Dairy Production
Level-III

Learning Guide 26

Unit of Competence: Establish pastures and forage for dairy production

Module Title: Establishing pastures and forage for dairy production

LG Code: AGR DRP3 M07 LO1- LG-26

TTLM Code: AGR DRP3 TTLM 1219 v1

LO 1: Prepare for pasture and forage establishment

Instruction Sheet	Learning Guide -26

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics: –

- Following organizational occupational health and safety rules and regulations
- Identifying and using appropriate personal protective equipment's
- Identifying and using tools, equipment's and machineries
- Identifying and selecting an appropriate forage production strategy.
- Identifying and selecting suitable forage species

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to: **-**

- Follow organizational occupational health and safety rules and regulations
- Identify and using appropriate personal protective equipment's .
- Identify and use tools, equipment's and machineries .
- Identify and select an appropriate forage production strategy.
- Identify and select suitable forage species

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information "Sheet 1, - Sheet 5".
4. Accomplish the "Self-check 1-Self-check 5" **in page -3, 7,11, 18, and 31** respectively.

Information Sheet-1	Following organizational occupational health and safety rules and regulations

1.1. Supporting OHS requirement and work place information

Occupational Health and Safety (OHS): Any occurrence which results in personal injury, disease or death, or property damage

Occupational Health & Safety (OH&S) legislation requires businesses to provide employees and visitors with safe premises. There are many different situations where an incident may affect safety in the workplace and needs to be quickly and effectively communicated to the correct response teams. Perhaps you have personnel who handle dangerous chemicals and need to raise alarms when a leak or spill occurs.

Likewise, production companies have to monitor the product through every stage of the process. Notifications need to be in place to report any equipment failures, downtimes, or out-of-tolerance conditions that occur during these steps especially if your company is spread over multiple buildings and sites, and management needs to be informed when any safety or production incident occurs in another location

- **Hazard:** is a situation that has the potential to harm a person, the environment or damage property.
- **Risk:** is the probability (likelihood) of harm or damage occurring from exposure to a hazard, and the likely consequences of that harm or damage
- **Risk Assessment:** is the process of evaluating the probability and consequences of injury or illness arising from exposure to an identified hazard.
- **Hazard Control:** is the elimination or minimization of risk associated with an identified hazard.

Related to pasture establishment identification of expected hazards are by most caused by using unsafe hand tools and equipment, plant allergy, insects, spiders, snakes, poor manual handling , therefore the process of hazard identification should be guided by taking in to consideration of the above and other related situations.

During the operation of conservation work the workers use different tools, which are sharpen. To keep their health the workers are expected to fulfill the following requirements;

- Provide first aid kit
- Before starting their work, the workers check the arrangement of the tools
- Pick up the tools with great care
- Take care of sharpen tools
- Use these tools properly
- Identify rusted tools
- If they are reusable use them for other purpose

Before beginning their activities the workers be aware about the work place. This awareness may help the workers about what they will do, which instruments they will use, and what type of conservation mechanism they will apply and so on.

During these activities different occupational health hazards may occur. From these hazards some of them may be; erosion, slip, injury and others damages are expected.

Self-Check -1	Written Test

Directions*:* Answer all the questions listed below. Use the Answer sheet provided in the next page

1. What is hazard? (3 point)?
2. What is OHS? (3 point)?
3. What is hazard control? (3 point)?
4. What are OHS requirement and work place information? (3 point)?

Note: **Satisfactory rating - 12 points** **Unsatisfactory - below 12 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions:

1. _____

_____

2. _____

_____

3. _____

_____

4. _____

_____

Information sheet 2	Identifying and using appropriate *personal protective equipment's*

2.1. Personal protective equipment (PPE) is clothing and equipment

What is PPE?

PPE in this guidance notes means an equipment that is intended to be worn or otherwise used by a person at work and that protects the person against one or more risks arising from chemical or chemical operation to the person's safety or health. It includes any addition or accessory to the equipment designed to meet a similar objective.

Examples of PPE for use and handling of chemicals include protective clothing, apron, gloves, footwear, eye protector, face shield, and respirator. They can be roughly classified into the following categories:

(a) Protective clothing

(b) Hand and foot protective gears

(c) Eye and face protective equipment and

(d) Respiratory protective equipment.

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- **Codes of Practice**: First Aid Facilities and Services, Workplace Amenities and Facilities, Personal Protective Clothing and Equipment 2002, provides guidance on the selection, provision and use of personal protective equipment and requirements for specific hazards.
- **Occupational Safety and Health Regulations 1996 also provide guidance.**

In the hierarchy of controls (elimination, substitution, engineering, administration and PPE), personal protective equipment is considered the least satisfactory method in the prevention of work-related injury or illness and is only to be used when other measures are not feasible or cannot be implemented immediately. PPE should be used, however, to supplement or augment other means of hazard control, to further minimise the risk of injury.

Issues affecting use of PPE include discomfort and inconvenience, and inappropriate or poorly maintained equipment. It is vital that problems caused by inadequate selection, fit and maintenance do not undermine the effectiveness of the equipment.

Types of personal protective equipment

PPE can be considered in the following categories, based on the type of protection afforded by the equipment:

- **Respiratory protection** - for example, disposable, cartridge, air line, half or full face
- **Eye protection** – for example, spectacles/goggles, shields, visors
- **Hearing protection** – for example, ear muffs and plugs
- **Hand protection** – for example, gloves and barrier creams
- **Foot protection** – for example, shoes/boots
- **Head protection** – for example, helmets, caps, hoods, hats
- **Working from heights** - for example, harness and fall arrest devices
- **Skin protection** – for example, hats, sunburn cream, long sleeved clothes
- **Other personal protective equipment:** This may include PPE for specific tasks such disposable clothing for working with chemicals, radiation hazards, welding, painting.

  Examples include: lead aprons for x-ray protection; sleeve protectors, aprons, coveralls when using chemicals; leather jackets, trousers and spats for welding; thermal and cold protective clothing for work near furnaces and cool rooms.

2.2. Responsibilities for equipment

Management must ensure that:

- The needs for PPE are assessed by a person who is competent to judge whether other methods of risk control can offer better protection of safety and health than the provision of PPE
- Professional advice is obtained, where necessary, to identify the most suitable types of PPE for the tasks to be carried out

- Training is provided to supervisors and employees to enable them to ensure the proper selection, fit, use, cleaning and maintenance of PPE
- Supervision and enforcement of the PPE policy is undertaken
- Evaluation of the effectiveness of the PPE program is carried out on a regular basis
- Suitable PPE is provided for visitors who may be exposed to hazards in the workplace.

2.3. OHS requirements and workplace information.

- Hazards may include solar radiation, dust, noise, air- and soil-borne micro-organisms, fire hazard, chemicals and hazardous substances, sharp hand tools and equipment, manual handling, holes, and slippery and uneven surfaces
- OHS requirements always must be applied in accordance with regulations/codes of practice and enterprise safety policies and procedures.

2.4 Identify and report OHS hazards.

- **Identifying and reporting OHS hazards**

The main hazard include:-

- Solar radiation
- Dust
- Noise
- Air and soil-borne micro-organisms
- Chemicals & hazardous substances
- Sharp hand tools and equipment
- Manual handling
- Holes ,slippery and uneven surfaces

Self-Check -2	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page. (3pts each)

1. Issues affecting use of PPE are categorized under discomfort and inconvenience, and inappropriate or poorly maintained equipment. (True/False)
2. Hazards in pasture establishment does not include solar radiation, dust, noise, air- and soil-borne micro- organisms, fire hazard, chemicals and hazardous substances. (True/False)
3. Professional advice is not necessary for new employees in selecting and identify the most suitable types of PPE for the work. (True/False)
4. Solar radiation is not common in a person working daily on pasture management and suitable PPE for this is not required. . (True/False)

Note: **Satisfactory rating - 12 points** **Unsatisfactory - below 12 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Say true or false:

1. _____
2. _____
3. _____
4. _____

Information Sheet 3	Identifying and using tools, equipment's and machineries.

- **Machinery:** are mechanical devices with moving parts, often powered by electricity used to perform a task especially one that otherwise be done by hand
  - ❖ Cyclone seeder
  - ❖ Cultic packer
  - ❖ Spinner spreader
  - ❖ Melcher
- **Tools :** are devices for doing work: an object designed to do a specific kind of work such as cutting or chopping by directing manually applied force or by means of a motor
  - ❖ Machete
  - ❖ Picks
  - ❖ Sickle
  - ❖ Mattock and shovel/spade
  - ❖ Axe
  - ❖ Hay fork
- **Equipment's :** are necessary items **(** the tools, clothing, or other items) needed for a particular activity or purpose
  - ❖ Wheel barrow
  - ❖ Water can
  - ❖ Sacks
  - ❖ Water pump
  - ❖ spray

Tools, equipment and machinery

Mower a machine, often power-operated, that cuts grass with rotating blades

Baler is a farm machine used to compress a cut and dried crop (hay, cotton or straw) in to compact bales that are easy to handle, transport and store

Hay fork is a grapple device used for moving and turning hay

Plastic sheet is a sheet of plastic used to cover and pack something**.** It can be used to cover inner surface of pit silo to prevent moisture and air from entering in to the silage

Machete a large heavy knife with a broad blade used as a tool for cutting through vegetation

Axe a tool consisting of a flat heavy metal head with a sharpened edge attached to a long handle, used to chop wood or fell trees

Sickle a short-handled implement with a curved blade used for cutting tall grass or grain

Tractor farm vehicle (a motor vehicle)used for pulling heavy loads, especially on farms, where its large rear wheels enable it to move in fields

Plough a heavy farming tool with a sharp blade or series of blades for breaking up soil and making furrows, usually pulled by a tractor or draft animal

Shovel/spade a hand tools consisting of a broad, usually curved blade attached to a long handle, used for lifting and moving loose material

Melcher is a specialized rotary cutter used to cut grass , mulches and spreads it evenly over the cutting width, encouraging quick re-growth.

Machinery, tools and equipment refers should be Checked to the process of examining their parts to ensure their normal functioning

Importance conducting pre-operational checks on Machinery, Tools and Equipment's

- To identify the problems (defects, damages) of the Machinery, Tools and equipment's and take actions to correct or change them before using them

- To identify any hazards and risks that can be raised from using of the Machinery, Tools and equipment's and take minimization action timely

The causes of risks associated with machinery equipment's and tools

- Using wrong equipment or/and tools for a job
- Not fitting adequate guards on machines leading to accident caused by entanglement, shearing crushing and trapping
- Not fitting adequate controls or wrong type of controls so that equipment cannot be turned off quickly and safely, or starts accidentally
- Not providing right information, instruction and training for those using the equipment
- Not maintain work equipment or carrying out regular inspections and thorough examinations
- Not providing the personal protective equipment's needed to use certain equipment's and machinery

A guideline to conduct pre-operational checks on equipment's and tools

You should make sure that the equipment's and tools used for work are safe to use .Here is a list of actions that should be taken to ensure this is so.

