Meadows and Pastures

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Terms

Vegetation Terms	Definitions
Forage	Edible parts of plants, other than separated grain, that can provide feed for grazing animals, or that can be harvested for feeding. Includes browse, herbage, and mast.
Browse	Leaf and twig growth of shrubs, woody vines, trees, cacti, and other non-herbaceous vegetation available for animal consumption.
Herbage	The biomass of herbaceous plants, other than separated grain, generally above ground but including edible roots and tubers.
Forb	Any herbaceous broadleaf plant that is not a grass and is not grass-like.
Legume	Members of the plant family Fabaceae.
Grass	Members of the plant family Poaceae.
Grass-like	Vegetation that is similar to grass in appearance and is usually a member of the plant family Cyperaceae (sedges) or Juncaceae (rushes).
Pasturage	Not a recommended term.The recommended definition of pasture refers to a specific kind of grazing management unit, not that which is consumed, which is forage. Thus, pasturage is not a useful term.
Mast	Fruits and seeds of shrubs, woody vines, trees, cacti, and other non-herbaceous vegetation available for animal consumption.
Forage crop	A crop of cultivated plants or plant parts, other than separated grain, produced to be grazed or harvested for use as feed for animals.
Aftermath	Forage grown following a harvest.
Residue	Forage remaining on the land as a consequence of harvest.
Silage	Forage preserved in a succulent condition by partial anaerobic, acid fermentation.
Hay	Grass or other plants, such as clover or alfalfa, cut and dried for fodder.
Haylage	Product resulting from ensiling forage with around 45% moisture, in the absence of oxygen.
Fodder	Coarse grasses such as corn and sorghum harvested with the seed and leaves green or alive, then cured and fed in their entirety as forage.
Green chop	Fresh cut forages.
Source:	Allen, 1991

feed

- **FEED**
- Substances that are not harmful to animal health when given in appropriate amounts
- Meet the maintenance and production requirements of animals
- Consist of one or more nutrients of organic or inorganic origin
- Can be derived from plant, animal, or naturally occurring sources
- Definition from the feed law:
  Any processed, partially processed, or unprocessed substance or product, including feed additives, used for the purpose of feeding animals orally.

FORAGES (FARM FEEDS)

- Green feeds
- Grasslands and pastures
- Forage crops
- Root and tuber leaves
- Root and tuber feeds
- Root feeds, tuber feeds
- Fiber-rich feeds
- Straws, husks, shells, cobs
- Preserved feeds
- Dried forages
- Silages

CONCENTRATED (COMMERCIAL) FEEDS

•Grain feeds
Wheat grains, legume grains, and oilseeds
•Industrial by-products:
•Milling industry residues
•Sugar industry residues
•Oil industry residues
•Starch industry residues
•Fermentation residues
•Animal-origin feeds:
•Milk and dairy products
•Meat and meat products
•Fish and fish by-products
•Poultry and poultry by-products
•Mineral feeds
•Feed additives

IMPORTANCE OF CONCENTRATED FEEDS

- Nutrient-rich feeds containing energy, protein, vitamins, and minerals
- High digestibility
- Necessary for animals with incomplete rumen development, high-yielding dairy cows, and beef cattle, whose nutritional needs can only be met by adding concentrated feeds to the ration
- Rich in energy
- High protein content
- Low in fiber (cellulose)
- Generally palatable, leading to quick consumption
- Do not stimulate rumination
- Ferment faster in the rumen compared to forages

IMPORTANCE OF FORAGES

- Forages are cost-effective.
- They meet the maintenance (+ production) nutrient needs of ruminant animals.
- They are rich in fiber (cellulose).
- Help prevent metabolic diseases and digestive disorders.
- Assist in the secretion of necessary enzymes by the rumen microflora.
- Speed up rumen development.
- Stimulate saliva secretion.
- Promote rumen contractions and the passage of digestive contents through the rumen.
- Positively impact milk fat levels.
- Generally, the feeds in this group contain a high amount of fiber (over 30% NDF) and low levels of protein and energy. The protein, energy, mineral, and vitamin levels in forages vary significantly. For instance, while the crude protein in legume hay can reach up to 20%, it may drop to as low as 3% in cereal straws.

