder. The exclusion of air from silo minimizes the loss of nutrients due to respiration and encourages the growth of lactate producing bacteria, prevents the growth of aerobic organisms producing heat at the expense of nutrients. The silo should be airtight which can be done by providing polythene sheets all around (top, side and bottom). Inoculation with lactic acid bacteria (e.g. *Lactobacillus plantarum*) results in lactic acid production provided that forage contains sufficient amount of soluble carbohydrates. Silage is ready after 4-6 weeks Higher moisture (>70%) should be avoided as it promotes undesirable clostridia. As far as possible, soil contamination should be avoided.

Tower and trench silos can be used for silage making. Silos should have air tight walls having no cracks whether they are above or below ground. If above ground, air may enter through cracks and moulds may grow while below the ground invites rain water and spoilage.

Fig. 4.2. Silage making

Advantages of silage making

- Silage can be prepared from green fodders when weather does not permit hay making.

- Silage can be prepared from plants which have thick stems and normally not suitable for hay making (e.g. sorghum, maize etc.)
- Weeds can be used alongwith major crops for ensiling. The process also destroys weed seeds.
- It is highly palatable to cattle and buffaloes.

Sample questions

1. What is the importance of hay and silage making?

2. What are suitable crops for hay or silage making?

3. What are the characteristics of good hay and silage?

4. How would you prepare hay and silage**?**