Theme 2: Forage conservation

ESTIMATING IDEAL TIME OF HARVESTING (Level 3)

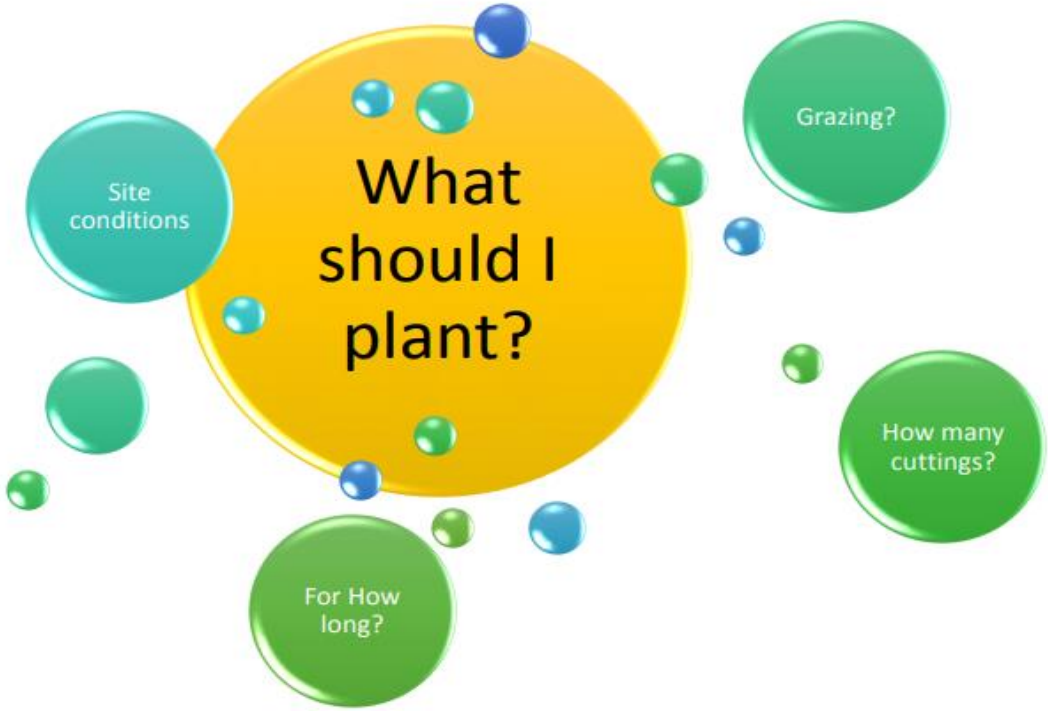
Topic	Training & information Content
2.1	Fodder conservation and storage
2.2	Estimating ideal time of harvesting
2.3	Guideline for silage making
2.4	Fermentation process
2.5	Treatment of straw with Urea
2.6	Making of urea/molasses/mineral lick
2.7	Management of silage pit (feed out)
2.8	Estimating fodder supplies for dry season feeding & planning of feeding management

1. You will learn about (learning objectives):

- ❑ The trainee knows the best stage at which to harvest grasses, maize and legumes used as forage
  - Forage quality
  - Selection of crops and stage of harvest
  - Good vs bad silage
  - Hay making
  - Machinery for harvesting and chopping maize and kernel crashers

2. Introduction

- Every forage crop has an optimum stage of harvesting
- The optimum stage is a balance between maximum yield and the best quality
- The optimum stage depends on how the forage material will be utilized i.e. either fresh feed or conserved feed (hay or silage)



3. Forage quality: Grasses, Alfalfa and Maize

- Forage quality is influenced by the stage of harvesting. The stage/time of harvesting and condition of forage material vary based on:
  - maturity
  - moisture content
  - type of forage crop
  - conservation method to be used