•**Dairy cows**:
The dry matter of forages given to dairy cows should be 1-2% of their body weight.
It fulfills the animal's need for bulk feed.
Necessary to maintain optimal milk fat levels.
Generally, it is recommended that forages constitute no less than 50% of the total ration.
•**Young cattle**:
The forage-to-concentrate ratio should be 1:2.5 for young animals and 1:1.5-2 for older animals.
In intensive beef cattle farming, forages make up 20-30% of the total ration, while in extensive systems, the ratio can go as high as 70-80%.
•**Sheep**:
Sheep are the best utilizers of forages.
More than 75% of sheep rations consist of forages.
In lamb fattening, the proportion of forages in the total ration is 10-20%, while it can reach up to 90% in sheep feeding.

GRASSLANDS AND PASTURES

- **GREEN FEEDS**
- Green feeds refer to the feeds consumed by animals through grazing or after being harvested, during the vegetative stage of plant growth when the plant is leafy and not fully mature.
- **MEADOWS AND PASTURES**
- Meadows and pastures refer to green areas covered with forage plants, including grasses, legumes, and other plant families.
  - **Summer pastures**: Grazing areas used in the summer.
  - **Winter pastures**: Areas used for animal sheltering and grazing during the winter.
  - **Meadows**: Lowland areas with high groundwater levels, mainly used for hay production.
  - **Pastures**: Areas where animals graze.
- Based on their formation, pastures can be natural or artificial.
  Based on their duration, pastures can be permanent or temporary.

MEADOW AND PASTURE FORAGE CHEMICAL COMPOSITION

- **MEADOW AND PASTURE FORAGE CHEMICAL COMPOSITION**
- **Water**:
  The water content of meadow and pasture plants is:
  - 75-85% during the growth period
  - 65% when mature
- **Carbohydrates**:
  - Meadow forage contains high amounts of water-soluble carbohydrates (fructans, glucose, fructose, sucrose, raffinose, and stachyose).
  - Stems contain more carbohydrates than leaves.
  - The peak carbohydrate content is during full flowering.
  - The cellulose content in meadow forage generally ranges between 20-30% in dry matter and can rise to 40% as vegetation progresses.

Table 1: Chemical composition of high-quality meadow forage

Component	% in Dry Matter
Crude Protein	19.0
Crude Fat	4.5
Crude Fiber	20.8
Nitrogen-Free Extract	45.0
Crude Ash	10.8

- **PROTEIN**:
- The protein content in meadow and pasture plants varies from 3-30%, depending on factors like the vegetative stage, botanical composition, and fertilization.
- The amount of protein and non-protein nitrogen compounds (NPN) is higher at the beginning of vegetation and decreases as the plants mature.
    - NPN compounds: Glutamine, asparagine, nitrates
    - Nitrates are absorbed by plants as NO_3^- and NH_4^+ ions.
    - Nitrates, when converted to nitrites in the rumen, can become toxic, leading to a condition called nitrate poisoning. This occurs when nitrite oxidizes iron in hemoglobin, turning it into methemoglobin, which cannot carry oxygen, leading to symptoms like tremors, increased respiration, staggering, and potentially death.
- **LIPIDS**:
- Lipids in meadow and pasture plants are typically less than 6%.
    - These include triacylglycerols, glycolipids, phospholipids, and sterols.
    - 60-75% of the fatty acids are essential, primarily linolenic acid.
- **MINERAL MATTER**:
- The mineral content of meadow forage depends on the plant type, vegetative stage, soil composition, and fertilization.
    - Legume forages are generally richer in calcium, phosphorus, and magnesium compared to grasses.
- **VITAMINS**:
- Green forage crops are rich in β-carotene (250-350 mg/kg in dry matter), and they are a good source of vitamins E and B-complex.
- **ENERGY**:
- The energy content decreases as the vegetative stage advances.