- Perform a risk assessment to identify the hazards , the risks arising from those hazards and the control measures you should use
- Check that the equipment/tool is suitable for work and way in which it is going to be used
- Check that the equipment/tool is in good condition
- Make sure that the user knows which personal equipment to use and how to use it
- Think about who will use the equipment/tool including experienced workers, workers with language difficulties, new starter

Self-Check -3	Written Test

Directions*:* Answer all the questions listed below. Use the Answer sheet provided in the next page. (3pts each)

1. A machine, often power-operated, that cuts grass with rotating blades

   A. Mower B. Baler C. Hay fork D. Sprayer

2. It is a farm machine used to compress a cut and dried crop (hay, cotton or straw) in to compact bales that are easy to handle, transport and store

   A. Mower B. Baler C. Sprayer D. Hay fork

3. Of the following one is a grapple device used for moving and turning hay

   A. Mower B. Hay fork C. Baler D. Sprayer

***Note:* Satisfactory rating - 12 points** **Unsatisfactory - below 12 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Choose the correct answer:

1. _____
2. _____
3. _____

Information Sheet 4	Identifying and selecting an appropriate forage production strategy.

4.1. Definition of Terms

- **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
- **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.
- **Fodder:** Course grasses such as corn and sorghum harvested with the seed and leaves green or alive, then cured and fed in their entirety as forage.

4.1 Some selected Forage production strategy

I. On Farm Strategies

- Backyard Forage Production
- Under sowing and Interplanting
- Contour Forage Strips
- Agroforestry

II. Common Land Strategies

- Over sowing Common Grazing Areas

- Stock Exclusion Areas/Forage Banks
- Permanent Pastures

1. Backyard forage production

Backyard forage production is a strategy based on small plots and hedges of productive forage and browse planted within house compounds and around their boundaries. This is the most important initial strategy since it is developed in the farmer's household, and is very convenient for intensive feeding of dairy cattle. The higher fertility level typically found in and around house compounds also helps with the successful establishment of backyard forage. This strategy has a major impact in exposing farmers to the management and productivity of new species and also provides a seed bank to help establish new plantings for other forage strategies. Woody leguminous browse species are particularly suited to this strategy because of their multipurpose benefits (e.g. provides forage and fuel wood, used as shelter, increased privacy, wood products construction and implements, and bee products) and rapid growth rates. Tall growing tropical grasses are also suited to backyard forage development. Backyard forage can be cut and carried to tethered or housed animals, or cut and conserved for dry season use in mixes with crop residues and natural pasture hay or roughages.

I. The most commonly used backyard tree legumes in Ethiopia are leucaena, sesbania, pigeon pea and Tree Lucerne, whereas Greenleaf, silverleaf, alfalfa, vetch and vernano stylo are herbaceous forage legumes.
II. Similarly, grasses including Rhodes grass, elephant grass, panicum, phalaris and oats can be used as a backyard forage.

Figure 1: Backyard fodder plant

The backyard forage strategy provides an opportunity to reach large numbers of farmers very quickly and can therefore have a great impact nationally, even in the short term.

2. Under-sowing and inter-planting

Under-sowing and inter-planting is the establishment of forage species in an annual crop or perennial plantation. This strategy provides the most convenient approach to rapidly increasing on-farm forage supplies over a large number of farmers and should have a major impact in the short to medium term. The use of legumes in this system will contribute to the improved fertility and structure of cropping soils. This is normally the second strategy to promote after backyard forage has been adopted by farmers. Under-sowing and intercropping are probably the most important of the forage development strategies.

Under-sowing works best with sprawling, low growing annual legumes but can also work well with climbing legumes.

The strategy is particularly suited to the production of:-

- Tall growing cereals such as maize, sorghum or millet but also works with other cropping systems.
- Produce large quantity of high quality forage for utilization by post harvesting or cut and carry systems
- Protects the soil from erosion rains
- Increase its intake and utilization of nitrogen by plants
- The strategy works well with sprawling and climbing legumes

Where crop weeding practices are very thorough, forages should be under-sown at the time of final weeding. This avoids any risk of the under-sown legume competing seriously with the cereal crop but often means that the legumes have insufficient time to produce ripe seed prior to crop harvest. In areas of poorer weeding practices, under-sowing should coincide with an earlier weeding. In this way sufficient legumes survive any subsequent weeding to provide an adequate seeding capacity prior to crop harvest. Early maturing cereals generally favor better forage production because they compete with the under-sown forage legume for a shorter period of the growing season. The competitive balance between crop and under-sown or intercropped forage legume is very sensitive to sowing time.

3. Contour forage strips

Forage strips are broad based mixtures of herbaceous and tree legumes, and grasses planted on contour bunds or in narrow strips along the contour without any physical structures. This is a multipurpose strategy providing forage, shelter, soil stabilization, and fuel wood. Forage strips planted along the contour contribute to soil conservation by directing ploughing along the contour and by reducing run-off down the slope. This increases infiltration and reduces soil erosion, especially where a thick sward of grass or herbaceous legumes is included in the forage strip. Contour forage strips are particularly successful when perennial, thick rooted grasses are mixed with woody leguminous species. Because this strategy integrates forage production in cropping

areas, potentially weedy species such as stoloniferous grasses should not be used for forage strip plantings.

Their key problem with forage strips is :-

- The difficulty some farmers have in establishing them where livestock have free grazing access to fallow land or crop stubbles after harvest.
- Requirements of shepherds to apply cut and carry feeding systems

The most reliable tree legume (leucaena, sesbania, pigeon pea and Tree Lucerne), forage legume (siratro, axillaris, silverleaf, greenleaf, vetch, verano stylo, white clover, native clover, alfalfa, and makulotus) and grass (panicum, setaria, vetiver, phalaris and setaria) species can be used in contour forage strips

4. Agroforestry

Agroforestry is the combination of trees and agriculture in an integrated and sustainable farming system. Many of the forage production strategies can be developed as agroforestry systems. In particular contour forage banks and under-sowing of tree crops or forest plantations can be designed as agroforestry systems where leguminous browse species provide an upperstory in a forage system or under-sown legumes and grasses provide an understory in a forestry or horticultural system. Agroforestry maximizes the use of land by adding a third dimension to the above and below ground areas of utilization. This aspect is particularly important for farmers with limited land resources.

Because many agroforestry strategies include leguminous species, they are also attractive to farmers facing problems of declining soil productivity.

5. Over-sowing common grazing area

Over-sowing is the simplest of the forage development strategies and can be undertaken at very low cost depending on the seeding rates used. It involves

broadcasting or sowing improved forage species into common grazing lands, native pastures and degraded areas without any cultivation or other inputs. Typically there is no attempt to modify grazing management but existing stocking rates should not be increased after over sowing. The strategy includes sowing roadsides from vehicles and is suited to aerial seeding where very large areas are to be developed. Aerial seeding is also another way of establishing improved extensive grazing areas using over-sowing techniques.

Farmers are more likely to gain long term advantages from over-sowing strategies if there is some of grazing management group or pastoral association, which manages common grazing areas.

6. Stock exclusion areas or forage banks

Stock exclusion areas are an important means of protecting degraded areas, key watersheds, and common land. They also provide an opportunity to develop forage banks for use during droughts or periods of seasonal forage shortage. Stock exclusion areas are particularly important for the conservation of highlands but are only accepted by farmers where they see sufficient benefits to organize grazing management groups or pastoral associations to control stock exclusion areas and voluntarily keep stock out.

The introduction of browse species, productive legumes and improved grasses can rapidly increase the productivity of exclusion areas. The strategy is suitable for aerial seeding techniques which enable very large areas of land to be sown to forage quickly. Cultivation is not necessary to establish forage banks or rehabilitate stock exclusion areas, especially on very bare sites, but broadcast sowing should take place after commencement of the main rains to ensure that there is enough soil moisture to sustain germination. Leguminous browse and tall grass species should always be included in stock exclusion areas to maximize the production potential and drought resistance of the species mix.

Forage banks should be established at the beginning of the wet season. *Stylosanthes hamata* cv Verano and *S. guianensis* cv Cook are particularly suitable for forage banks and should be established with 8 to 10 kg seed per hectare. Forage banks are left ungrazed during the growing season to provide a supply of high quality forage during the dry season.

5. Permanent pastures

Permanent pastures comprise a broad range of annual and perennial legumes and perennial grasses. Productive mixed pastures can be readily established, particularly in the low and medium altitudes with warmer growing conditions. Grazing management is a significant problem for sustainable pasture production in some regions, which is best overcome with cut and carry systems.

Permanent pastures are most useful for dairy farmers who rely on optimal productivity of their livestock investment for their livelihood. Permanent dairy pastures should include a mix of legumes and grass species with high palatability and productivity. Siratro, greenleaf, silverleaf, seca stylo, verano stylo, white clover, vetch, alfalfa, and makulotus are the most commonly used legume forage species under for permanent pastures varying AEZs. Similarly, Rhodes grass, panicum, setaria, oats, phalaris and cocksfoot are the most common grasses to be used for this strategy .

Self-Check -4	Written Test

Directions*:* Answer all the questions listed below. Use the Answer sheet provided in the next page. (4 pts each)

1. Of the following forage productions Strategies which one belongs to on Farm strategies?

   A. Backyard Forage Production B. Under sowing and Interplanting

   C. Contour Forage Strips D. Agroforestry E. All

2. Of the following forage productions Strategies which one belongs to Common Land Strategies?

   A. Over sowing Common Grazing Areas B. Stock Exclusion Areas/Forage Banks C. Permanent Pastures D. All

***Note:* Satisfactory rating - 8 points** **Unsatisfactory - below 8 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Choose the correct answer:

1. _____
2. _____

Information Sheet 5	Identifying and selecting suitable forage species

5.1. Identifying different forage species

Forage includes all plant materials used to feed livestock. The most common types of forage are grasses, legumes and trees leaves. Forage with high fiber content is called roughage. Lush forage with high water content is called fodder. In zero- grazing units, forage can be fed to animals either fresh or in preserved forms, such as hay or silage. Crop residues, such as maize stove, can be fed directly as they are, or after treatment with for example urea or molasses to improve the nutritive value.

To properly manage and understand a forage system whether it is used for hay, pasture, wildlife, conservation, or some combination of uses it is important to be able to identify the species present and understand their establishment, management, and productivity.

5.2. Morphology of Grasses and Legumes

Understanding the general structure, or morphology, of forage grasses and legumes aids in their identification. Generalized drawings of a legume and a grass are shown in Figures 1 and 2. These drawings are composites and contain characteristics of several different legumes or grasses.