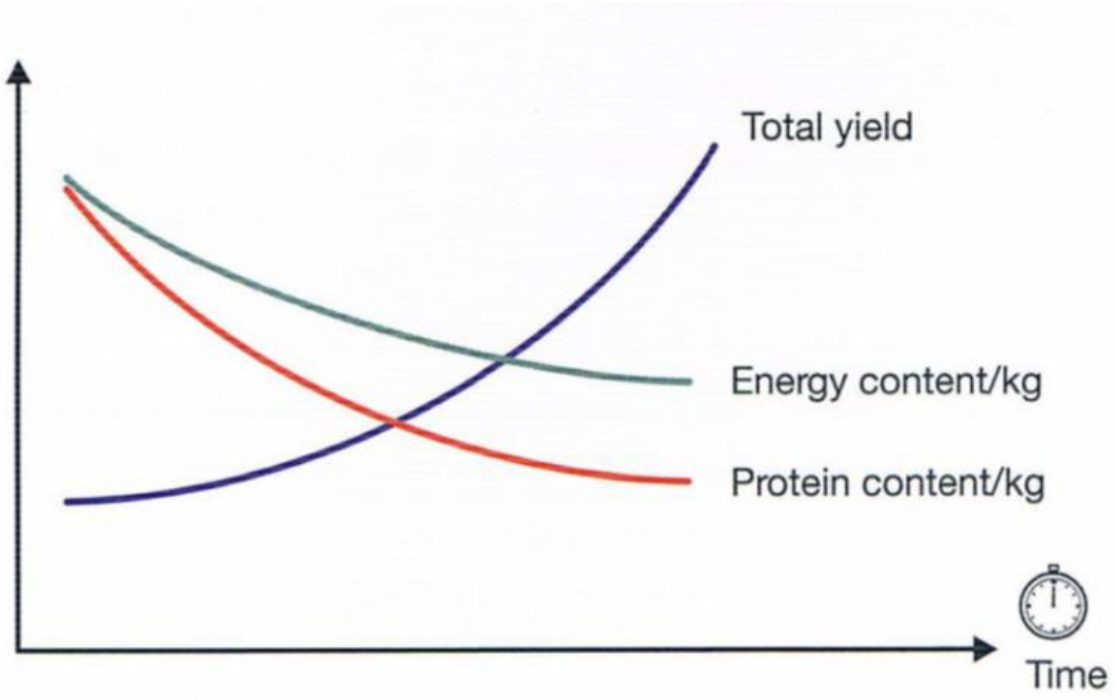
- In this module we are focusing on three main forages;
  1. Grass for silage and hay
  2. Alfalfa for hay
  3. Maize silage

4. Grasses: Best stage for harvesting grasses

- At the ideal harvesting/cutting stage, the grass should;
    - Be highly palatable
    - Have high intake
    - Highly digestible
    - Have high nutrient content
    - Have limited anti-quality (nutritional) factors
    - Improve animal performance

5. Drop in grass quality over time

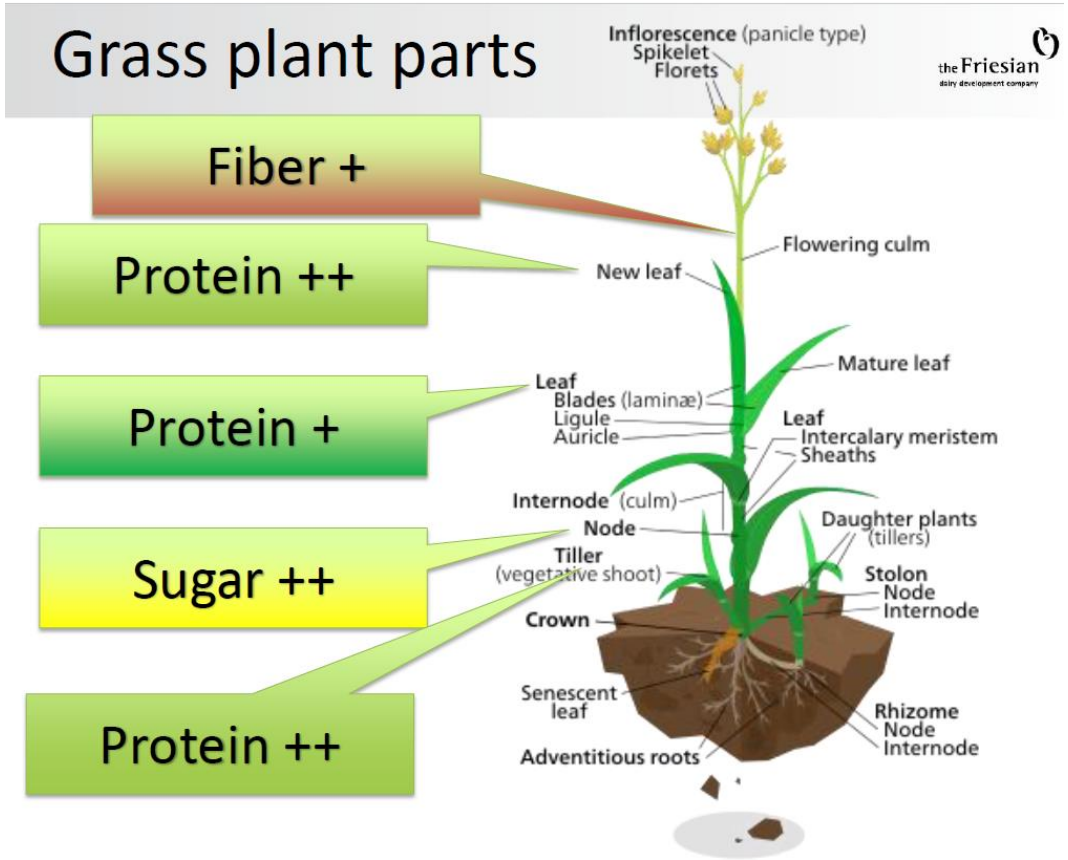
- The quality of grass (energy and protein) drops as the grass matures
- The longer you wait for the yield to increase the higher the nutrient losses