Table 2: Mineral elements in meadow plants (in Dry Matter)

Element	Low	Normal	High
Potassium (%)	<1.2	1.5-3.0	>3.5
Calcium (%)	<0.20	0.25-0.50	>0.60
Phosphorus (%)	<0.20	0.20-0.35	>0.40
Magnesium (%)	<0.10	0.12-0.20	>0.25
Iron (mg/kg)	<45	50-150	>200
Manganese (mg/kg)	<30	40-200	>250

Table 3: Nutritional values of some grasses during different growth stages

Growth Stage	Crude Protein (%)	Digestibility (DM, %)
Early head emergence	17.0	66
Early flowering	14.7	63
Late flowering	12.5	57

- **FACTORS AFFECTING THE QUALITY OF MEADOWS AND PASTURES**
- **Vegetative stage**:
  As the vegetative stage progresses, the amount of structural carbohydrates (cellulose, hemicellulose, lignin) increases, while protein, mineral, vitamin, energy, and other organic matter content decreases, and digestibility declines.

•**Plant type**:
•The type of plant, determined by soil structure, climate, etc., affects the nutritional value.
•Meadows and pastures consist primarily of species from the grass family, legumes, and other families.
•**Climate**:
•Climate greatly affects plant types and yield in meadows and pastures.
•High temperatures cause early maturation in meadow plants, reducing their nutrient density.
•**Grazing method**:
•Meadows and pastures should be grazed in a controlled manner, once the plants have reached a certain height.
•Frequent and excessive grazing can reduce the number of leaves available for photosynthesis and slow plant growth.
•**Soil structure and fertilization**:
•The soil structure affects the composition of forage plants, especially their mineral content.
•The nutrient requirements of forage plants can be met through fertilization.
•The application of farmyard manure during winter on grazing lands is beneficial.

- **KEY POINTS TO CONSIDER IN PASTURE MANAGEMENT**
- For optimal use of pasturelands, vegetation and soil should be used according to proper methods.
- Pasture management is the science of organizing proper grazing practices.
- **Principles to follow for proper pasture utilization**:

1. Grazing pastures at the right season.
2. Grazing pastures within their capacity.
3. Distributing animals evenly across the pasture.
4. Grazing with the appropriate type of animal for the feed available.

- **1 Grazing Pastures at the Right Season**
- Pasture plants should be grazed once they reach their grazing maturity.
- The most sensitive periods for plants, when they are most vulnerable to heavy grazing, are during early spring and autumn, when they start to regrow.
- The time between the start of growth and the beginning of excess nutrient storage is called the "critical period," during which plants are physiologically weak.
- Once plants pass the critical period and reach a sufficient height, they are considered ready for grazing.

- **2. Grazing Pastures Within Their Capacity**
- If pastures are grazed with more animals than their capacity during the grazing season, the plants will suffer more damage.
- The grazing capacity of a pasture refers to the maximum number of animals that can be grazed on a specific area for a set period without damaging the vegetation, soil, or other resources.
- In arid regions, pasture plants can only withstand grazing up to 50% of their growth.

- **3. Distributing Animals Evenly Across the Pasture**
- For proper grazing of a pasture, all areas must be grazed evenly. This ensures that the entire pasture is used optimally, and that grazed plants have time to recover.
- Various grazing systems are applied to achieve uniform grazing. The best-known system is **rotational grazing**.
  - **Rotational grazing**: In this method, the pasture is divided into equal sections based on its grazing capacity. The grazing duration is determined by the recovery time needed for the plants. Typically, after grazing, pasture plants are left to rest for 3-4 weeks.
  - To determine the average rest period, the total number of sections is divided by one less than the number of sections.

