COURSE CODE: PRM 501

COURSE TITLE: Forage and Seed production technologies

NUMBER OF UNITS: 2units

COURSE DURATION: *Two hours lecture*

COURSE DETAILS:

Course Coordinator: **Dr O.M. Arigbede**
Email: **arigbede2002@yahoo.com**
Office Location: **PRM Department, COLANIM**
Other Lecturers: **Miss O.J. Bolaji**

COURSE CONTENT:

Definitions, Major species of grasses and legumes (Botany, Classification, Management), Effects of environmental factors on forage plants, Forage legumes and their roles in tropical farming systems, Fodder bank technology (IFG), Shrub and tree legumes, Agronomic management for seed production, Seed harvesting, processing, transporting and storage.

COURSE REQUIREMENTS:

This is a compulsory course for all students in PRM, ANN and APH departments in the College of Animal Science and Livestock Production. In view of this, students are expected to participate in all the course activities and have a minimum of 70% attendance to be able to write the final examination.

READING LIST:

1. Whiteman, P.C. 1980: Tropical Pasture Science. Published by Oxford University Press.
2. Hogson, J. and Illius, A. W. 1996: The Ecology and Management of Grazing Systems. CAB International Wallingford, USA.

3. Micheal, B. Jones and Alec Lazenby, 1988: The Grass Crop. The Physiological Basis of Production, Chapman and Hall LTD., USA.

4. Pearson, C. J. and ISN, R. L. 1987: Agronomy of Grassland Systems. Cambridge University Press NY.

5. Crowder, L. V. AND Chheda, H.R. 1982. Tropical Grassland Husbandry. Tropical Agriculture Series. Longman, London.

6. Humpherys, L. R. 1991: Tropical Pasture Utilization. Published by the Press Syndicate of the University of Cambridge NY.

7. Bogdan, A. V. 1977: Tropical Pasture and Fodder Plants (Grasses and Legumes). Tropical Agriculture Series. Longman London

LECTURE NOTES

Definitions:

- Pasture is a piece of land on which forage crops are grown
- Forage plants are crops planted for the feeding of animals
- Natural pastures
- Cultivated pastures
- Carrying capacity of a pasture
- Livestock units

Introduction

Throughout the world, there are an estimated 600 genera of grasses containing some 7,500 species. Despite this abundance and wide variation, only some 40 species have come into use as pasture grasses and some of this have been improved to give a range of strains or cultivars.

Important tropical grasses with African origin include species of Andropogon, Brachiaria, Cenchrus, Chloris, Cynodon, Dichanthium, Digitaria, Eragrostis, Hyparrhenia, Melinis, Panicum, Pennisetum, Setaria, Sorghum, Urochloa. Those with South American origin are Axoponus, Paspalum, Tripsacum and Zea.

More attention has been given to the temperate legume species of Medicago, Trifolium, Vicia and Mililotus than tropical species. It is only within the last 4 decades that tropical legumes began to receive attention as pasture and forage crops. Those of African Origin include Glycine, Vigna, Indigofera, Doliches and Alyscarpus. The greater majority are indigenes of tropical America such as Calopogonium, Centrosema, Desmodium, Leucaena, Phaseolus, Stylosanthes, Terasmus.

MAJOR SPECIES OF GRASSES

1. Genus – Panicum – over 500species, perennial

   a) Common guinea - *Panicum maximum* var. typical
   b) Green panic – *Panicum maximum* var. trichoglume
   c) Blue panic – *Panicum antidotale*
   d) Makarikari grass – *Panicum coloratum* var. makakariense
   e) Tall panic – *Panicum dactylon*
   f) Improved panic – *Panicum maximum* var. ntchitsi

2. Genus – Pennisetum – annuals and perennials

   a) Elephant or Napier grass – *Pennisetum purpureum* cv. Capricon
   b) Kikuyu grass – *Pennisetum clandestinum* cv. Whittet

3. Genus – Brachiaria – perennials

   a) Signal grass – *Brachiaria decumbens* cv. Basilisk
   b) Para grass – *Brachiaria mutica*
   c) Ruzi grass – *Brachiaria ruziziensis*

4. Cenchrus spp – annuals and perennials

   a) Buffel grass – *Cenchrus ciliaris* cv. Doela
   b) Birdwood grass – *Cenchrus setigenus*

5. Chloris – annuals and perennials

   a) Rhodes grass – *Chloris gayana* cv. Pioneer

6. Cynodon

   a) Bermuda grass / green couch – *Cynodon dactyon*
   b) African star grass – *Cynodon plectostachyus*
   c) Giant star grass – *Cynodon nlemfuensis*

7. Digitaria

   a) Pangola grass – *Digitaria decumbens*

8. Melinis

   a) Molasses grass – *Melinis minutiflora*

9. Paspalum

   a) Common paspalum *Paspalum dilatatum*
   b) Bahia grass *Paspalum notatum*
   c) Scorbic grass *Paspalum vaginatum*
   d) Plicartulum *Paspalum setaceum*

10. Setaria

   a) Setaria viridis
   b) Setaria sphacelata

Tropical legumes

1. Calopogonium – climbing and perennials

   a) Calopo – *Calopogonium mucunoides*

2. Centrosema - climbing and perennials

   a) Common centro – *C. pubescens*
   b) Centro – *C. pascorum*
   c) Centro – *C. brasilanium*