6. Parts of a grass plant

- A good understanding which parts of the plant provide nutritive components (such as sugar, protein, fiber and starch) and can help to choose the best stage of harvesting

- Parts of the grass plant include;
  - Rhizome node
  - Adventitious roots
  - Crown
  - Stolon node
  - Tiller
  - Node
  - Inter node
  - Daughter plants (tillers)
  - Leaf
  - Leaf blades
  - Mature leaf
  - New leaf
  - Flowering culm
  - Inflorescence spikelet
  - Florets



7. Selection of crop and stage of harvest

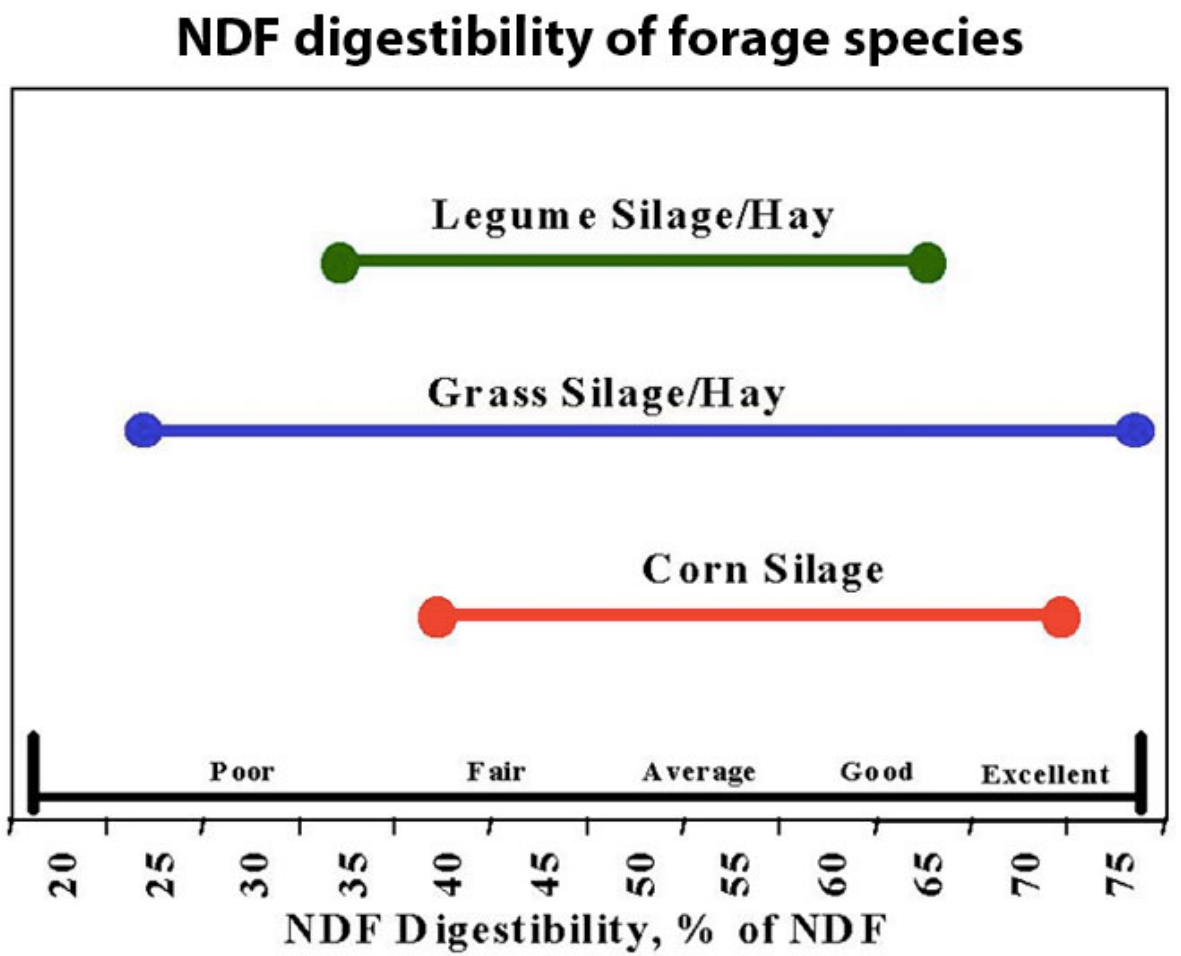
- The primary methods of preserving forage crops include silage making and hay making. The crops can also be harvested as green chops or grazed