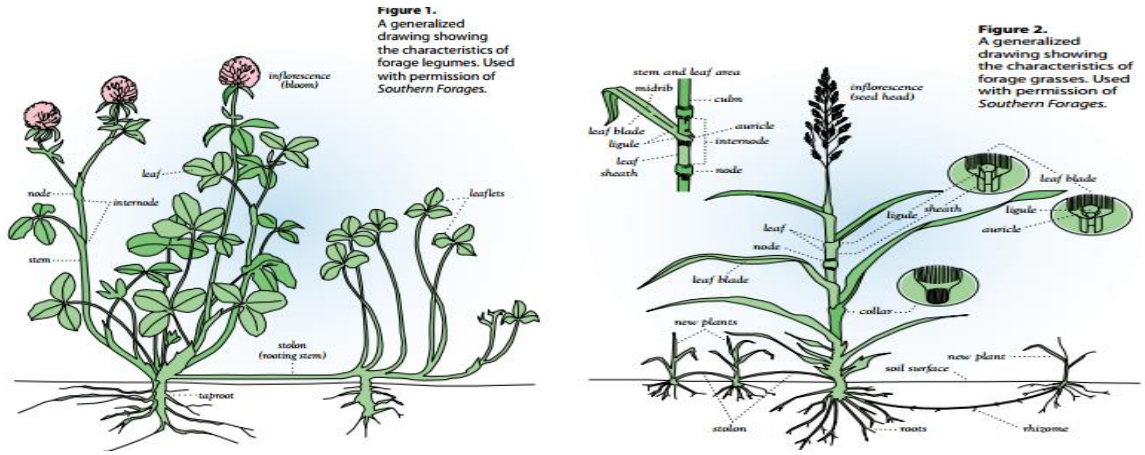

Figure 5.1. Characteristics of Grass and Legumes

5.3. Grasses and Legumes for Tropical Pastures

1. Many grasses spread by rhizomes or stolons, which readily form adventitious roots and give rapid ground coverage.
2. New tissues produced during growth, arise chiefly at the base of the leaves where these are least to be damaged by cutting or grazing.
3. The root system binds the soil particles together forming a sod and brings to the surface layer nutrients, which have been leached into the sub soil by heavy rainfall.
4. In addition to above while selecting the species for pasture, the qualities desired are productivity, palatability, high nutritive value and adaptation of the species with local soil and climatic conditions

1. Legumes Species

A. Desmodium intortum (Mill)

- **Common name:** Green leaf desmodium (E)
- **Description:** It is a large, trailing and climbing perennial; roots at nodes and has deep tap root; long, pubescent stems, branch freely and are often reddish brown. Internodes are shorter. Leaves usually have reddish brown to purple flecking on the upper surface. Leaflets are 2-7. cm long and 1.5-5.5 cm broadwith a length width ratio of 1.4 to 1 and rounded. Inflorescence is fairly compact with deep lilacto pinkflowers born in pairs. The pod is curved and contains 8-12 seeds. The pod adheres to animals and to' clothing. The seed count 7,55,000/kg.
- **Distribution:** It is native of Central and South America and widely distributed throughout the tropical and sub-tropical regions of Africa, Australia and the New World. It was introduced in India as forage.
- **Climate:** It is best suited to sub-tropical coastal areas with an annual rainfall of 900 to 1275 mm and requires a long warm growing season.
- **Soils:** It grows on a wide range of soils from light to clay loams with neutral to moderately acidic in reaction and is well adapted to poorly drained or water logged conditions. It has no tolerance to salinity.

- **Cultural practices**: Because of its small seed size, it requires well prepared field and can be established by drilliing or broadcasting using 2.2 kg seeds/ha at 1 cm depth. It can be established even by cuttings, although the establishment is only 30 to 40 per cent but when these cuttings are rooted in banana fiber baskets under light shade, the results are good. These cuttings are transplanted at 1x1 m spacing.
- **Fertilizer application :** It usually requires adequate levels of phosphorus (40-50 kg/ha) sulphur (15-20 kg/ha), potash (20-25 kg/ha) and Molbdenum for growth.
- **Management schecule:** In first year the pasture should be grazed moderately thus leaving a large number of axillary buds for ensuring rapid regrowth.
- **Forage yield:** Green forage yield is around 19 t/ha while average dry matter yield ranges from 5.8 to 12.5 tlha depending upon the stage of the crop.
- **Seed yield:** 80 to 100 kg/ha.
- **Nutritive value:** It contains 13.1 per cent C.P., 0.34 per cent P and 1.44 per cent Ca
- **Utilization**: In addition to fodder value it builds up a good surface layer of organic matter which adds to the moisture holding capacity and fertility of sandy soils. It contributes large quantity of N to soil too.
- **Compatibility:** It competes strongly with weeds and associates well with a number of grasses including Setaria, green panic, molasses' grasses. Among legumes it grows well with siratro and glycine.

B. Lablab purpureus (Linn.) Sweet

- **Common names**: Dolichos, Lablab bean, Hyacinth bean, Field bean (E), Sem (H).
- **Description:** It is an annual or biennial legume and attains a height of 0.9 to 1.8 m. The stems are robust and well branched. Leaves are large trifoliate. Leaflets are oval 10-15 cm long smooth on the upper side and slightly hairy under neath. Inflorescence is loose and many flowered .. Flowers are white, purple or reddish on axillary racemes. Pods are 3 to 12 cm long, curved with 2-4 big seeds. Seeds are globose, ovate or flattened, brown to black in colour with conspicuous white line at the hilum or point of attachment to the pod. Seed count 4000/kg.

- **Distribution:** It is widely distributed in subtropical area of Africa, Central and South Amercia, West Indies and many parts of South East Asia and Indonesia. It is found in most of the parts of India.
- **Climate:** Warm humid climate is suited to it and grows well in the areas under 510-1500 mm annual rainfall. It is drought resistant.
- **Soils**: It is found on a wide range of soils (deep sands to heavy clays) and pH (5.0 to 7.5).
- **Cultural practices:** After a light soil working it is sown at the onset of monsoon either in line or broadcast as pure crop (40 to 45 kg/ha) or mixed (20 to 25 kg/ha) with forage grasses. After sowing, the seed should be covered with soil. In beginning weeding is essential. The seeds are sown at 1.0 m row distance.
- **Fertilizer application:** In well fertile soil no fertilizer is needed but in poor soils 10 to 15 kg N + 40 -60 kg P20S and 20-25 kg Potash/ha are applied for higher forage and seed production.
- **Forage yield :** As pure crop its average dry forage yield is 2.0 t/ha but in well managed pasture it produces 5.4 t/ha dry forage.
- **Nutritive value:** In this species about 11.74 per cent C.P., 37.67 per cent crude fiber and 39.47 per cent carbohydrate are found.
- **Utilization:** It is palatableto all types of livestock and used for hay as well as for grazing purpose. It gives good silage with sorghum. Dolichos is also used as green manure and cover crop for soil protection against erosion.
- **Compatibility:** Generally it is sown as a pure crop but some time with maize or sorghum at a wide spacing because of its slow growth.

C. Macroptilium atropurpureum (DC.) Urb. Synonym - Phaseoulus atropurpureus
Common name: Siratro (E)

- **Description:** Siratro is a deep rooted perennial herb and has trailing habit. Stem is hairy and root readily at the nodes. Leaves are trifoliate, dark green and silvery slightly hairy on upper and very hairy on lower surface. Leaflets are somewhat oval shaped but the lateral ones are unevenly lobed. Inflorescence is raceme; pendunclet u-su cm long with a cluster of 6-12 flowers, often paired,deep purple in

colour. Pods are straight, cylindrical, pointed, 8 cm long many seeded. Pods dehisce violently when ripe. Seeds are flattended, brown to black in colour and 4x 2.5 x 2 mm in size. The seed count 75000 per kg.

- **Distribution:** The species is native to central and south America and is now distributed to Australia, South East Asia and Pacific Islands. In India it is found in semi-arid regions.
- **Climate:** It is adapted to sub tropical to tropical climates and is found in areas of 615 to 1800 mm rainfall and 26.5 to 30°C temperature.
- **Soils:** Siratro thrives well on wide range of soils from light textured sandy soils to heavy clays with good drainage. It grows over a range of pH from 4.5 to 8.0 and even in moderately saline soils.
- **Cultural practices:** For natural grassland or already established pasture seed should be sown after interculturing at the onset of rains. For pure pasture seed rate is 12 kg/ha but for mixed it is 6 kg/ha. Seeds are sown in July after first heavy shower either in line at 50 cm space or broadcast. SOWing depth is 1.0 to 1.5 cm. During monsoon one interculturing or weeding improved the crop performance.
- **Fertilizer application:** In beginning 10 cart loads of FYM is thoroughly mixed in soil followed by 10 kg Nand 30 kg P20/ha. In subsequent years 30 kg P205/ha is broadcasted at the onset 37 of monsoon. On fertile soils, no fertilizer will be necessary for a number of years.
- **Forage and seed yield:** The average green fodder yield ranges from 15 to 20 t/ha and dry fodder from 3 to 5 t/ha. It produces the seeds two times in a year i.e. October-November and April-May The total seed production is 50-100 kg/ha.
- **Nutritive value:** It gives high yields of palatable protein rich fodder with 16.8 per cent C.P., 33.4 per cent crude fiber and 9.8 per cent ash.
- **Compatibility**: It fixes nitrogen very effectively and can be grown with a wide range of grasses such as Rhodes, Setaria, green panic and guinea grass.
- **Utilization:** It is utilized as hay and for qrazinq purpose and is persistent under heavy grazing when the plants are well established. It is also used for silage. Due to

heavy and fast leaf fall it helps in improving the soil and used for checking the soil erosion.

D. Macrotyloma axilares (E. Mey.) Verdc. Syn. Dolichos axillaris

- **Common name:** Archer dolichos (E) and hairy. Leaves are trifoliate, oval, 4-5 cm long **Description**: It is a summer growing trailing leaflets which are hairy on both surfaces. and twining perennial legume. Stem is cylindrical Flowers usually born in threes and are greenish yellow. Pods are hairy, slightly curved, 3-5 cm long and contain 6-8 seeds which are oval and mottled. Seed count 20,OOO/kg.
- **Distribution:** It is widely spread in tropical Africa and also in Sri Lanka. It became popular for commercial use in 1960.
- **Climate:** This legume is well adapted to a frost free subtropical or tropical climate with an annual rainfall of 1000 mm.
- **Soils:** It grows on variety of soils from sands to clays with good drainage. It requires a pH in excess of 5.5. It tolerates salinity.
- **Cultural practices:** In a well prepared field the seeds are sown in line or may be broadcasted at the rate of 2-2.5 kg/ha as a pure stand and 0.5-1 kg in mixture at a depth of 1- 2.5 cm during late spring to summer. It may grow even from cuttings in roughly prepared fields. Seeds may be dispersed through cattle dung and stands may thicken up from self-sown seedlings. It is drought tolerant and survives in areas with a 6-8 months dry season.
- **Fertilizer application:** It responds well to phosphorus and for higher production 120 to 250 kg/ha super- phosphate is recommended.
- **Forage yield**: Its dry forage production is 15.5 tlha. Seed yield: Seed production is poor because of sparse flowering. Generally, 100-150 kg/ha seed is obtained.
- **Nutritive value:** It contains 11.9 per cent C.P. in full growth which declines to 6.2 per cent at seed formation stage.
- **Utilization:** Animals do not like it initially but afterwards they relish it much. It fixes ample nitrogen in the soil.

- **Compatibility:** It grows well with pasture grasses viz., Setaria, Paspa/um, Rhodes and Panicum spp.

E. Stylosanthes hamata (L.) Taub.

- **Common names:** Carribean stylo and Verano stylo (E)
- **Description:** Carribean stylo is herbaceous and dichotomously branched perennial. It attains a height of 1.2 m. The stems have short white hairs down one side. Leaves trifoliate, leaflets lanceolate, acute, glabrous with 4-6 pairs of veins, rachis 4-6 mm long and bidentate stipules adnate to the base of the petiole with hairs on the sheeth and teeth. The inflorescence is an oblong spike with 8-14 yellow flowers on a long stem. The pods or so called seeds are medium to dark brown in colour, 2-2.5 mm long asymmetrical by reniform, radical ends fairly prominent and beak is slightly coiled. Actual seed comes after removing the brown covering and is light yellow in colour. In appearance it is similar to Townsville stylo. The seed count 450000/kg.
- **Distribution**: It is a native of the islands of West Indies and found generally adjacent the coastal regions of North and South America, and introduced in many tropical regions of Australia, Burma and India.
- **Climate:** It thrives well in the areas receiving 42 annual rainfall from 500-1270 mm with a pronounced dry season.
- **Soils:** It is adapted to a wide range of soil types and is drought resistant.
- **Cultural practices**: In a well prepared field the seeds are broadcasted or sown in line at 50 cm apart @ 5-6 kg/ha in pure and 3-4 kg/ha in mixed pasture during the early rainy season. The seeds should be covered slightly with soil by dragging the twig. During the establishment year 1-2 weeding and interculturing are required for better growth.
- **Seed treatment:** Before sowing, the seeds should be scarified or treated with hot water for 1-1.5 minutes. Fertilizer application: At the time of field preparation and before sowing 5 to 8 t/ha FYM + 10-15 kg Nand 30 kg P20/ha are applied. From second year onwards 30 kg P20S and 15 kg N/ha are sufficient.
- **Management schedule:** During establishment year (first year) it should not be grazed at all but should be harvested at the height of 10 cm from ground level after

four months of sowing. From second year onwards it may be grazed or harvested 2-3 times. Rotational grazing is preferred for higher production.