3. Desmodium – perennial and annual

   a) Hetero- *D. heterophyllum*
   b) Green leaf Desmodium – *D. intortum* cv. Green leaf
   c) Silver leaf Desmodium – *D. uncinatum* cv. Silver leaf

4. Lablab – annual, erect

a) Lablab – *Lablab purpureus* cv. Rougai

5. Lotononis – perennial herb, creeping stems

a) Lotononis – *Lotononis bainesii* cv. Miles

6. Macroptilium – perennial trailing or creeping stolons, rooting at the nodes

a) Siratro – *Macroptilium atropurpureum* cv. Siratro

7. Genus Macrotyloma – trailing and twining, perennial herb, drought tolerant, not tolerant to waterlogging

a) Horse grain – *Macrotyloma uniflorum* cv. Leichhardt
b) Archer axillaris – *Macrotyloma axillare* cv. Archer

8. Medicago – erect, perennial, drought tolerant, frost tolerant, intolerant to waterlogging

a) Leucerne – *Medicago sativa* cv. Hunter river

9. Genus Pueraria – Vigorous climber, dense hairs, drought tolerant

a) Puero – *Pueraria phaseoloides*

10. Stylosanthes - Herbaceous, erect and perennial

a) Cook stylo – *S. guianensis* cv. Schofield
b) Carribean stylo – *S. hamata* cv. Verano
c) Townsville stylo – *S. humilis* cv. Gordon
d) Shrubby stylo – *S.scabra* cv. Seca

11. Trifolium – creeping, annuals and perennial, drought tolerant (grows in spring)

a) White clover – *Trifolium repens* cv. Ladino
b) Kenya white clover – *T. semipilosum* cv. Safari

12. Glycine – perennial, climbing and trailing, twinning except soyabean.

a) Glycine – *Glycine wightii*
b) Soyabean – *Glycine max*.

13. Vigna – annual or perennial, pulse.

a) Cowpea - *Vigna unguiculata*
b) Dalrymple vigna – *Vigna inteola* cv. Dalrymple

Others

Some examples of browse trees include:

Enterolobium cyclocarpum

Pterocarpus santalinoides

Gmelina arborea

Calliandra calothrysus

Moringa oleifera

Leucaena leucocephala

Gliricidia sepium

Millettia griffoniana

Grewia pubescens

Treculia africana

EFFECTS OF ENVIRONMENTAL FACTORS ON FORAGE PLANTS

Plant environment includes those biotic and abiotic factors that influence growth, development and quality of forages. These include both climatic and management factors as well as those that are inherent to the plant itself.

1. Biotic factors

   a) Plant morphology
   b) Pests
   c) Diseases
   d) Weeds
   e) Management

2. Abiotic factors

   a) Temperatue
   b) Rainfall
   c) Soil nutrients
   d) Humidity

A) Plant Morphology

Herbage age and maturity generally have a larger influence on forage quality than biotic factors except that environmental factors cause deviations in forage quality even when harvested at the same maturity.

Genetic potential of forage plant itself for yield and nutritive value, adaptation to the environment, plant acceptability to grazing animal, coppicing and persistence during dry season are all determinants of forage quality.

B) Pests

Pests markedly influence both yield and quality of forages, though insects are known to reduce yield more than quality.

Losses of forages to insects are often not monitored and may be overlooked because of the relatively low value of forage crops compared to other crops which normally makes the high costs of control of pests unjustifiable.

Insect pests are categorized into 2:

1. Leaf mass consumers - which damage plants mainly by consuming their leaves (they get them perforated or consumed totally) and feed on young developing buds i.e. they cause;

- Defoliation of the plant canopy
- Defoliation of re-growth buds after harvesting or grazing

2. Assimilate removers: these possess piercing and sucking mouth parts with which they extract plant juices thereby disrupt translocation functions of the plant.

Defoliating insects initially remove mostly leaf material, which slows subsequent stem development and maturation of plants while the leaf area is being established. The result can be yield reductions, alterations of the leaf / stem ratio or even total damage of plant over an extended period of time.

C) Diseases

Foliar diseases have the greatest adverse effects on forage quality by reducing digestibility. Studies have shown that diseased forages have lower digestibility and non structural carbohydrate concentrations than healthy plants. Diseases have also been associated with browning of leaves and leaf loss.

D) Weeds

Though some weeds reduce forage quality, many have nutritive values similar to forages and have little impact on forage quality. Toxic or unpalatable weeds reduce animal performance if present in sufficient quantity to reduce the overall acceptability of forage.

Invading weeds compete with forage for soil water and nutrients as well as for solar radiation. Thus, they usually reduce yield of forages, but their added biomass compensates for some of the loss. Tall weeds cause shading of herbaceous forage plant with loss in quality. Many weeds are nutritious when immature and their overall effect on quality of forage herbage plus that of weeds may be relatively small. Weed control may also affect forage stands.

E) Management

Type of animal grazed on a pasture, stocking rate and grazing methods employed are all very important determinants of forge quality. Rotational grazing system will definitely produce more quality herbage than set stocking. Also, fertilizer strategies weed control methods and other cultural practices will affect both forage quality and yield.