- Each of these methods of forage harvest and/or preservation has benefits and limitations that make it more desirable than the others for a specific livestock operation

- Farmers, based on the scale of their farm and level of intensification, must review each management practice and evaluate their own production situation to determine which method to use to gain maximum economic returns

8. Factors affecting the choice of harvesting stage

- Grass variety
- Protein content
- Fibre content (NDF)
- Stage of maturity
- Balance between yield and nutritive value



9. Young grass is a source of nutrients

- Grass is a very good source of protein when harvested before flowering

- To optimize the nutrients available in the plant, feed the grass when fresh. If there is more than the cows can finish, make silage

10. Napier grass – stage of harvesting

- Cut the grass at the vegetative stage
- Napier silage should be made when the grass is between 60-90 cm to get the right balance between yield and quality
- Alternative way is to cut the grass every 4-6 weeks

11. Napier grass silage

- In silage making, ensure good chopping and compaction

- Well wilted and chopped Napier silage will result in good compaction hence nutrients are preserved and minimal loses experienced

11.1 Steps in making grass silage

1. Harvest grass when there is excess and quality is high
2. Wilt the grass to approximately 30-35% Dry Matter
3. Ideally chop the forage into pieces of 1-3 cm before ensiling.
4. Add fermentable substrate (e.g. molasses) when ensiling
5. Compact the forage tight and repeatedly in layers of 10- 15 cm of forage material
6. Complete the entire pit or clamp within 24 hours
7. Seal the pit immediately after filling
8. Cover the pit / silo with about 10 cm of soil
9. Maintain airtight seal until feeding out
10. Feed out the whole face of the pit to a depth of 15-30 cm very day day

12. Good vs bad silage

- Good quality silage is light brown and palatable with a sweet smell and can be kept for years under anaerobic conditions
- The forage material is high in carbohydrates with a low moisture content (after wilting)
- There should be a balance between yield and digestibility; higher yielding crops will be more stemmy therefore the digestibility is lower
- The first cut is generally higher in energy, with later cuts being more fibrous

Grass silage from star grass

12.1 Good vs bad silage Cont'd…

- A mature grass crop will have low sugar content, leading to poor fermentation
- If the crop is mature and too dry, it will be difficult to compact which can lead to spoilage on feed out
- Poorly made silage will result in cows refusing to eat the silage which leaves the farmer with a lot of waste
- Poorly made silage and contaminated with soil can also make cows sick: Listeria, botulism and clostridia thrive in the soil and can be picked up when harvesting the grass

13. Effects of stage of harvest when making silage

- This mower chops the forage material short, but the mature stage of the grass makes it difficult to make a good quality silage because there will not be enough water-soluble sugars in the forage material