- **Forage yield:** The green forage production ranges from 20 to 30 t/ha while the dry forage is 6 to 10 tlha.
- **Seed yield:** It generally produces 350 to 400 kg seeds/ha but from well managed pasture seed production reaches upto 1000 kg/ha.
- **Nutritive value**: It contains 10-14 per cent C.P, 0.61 to 1.72 per cent Ca, 0.10-0.12 per cent P and 7.0 to 14.2 per cent ash.
- **Utilization:** It is grazed in situ. Being nutritive and palatable it is used as feed for all types of animals in the form of hay, silage.
- **Compatibility:** It may be mixed with Cenchrus, Dichanthium Heteropogon Sehima, Chrysopogon Nixon Sabai grass and Blue panic.

2. Grass Specise

On the basis of following characters the grasses are considered suitable as forage plants for grazing or mowing.

1. Grasses (members of Gramineae/Poaceae) have wider range of adaptability than the species of any other family, being found in humid tropics, arid areas and alpine peaks.
2. Reproduction of fresh shoots by tillering provides a means of recovery from grazing or cutting.
3. Many grasses maintain continuous vegetative growth interrupted only by drought or cold.

A. Chloris gayana

- **Common name: Rhodes grass**
- **Description:** It is fine stemmed, leafy, perennial, erect, rhizomatous or spreading, stoloniferous grass. Culms are 0.6 to 1.2 m tall with long and stout internodes. Leaf blades are 15-30 cm long and 3-5 mm wide, tapering to fine pointed tips.

Inflorescence is spreading with 10-15 cm long, spikelets crowded, straw coloured on ripening. It produces profuse amount of seeds. Seed count 7250000 to 9500000/kg.

- **Distribution:** It is a native of South Africa and was named after the famous Cecil Rhodes, who popularised it. The species was introduced in India through USA and later on in Karnataka in 1920. Being drought resistant it is found in semiarid parts of the country and low lying areas.
- **Climate:** It grows well in warm-moist conditions.
- **Soils:** It prefers loamy to sandy loams and can grow even on a fair degree of salinity but can not withstand stiff clayey or waterlogging conditions.
- **Cultural practices:** It can be established by seeds as well as by rooted slips. The establishment by seed is cheaper and for this a firm seed bed is prepared on well ploughed land and seeds are broadcast @ 5 kg/ha at the onset of monsoon by mixing the moist soil. In high rainfall zones or under irrigated condition higher seed rate (10 kg/ha) is recommended or rooted slips can be transplanted in the lines at a distance of 50x50 cms for which nearly 40000 . slips are required for one hectare. 1-2 interculturing and gap filling are required in the first year to ensure good establishment.
- **Fertilizer application :** Since this grass responds well to manuring, 10-15 tonnes of FYM or compost alongwith 30 kg P20/ha as basal dose followed by 20 kg N/ha as top dressing for ensuring sustained productivity. In case of irrigated crop, irrigation after every 2-3 weeks alongwith 20 kg N/ha increases the foraqe production.
- **Forage yield:** In pastures raised through seeds, first clipping can be taken after 3 months, while that from rooted slips after 2 months and subsequently after every month in both types of pastures. Thus, nearly 6 cuttings with an average yield of about 17.0 t/ha (green) are possible under rainfed conditions but under irrigation the yield is as high as 175.6 t/ha.
- **Seed yield :** The seeds of this grass mature 9 after monsoon and are collected in OctoberNovember. The well fertilized pasture produces 100 kg seeds in one

hectare. **Nutritive value:** At preflowering stage C.P. is nearly 5 per cent with a balanced content of Ca (0.5 per cent) and P (0.3 per cent).

- **Utilization:** The grass is suitable for pasturage,silage and hay but it is generally used for soiling. Even after severe trampling it provides grazing upto September and could be utilized for hay thereafter.
- **Compatibility:** It grows well with Stylosanthes guianensis and Neonotonia wightii and consequently 20 and 100 per cent increase in forage yield was recorded respectively.

B. Panicum maximum

- **Common names:** Guinea grass, Green panic (E)
- **Description:** It is a tall erect, densely tufted, perennial tussocky grass having large number oftillers with short and stout rhizomes. The culms are 1.8 to 2.7 m tall, nodes densely hairy, leaf sheath pubescent. The leaf blade is 60 cm long and 2.5 to 3.8 cm wide and light green. Inflorescence is an open panicle, 50 cm long and 10 to 30 cm wide much divided with stiff branches in whorls. Seed count 17,50,000 to 22,00,000 per kg.
- **Origin and distribution:** It is a native of tropical Africa and has spread to many warm countries like Australia, South States of USA and Philippines. In India it was introduced in 1793 in military farms.
- **Climate:** Warm and moist climate of semi arid tropics is an ideal situation for this grass.
- **Soils:** It grows best in well drained, medium and fertile soils under shades, but in high rainfall areas or under irrigated conditions it is found even on loamy soils.
- **Cultural practices:** It requires well prepared land (2-3 times ploughed up with 3-4 harrowings). Pasture is easily established by planting rooted slips in lines at about 1 m distance in rows and 50 cm between plants during the rainy days in monsoon under rainfed conditions. When it is established through seed, 3-6 kg seed/ha (1-2 kg for Hamil) is required. One-two weedings are needed after establishment to check the weeds.

- **Fertilizer application**: It is better to grow it along the irrigation channels, gardens and orchards etc. Being highly responsive to manuring 10 to 20 tonnes FYM + 30 kg P20/ ha as basal dose, besides top dressing with 50-60 kg N/ha in two doses after every cut are given. After a period of 4-5 years the pasture needs to be replanted due to its ageing which can be done in the inter spaces of the standing crop.
- **Management schedules:** Generally Guinea grass pasture is ready for first cut after 60 days of planting and subsequently at monthly (30-40 days) intervals.
- **Forage yield:** It provides 50.0-60.0 tlha (green) forage in 5-6 cuts under rainfed and 80.0-100.0 t/ha (green) under irrigated condition in 10-11 cuts. However at sewage irrigation 225.0 t/ha (green) forage may be obtained in 12 cuts.
- **Nutritive value:** It contains 5-8 per cent C.P depending on the stage of clipping.
- **Utilization:** This grass can be used both for ,grazing and soiling but being preferred for silage. It is the best to keep it below l' m. height for maximum quality forage. After the pasture grazed, it can be cut back to 10-15 ern height for early regrowth. It is a better fodder than jowar and maize. **Cultivars:** Its cultivars are Hamil panic, Coloniao, Makueni, Gramalote, Silky Guinea, Riversdale, Embu, Coarse Guinea, Common Guinea, Likoni Guinea etc.

Self-Check -5	Written Test

Directions*:* Answer all the questions listed below. Use the Answer sheet provided in the next page. (4 pts each)

1. Explain about 4 legume species with characters and climatic conditions for establishment.
2. Explain about two species of grass with the utilization methods

Note: **Satisfactory rating - 8 points** **Unsatisfactory - below 8 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Choose the correct answer:

1. _____
2. _____
3. _____

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Dairy Production

Level-III

Learning Guide 27

Unit of Competence: Establish pastures and Forage for dairy production

Module Title: Establishing pastures and Forage for dairy production

LG Code: AGR DRP3 M07 LO2- LG-27

TTLM Code: AGR DRP3 TTLM 1219 v1

LO 2: Implement pasture and forage production program

Instruction Sheet	Learning Guide 27

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics :–

- Identifying and recognizing methods of pasture and forage production
- Identifying and recognizing method of sowing pasture and natural pasture establishment.
- Identifying advantages and uses of pasture establishment,
- Undertaking land preparation activities for pasture Production (clearing, sowing, digging pit, preparing seed bed, rolling)
- Carrying out Pre-treatment (including inoculation) of seed is prior to sowing.
- Implementing appropriate method of breaking seed dormancy .
- Identifying and implementing methods of planting, seed rates, and spacing.
- Undertaking management activities including fertilizing and manure application, weeding, and pest and disease control.
- Applying fertilizers and pesticides at correct rate and stage of growth

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to: **–**

- Identify and recognize methods of pasture and forage production
- Identify and recognize method of sowing pasture and natural pasture establishment.
- Identify advantages and uses of pasture establishment,
- Undertake land preparation activities for pasture Production (clearing, sowing, digging pit, preparing seed bed, rolling)

- Carry out Pre-treatment (including inoculation) of seed is prior to sowing.
- Implement appropriate method of breaking seed dormancy .
- Identify and implement methods of planting, seed rates, and spacing.
- Undertake management activities including fertilizing and manure application, weeding, and pest and disease control.
- Apply fertilizers and pesticides at correct rate and stage of growth

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1, - Sheet 9”.
4. Accomplish the “Self-check 1- Self-check 9 **in page -4, 8, 12, 16, 19, 24, 29, 34 and 37** respectively.
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1,” **in page -38, 39, 40 and 41.** respectively
6. Do the “LAP test” **in page – 42** (if you are ready).

Information Sheet-1	**Identifying and recognizing methods of pasture and forage production**

1. 1. Forage

Forage is a plant material (mainly plant leaves and stems) eaten by grazing livestock. Historically, the term *forage* has meant only plants eaten by the animals directly as pasture, crop residue, or immature cereal crops, but it is also used more loosely to include similar plants cut for fodder and carried to the animals, especially as hay or silage.The term forage fish refers to small schooling fish that are preyed on by larger aquatic animals.

While the term *forage* has a broad definition, the term forage crop is used to define crops, annual or biennial, which are grown to be utilized by grazing or harvesting as a whole crop**.**

1.2. Pasture can be defined in many ways depending on purpose:

- Pasture is defined as an area of land occupied with forage plant species either natural or planted by man for the purpose of providing qualitative feed to livestock at the right quantity.
- It could refers to any forage specie valuable as livestock feed
- It can also refer to an act of feeding; grazing or browsing animals on pasture plants or pastures.

1.2. Classification of Pasture Plants

Pasture plants can be classified into the following:

a) Grasses: These belong to the family Gramineae. They are characterized by high energy, low crude protein, fast growth rate, cylindrical stems and leaves. The leaves have parallel venation pattern and stem is hollow. They have fibrous rooting system with light and small seeds. Other related family members in this family include maize, millet sorghum, barley and rye.

b) Legumes: These belong to three different families (Mimosoideae, Caesalpinoideae and Papilionaceae) depending on the nature and shape of their flowers. They have broad leaves with net venation pattern. They are herbaceous plants with flowers occurring mainly at the terminal buds. However, it is also possible to have flowers in other parts of the plant such as auxiliary branches. These flowers produce seeds in pods. Examples include Centrosema pascourum, Alysicarpus varginalis and Mucuna pruriens.

c) Grazed Plants: These are short herbs that are consumed with both leaves and stems together. Examples include: Brachiaria ruziziensis, Sorghum almum (Columbus grass), Arachis pintoii and Digitaria smutsii.

d) Browed Plants: These are woody plants whose leaves and twigs (soft stems and buds) are eaten while the woody stem is left uneaten. e.g. Leucaena leucocephala, Gliricidia sepium and Gmelina aborea.