ABIOTIC FACTORS

A) Temperature

Temperatures usually have a greater influence on forage quality than other environmental factors encountered by plants. Cell wall materials deposited at lower temperatures are less lignified and higher in digestibility than those deposited at higher temperatures.

Studies have shown that acid detergent fibre (ADF), Cellulose, Lignin and Silica concentrations all increased with increasing temperature but neutral detergent fibre (NDF) and Hemicellulose concentration decrease. Lignin is the compound that is most highly negatively correlated with digestibility.

Temperature determines which forage species will grow in a certain region. With the onset of “Global warming” the length of vegetative stages of forages will be reduced and the economic implication of this should not be ignored.

Temperature is influence by:

- Radiation flux density
- Heat conduction
- Heat convection
- Latent heat

B) RAINFALL

Adequate water through constant rainfall is a crucial component of plant cells as almost all metabolic processes depend on its presence. Adequate water is required for maintenance of tugor pressure, guard cell function and solute diffusion in cells. Water provides the O_2 evolved during photosynthesis and the hydrogen used for CO_2 reduction. Almost all water in forage plants comes from the soil through their root systems. Both excess and deficiency of it can induce stresses in forages.

Excessive rainfall result in waterlogged soils which are depleted of oxygen by microorganisms and root respiration leaving forage root system in an "ANOXIC ENVIRONMENT" which greatly reduce forage yield.

Inadequate rainfall results in water deficits. This results in transpiration exceeding water absorption by roots. This adversely affects many enzymatic reactions and most physiological processes. The resultant effects are stomata closure, reduced transpiration rates, elevated foliage temperatures and plasmolysis. This may consequently lead to reduced leaf area and loss of stand in prolonged cases.

C. SOIL NUTRIENT

Soil nutrients only have small effects on forge quality. Fertilizer nutrients are applied to forage crops to increase yields by correcting deficiencies in the soil. In pastures, selected nutrients frequently are applied to manipulate botanical composition to maintain a balance of desired species.

The nutrient requirements of pastures vary according to cultivar, maturity and soil. Most soils require nitrogen fertilization to produce maximal yields for many plants especially cereals and grasses that do not fix it.

Phosphorus is added to many soils because of its low mobility and fixation and reactivity with so many soil fractions and chemicals

D. SUNLIGHT – Daylight – Photoperiod

E. HUMIDITY

FORAGES LEGUMES AND THEIR ROLES IN TROPICAL FARMING SYSTEM

1. Forage legumes as source of feed for ruminant animals.
   - Pasture legumes along with grasses provide a major proportion of ruminant feed as fresh green fodder. They contribute over 85% of ruminant feed in many countries.
   - Ruminant animals are able to convert nutrients in forage legumes into meat, milk, wool, bones, organic manure, hinds and skin.
   - Apart from their high N content, legumes are usually more digestible and this enhances the DMI of ruminant animals.
   - Legumes could be grazed directly or cut and carried to livestock in their pens. By this the cost of production (i.e. expenditure on feeding) is drastically reduced.
   - Legumes are good silage and hay materials for dry season conservation and feeding.
2. Legumes as cover crops

- Most herbaceous forage legumes creep on the ground and thereby form canopy over the soil. This help to prevent soil against direct sunlight, thereby reducing evaporation of soil water from soil surface.
- They reduce the force at which rain drops on the ground thereby reducing the rate of surface run off i.e. erosion.
- Their dense cover helps to conserve moisture on the ground towards dry spells. They are also good mulching materials.

3. Legumes are cheap sources of Nitrogen for soil improvement.
   - Legumes act as soil builder in that Nitrogen fixations by their roots increase soil fertility and consequently soil structure and texture.
   - Leaves of trees, herbaceous legumes, etc. that fall to the ground are degraded by soil micro-organisms into organic matter useful for soil improvement. This help in the growth and production of agricultural crops at cheaper costs. Apart from N, the litters returned to the soil are rich in Ca, P, K and Vitamins which are both soil nutrients and stabilizers.
   - Forage legume roots penetrate deep into the sub soil thereby ensuring improved soil tilt. By this they also help to improve soil aeration and drainage.
   - The green manure from dead legumes is a form of organic fertilizer which helps to regenerate degraded land during fallow.
4. Environmental stabilization
   - Leaves of pasture legumes join that of existing vegetation to absorb CO_2 from the atmosphere for photosynthesis and liberate O_2 useful for human breathing. This

process of "AIR PURIFICATION" guarantees healthy and good living for both man and livestock.

- The life-span of the dam, road and lawns is prolonged through planting of legumes- and grasses to check surface run-off and soil deposition.

5. Source of research materials
    - On-going global research on evaluation of different species of forage legumes, pasture utilization and simulation, crop-livestock interaction as well as agro forestry systems derive their research materials from forage resources.
    - Legumes are agro forestry research materials this include
    - Alley cropping and hedgerow intercropping
    - Alley farming and livestock integration
    - Alley-grazing-direct grazing versus cut and carry system.
    - Intensive feed garden system
6. Forage legumes as economic plants
    - As source of income, the counting at large and the farmers could generate a lot of money through exportation and sale of pasture seeds and fruits.
    - Leaves and twigs could be cut, bailed and sold to pastoralists (livestock rearers).
    - Seeds could be processed, packaged and sold to researchers both within and outside the country.
    - Firewood is an annual source of income from forage trees during dry season.
    - Some seeds are sold in markets for human consumption
    - Increase in live weight gain of animals and consequent increase in revenue.
7. Legumes as source of industrial raw materials.