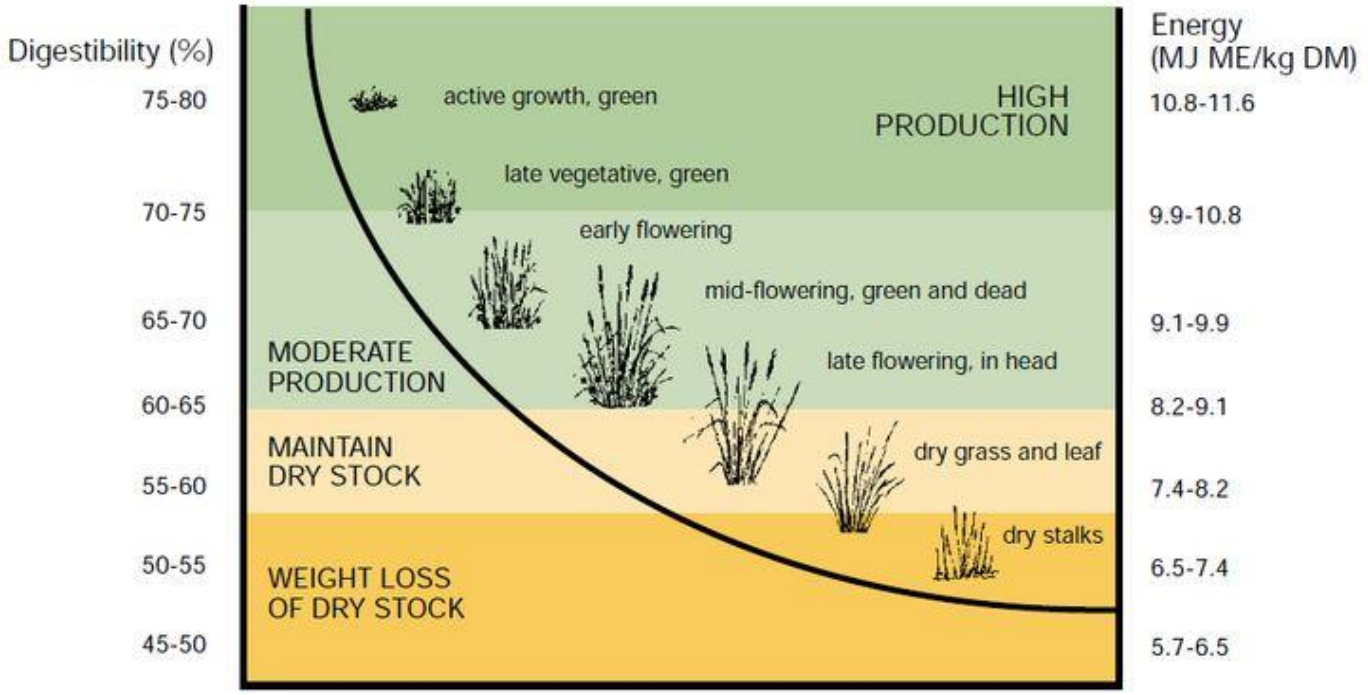
- This mower chops the forage material longer, but the younger stage of the grass makes it likely to make a better quality silage because the grass can be left to wilt for some hours and the grass will have more water-soluble sugars.

14. Stage of harvest for hay making

- Hay made when grass is overgrown is of poor quality
- Early flowering stage is a good alternative between the number of hay bales per hectare and nutritive value (quality)

15. Energy and digestibility of maturing pasture

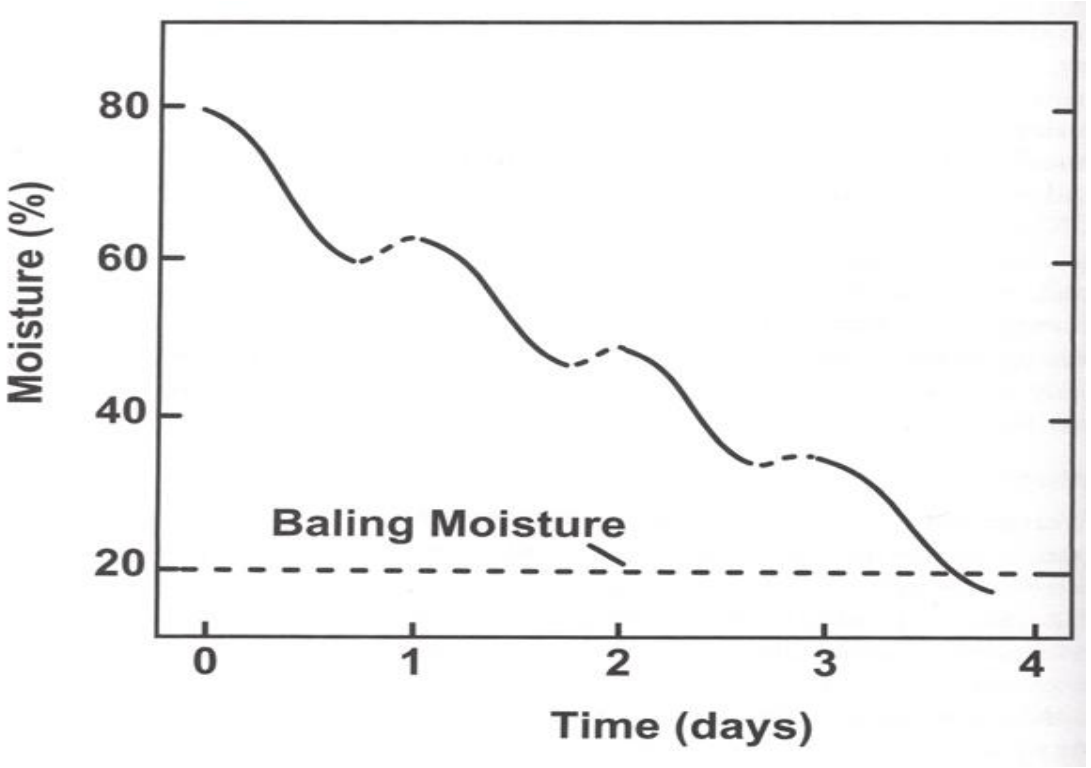
- The nutritional value of maturing pasture decreases once the grass starts flowering
- To aim for high (milk) production level it is recommended to cut the grass in the vegetative growth stage



