

remaining part of the day when stomata (tiny breathing holes on leaf surface) are still open. When the stomata close (which happens a few hours after cutting), drying rate also decreases.

Herbage does not die immediately after cutting. It continues to live (or respire) until its normal metabolic processes are stopped by lack of moisture. As it lives, it continues to waste-away nutrients within the plant cells. Therefore, it is important that the herbage is dried as quickly as possible to preserve the herbage's nutritive quality.

2.1.2 Cutting equipment

Resource-constrained farmers can use hand-held sickles or slashers to cut grass and legume crop. Where resources permit, tractor mounted mowers can be used to harvest the pastures.



2.2. Conditioning

Leaf and stem material is normally covered with wax like material (cuticle) on its skin (epidermis), to protect the plant from unwanted water loss. Water lost by transpiration comes out through the stomata (breathing holes). Forage can be subjected to physical treatment at cutting or immediately after, to hasten drying. Such treatment is usually aimed at bruising or pressing the herbage to break the skin and its cuticle and so avoid stomatal

1. Why hay?

Hay is a very popular form of forage preservation which can be a very important source of feed in the smallholder farming sector where veld (natural rangeland) is becoming limited. Hay is commonly made from fresh grass but forage legumes such as cowpeas, (*Vigna anguiculata*) Velvet bean (*Mucuna pruriens*) and Lablab (*Lablab purpureus*) can also be turned into hay. During hay-making forage is harvested by cutting and left to sun-dry up to a moisture content of about 20% dry matter (DM), at which stage, it can be stored away safely.

2. Steps in hay making

2.1 Harvesting

Plants should be harvested by cutting at the appropriate stage of growth. As the plant matures, its herbage yield increases and nutritive value declines. Hay must be harvested at a stage of growth when both nutritive value (chiefly forage digestibility and protein content) and herbage yield are optimized - usually at flowering time.



2.1.1 Timing

Forage intended for hay-making should be harvested when the farmer is confident that there will be 3 or more days of sunny weather conditions. Harvesting is best done in the morning, to allow the cut forage to start drying during the

PRINCIPLES OF HAY-MAKING USING TROPICAL GRASSES AND LEGUMES



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resistance during drying. This can be achieved by rolling a 200ltr steel drum, covered in mesh wire, over forage that is lying on a hard surface.

2.3 Turning

Cut and conditioned herbage must be turned several times to speed the rate of drying. Turning fluffs up the cut hay and allows the air and sunshine to reach the under surfaces, to promote drying. Turning must be done once or twice per day. However, too much turning, especially when the hay is semi-dry, will cause the leaves to shatter (breaking into pieces). Legume hay is very prone to leaf shatter.



2.4. Baling

Baling hay too early (>23% moisture) will trap moisture in the bale and promote growth of thermophilic bacteria, resulting in spoilage from heating and even burning of the haystack. Late baling (15-16% moisture) will result in shattering of leaves due to extreme dryness. Ideal moisture will vary from 18-22 % moisture content, depending on forage species. In the absence of a baling machine, smallholder farmers can compress hay using their feet into portable wooden crates of dimensions 90cm (L) x 60cm (W) x 60cm (D) or dig a pit in the ground of same dimensions.



3. Storage

Proper storage is a critical step in making high quality hay. Hay bales should be stored in well-ventilated farm sheds that also provide sufficient cover from rain damage. It is important to ensure that the sheds or barns do not expose the hay to very moist conditions that will lead to spoilage from moulds. Hay sheds can be built using simple materials such as wooden poles and grass thatching. Wooden pallets or raised platform can be used avoid direct placement of hay on the floor, as shown in the picture below.



4. Field losses and quality changes

Serious losses in dry matter quantities and nutritive value can occur during hay-making and these should be minimized to ensure profitability. Losses in the hay-making process can occur in the following ways:

i. Respiration losses - As already indicated, harvested forage will continue to breathe after cutting and cause DM loss from expended nutrients. Therefore,

drying should be as quick as possible to minimize losses. Under normal conditions losses can amount to 1 - 5% of total dry matter yield.

ii. Leaching of nutrients - This occurs when showers or rain falls on the cut herbage, before it is dry or stored away. For best results, the hay crop should be dried in dry and sunny conditions. Farmers can use their experience or information from weather forecasts to determine the best time to cut hay. Losses from rainfall damage can be as high as 15% of total dry matter.

iii. Mechanical losses – On smallholder farms mechanical losses are minimal because farmers use simple equipment such as sickles to cut herbage and the area covered per day is relatively small, such that most of the cut forage is picked-up by hand. In mechanized operations, losses can occur from crop that is not picked up by the machinery –either at harvesting or baling. This usually occurs when chop length is too small, making it difficult for the machine to pick it up. This can also occur when the mower, rake or baler is not in good working order.

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