- Legume seeds and nuts are good sources of feed ingredients which are raw materials for livestock feed mills.
- Some legume seeds contained oil which is very useful source of industrial oil for soap and detergent making.
- Dyes, gums arabic and adhesives are products of forest and forage legumes.
- Industrial gas (Biogas) could be generated from dry foliage and wood from legumes

8. Miscellaneous use of forage legumes
   - As roofing/Bedding and packaging materials – some forage legumes and grasses are used in the North for roofing farmsteads e.g. Rhombus, local farm buildings, etc.
   - Foliage (dry) is a useful source of bedding materials for animal to prevent pneumonia.

ii. Source of Herbs

- Leaves, stem, roots, seeds and fruits of many pasture legumes are good herb for orthodox medicine e.g. Pigeon pea

iii. Stakes: Yam stakes, poles, boundary posts, are all derivable from tree braches

iv. Materials for lawn and turf making:

- Estate lawns around residence and home gardens could be established with pasture legumes.
- Legumes are useful for turf, stadia, and games village establishment.

Fodder bank – is a forage reserve planted with forage trees which could be lopped for feeding animals especially during dry seasons.

Intensive feed garden – is a system in which fodder trees are cultivated either in sole stands or in combination with grasses.

Alley grazing – is the grazing of alley farms by ruminant animals during periods when no cropping is carried on the land.

Alley farming- this involves the planting of leguminous or other soil improving fodder trees in rows with available crops forms and livestock rearing on the same farm.

FODDER BANK TECHNOLOGY & INTENSIVE FEED GARDEN (IFG)

Fodder bank is a forage reserve planted with forage trees which could be lopped for feeding ruminant animals especially during dry seasons. It involves the planting of dense stands of forage trees/slumps for cut-and-carry system of ruminant feeding. Its intention is to supplement other forage resources and supplement feeds available to animals. Harvests generally continue throughout the year.

When fodder bank is meant for feeding of livestock, it may be irrigated to keep the trees in production throughout the year. Sometimes fodder bank may be established as Live-gene banks or field gene banks to preserve some endangered species from extinction. In this case, few seeds from many tree species are planted to produce seeds for genetic evaluation and multiplication elsewhere over some years. The trees must however be established and managed correctly so as to keep the genetic quality desired in them for a long time.

When fodder bank is for intensive fodder production, fewer tree species and larger number of seeds are used at a closer spacing. Leguminous and fast growing species noted for high biomass production should be established preferably in humid and sub-humid zones where moisture is not critically limiting.

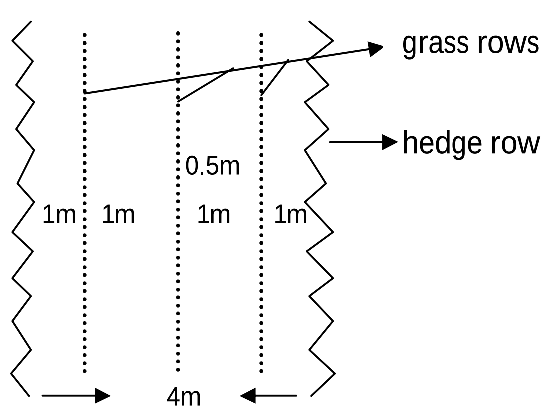
Biomass productivity under this system is dependent on; tree species, its planting density and spacing as well as management systems such as: cutting frequency. Inter-row spacing of between 0.5 – 2.0 m and intra row spacing of 0.25 – 0.5 m has been tested with cutting frequency of between 6-12 weeks.

Fodder bank may also involve livestock having grazing access to portions of the field on a rotational basis for a short period of time. This is possible when species that could not be debarked are used. It is also only feasible for young trees with height within the reach of animals.

For old stands of trees, branches could be lopped and carried to intensively managed animals in their pens. Such animals could also have intermittent exercise during which they have access to such lopped branches on their grazing ground.

INTENSIVE FEED GARDEN

This comprised of intensively cultivated plots of leguminous fodder trees as hedgerows under-sown with productive grasses. The fodder trees are cultivated either in sole stands or in combination with grasses. Unlike Alley farms no feed crops are planted in intensive feed gardens.



The space between tree rows is planted to grasses only and mainly for livestock feeding and/or grazing. Productivity in an intensive feed garden depends on the ratio of grasses to trees and the cutting management adopted. With trees spaced at 4m apart and 3 rows of Panicum within alleys, DM yield of over 20 tonnes DM/ha is possible.

Row spacing of 2.5m and 1m has been used under various conditions with success. With trees spaced at 4m apart and 3 rows of Panicum within alleys, there is possibility of transforming a feed garden into an alley farm after a number of years of production.