Source: *Energy and digestibility of maturing pasture (adapted from Bell 1998)*

16. Hay Making – drying time

- When making hay, the drying time (period which the forage material is in the field) is important
- Grass in vegetative growing stage is leafy and will dry faster
- Grass at late flowering stage is more stemmy. The stems will dry more slowly and will take longer to dry
- Under ideal weather conditions it will take at least 4 days to reduce the moisture content from 80% (= 20% Dry matter) to 20% (=80% Dry matter)



17. Harvesting stage for maize silage

- The following are factors that affect harvesting stage of maize for silage:

  - Dry matter
  - Maize variety (uniform ripening cob/stem)
  - Starch content
  - Forage choppers used

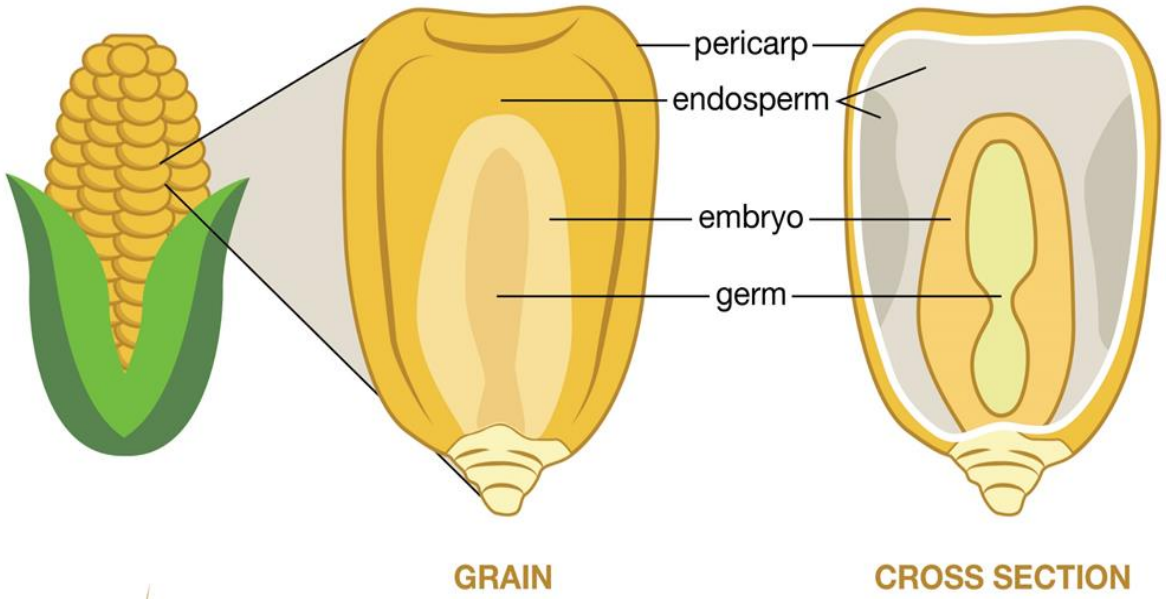



18. Access the crop on dry matter (DM) yield

- Identify the % dry matter; should be between 30-35% DM. The cob and kernel maturity correlate directly to dry matter;

    - Firstly, collect at least five representative cobs and pull back the outer leaves
    - Secondly, break the cobs in half to examine kernels
    - Thirdly collect at least five stalks (stalk/leave maturity), crack and twist
    - Fourthly, decide on the intended cutting height