- **Annual/perennial grass types**

The labeling of plants as annuals, biennials, or perennials goes back to the early Greeks.

1. Annuals

Plants with annual life cycles complete their growth cycle in a single growing season (which is not usually an entire year), and are perpetuated by seed. The major row crop plants of the world are annuals; corn, rice, wheat, and barley.
e.g. annual ryegrass, annual bluegrass, pearl millet, corn, and sorghum/sudangrass

1 Biennials

Biennials are plants that take two seasons or years to complete their growth cycle. The first year is a time for accumulating food reserves in storage organs. The second season produces reproductive flowers and seed. There are no common biennial grasses.

2 Perennials

Perennials are plants that continue to grow indefinitely. Some may die back to the ground each winter (herbaceous perennials), but revive from the roots in the next spring. They propagate by tillers and seeds. Many of the forage grasses function in this way. Most perennial plants add new growth each year as trees do.

E.g. orchardgrass, tall fescue, perennial ryegrass, kentucky bluegrass, smooth bromegrass, meadow foxtail, timothy, colonial bentgrass, bermudagrass, reed canarygrass, wheatgrasses, big bluestem, switchgrass, and indiangrass.

1.3 Common Forage Crops used in Livestock Feeding

The most common forage crops used in livestock feeding in Nigeria include the followings:g

- Maize plant used in making silage
- Sugar Beet used in making hay and silage
- Sorghum almum (Columbus Grass)
- Lablab (Lablab purpureus L. Sweet)
- Andropogon gayanus (Northern Gamba Grass
- Andropogon tectorum (Southern Gamba Grass)
- Hyparrhenia rufa (Shuchi Grass)
- Pennisetum typhoides cv Maiwa
- Stylosanthes guianensis cv Schofield stylo
- Stylosanthes hamata cv Verano stylo
- Brachiaria decumbens (Signal Grass)
- Digitaria smutsii (Woolly Finger Grass)

Self-Check -1	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page. (4 pts each)

1. Explain the common Grass forages for the livestock's.
2. Explain different forage grass/legumes based on their lifecycle.
3. Define pasture and forage

Note: **Satisfactory rating - 12 points** **Unsatisfactory - below 12 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Choose the correct answer:

1. _____
2. _____
3. _____

Information sheet 2	Identifying and recognizing method of sowing pasture and natural pasture establishment.

2.1. Natural pastures and their productivity

Production and productivity of natural pastures is dependent upon different factors. Some of these factors can be summarized under the following headings discussed below.

- **Climatic Factors:** These factors include temperature, rainfall & humidity. But above all these factors rainfall is the most crucial in determining the type of vegetative cover in an environment. Generally, grassland communities develop where the rainfall average is between 250-750mm.
- **Edaphic Factors /Soil Factors/:** When soils are discussed in relation to vegetation the main emphasis is usually on classification & fertility. Sandy soils have very low fertility & poor water holding capacity resulting in poor forage. Poor soil fertility results in poor productivity of the pasture species.

- **Vegetation Factor /:** Predominance of grass species in natural pastures is common feature throughout the tropics. Many types of grassland also contain shrubs & woody plants (trees) at varying proportions to be utilized basically as a source of browses. Natural pastures mostly lack legume species.

- **Utilization Factor:** the degree of utilization has a profound effect on the production & Productivity of natural pastures. Overgrazed pastures result in poor vegetative growth and higher soil degradation.

- **Human Factor:** Human interference is the other important factor to influence the production and productivity of natural pastures. Deliberate firing of natural pastures, for example, has its own impact on vegetative growth. Firing could be both beneficial as well as detrimental depending up on various conditions.

2.2. Improved forage and pasture production strategies

In many of potential areas of the country dairy production has been intensified due to development interventions encouraging intensification and the interest of farmers to intensify, while there is insignificant production of improved pasture and forages. Livestock feed resources in Ethiopia are mainly natural grazing and browse, crop residues, improved pasture, forage crops and agro-industrial by-products.

Grazing lands have been degrading due to growing pressure on land resources from increasing populations and greater cropping intensity. Crop residues are also poor quality feed resources which could not provide nutritional requirements of the animal.

Furthermore, costs for industrial by-products is too expensive for smallholder dairy farmers to afford. Producing improved forages can help dairy farmers to withstand the prevailing feed shortages in different parts of the country. In dairy systems where feed scarcity is challenging, improving feed supply is possible if backyard forage production, under-sowing, over sowing and growing improved pasture and forages are widely adopted.

Forage production strategies

I. On Farm Strategies

- Backyard Forage Production
- Under sowing and Interplanting
- Contour Forage Strips
- Agroforestry

II. Common Land Strategies

- Over sowing Common Grazing Areas
- Stock Exclusion Areas/Forage Banks
- Permanent Pastures

Other strategies

Aerial sowing*:* Aerial sowing enables very large areas to be over-sown with improved forage seeds. The success of establishment depends largely on the selection of suitable sites. The most suitable sites have rough often gravelly surfaces. Sites with compacted or hardpan surfaces do not enable good establishment of aerial sown or broadcast seed.

Roadside sowing*:* Roadside sowing is a successful means of implementing the over sowing strategy. It is quick and effective and provides an impressive visual impact which can be used to excite farmer interest and provide an incentive for the formation of grazing management groups or pastoral associations. This strategy can be highly cost-effective, particularly when using species with the ability to spread under grazing.

Self-Check -2	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page. (6 pts each)

1. Explain the factors determining production and productivity of pasture.
2. Explain different strategies of pasture establishment

Note: **Satisfactory rating - 12 points** **Unsatisfactory - below 12 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short answer:

1. _____
   _____
   _____
2. _____
   _____
   _____

Information Sheet-3	Identifying advantages and uses of pasture establishment

3.1. Pasture establishment procedures

- Establishing pastures should be planned well in advance.
- Take a soil sample and have it analyzed in order to correct the basic fertility.
- Separate soil samples should be taken for every variation in soil type and each different crop.
- In the summer rainfall areas, January and February are usually the most suitable months for establishing pasture, because there is less competition from weeds which have to be controlled during the preceding months.
- There is an improved soil moisture status at this time of the year.
- A firm seedbed should be prepared if the pasture is to be irrigated.
- For reasons of economy, plant as early as possible (February/March).
- Use only high-quality seed at the recommended sowing rates.
- About 20% less seed is used if the pasture is planted in rows.
- Use certified seed, which has to comply with certain minimum standards.
- These standards ensure that the germination, purity and genetic stability of each variety within a species are maintained at a prescribed level.
- The use of certified seed protects the farmer from introducing unwanted weed seed and poor germination.

3.2. Advantages and disadvantages of pasture establishment

Whether a producer is part time or commercial, good pastures are profitable. They can provide an economical source of livestock feed, reduce labor requirements, build soil tilth and fertility, reduce erosion, and reduce invasions of noxious and poisonous weeds.

When obtaining new land that will be used for forage production, especially pasture, a forage-livestock producer is encouraged to use the first year carefully. Fertilizing wisely

and managing the pasture strategically enables the producer to learn much about what the land is capable of producing. Investing in establishing a pasture from scratch may sound thorough but the pasture can easily revert to the previous plant composition in a few years, becoming a waste of money, time, and labor, if the land is poorly managed. Well established and managed perennial pastures can produce effectively for five to ten years or more.

Successful pasture establishment has three essential building blocks:

- Good soil conditions
- A properly adapted speciesa
- Good weather.

The best one to start with is a well-adapted species. Choose to plant a species that is :-

- Well adapted to the soil pH
- The expected climate conditions (winter hardiness)
- Realistic drought or flood tolerance and
- Well suited to the intended use and livestock type.

Successful establishment of a pasture is greatly determined by weather. The temperature extremes, expected precipitation, and flooding possibilities need to be considered.

Overall, establishing a pasture can mean a high-quality forage that is well matched to the intended livestock and use. A producer can carefully plan what is best for his operation. If well planned and carried out, establishing a forage stand can mean years of high-quality feed. On the other hand, establishing a forage stand requires careful planning, usually a year in advance, and specific steps in preparation, but the efforts may fail if weather conditions sabotage the efforts.

Dis advantages of pasture renovation

- The possibility of erosion
- High cost, and

- Extensive labor
- High cost forpartial or complete destruction of a sod and liming
- Fertilizing
- Weeding, and
- Seeding as required to grow desirable forage plants.

Frequently, where an old pasture is to be replanted, taking an extra year and growing an annual crop for pasture, hay, or grain to allow time for old sod to decay will yield more desirable results.

Self-Check -3	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page. (6 pts each)

1. Explain the factors determining production and productivity of pasture.
2. Explain different strategies of pasture establishment

Note: **Satisfactory rating - 12 points** **Unsatisfactory - below 12 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short answer:

1. _____
   _____
   _____
2. _____
   _____
   _____

Information Sheet-4	Undertaking land preparation activities for pasture Production (clearing, sowing, digging pit, preparing seed bed, rolling)

4.1. Land preparation

When establishing a new date plantation, certain actions need to be implemented to ensure the long term success of the plantation. One of these actions involve the initial land preparation which should be done prior to transplanting of the plant material (offshoots or tissue culture-derived plants).

The purpose of land preparation

- To provide the necessary soil conditions which will enhance the successful establishment of the young offshoots or the tissue culture plants received from the nursery.

Critical factors to consider during this planning exercise are summarised as follows:

- Availability and quality of irrigation water
- Field selection
- Mechanical actions to be implemented
- Chemical needs for pre-plant soil improvement
- Tools and equipment needed for date cultivation
- Labour needs
- Irrigation design and installation
- Leaching schedule
- Hole preparation
- Financial requirements
- Time schedule.

4.2. Field selection

The area selected for the establishment of the date plantation can infl uence the cost of land preparation to the extent that it may not be viable to proceed with the development at all.

I. Availability of water

Critical factors regarding water for irrigation purposes are:

(i) the sustainability of the water source

(ii) the quantity of water available for irrigation

(iii) the distance to the fi eld, and

(iv) the quality of the water.

II. Soil depth

Besides the importance of root development, soil depth also infl uences drainage and leaching possibilities..

II. Soil quality

The soil quality is related to its drainage capacity mainly when soils are salty or the irrigation water is characterised with a high salt content. Sandy soils are common in most date plantations of the old world. Rare cases of clay soils

4.3. Land clearing

Newly-cleared land is often used for seed crops to ensure less competition from weeds and other pasture plants (and therefore less contamination of the crop).

4.4. Seed-bed preparation

For seed crops, thorough land preparation is essential to provide a clean, firm fine seed-bed. Land levelling is advantageous for irrigated systems or mechanised harvesting.

Rough, weedy underdeveloped/under-prepared seed-beds may cause poor establishment giving poor plant populations which allow uneven tiller and seed maturation. Cultivation affects the size, distribution and packing of soil particles. It

provides a tilth next to the seed and should optimise the condition of the soil surface to maximise emergence, water infiltration and maintain gas diffusion to avoid short-term anaerobic conditions caused by slaking and crusting.