USES OF IFG

1. Ready source of protein supplement and bulk feed for ruminant animals all year round.
2. The branches could serve as live fences and shade trees round the home.
3. Loppings from tree branches could better replace traditional diets of ruminant animals.
4. Since selected trees from screening trials are planted, dangers of toxicants are eliminated.
5. The trees help to regenerate degraded land through improved soil fertility over time while erosion is curtailed.
6. IFG reduces the total cost of pasture production by reducing the need for inorganic fertilizers.
7. IFG makes the establishment of pasture more economically feasible for those who showed some intensification in ruminant production.

Pasture species for IFG:

Grasses	Legumes
Panicum maximum	*Centrosema pubescens*
Pennisetum purpureum	*Stylosanthes gracilis*
Cynodon spp	*Pueraria phaseoloides*
Andropogon gayanus	*Calopogonium mucunoides*
Digitaria decumbens	*Luecaena leucocephala*
Brachiaria mutica	*Gliricidia sepium*
Melinis minutiflora	*Moringa olifera*
	Sesbania sesban
	Calliandra calothyrsus
	Grewia rubusta
	Albizia lebbek

The IFG is intended to produce the maximum amount of fodder per hectare through intensive cultivation of fodder tree with or without grasses, on a limited area of land. It is ideal where increased population has led to scarcity of land resulting in intensive cultivation in compound farming and compulsory confinement of sheep and goats. Establishment of IFG close to the household provides good quality supplementary feed for confined animals.

ALLEY FARMING (AF)

AF is basically the cultivation of browse trees with integration of livestock and food crops. It involves planting leguminous multipurpose trees in rows (hedgerows) on available land, with food crops planted between the tree rows (in the alleys).

Alley farming combines cropping and fallow periods which is separated under traditional farming systems. Tree foliage is used to maintain and improve soil fertility while cropping is in progress, similar to the natural process that occurs during the traditional fallow period, thus increasing land use efficiency.

The tree species chosen must therefore be capable of maintaining and improving soil fertility, remain productive under regular pruning, allow improved crop production and provide nutritious and palatable livestock feed to supplement the existing diet.

Benefits of AF

1. Limiting soil erosion
2. Source of mulching material – tree foliage prunings
3. Organic manure – fertilizer for food crops
4. Feed supplement – to supplement existing diet of small ruminants.

   Establishment of trees in AF is possible either from seed or by stem cuttings, depending on the species being used. Owing to the generally high tree populations required, stake establishment can be costly, inconvenient and impracticable if parent trees from which cuttings could be obtained are not locally available. Seeds have the advantage of being less bulky and could therefore be distributed more efficiently and at lower cost. The use of cuttings and seedlings is however preferable for quick establishment. It may also be required for species with short periods of seed viability or unavailability of seeds during certain periods of the year.

Seedlings are raised towards the end of the dry season and transplanted at the beginning of the rain. For direct seedling, seed treatment may be required to break the seed coat dormancy of some species e.g. Leucaena, Cassia. The depth of planting also varies with species- while shallow planting of about 0.5-1 cm is required for some species others required depths of more than 2cm.

Hedgerow in alley farming can be managed for different purposes and this dictates inter - and intra hedgerow spacing and the pruning regime to be adopted as follows:

1. For mulch production 2m inter x 50cm intra
2. For mulch and fodder production 2m inter x 50cm intra, 25% fodder.
3. For fodder production only 4m x 0.5m

Indeterminate plant habit, flowers are produced on auxiliary buds, the main apex often stays vegetative.

AGRONOMIC MANAGEMENT FOR SEED PRODUCTION

The overall growing condition for any crop are set by local environment for this reason, regional location is an important step in the process of producing seed of most tropical pasture grasses and legumes. It also influences how such pastures should be managed. While most forage grasses are still essentially wild plants much has been accomplished in the development of improved cultivars of forage legumes for specific purposes.

Herbaceous legumes have been grouped into two morphological groups;

- Determinate legumes – whose shoots produce terminal inflorescence, thereby stopping further vegetative development of the apex thus, restricting further flexibility e.g Stylosanthes and Desmodium species.

- Indeterminate legumes – those having a twining growth habit with their apices remaining produce more than one seed crop/year vegetative indefinitely, but alternate between the formation of vegetative and floral axillary buds. This group of plants have the flexibility to change from vegetative to reproductive growth and to revert back again without major structural reorganization. e.g. Pueraria, Macroptilium spp, Lotononis and *Trifolium semipilosum.*
- The group a species belongs as well as its morphological habits will dictate the agronomic management to be adopted.

Some common agronomic management includes:

1. Weed control
2. Burning
3. Fertilization
4. Irrigation
5. Pests and diseases control
6. Defoliation (Harvesting)
7. Post harvest and regenerative practices.

Weed control:

Weed control problems in established pastures are generally less serious in grasses than in legumes but still require proper attention. The production of weed-free seed begins from the field. Seed yields can be reduced through weed competition in the field and the need to separate some seed during post harvest cleaning to remove contaminant weed seeds. Contaminated weed seed lots are more costly to clean and attract lower prices or may not be marketable at all.

In developing continues, where labour is cheap relative to herbicides, clean weed free pasture stands are maintained by hand weeding and hoeing. Higher labour costs have however preclude the use of mammal methods in developed countries, so emphasis instead is on chemical and mechanical control.