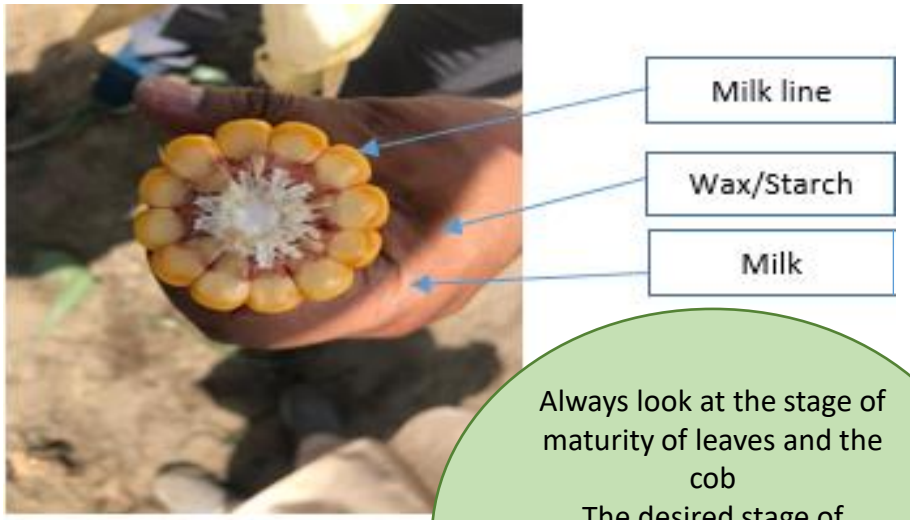
Note: *Dry down rate is 0.5-0.75 % per day → higher in hot climate*



Maize kernel (grain)

19. The maize kernel at 30-35% dry matter

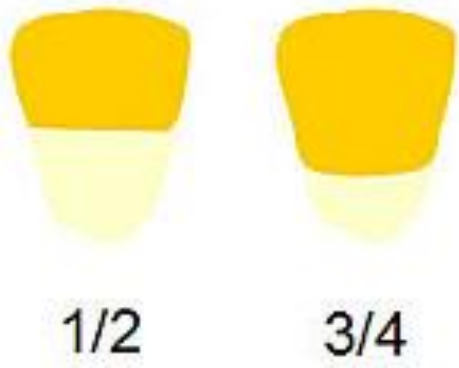
- Milk ripe:
  - milk white (or yellow) kernel
  - kernel is filled with milky substance
  - the outer skin (pericarp) is tight
- Soft dough ripe:
  - cream white (or darker yellow) kernel
  - kernel is filled with dough like substance
  - some milky substance still comes out of the kernel when is squeezed
- Dough ripe:
  - cream white/glazy (or dark yellow)
  - pressing your fingernail into the kernels should result in a soft cheese texture at top of the cob and
  - leave no indentation in kernels in the middle and bottom
- Hard dough ripe:
  - top kernel is hard
  - difficult to press your finger nail in top of the kernel



Always look at the stage of maturity of leaves and the cob
The desired stage of harvesting maize is when the milk line is at ¾ of grain. This is when starch content is at optimum

20. The kernel milk line

- To see the milk line, break a cob, look at the non-embryo side of the kernels. The broken surface of the tip is half of the cob
- Find the line between milky and dry endosperm
- A visual average around the cob is considered kernel milk line
- Half milk line occurs at about 35% dry matter



21. Determining dry matter in maize crop

- When you twist the stem of the maize crop, the number of drops indicate the level of Dry matter

  4 drops ≤ 18 % DM 100 % green
  3 drops ≈ 21 % DM 75 % green
  2 drops ≈ 24 % DM 50 % green
  1 drop ≈ 27 % DM 25 % green
  0 drops ≥30 % DM 0 % green

22. Stubble height

- Cut at a higher height (leaving 30 to 40 cm of the stalk)
  - lower fibre and lignin
  - higher starch (cut at dough ripe stage)
  - increased energy content and nutrient digestibility

- The stubble height can be a tool to manage
  - dry matter content
  - harvest timing of maize silage

Note: *Leaving more of the stalk in the field with high fibre and lignin content will improve soil conditioning*

23. Machinery used for harvesting maize

- Always make sure the knives are sharpened regularly (4-8 hours) to ensure the correct chopping size (0.8- 1.5 cm)
- If a forage harvester or chopper has no kernel crusher, many grains will pass unbroken (not damaged). These kernels can not be digested in the rumen and can be found in the manure
- The energy in the kernels is lost for the cow
- In this case it is better to harvest the maize earlier at the dough stage

24. Machinery used for chopping maize

- If a machine has no kernel crusher, many kernels (grains) will pass unbroken, this will force early (sub optimal) harvest i.e. at milky stage

25. Machinery with kernel crushers

- A machine with kernel crusher will allow maize to be harvested at dough-ripe stage

26. Legumes

- Legumes are best fed fresh or harvested as hay
- Making silage using legumes is not easy because of the high protein content

Lablab

Sunn hemp (Clotolaria)

Alfalfa (Lucerne)