Two methods of seedbed preparation are recommended.

I. **Conventional or Clean Tillage** – This type of seedbed can be prepared with plows, discs, chisels, tool-bars using sweeps or other types of equipment. After the tillage operation is completed, the land should be smoothed and firmed using equipment such as a roller harrow, cultipacker, spike tooth harrow or other implement to firm the final seedbed.

II. **Standing Stubble** – Seed can also be inter-seeded directly into most cereal grain stubble on coarse- to medium-textured soils. Stubble free from weeds and volunteer grain provides a firm seedbed and a favorable micro-climate for seedling establishment.

4.5. Time of sowing

Planting time depends largely on the reliability of rainfall and potential evapotranspiration.

Early sowings have the best chance of producing a good harvest. Within given areas, small niches may exist which allow for different timetables to take advantage of rainfall extremes, irrigation and weed control patterns.

Self-Check -4	**Written Test**

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page. (6 pts each)

1. Explain the Critical factors to be consider during the land preparation planning.
2. Explain the two methods of seed bed preparations.

Note: **Satisfactory rating - 12 points** **Unsatisfactory - below 12 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short answer:

1._____

_____

_____

2._____

_____

_____

Information sheet 5	Carrying out Pre-treatment (including inoculation) of seed is prior to sowing

5.1. Reduction of seed hardness

Any legume, which is hard, should be softened to increase germination. pulse (food) legumes have low proportion of hard seed and also grass do not need /required seed softness/treatment but herbaceous and tree legumes are need treatments .In some case the proportion of hardness varying in between species. For example seca, verano, stylo, leuceanea have hard cover. There are deferent methods of reduction of seed hardness.

5.1.1. Types of treatments

A. **Hot water:** - we used in most hard seeds.

Procedures:

- Boil a container of water
- Remove the hot water from heat source until the to 80- 90^{o}c
- Soak the seed for 5'-10'
- Rapid cool the seed by spreading out in thin layer (10mm tick) in shade to avoid direct sun light.

B. **Scarification:-** is defined as any process of scratching the seed surface. Such scratches might not be visible but they allow absorption of water by the seed surface to enable faster germination of the seed. It means any process, which slightly scratches the seed surface.

There are 2 types:

- **Mechanical: -** The major advantage is that it can be mechanized to treat large quantities of seed rapidly.

Methods of mechanical scarification include:

1. Placing the seed with gravel in a cement mixer and rotating it for at least 30 min.
2. Rubbing seeds on abrasive surface, like concrete or sand paper.

3. Passing seed through a hammer mill or using a specially designed scarifies with a rotating abrasive disc.

   A major advantage of mechanical scarification is that it can be mechanized to treat large quantities of seed rapidly.

❖ **Acid Scarification: -**

This technique is mostly used for small experimental samples.

1. Immerse a well dried seed in a concentrated H_2SO_4 for 5 minutes.
2. Immerse a seed, after wards, in a large volume of water.
3. Acid scarification has the advantage of killing any disease organisms on the surface of the seed.

After it is thoroughly dried the seed treated in hot water treatment or acid scarified can be stored for 1-3 months in a cool & dry seed store.

C. Inoculating legumes

Some legumes fix rhizobal bacteria from the soil but other not so it needs bacteria by inoculation process.

Methods:

- ❖ Packed inoculums rhizobal bacteria
- ❖ Add to1 to 2 litters of water
- ❖ Mixed thoroughly with 50 kilogram of legume seed
- ❖ Dried in shade other wise bacteria may damage by sunlight.

D. Pelleting

Coating seeds by inoculants, fungicide. This improves water absorption, overcome soil acidity, and repels insects, birds and pests.

Self- Check-5	Written test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page: (2 points each)

1. Used to break the hardest seeds by boiled water.

   A. Hot water B. Scarification C. Inoculation

3. It improves water absorption, overcome soil acidity, and repels insects, birds and pests.

   A. Pelleting B. Hot water C. Scarification D. Inoculation

Note: **Satisfactory rating - 6 points** **Unsatisfactory - below 6 points**

You can ask you teacher for the copy of the correct answers.

Score = _____

Rating: _____

Name: _____ Date: _____

Answer Sheet

1._____

2._____

Information Sheet 6	Implementing appropriate method of breaking seed dormancy

6.1. Seed dormancy

Seed dormancy is an evolutionary adaptation that prevents seeds from germinating during unsuitable ecological conditions that would typically lead to a low probability of seedling survival.

Dormant seeds do not germinate in a specified period of time under a combination of environmental factors that are normally conducive to the germination of non-dormant seeds.

Many species of plants have seeds that delay germination for many months or years, and some seeds can remain in the soil seed bank for more than 50 years before germination.

6.1.1. Exogenous dormancy

Exogenous dormancy is caused by conditions outside the embryo and is often broken down into three subgroups:

- Physical dormancy
- Mechanical dormancy
- Chemical dormancy

I. Physical dormancy

Dormancy caused by an impermeable seed coat is known as physical dormancy. Physical dormancy is the result of impermeable layer(s) that develops during maturation and drying of the seed or fruit. This impermeable layer prevents the seed from taking up water or gases.

In natural systems, physical dormancy is broken by several factors Like

- High temperatures
- Fluctuating temperatures
- Fire

- Freezing/thawing
- Drying or passage through the digestive tracts of animals.

II. Mechanical dormancy

Mechanical dormancy when seed coats or other coverings are too hard to allow the embryo to expand during germination. These endogenous factors include low embryo growth potential.

III. Chemical dormancy

Includes growth regulators etc. that are present in the coverings around the embryo. They may be leached out of the tissues by :-

- Washing or soaking the seed,
- Deactivated by other means.
- Rainwater or snow melts.

6.1.2. Endogenous dormancy

Endogenous dormancy is caused by conditions within the embryo itself, and it is also often broken down into three subgroups:

- Physiological dormancy
- Morphological dormancy
- Combined dormancy

I. Physiological dormancy

Physiological dormancy prevents embryo growth and seed germination until chemical changes occur. Physiological dormancy is indicated when an increase in germination rate occurs after an application of gibberellic acid (GA3) or after Dry after-ripening or dry storage. It is also indicated when dormant seed embryos are excised and produce healthy seedlings: or when up to 3 months of cold (0–10 °C) or warm (=15 °C) stratification increases germination: or when dry after-ripening shortens the cold stratification period required. In some seeds physiological dormancy is indicated when scarification increases germination.

Physiological dormancy is broken when inhibiting chemicals are broken down or are no longer produced by the seed; often by a period of cool moist conditions, normally below (+4C) 39F, or in the case of many species in Ranunculaceae and a few others,(−5C) 24F. Some plants like Peony species have multiple types of physiological dormancy, one affects radicle (root) growth while the other affects plumule (shoot) growth.

- **Drying**; some plants including a number of grasses and those from seasonally arid regions need a period of drying before they will germinate, the seeds are released but need to have lower moisture content before germination can begin.
- **Photo dormancy** or light sensitivity affects germination of some seeds. These photoblastic seeds need a period of darkness or light to germinate.
- **Thermo dormancy** is seed sensitivity to heat or cold. Some seeds including cocklebur and amaranth germinate only at high temperatures (30C or 86F).

II. Morphological dormancy

In morphological dormancy, the embryo is underdeveloped or undifferentiated. Some seeds have fully differentiated embryos that need to grow more before seed germination, or the embryos are not differentiated into different tissues at the time of fruit ripening.

1. **Immature embryos** – some plants release their seeds before the tissues of the embryos have fully differentiated, and the seeds ripen after they take in water while on the ground, germination can be delayed from a few weeks to a few months.

III. Combined dormancy

These seeds have both morphological and physiological dormancy.

- **Morpho-physiological** or **morphophysiological dormancy** occurs when seeds with underdeveloped embryos, also have physiological components to dormancy. These seeds therefore require dormancy-breaking treatments as well as a period of time to develop fully grown embryos.
    - ❖ Intermediate simple
    - ❖ Deep simple

- Deep simple epicotyl
- Deep simple double
- Intermediate complex
- Deep complex

Combinational dormancy

Combinational dormancy occurs in some seeds, where dormancy is caused by both exogenous (physical) and endogenous (physiological) conditions. Some Iris species have both hard impermeable seeds coats and physiological dormancy.

Self-Check -6	Written Test

Directions*:* Answer all the questions listed below. Use the Answer sheet provided in the next page. (6 pts each)

1. Of the following one is the exogenous dormancy is caused by conditions outside the embryo.

   A. Physical dormancy B. Mechanical dormancy C. Chemical dormancy D. All

2. Of the following one is the endogenous dormancy is caused by conditions within the embryo itself

A. Physiological dormancy B. Morphological dormancy C. Combined dormancy D. All

Note: **Satisfactory rating - 12 points** **Unsatisfactory - below 12 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Choose the correct answer

1._____

2._____

Information Sheet 7	Identifying and implementing methods of planting, seed rates, and spacing.

7.1. Seeding Methods

The type of seeding method you choose will depend on the type of equipment available and whether planting on a no-till or a conventional seedbed. To ensure good soil to seed contact and that seed will germinate and emerge in a timely manner, different seeding methods are available. Some of these methods include:-

- Drilling
- Cultipacking, and
- Broadcasting.

Drilling cuts a thin furrow in the soil, deposits the seed, then covers it and firms the soil with press wheels. A good rule is to plant the seed three to four times as deep as the diameter of the seed. With a cultipack planter, the seed is dropped from a hopper onto the soil where toothed rollers press the seed below the surface.

sowing /planting

Plants can be propagated either sexually or asexually, sexual propagation is possible by direct seeding or use of seedlings. Asexually propagation is also possible through use of cuttings, for legume species & splits grass spicies.

I. Direct seeding

Seed crops are sown on a well-prepared seed bed. The sowing method can be either by:-

- Broad casting or
- Sowing in rows.

Advantages of sowing in rows over broad casting are: -

- Weeds are more readily controlled
- Harvesting the yield (forage or seed) will be easier

Row sowing of improved forage species is more common in case of seed production. Smaller forage seeds are broad casting & larger seeds can be sown in rows. Sowing time

depends up on the local environmental conditions. The best time of the year for sowing of forage crops in Ethiopia is said to be at the beginning of “Kermit” rains. This will very much ensure the successful establishments of this species.

II. Planting seed lings

These is practiced especially for planting free legumes.

The advantage of plant seedlings are:-

- ❖ There is a higher rate of survival
- ❖ They will achieve greater size when they are planted using seedling.

Seedlings are first grown in nurseries & they are later on transplanted in to the field into moist soil survival of transplanted plants of specially tree legumes has been higher than that of plants from direct seeding methods.

III. Planting cuttings / splits

Vegetative propagation of tree legumes using cutting & grasses using grass split is used for propagating some forage species.

A. **Tree legume cutting:** - should be taken from mature branches. These cutting should be about 30-50cm. In length & more than 7cm. In diameter. They are normally out at both ends obliquely at 450 angle & planted in to the ground not less than 20cm depth.
B. **Grass cutting /splits/:** - grass cuttings are usually called splits, they can be used to propagate bunch type grasses such as phalaris and guinea grass. Rhodes grass are propagated using stolons.

In case of stoloniferous grasses, the mature stolon with at least three nodes should be used for planting. In case of the bunch type grass, the grasses must first be cut low before digging out the roots. The splits thus prepared will be used to planting wet seed beds.

Grass cuttings are the only way planting infertile grasses such as hybrid phalaris.