- **4. Grazing with the Appropriate Type of Animal for the Feed Available**
- Grazing a pasture with only one type of animal can reduce its productivity over time.
- Based on the grazing preferences of different animals, decisions should be made regarding which types of animals are best suited for grazing the pasture.
- Grazing with different types of animals is the most economical way to use the pasture.
  - Short grasses – Sheep
  - Tall grasses and legumes – Cattle, horses
  - Shrubs and trees – Goats

- **ROLE AND IMPORTANCE OF MEADOWS AND PASTURES IN ANIMAL NUTRITION**
- In livestock farming, feed accounts for 70-80% of total expenses.
- In our country, the meadows and pastures can only meet about one-third of the roughage needs of the animal population.
- For modern livestock farming, it is recommended that 200 days of roughage for cattle and 300-325 days for small ruminants be obtained from pastures.
- High-quality meadows and pastures are rich sources of protein (10-30%), calcium, beta-carotene (150-350 mg/kg), vitamin E, and B-complex vitamins.
- Additionally, meadows and pastures positively affect animal health and the ecosystem due to their fresh air, sunlight, and opportunities for physical activity.

- **USE OF MEADOWS AND PASTURES IN CATTLE NUTRITION**
- Cattle cause the least damage to pasturelands.
- They tear grass with their tongues from relatively higher up, minimizing damage to the plants.
- They graze without selecting specific plants, leaving the botanical composition of the pasture largely intact.
- Cattle can consume 70 kg of pasture forage during an average of 7 hours of grazing per day.
- Medium to high-quality pastures can meet the nutrient needs of dry cows and young animals.
- The mineral needs of cattle can be supplemented with salt and mineral mixes containing trace elements.
- In addition to pasture grazing, calves and lactating cows should be provided with grain mixtures and protein supplements.

- **USE OF MEADOWS AND PASTURES IN SHEEP NUTRITION**
- A good pasture during the growing season, followed by good-quality hay in winter, is usually sufficient for the normal nutrition of sheep.
- Sheep nutrition without pastures is unimaginable.
- **Key points in grazing sheep on pastures**:
- The hygienic condition of the pasture must be adequate.
- There should be no toxic plants or marshy areas.
- Recently fertilized meadows and pastures should not be used for grazing due to the risk of parasites and other disease agents.
- Sheep should not be allowed to graze before the morning dew has evaporated.
- During winter or rainy weather, sheep should be given some dry hay before being taken to the pasture.
- Sheep grazed on clover or alfalfa should not be given water for a short period afterward. Instead, they should be given dry hay before being taken out to the pasture.
- A well-managed pasture can support 5-8 sheep per hectare year-round.
- Older sheep and female lambs should not graze together to prevent the transmission of diseases.

- **USE OF MEADOWS AND PASTURES IN HORSE NUTRITION**
- Nutrient-rich pastures can meet the nutritional needs of horses.
- Horses can graze for up to 12 hours a day on pastures.
- Horses that graze on pastures generally maintain good body condition.
- However, for horses involved in heavy work or training, pasture forage alone may not be sufficient to meet their energy needs. In such cases, grain mixtures should be supplemented (about 0.75-1.50% of body weight).
- A good-quality hectare of pasture can meet the annual roughage needs of 3-4 light-built horses weighing around 400 kg.

- **CULTIVATED GREEN FORAGE CROPS**
- **Legume green forages**
- **Grass green forages**
- The species of the plant, harvest time, harvest method, wilting after harvest, weather conditions during and after harvest, fertilization, soil composition, irrigation, time until consumption, and storage duration and method are the most important factors affecting the composition and quality of forages.

- **LEGUME GREEN FORAGES**
- Legume green forages are feeds that increase both animal and soil productivity. Legumes are rich in protein, minerals, vitamins, and growth-promoting substances and are palatable for animals.
- Through their symbiotic relationship with Rhizobium bacteria (nodules) on their roots, legumes can fix atmospheric nitrogen into the soil, enriching it in nitrogen (N).
- Their root systems, including those of rhizomatous and vining plants, help control soil erosion.
- When legumes and grass forage crops are grown together, the yield of forage and protein content increases.
- Some legume forage crops, like sainfoin and alfalfa, are also excellent nectar plants for bees.