Broad leaf weeds can be controlled using selective herbicides, such as 2, 4, -D, dicamba. In some cases post-emergence herbicides with activity on specific grass species e.g. atrazine, chlorsul furon, metsulfuron can be used. Non selective herbicides (glyphosate) are also used for special purposes e.g spot spraying of scattered grass weeds and removal of tall grass weeds from shorter forages.

BURNING

Burning has so far been recognized as a cheap and effective management tool in pasture husbandry. Burning is an alternative to cutting or grazing for residue removal after seed collection. In some cases, it may have additional roles, including removal of diseased material and renovation of older sod-bound stands.

Different pasture species vary in their response to burning. Many grasses, particularly those adapted to drier areas, tolerate quite severe fires others can be badly damaged by much less intense fires. The use of fire to remove residues have been implicated as imprecise and based on art than on science. Its severity always depends on temperature, humidity, wind velocity and direction.

FERTILIZATION

Adequate levels of all nutrients are required for optimum forage development. For used crops, the main aim of fertilizer application is to increase seed yield and quality via inflorescence density. Generally nitrogen application suppresses legume growth and yield while phosphatic fertilizer supports vegetative growth with delayed reproductive growth. Seed legumes may not require any fertilization except where the soil is deficient in certain mineral.

For grass seed crops, N application is noted for increased inflorescence density, yield and quality. However the amount of N and time of application will depend on the grass species and soil on the pasture is established. Generally, lower rates of N are required by grasses in the established year than for subsequent years. This does not undermine the fact that some N fertilization is always necessary with new grass seed crops to produce harvest in the first year. The usual practice is for a maximum of 50kg N ha^{-1} to be applied to a first-year crop and 100-200 kg N ha^{-1} in subsequent years and depending on species.

Eg. *Panicum maximum* – 100 kg N ha^{-1}

Setaria sphacelata - 168kg N ha^{-1}

To maximize inflorescence numbers and consequently increase yield, N fertilizers should always be applied at “closing” i.e. when grazing / defoliation has ceased and tillering has started. Application of N stimulates and synchronizes tiller development and promotes early closure of the grass canopy. It should be noted that N requirement by grasses can vary from year to year and site to site depending on weather conditions, soil fertility and other aspects of crop management, including inter and intra row spacing, residue disposal and age of stand.

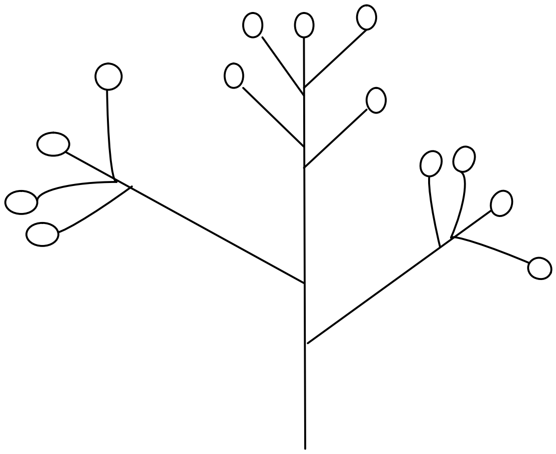
Also, soil tests will always be necessary to provide information on the status of N and other nutrients especially phosphorus and potassium which is required should be applied manually.

IRRIGATION

Pasture grasses and legumes are normally grown under natural rainfall. With adequate rainfall, developing pasture will make continuous growth. However, in most tropical countries, periods of adequate rainfall are always punctuated by periods of low or erratic rainfall. At this period, crops are exposed to moisture stress with consequent check in growth, delayed maturity and tillering. This can be avoided by irrigation, preferably applied before any visible stress symptoms so that maximum growth potential can be maintained. Irrigation improves reliability of production, which is particularly important where forward contracts need to be met.

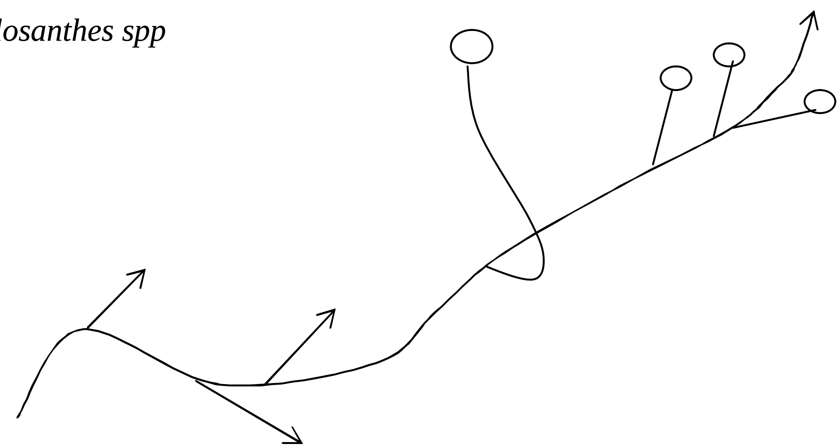
Irrigation is particularly important with moisture-sensitive crops e.g. Sphacelata and late-maturing cultivars e.g. *Chloris gayana* because it ensures adequate moisture for flowering and seeding towards the end of the growing season. It helps to maximize potential seed yield of pasture grasses (legumes) through its various components: the number of inflorescences, inflorescence size, seed set and seed size.