The most common advantage of planting cuttings instead of direct sowing is that the plants are more rapidly established that are genetically identical to the parent lines without the need for seed collection.

7.2. Seeding Time

Seeding on the correct date is also very important. Cool-season grasses are established in late summer or early fall (August to November. Warm-season grasses should be planted in late spring to early summer after the soil has reached a temperature of 65°F or above. Usually spring seeding has plenty of moisture for seed germination, but there is an increase in weed pressure. Spring seeding should be made at least four weeks after the last frost killing. Late summer seeding is recommended for wet areas, since the soil is usually dry enough during the summer with less weed pressure.

Fall seeding should be made at least four to six weeks before the first killing frost in the fall; this will allow seed time to have adequate growth before winter. No till-drill planting in late summer might provide adequate moisture for seed germination since organic matter provides cooler soil temperatures and higher moisture levels.

7.3. Sowing depth

This is usually related to seed size, seeding emergency, and survival of small seeded species. The optimum depth of most grasses and small-seeded legumes lies between 1 to 3 cm but varies according to species or cultivars and care should be taken. The largest seed of legume placement between 2.5-5cm below the soil like leuceanea, susbania, cowpea, lablab and the smallest seed not more than 0.5cm.

N.B. Planting depths greater than 2 inch will decrease seedling emergence as much as 50% in some forage species. Seed of good quality (high purity and high germination rate) should also be used to obtain a good establishment.

7.4. Seeding Rates

Determining proper seeding rates depends on species and seeding method being used. It is important to make sure that the seed used is good quality (germination rate and purity)

and has not been stored for a long period of time. If the seed is poor quality, the seed must be applied at higher rates to obtain a desirable stand.

The use of certified seed with good quality is recommended. Buying lower cost seed does not always translate into savings, since the seed quality may affect the amount of pure live seed necessary to achieve the desired seeding rate. If legumes are seeded, make sure the seed is inoculated with the proper bacterial strain. In many cases, legume seed have been pre-inoculated. If the seed is not pre-inoculated, mix prepackaged inoculum with the seed just prior to seeding .

No	Forage species	Seed rate
1	Chloris Gayana	3-5Kg/ha
2	Callide Rhodes	10Kg/ha
3	Baffle Grass	10Kg/ha
4	Trifolium Tembensa	5Kg/ha
5	Fodder Beet	10Kg/ha
6	TrifoliumQuartinianum	5Kg/ha
7	Siratro	4Kg/ha
8	Lablab	20Kg/ha
9	Trueppellianum	5Kg/ha
10	Setaria	10Kg/ha
11	Cow pea (VignaUngiculata)	20Kg/ha
12	Marculatus	6Kg/ha
13	Alfalfa (Sequel)	10Kg/ha
14	Green Leaf	5Kg/ha
15	Seca	4Kg/ha
16	Medic ago Truncatula	10Kg/ha
17	Leucaena Palide	Seedlings
18	Red Clover	6Kg/ha
19	Trifilium Steudneri	5Kg/ha
20	Verano	6Kg/ha
21	Vetch	20Kg/ha
22	Panicum Coloratum	15Kg/ha
23	Tall Fescue	15Kg/ha
24	Melilotusalba	10Kg/ha
25	Phalaris Aquatica	15Kg/ha

Table 1. Seeding rates for different forage species

Self-Check -7	Written Test

Directions*:* Answer all the questions listed below. Use the Answer sheet provided in the next page. (4 pts each)

1. Direct seeding of forage seeds can be categorized in to raw sowing and Broad casting methods based on the size of seeds. (True/False)
2. Grass species can be propagate by splitting methods in addition to seed sowing methods. (True/False**)**
3. Seeding rates for different species of forages are similar per a given hector of land. (True/False)

Note: **Satisfactory rating - 12 points** **Unsatisfactory - below 12 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Say True or False

1._____

2._____

3._____

Information sheet -8	**Undertake management activities including fertilizing and manure application, weeding, and pest and disease control.**

8.1. Introduction

Fertilizers are needed in pastures for better establishment and quality. This is due to the supply of necessary nutrients (macro and micro) that are highly essential for pasture growth. Lack of these nutrients in the soil can lead to poor growth and performance of pasture species. Different pasture species have different fertilizer requirements. For example, grass species require more of nitrogenous fertilizers than phosphorus, although phosphorus is also critical to the survival of the species. Legumes need more of phosphorus and calcium rather than nitrogen.

8.1.1. Soil Fertilization

Soil Fertility:- is the capacity of the soil to supply nutrients to plants in adequate amount & proportion.

Plants need about 16 nutrients for normal growth & development. The major nutrients essential for pasture crops are N, P,K,S & Mg. Nitrogen is the most important of all nutrients necessary for herbage yield.

Nutrient deficiency of soils can be corrected by fertilization (application of fertilizers).
Fertilizers are chemical compounds that can supply nutrients to plants. Fertilizers should applied based on soil test. Fertilizers are useful for forage species to improve forage yield & forage quality.

Most legume grass forage crops have been found to grow & produce adequate seeds on a wide range of Ethiopian soils without fertilizer. But nitrogen fertilizer is applied in some cases to increase herbage & seed production of grasses. Legumes can supply their own nitrogen requirements.

In various parts of Ethiopia Nitrogen & Phosphorus deficiencies have been observed. However, knowledge of the soil nutrient status is necessary for decisions on specific deficiencies.

Fertilizers in any case are placed alongside or underneath seeds with an intervening layer of soil in between. But if inorganic fertilizers are put in contact with seeds or new plant roots, they can damage plant tissues resulting in death of the plant or the seed.

8.1.2. Types of Fertilizers for Pasture Species

There are two types of fertilizers used in pasture management.

- ❖ Organic fertilizers or farm yard manure
- ❖ Chemical fertilizers.

All of these fertilizer sources supply the same type of nutrients to pastures. However, the rate of release of these nutrients differed between the fertilizer sources.

- ➢ Organic manures are very slow in the release of nutrients compared to chemical fertilizers.
- ➢ Chemical fertilizers are further categorized into straight (e.g. Urea 46%N) and compound fertilizers (e.g. NPK 15:15:15) depending on the number of chemicals they contain.

Manuring soil with well-decomposed organic fertilizers, like compost, green manure & animal droppings will improve the physio-chemical and biological properties of the soil. They should be applied 20-30 days before sowing.

8.1.3. Methods of Application of Fertilizers to Pasture Specie

Fertilizers can be applied to pastures either during land preparation or at planting. Phosphatic fertilizers such as Single Super Phosphate (SSP) can be applied at single dose during land preparation because it is immobile in the soil. However, nitrogenous

fertilizers such as urea can be applied in split doses to capture the highly mobile nitrogen in the soil. Therefore, it is advisable to apply nitrogenous fertilizers to pastures at 3 and 6 weeks after planting for better results. Fertilizers are mainly applied using broadcasting method but they can also be drilled. However, spot application is only possible in pasture species such as forage maize.

8.1.4. Sources of Nutrients in Pasture Species

Nutrients in pastures can come from different sources, which may include the following:

- Fertilizer application
- Urine of livestock
- Faeces/dung of livestock
- Decay of organic matter in the soil
- Atmospheric deposition e.g. SO4 2- , NO3 2-
- Activities of soil living organisms such as bacteria

8.2. Weed Control

8.2.1. Definition and Types of Weeds

Weeds are unwanted plants in pastures that have not been planted by the farmer. They are of different genus and species with the pasture plants, and therefore, when allowed to grow with the selected species, they can easily adulterate the pasture. Weeds are part of pastures grown where pastures are poorly managed. There are many types of weeds that can easily multiply and take over the pastures within a short period of time.

There are two types of weeds in pastures.

- Narrow leaved weeds-mainly grasses
- Broad leaved weeds-mainly legumes.

There is need to control these weeds before and after planting because at the initial stage of pasture establishment, the pasture species grow very slowly, while weeds grow very fast, thereby smothering the pasture species. However, it is important to note that there are weeds that are beneficial to livestock and farmers (non-toxic weeds) as against toxic

weeds which cause economic loss and environmental hazards. Weeds can be controlled by Cultural, biological or chemical application.

8.2.2. Economic implications of Weeds in Pastures

Weeds in pastures have serious economic implications which may affect the goal of the farm. These implications include the following:

- Weeds reduce forage yield and quality due to existing competition in the pasture
- Weeds cause serious economic loses to farmers
- Weeds reduce the lifespan of pastures
- Some weeds are poisonous to livestock and herders
- Weeds affect pasture seed quality and viability
- Some weeds serve as hosts to certain pests and diseases

8.3. Pest and Disease control

Definition of terms

A **pest** is any animal or plant detrimental to humans or human concerns, including crops, livestock and forestry, among others. The term is also used of organisms that cause a nuisance, such as in the home.

Self-Check -8	Written Test

Directions*:* Answer all the questions listed below. Use the Answer sheet provided in the next page. (4 pts each)

1. List at least 6 Economic implications of Weeds
2. Least the two types of fertilizers and their times of application
3. Mention shortly how weeds can be controlled.

Note: **Satisfactory rating - 12 points** **Unsatisfactory - below 12 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short answer

1._____
_____
_____

2._____
_____
_____

3._____
_____
_____

Information sheet 9	Applying fertilizers and pesticides at correct rate and stage of growth

9.1. Application of fertilizer

Helps to correct the soil gap of nutrients.

- **Urea (N)**: improve the vegetative growth of the plant.
- **DAP (P)**: increase strength of the plant

Proper fertilization

- Continues removal of the grass cover and consequent leaching may deplete the soil of plant nutrients. This limits the growth of vegetation particularly in arid grasslands, which are often subjected to erosion hazards and are highly depleted.
- The productivity of grasslands can be restored and further be increased only by use of fertilizers to supply the deficient nutrients. Majority of grasses need nitrogenous and phosphate fertilizers. Fertilizers should be applied based on fertility of pastureland.
- To maintain their productivity, pastures need adequate nutrition, clipping or controlled grazing to eliminate weeds and over-ripe grass, and protection from overgrazing. Fertilizers and added manure provide the nutrition.

Apply nitrogen only after the grass stand is successfully established. If the stand has a legume component, limit the use of synthetic nitrogen fertilizers. In general, nitrogen fertilization favors grass growth, and phosphorus fertilization favors legumes. Yearly applications of 20 to 50 pounds per acre of phosphorus can significantly increase alfalfa yields and stand persistence in areas deficient in phosphorus.

Fertilizer

One caution with applied fertilizer is that fertilizer application interacts with soil *pH* and with the uptake of micronutrients and minerals. For example, heavy applications of superphosphates can lower soil *pH* which in turn can lower the uptake of selenium and other minerals by forage. A soil which had adequate selenium content to avoid white

muscle disease in sheep or equines may suddenly see a drop in selenium uptake to the forage if very heavy doses of superphosphate are added to increase clover production in the pasture. Cautious steps and frequent soil tests will avoid most problems.

Manure

Applied manure, in addition to the animal droppings, is good for a pasture. Ten tons per acre of cow manure (two-thirds that amount of sheep manure), well-flailed and spread after grazing has stopped is ideal. Chicken manure application should be no more than 3-4 tons per acre, and the high level of copper in chicken manure may be too much for sheep pastures. If you don't have a manure spreader, you may be able to borrow one, or hire a neighbor to custom spread your manure.