- **ALFALFA (Medicago sativa L.)**
- Alfalfa is the most important forage crop, with 30 species found in our country. The most important varieties are:
  - Common alfalfa with purple flowers
  - Yellow-flowered alfalfa
  - Hybrid alfalfa
  - Hop alfalfa
- Alfalfa is known as the "queen of forages."
- It is a perennial forage crop with an economic lifespan of 7 years.
- The first cutting of alfalfa is often used for silage.
- It should be harvested when 1/10th of the plants are in bloom.
- Typically, alfalfa can be harvested 3-4 times a year.
- It can be harvested every 6-8 weeks.
- Alfalfa is adaptable to all soil and climate conditions, but it performs best in dry climates with adequate irrigation.
- Alfalfa can tolerate warm climates, though it may be affected by cold during winter and early spring.

•Alfalfa is highly palatable and rich in protein, minerals, and vitamins.
•Due to its low cellulose content, it should be fed together with other dry forages.
•It can be fed fresh, dried, or as silage, and it can also be used for grazing.
•High-quality dried alfalfa contains 50 mg/kg β-carotene and 650-2200 IU/kg Vitamin D2.
•Alfalfa can meet the nutrient requirements of all herbivorous animals.
•Recommended daily amounts:
•Cattle: 50-55 kg/day
•Sheep: 4-5 kg/day
•Horses: 20-25 kg/day

Effect of Maturity on Alfalfa Digestibility

Stage of Maturity	Digestibility (%)	Protein (%)	Dry Matter (%)
Budding	65.0	29	20
Early flowering	63.0	23	25
Full flowering	59.5	17	30
Mature	55.8	15	35

- **Precautions when feeding alfalfa**:
- Alfalfa contains the enzyme pectin methylesterase, which can cause bloating and gas, especially in ruminants that are not accustomed to it, such as those grazing on green alfalfa for the first time in the spring. The amount of this enzyme increases with the water content of the plant.
- A foam layer can form that traps gas, leading to gas accumulation.
- This can cause oxygen deprivation, resulting in the animal struggling to breathe and potentially suffocating.
- To avoid bloating:
  - Avoid grazing animals on very lush plants or during periods of heavy dew.
  - Cut the alfalfa and allow it to wilt slightly, reducing its water content before feeding.
  - Grow alfalfa mixed with grasses.

- **CLOVER (Trifolium spp.)**
- Clover is abundant in the meadows and pastures of our country.
- It is rich in protein, minerals, vitamins, and is highly palatable.
- The most commonly grown clover species in Turkey is white clover.
- Key clover species:
  - Meadow clover
  - White clover
  - Red clover
  - Crimson clover
  - Hybrid clover
  - Strawberry clover

- **Meadow Clover (Trifolium pratense L.)**
- After alfalfa, meadow clover is the second most widely grown legume.
- It plays an important role in improving the quality of meadows and pastures.
- It grows well in cool and humid areas.
- Bloating (timpani) is less frequent with meadow clover compared to alfalfa.
- It contains phytoestrogens and staffframine.

- **White Clover (Trifolium repens L.)**
- White clover is widely grown in Turkey, but it is less drought-tolerant than alfalfa.
- It is a perennial plant that thrives in cool climates and is highly palatable and rich in nutrients, similar to alfalfa.
- It contains elements that can cause bloating (timpani).
- It also contains cyanogenic compounds and phytoestrogens.
- It should be harvested when more than half the plants are in bloom.
- While other livestock enjoy white clover, horses do not.