However, irrigation may give little or no advantage in wetter regions and/or with more stress tolerant cultivars (e.g. *S. sphacelata* and *C. ciliaris*). For such species, with progressive harvesting four times per year, any restriction of seed yield by moisture stress on one occasion tender to be made up at a letter harvest following better rainfall.



Determinate

Stylosanthes spp



Key — Flora } Bud
→ Vegetative

Macroptilium atropurpureum spp

Indeterminate

Pest and Diseases Control

Pests and disease exert negative effects on the vigour and size of the vegetative framework and on the setting of seed. A number of insects and pathogens can damage grass and legume seed crops as follows;

Pests

- Pasture pests e.g Leucaena, Armyworms and Grasshopper
- Spittlebugs
- Seed Caterpillar e.g. Buffel grass seed caterpillar; *Manpaye rhodoneura.*
- Leaf hopper
- Animal pests e.g. *Rattus conatus* - removing ripening inflorescences
- Birds

Diseases

Fungi

Smuts **–**

Control

- Insecticides – though seldom used because of cost.
- Crop management – post harvest burning of stubble and trash
- Early harvesting – before population of pest build up.
- Crop location – drier, less infested areas.
- Quarantine measures (to reduce re-infection of next crop)

1. **Insecticides:** This method is expensive and therefore seldom used on pastures. Fungicides could be applied to control minor leaf diseases to obtain improved seed yield via better seed fill.

The timing and choice of spray of insecticides is very important as the insect may be within plant tissue or beneath the soil surface. Some legumes are prone to insect attack and may require multiple applications while others rarely need spraying.

2. **Crop Management:** (Timeline of Operations). This could be through early harvesting before the population of pest has built up and to minimize the time for fungal spores to build up. Also by post harvest burning of stubble and trash this can reduce re-infection of the next crop. Fire can also have a renovative effect on some grass species leading to increased seed production.

   Irrigation practices have also been found to promote vigorous growth and reduce disease pressure. A rotation in which legume seed crops are alternated with grass crops have been found to reduce diseases pressure.

3. **Crop Location**

   This refers to choice of site within desired geographical region and soil characteristics such that pasture is not established in non favourable locations. A dry and less infested area must be selected. The following climatic variable must also be put into consideration.

   Latitude or day length

   Rainfall distribution

   Temperature extremes

   Soil characteristics include:

   -Fertility

   -Texture

   -Drainage

   -Topography

   -Prevision land use record

Areas known to be weed infested, poorly drained, prime to water logging or flooding, steep or stony with problems of access should be avoided. A light – textured soil is important for ease of harvesting and seed cleaning while a virgin land will have a lower weed potential.

4. Quarantine

Quarantine measures at country boarders and farm gates will assist in prevention of new diseases being introduced. Source of seeds for planting should be regulated and minimized.

Seed Harvesting

The choice of seed harvesting methods in different countries will depend on relative costs, size of holdings and availability of labour and machinery. It also depends on the pasture species, especially its growth habit and seed structure as well as relative amounts of standing and fallen seed. In many developing countries, manual harvesting is common because of the low cost and ready availability of hand labour.

3 broad approaches to seed harvesting are:

- A single destructive harvest of standing crop
- Multiple non-destructive harvests from the standing crop.
- Recovery of mature seeds shed from the standing crop.

Single Destructive Harvests

This is the approach most widely adapted, particularly in mechanized situations. The method is purely for convenience such that harvesting is carried out once, with two or more seed crops in a year. The major problems arose when small proportion of stands are ready at a time due to poorly synchronized flowering and a short period of seed retention. It could be carried out with combined harvester or manually by sickles, seed heads are heaped up to 'sweat' for about 3days.

The crop is cut with sickles and allowed to dry in a swath or a stook before threshing or by sweating the heads in a heap for a few days so that the ripe seeds will fall off easily.

The major problem of this method is lower seed quality, compared with other methods that selectively target the more mature seeds either on the standing crop or as fallen seed. The method is the most commonly used for legumes because their overall ripeness is easier to recognize especially in species where flowering and maturation are well synchronized.

Windrowing is commonly used for legumes wherein ripe seed crop are quickly mown (cut) using windrower and dried for 4 – 7 days before threshing.

Multiple Non-Destructive Harvests (MNDH)

The main aim of this method is to leave immature seed heads intact and separated from matured ones; allowing them to continue ripening. As the crop ripens, groups of seed heads are tied into "Living sheaves" in the field. Ripe seeds are then shaken from the tied heads into a broad shallow receptacle which is a thick broad Nylon and/or white cloth. Seed is collected in this way at 3 – 5 day intervals over about 2 weeks until the loss of seed from standing crop makes further collection un – economic. Hand-harvesting is the commonest method of non-destructive harvest. However, Beater harvesters, brush harvesters and stripper harvesters have been developed for different pasture species. Generally MNDHB method ensures maximum yield from seed crops, improves the quality of harvested seeds as each harvest is well dried (and separated from subsequent harvests). However, the method is not feasible in swampy areas and/or during the raining seasons.