Self-Check -9	Written Test

Directions*:* **Answer all the questions listed below. Use the Answer sheet provided in the next page. (4 pts each)**

1. Explain the importance of Urea and DAP in forage production.

Note: **Satisfactory rating - 4 points** **Unsatisfactory - below 4 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short answer

1._____

_____

_____

Operation sheet 1	Seed treatment

Steps

1. Boil water in a container
2. Remove the hot water from heat source until the to 80- 90^{o}c
3. Soak the seed for 5’-10’
4. Rapid cool the seed by spreading out in thin layer (10mm tick) in shade to avoid direct sun light.

Operation sheet 2	Scarify seeds mechanically

Steps

1. Prepare seed to be treated
2. Placing the seed with gravel in a cement mixer and rotating it for at least 30 min.
3. Rubbing seeds on abrasive surface, like concrete or sand paper.
4. Passing seed through a hammer mill or using a specially designed scarifies with a rotating abrasive disc

Operation sheet 3	Chemical scarification

Steps

1. Safely prepare concentrated H_2SO_4
2. Immerse a well dried seed in a concentrated H_2SO_4 for 5 minutes.
3. Immerse a seed, after wards, in a large volume of water.

Operation sheet 4	Pasture establishment

Steps

1. Clear the land for pasture establishment
2. Sowing the land using different sowing mechanisms
3. Prepare seed beds based on the forage species
4. Sow the prepared seeds
5. Mulch the seeds beds
6. Under take management techniques

LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within --- hour.

Task 1. Treat seeds using hot water safely

Task 2. Mechanically scarify seed

Task 3. Teat seeds using H_2SO_4

Task 4. Establish pasture

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Dairy Production

Level-III

Learning Guide 28

Unit of Competence: Establish pastures and forage for dairy production

Module Title: Establishing pastures and Forage for dairy production

LG Code: AGR DRP3 M07 LO3- LG-28

TTLM Code: AGR DRP3 TTLM 1219 v1

LO 3: Implement harvest management

Instruction Sheet	Learning Guide 28

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics –

Identifying and implementing time and stage of development

- Identifying and implementing time and stage of development
- Recognizing production yield for grasses, herbaceous legumes, tree legumes and fodder crops.
- Identifying and recognizing harvesting and utilization methods

This guide will also assist you to attain the learning outcome stated in the cover page.

Specifically, upon completion of this Learning Guide, you will be able to: –

- Identify and implement time and stage of development
- Recognize production yield for grasses, herbaceous legumes, tree legumes and fodder crops.
- Identify and recognize harvesting and utilization methods

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1, Sheet 2 and Sheet 3”.
4. Accomplish the “Self-check 1, Self-check 2,and Self-check 3” **in page -5, 7 and 9** respectively.
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1,” **in page -21.**
6. Do the “LAP test” **in page – 22** (if you are ready).

Information sheet -1	Identifying and implementing time and stage of development

1.1. Timing of harvest should consider the following:

- End use of the silage ie. For animal production vs. Maintenance rations
- Weather conditions at harvest
- Soil types and soil moisture conditions at harvest
- If spring sowing, when the follow up pasture is to be sown
- If double cropping, when the follow-up crop needs to be sown
- Availability of suitable harvesting machinery
- Effect on dry matter yield

Figure 1.1. Different stages of forages

Cereals can be harvested at two stages:

1. Flag leaf/boot - early ear emergence stages
2. Soft dough stage.

1.2. Flag leaf/boot - early ear emergence stage

The flag leaf, usually a wider leaf than most to date, is the last leaf to appear before the ear or head starts to emerge. The flag leaf sheath contains the "boot", a swelling in the sheath, from which the ear will emerge Once the ear has emerged flowering or anthesis commences, beginning from the middle of the head and spreads upwards and downwards. The plant has vegetative leaves up to this stage.

All cereals can be harvested before or at this stage, producing high energy silage (over 10 MJ ME) but will have lower yields compared to their potential if harvested in the grain formation stages. If a silage of high nutritive value is required they should be harvested at the vegetative stage although they will need to be wilted to the recommended dry matter contents before harvesting or baling.

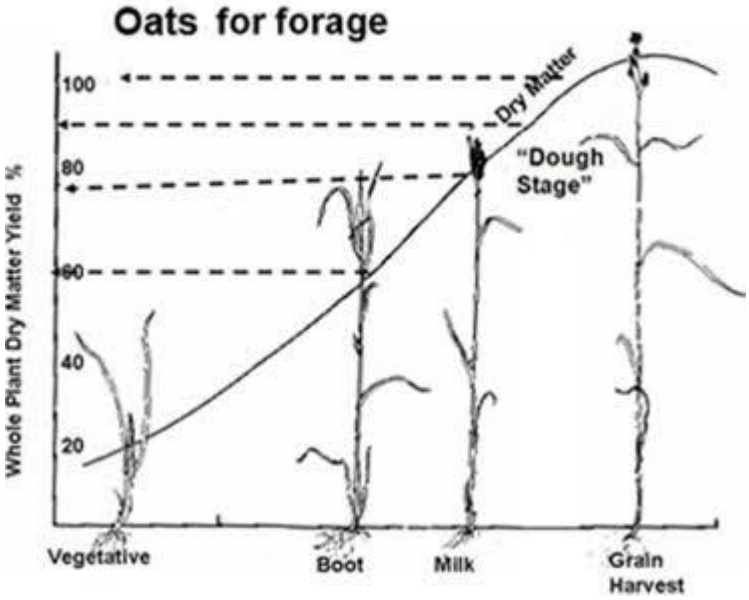

Figure 1.2. Growth stages: R-L Early, mid, late and full early emergency

Note: It is recommended that whole-crop cereals should not be harvested for silage at the clear liquid - early milk stages. At this stage the soluble sugars in the plant are being converted into starch in the heads. The nutritive value at this stage is often reduced but importantly, palatability of silage made at this stage is sometimes greatly reduced.

1.2.1. Soft dough stage

As the plant reaches maturity, sugars in the stems and leaves are translocated to the grain and converted to starch. These changes are associated with changes in colour from an all-green plant in the vegetative stages to an all-yellow plant in the fully mature plant at the hard grain stage.

As the grains themselves form and mature they pass through the clear liquid stage, then become milky, followed by soft and hard dough stages (See figure 1. 3) and finally to hard dough and eventually as a dry grain suitable for grain harvesting.

Figure 1.3. Harvesting soft drought stages

The recommended time to harvest forage cereals is at the soft dough stage. This later harvesting results in much higher DM yields but of slightly lower energy and much lower crude protein levels than at the vegetative stage. Plant neutral detergent fibre (NDF) levels will also be higher at this stage of cutting along with lower calcium and sodium levels.

The time to harvest a mixed cereal/leguminous crop is usually based on the maturity of the cereal component (soft dough) and whether lodging is imminent.

However, if the legume component of the crop mixture is greater than about 40% - 50%, the dry matter (DM) content of the crop at cutting may be lower than if it was a cereal crop only, necessitating the crop to be wilted before harvesting.

Determining when to harvest forage cereals

Determining the timing of cutting is often based on one of the following:

- DM content
- Stage of growth

1. **DM content**

The recommended dry matter contents at which to harvest forage cereals varies widely between experts, the majority agreeing to the range of 33% to 50% DM .

The DM content in whole-crop cereals can be determined by using the micro-wave oven technique for estimating DM levels and/or using the stage of growth as a guide.

2. Stage of growth

As forage cereals mature, the physiological state of the plant changes, along with an increase in DM content of the plant.

Stage of growth Crops should be cut at a proper stage of maturity as it is the most important factor for controlling the silage quality. The appropriate stage of growth for cutting different fodder crops for silage making is given below:

- Sorghum - Flowering to dough stage
- Maize - Milk to dough stage
- Oat - 50% flowering to dough stage
- Grasses - Early flowering stage

Self-Check -1	Written Test

Directions*:* Answer all the questions listed below. Use the Answer sheet provided in the next page. (4 pts each)

1. Explain the conditions determining harvesting times in forages.
2. Mention detail the stages at which cereal forages are harvested.
3. Explain the Stage of growth harvest for different crops for silage making

Note: **Satisfactory rating - 12 points** **Unsatisfactory - below 12 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short answer

1._____

_____

_____

2._____

_____

_____

Information sheet -2	Recognizing production yield for grasses, herbaceous legumes, tree legumes and fodder crops.

2.1 Recognizing production yields of grass

Forages as a group are made up of many different types of plants, including grasses, legumes and other forbs, and shrubs. Most forage species, however, are grasses. Understanding grass growth is crucial information for a livestock manager. Grasses can be extremely productive when managed properly because they will grow back throughout the season when defoliated (grazed or mowed) properly.

The first step in understanding grass growth is an awareness of the different groups into which grasses can be categorized. Grasses can have annual or perennial life cycles, tall or short statures, jointed or non-jointed regrowth mechanisms, sod or bunch growth habits, warm or cool-season responses to climates, and requirements or no requirements for vernalization.

2.2. Forage Yields

Forage yields are general determined by one or more of the following things.

- Soil type (Potential plant rooting depth and plant available soil water holding capacity)
- Precipitation (Annual total and seasonal distribution)
- Soil fertility (Optimal fertility soils are more productive than low fertility soils)
- Forage species (Deep – rooted species are more productive than shallow rooted species)
- Nitrogen availability (Legumes fixed or applied fertilizer)
- Grazing and haying management

Self-Check -2	Written Test

Directions*:* Answer all the questions listed below. Use the Answer sheet provided in the next page. (8 pts each)

1. Explain the general factors determining the yields of forage lands.

Note: **Satisfactory rating - 8 points** **Unsatisfactory - below 8 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short answer

1._____

_____

_____

Information sheet -3	Identifying and recognizing harvesting and utilization methods

3.1. Utilization of Forage

Forage is normally used in two different ways.

- Grazing system
- Cutting carry system

The same field may be used for both purposes in the same season. Both uses have a number of different aspects to be considered.

Grazing

Grazing is by far the cheapest way of utilizing forage. In many parts of the world it is also the only way when the pastures are either too dry, wet, or hilly to be utilized by machines. In many cases, grazing is carried out extensively with very low input.

Good forage management is an essential part of intensive grazing management. Grazing can be done in different ways:

- Continuous Grazing
- Rotational Grazing

In continuous grazing livestock are in the same area for a long period of time. The stocking rate is high, and the number of fields limited.

In rotational grazing the area is divided into a number of paddocks. Livestock graze each paddock for a set number of days before moving on to the next paddock. Any surplus of grass is used for silage or hay and the stocking rate is high. The number of paddocks can vary from 2 to 4 and up to 10 to 14. Stripe grazing is a system of rotational grazing, where the livestock are offered new grass every day; one stripe which gives the necessary feed for one day of grazing.

For cutting, the principal ways of utilization are:

- Silage
- Hay
- Green Chop

Self-Check -3	Written Test

Directions*:* Answer all the questions listed below. Use the Answer sheet provided in the next page. (10 pts each)

2. Explain the different ways of forage utilization briefly based on the previous experience obtained in this competence.

Note: **Satisfactory rating - 10 points** **Unsatisfactory - below 10 points**

You can ask you teacher for the copy of the correct answers.

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short answer

1._____

_____

_____

References

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2. https://pss.uvm.edu/vtcrops/articles/Forage and Pasture Plant_ID_Presentation.pdf
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5. https://forages.oregonstate.edu/nfgc/eo/onlineforagecurriculum/instructormaterials/availabletopics/esablishment/advantages
6. https://extension.msstate.edu/sites/default/files/newsletter/forage-news/2008/4.pdf

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