- **SAINFOIN (Onobrychis sativa L.)**
- After alfalfa, sainfoin ranks second in importance as a forage crop in animal nutrition.
- It is a perennial plant, resistant to cold and drought.
- It does not cause bloating (timpani).
- Contains 14-19% crude protein (in dry matter) and is rich in minerals.
- It is an excellent forage crop for bees, providing a good source of nectar.
- Sainfoin should be harvested when 1/10th of the plants are in bloom.
- It helps prevent soil erosion and can be fed to animals in similar quantities as alfalfa.
- Recommended daily amounts:
  - Cattle: 50 kg/day
  - Horses: 20-25 kg/day
  - Sheep and goats: 4-5 kg/day

- **VETCH (Vicia L.)**
- Vetch is used as both a green and dry forage. There are about 150 species of vetch, with common vetch, hairy vetch, large vetch, and Hungarian vetch being particularly important.
- It becomes bitter after flowering, and excessive amounts can spoil the taste of milk in dairy cows.
- Feeding large amounts of vetch to pregnant ewes can cause abortions (if the vegetative stage is too advanced).
- Vetch is an annual plant that grows in temperate climates worldwide.
- It is not highly resistant to cold and drought.
- Vetch is often planted with barley and oats to improve feed quality.
- It is suitable for dairy cows, containing about 23.9% crude protein in its fresh form.
- The seeds of vetch should be crushed before feeding, as they contain more than 29% protein.
- Vetch hay (straw) is quite nutritious when harvested for seeds.

- **FABA BEAN (Vicia faba L.)**
- Faba beans are harvested before or during the flowering period and fed to animals.
- They can spoil the taste of milk, so they should be given after milking.
- Faba beans may cause bloating (timpani) if not introduced gradually.
- They can also be used as silage when mixed with grasses.

- **GRASS PEA (Lathyrus sativus L.)**
- Grass pea is an annual forage crop that grows in the Eastern Mediterranean and Central Anatolia regions.
- It should be fed before the plant sets seed, as the seeds contain toxic alkaloids.
- Grass pea is grown for both green and dry forage.

- **BITTER VETCH (Vicia ervilia L. Willd)**
- Bitter vetch meets about half of the roughage needs of ruminants.
- It is not commonly fed to dairy cows.
- In terms of feed value, it is similar to vetch.
- Both the green and dry forage, as well as the seeds, are highly nutritious.
- The green forage contains 20.4% crude protein, while the seeds contain 22.3%, and the straw has 4.5% crude protein.

- **FORAGE PEAS (Pisum arvense L.)**
- Forage peas are nutritionally similar to alfalfa.
- They can be fed fresh, dried, or as silage.
- Due to their weak stems, forage peas are often planted with barley or oats.
- They can be used for silage in combination with other plants (barley and oats).

- **BIRDSFOOT TREFOIL (Lotus spp.)**
- Birdsfoot trefoil is a perennial forage crop that can grow in all regions of the country.
- It is rich in protein and is grown primarily for its dry forage.
- Birdsfoot trefoil can grow in poor soils and helps prevent erosion.
- It is highly valued as a pasture plant.
- It does not cause bloating (timpani).
- The nutritional value of its forage is high, with crude protein levels similar to alfalfa and clovers.
- Birdsfoot trefoil can easily reseed itself in pastures and renew the stand.
- Because of its thin stems, it dries easily after harvesting.
- It should be harvested at full bloom for optimal forage quality.

- **NOHUT GEVENI (Astragalus spp.)**
- Nohut geveni is a legume forage crop that grows naturally in temperate regions of Europe and Asia.
- It has recently gained importance as a forage plant.
- It prefers cool and moist areas.
- Nohut geveni develops more slowly than alfalfa and sainfoin after planting.
- Since it does not cause bloating, it can be used as a pasture plant.