Recovery of Mature Fallen Seed

Targeting fallen seeds for recovery during harvest avoids problems caused by poor crop synchronization. It is particularly good where only a small proportion of the potential yield is carried on the standing crop at any one time, as it can lead to large increases in harvested yield. The common method is by manual sweeping of fallen seeds from the ground although combine harvesters is often practiced. This is possible only where the harvester could trim only the seed heads above the leave company.

Manual sweeping is desirable because much higher yields are obtained and seeds swept up from the ground commands a market premium because its high germination and vigour promote more rapid and uniform establishment.

Manual sweeping, however, cannot be used under wet or humid condition and it is not applicable to some pasture species.

7. Post Harvest and Regenerative Practices

Drying: Except for seeds swept from the ground most harvested grass seed requires at least some drying to reduce its moisture content to 10% or less for safe storage.

Seed dying consists of two stages.

- Evaporation of moisture from the seed.
- Transport of that moisture away from the seed.

This could be accomplished by:

Natural drying in the sun,

Artificial drying-with supplemental heat from gas, electricity or diesel, this involves blowing air heated to 35^0C through false – bottomed bins.

Processing.

Seed processing refers to three district functions associated with raising the quality of harvested seed to a marketable condition.

It involves: Cleaning, Grading, Dressing

(A) SEED CLEANING

This is the operation that removes any materials other than the seed in question from its content. Included are contaminants such as other crop seeds, weed seed, sticks, straw, soil inert materials and stones. While it may not always be practicable to eliminate the items, they should at least be reduced to economically tolerable levels.

(B) SEED GRADING

This is the process of sizing seed to produce an even product suitable for use in a mechanical planter. Grading is also useful for eliminating dead and diseased seeds. This should be carried out after cleaning so that the grading unit has better control over the crop being processed.

(C)Protectant Dressing

- Is the process of coating or mixing seeds with a chemical formulation designed for a specific task or tasks e.g.

1. Insecticide application for protection from insect damage during storage e.g. lablab which is subject to bean weevil and other bruchids seeds of Stylo and Chloris are subject to attack by tropical warehouse moth.
2. Fungicide application to prevent development of seed-borne or soil-borne diseases after planting.
3. Seed coating and Pelleting - to add nutrients to increase the nutritive value and to increase the competitive ability of seedlings during establishment.

Seed Storage

Seed storage is a very important aspect of forage seed production technique because it is only through proper storage that seeds can retain viability and vigour over the required period.

Many physical, biological and environmental factors affect the viability of seeds during storage

Physical: Species

Initial seed viability

Seed moisture content: high moisture content will deteriorate rapidly. Storage temperature

Seed viability/durability

Germinability

Vigour

Physical integrity

Most small - seeded leguminous forages have orthodox seed – which can be dried to low moisture contents of 4-8% and stored for long periods. Examples include legumes:

Calopogonium mucunoides
Desmodium ovalifolium
Pueraria phaseoloides
Stylosanthes guianensis
Cajanus cajan
Canavalia ensiformis
Centrosema pubescens
Chamaecrista rotundifolia
Lablab purpureus
Vigna unguiculata

Grasses

Andropogon gayanus

Bracharia decumbens

Cenchrus ciliaris

Chloris gayana

Cynodon dactylon

Pennisetum clandestinum

Short – Lived (Un - orthodox)

Seeds of some forage species are naturally short-lived eg. *Panicum maximum*

Dormant (Had seeded) seeds

- Mainly legumes and some grasses
- Require scarification – for imbibitions of water and germination e.g.

Desmodium velutinum and uncinatium

Grasses

- Require an after ripening period of about 12 months before they germinate. E.g.

Panicum maximum

Setaria sphacelata

Cenchrus ciliaris

Brachiaria decumbens

Packaging

Seed packaging – is the use of moisture proof materials such as metal cans, plastic sheets and laminated aluminum foils to wrap seeds before storage. The selection of the type of packaging depends on; the quantity of seeds, the purpose of packaging and the period – whether it is for short – or long – term storage.

1. Appropriate packaging should always be employed to maintain seed viability during storage.
2. Since seeds are hygroscopic, dry seeds can absorb moisture from the air. Dry seeds should therefore be stored in moisture-proof containers to prevent re absorption of water.
3. Seeds are packed for ease of handling
4. For protection against pests and diseases
5. To separate different accessions or seed lots/

Seed storage

Seed storage is all the methods employed to keep dried forage seed in cool and clean conditions free from pests and diseases.

Storage

- Storage during transport
- On-farms storage
- Bulk storage in warehouse (cold rooms)

Seed Marketing

The market value of a forage or forage seed can be determined when all factors affecting its can be determined when all factors affecting its use, quality, nutritive value and availability of other alternative have been considered. There is always a price differential among forages in relation to their quality and nutritive value.

Some factors affecting the price of a forage seed include:

1) Quality index – including the proportion of wrinkled to glossy seed, the moisture content, and the presence of other materials like shafts, stalks and inert materials.
2) Crude protein content: the crude protein content is universally used as criteria for pricing seeds because there is a standard for all forage species.
3) TDN
4) NE
5) Nutritive value index
6) Digestible energy index
7) Relative feed value

   Generally, producers will invest in high quality forage and pay very well for its seed. To facilitate communication, there is a need for some uniform language among buyers and sellers

Packaging: appropriate packaging is important to prolong the shelve life of seeds and prevent loss in transit.