27. Making hay from Alfalfa

1. Start with a good, full stand of healthy plants

- Maintain your field well by ensuring proper fertilization and weed control

2. Cut at proper maturity under ideal drying conditions

- If weather permits, the ideal maturity to cut alfalfa is in the bud to 10 % flowering
- This maturity is the perfect blend of yield/ha and high nutritive value
- Alfalfa should be cut in the morning – leaving 1 to 2 inches of stubble, and it should be conditioned when cut to disrupt the waxy cuticle on the stem

27.1 Making hay from Alfalfa Cont'd…

3. Drying

- To promote rapid drying, alfalfa should be laid out in wide swaths that are at least 70% or greater the width of the cut row
- Wide swaths increase overall hay quality due to two main factors – the hay dries faster and hay cured in wide swaths has a lower ash content

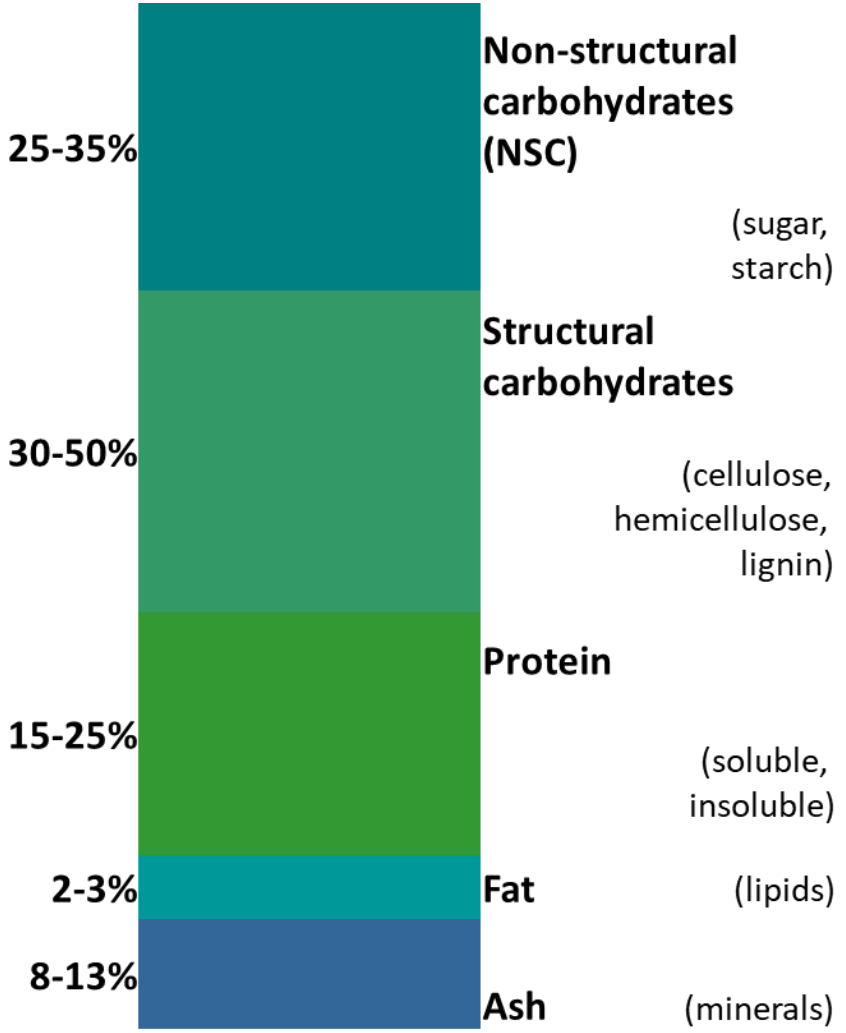
4. Bale the alfalfa quickly at optimum moisture levels

- Alfalfa is ready for baling only when you twist the forage crop in your hand there is no moisture

28. Whole plant analyses of Alfalfa

Nutritive value of alfalfa

- Alfalfa is a very nutritious forage when harvested at the right stage i.e., 10% flowering
- Alfalfa has a high protein content of between 15-15% of dry matter (DM)
- At this stage the crop contains 25-35% of DM non-structural carbohydrates (e.g. sugar, starch)
- Structural carbohydrates (fibre) are 30-50% of DM



29. Alfalfa hay – the nutrients are in the leaves

- Lucerne should be harvested at 10% flowering
- Care should be taken to ensure that there is minimal leaf are loss
- The leaves contain most of the valuable nutrients

After successful drying and baling the work is not finished if the bales are not transported and stored in time

- END -