NUTRITIONAL COMPOSITION OF SOME LEGUME FORAGES (g/kg, DM)

Forage	Dry Matter	Crude Fiber	Crude Fat	Crude Ash	Crude Protein	Metabolizable Energy (MJ/kg)
Meadow Clover	190	274	37	84	179	10.2
White Clover	190	232	42	116	237	9.0
Alfalfa	240	300	17	100	171	8.2
Sainfoin	230	209	26	61	196	10.3
Forage Peas	170	353	35	71	205	8.5
Vetch	180	290	28	83	178	8.6

- **Legumes that cause bloating**:
- Alfalfa
- Meadow Clover
- Faba Bean
- **Legumes that do not cause bloating**:
- Birdsfoot Trefoil (Lotus spp.)
- Sainfoin
- Nohut Geveni

- **GRASS GREEN FORAGES**
- Grass forages, when harvested before heading, have high nutritional value and are well-liked by animals.
- Compared to legumes, grasses are lower in protein, calcium, and carotene.
- If fed in large amounts without proper adjustment, grass forages can cause bloating (timpani) or gas accumulation (meteorism).
- These forages can be given fresh (green) or dried.
- The harvested form of grass forages is referred to as **"forage crops" (hasıl)**.

- **CEREAL FORAGES**
- Cereal forages are annual crops grown primarily for their grains, but they can also be used as green, dry, or silage feeds.
- During the vegetative stage, the crude protein content in cereal forages is about 8-12% (in dry matter).
- Cereal forages are low in calcium but rich in phosphorus.
- It is recommended to plant cereals along with legumes.
- The most important cereal forages are maize, oats, and rye, which are often fed in combination with legumes.

- **MAIZE FORAGE (Zea Mays L.)**
- Maize is rich in starch, sugar, and juice, making it a highly palatable feed for ruminants.
- However, maize forage is low in protein and can reduce milk fat content, soften butter, and spoil the flavor of milk.
- Recommended daily amount for cattle: 25-30 kg/day.
- Maize forage is deficient in trace elements (Mn, Co, Cu) and, when fed in excess, can cause diarrhea.

- **OAT FORAGE (Avena sativa L.)**
- Oat forage contains about 5% sugar, which makes it highly palatable for animals.
- Recommended daily amount for cattle: 30-40 kg/day.

- **MILLET (Panicum L.)**
- Millet is an annual warm-season forage crop.
- If exposed to cold or drought during early growth stages, millet can produce toxic hydrogen cyanide (HCN), which can be harmful to animals.
- All varieties of millet are deficient in protein and minerals.

- **SUDAN GRASS (Sorghum sudanense (Piper) Stapf)**
- Sudan grass is an annual, leafy, warm-season crop that is drought-tolerant and can be harvested up to four times a year.
- It is sweet due to its high sugar content and provides a palatable green forage for dairy cows during the summer.
- Sudan grass should be harvested when it reaches 60 cm in height, as the HCN content is low at that stage.
- The green forage yield is between 3-6 tons per hectare in dry or irrigated conditions.

- **COUCH GRASS (Agropyron Gaertn.)**
- Couch grass is a perennial, cool-season forage crop.
- It is well-suited to the arid conditions of Central Anatolia.
- There are several varieties, such as pasture couch grass, blue couch grass, high pasture couch grass, and quackgrass.
- Couch grass has good forage quality, with a crude protein content of 12.5-14%.
- When harvested at the beginning of flowering, it is highly palatable to animals.
- The green forage yield is 600-800 kg/da (decare).
- It provides abundant and high-quality forage until mid-summer.

- **SMOOTH BROME (Bromus inermis Leyss.)**
- Smooth brome is a perennial, cool-season forage crop.
- It is resistant to harsh climate conditions and can grow in various types of soil.
- It requires nitrogen in poor soils.
- Smooth brome is grown both for forage production and erosion control.
- The crude protein content is between 14-20% in dry matter.

- **TALL FESCUE (Festuca arundinacea Schreb.)**
- Tall fescue is a perennial, cool-season forage crop that is used in pasture mixtures.
- It can be grazed in spring, fall, and even winter in some areas.
- Tall fescue can grow in various soil types and has a strong root system, which helps prevent soil erosion.
- The dry forage yield is between 400-800 kg/da.

- **PERENNIAL RYEGRASS (Lolium perenne L.)**
- Perennial ryegrass is a perennial, cool-season forage crop that thrives in moist and rainy soils.
- It is resistant to grazing and trampling.
- The forage quality is excellent, and it is widely grown in Turkey.
- All livestock species enjoy it.

Table 4: Nutritional Values of Some Grass Forages at Different Growth Stages

Growth Stage	Crude Protein (%)	Digestibility (DM, %)
Couch Grass	17.0	66
Smooth Brome	18.0	72
Tall Fescue	16.0	62
Early Flowering	14.7	63
Late Flowering	12.5	57

- **OTHER GREEN FORAGES**

1. Sunflower green forage
2. Sugar beet leaves
3. Fodder beet leaves
4. Carrot leaves
5. Turnip, radish, cabbage, and Jerusalem artichoke leaves
6. Leaves of certain trees

- **SUNFLOWER GREEN FORAGE**
- Sunflowers are grown primarily for their seeds.
- The forage should be harvested before flowering to ensure quality.
- The best stage for harvesting sunflower forage is when 1/3 of the plants are in bloom, yielding the highest quality product.
- Digestibility is about 70%, but if harvested too late, it drops to 50%.
- Carbohydrate content increases, while crude protein decreases (1.5-1.9% crude protein).
- Recommended daily amounts for cattle: 25-30 kg/day.

SUGAR BEET LEAVES

- **Fodder Beet Leaves**: These leaves are harvested by detaching them from the root of the fodder beet.
- **Sugar Beet Leaves**: Harvested from the crown of the sugar beet.
  - Fodder beet leaves are high in protein and minerals like Cl, Fe, Mn, Ca, Mg, and Na.
  - Recommended daily amount for dairy cows: 30 kg/day.
  - Composition of fodder beet leaves: 14% dry matter, 2.3% crude protein, 0.4% crude fat, 1.6% crude fiber.
- **Sugar Beet Leaves**:
  - The crown leaves of sugar beets account for about 45% of the total beet mass.
  - Sugar beet leaves are rich in juice and highly palatable for animals.
  - Composition: 15-20% dry matter, 2-3% crude protein, 1.5-2.5% crude fiber, 8% nitrogen-free extract (NFE).
  - The NFE consists mainly of sugar, pectin, and pentosans.
  - Recommended daily amounts:
    - For fattening cattle: 30-40 kg/day
    - For dairy cows, sugar beet leaves should be given after milking as they can harden the milk fat and are generally not recommended for dairy cows.
    - Sugar beet leaves can also cause diarrhea due to the presence of oxalic acid and saponin.
  - 1 kg of sugar beet leaves can provide 1-1.5 g of calcium carbonate ($CaCO3$).
  - Maximum daily amount for dairy cows: 40 kg/day.
- **Oxalic acid and saponin**:
  - Oxalic acid binds calcium as calcium oxalate, reducing calcium absorption and potentially causing hypocalcemia.
  - Composition of oxalic acid and saponin in sugar beet leaves (in dry matter):
    - Saponin: 0.7-0.8%
    - Oxalic acid: 2.5-3%

- **CARROT LEAVES**
- Like other green forages, carrot leaves are rich in carotene.
- Carrot leaves improve the quality and color of milk.

- **TURNIP AND RADISH LEAVES**
- Contain about 20% crude protein (in dry matter).
- Other leaves like cabbage, cauliflower, and leek leaves contain around 2.2-2.5% crude protein.
- Some cabbage species contain thiocyanate compounds.
  - Maximum daily amount for dairy cows: 10 kg
  - Maximum daily amount for fattening cattle: 20 kg

- **OTHER GREEN LEAVES**
- The leaves of certain trees can also be used as green forage.

- **CONCLUSION**
- Green forages, particularly legume and grass forages, are valuable feed sources that play a vital role in animal nutrition, providing a variety of nutrients like protein, fiber, vitamins, and minerals. Proper management of green forage crops and pasturelands ensures that animals receive adequate nutrition throughout the year, contributing to optimal growth, health, and productivity.