

PASTURE IMPROVEMENT PROGRAMMES AND BREEDING

Pasture improvement and development programmes may be initiated through a number of different approaches.

- 1. The first approach is based on improved management and utilization of existing natural pasture resources.**
- 2. The second approach is to replace existing natural vegetation with introduced pasture species.**
- 3. While a third method is a combination approach, where an introduced species may be over sown into existing native pasture.**

The basic philosophy is that the existing species in the region are well adapted to the environment and research and management seeks to increase or at least maintain the most productive species for animal production.

Improvement of grassland takes many forms.
1. stock control and controlled grazing, and this has often led to a change in botanical composition without the deliberate introduction of new species.

2. casual or deliberate introduction of legumes, notably in Australia, and this has been linked with the recognition and correction of major and trace element deficiencies, particularly phosphorus and molybdenum.
3. A further stage of improvement is reached when new grass species are introduced deliberately, often with and an accompanying legume, with or without the destruction of indigenous grasses.

Selection of species or cultivars

- ❖ In selecting a new grass or legume; or in replacing an older one with and improved cultivars of the same species; the following points should be considered:
- ❖ A. Characters required in the pasture plants. The species or cultivar characteristics are important. They are :
 - ✓ 1. High yield of good quality forage and re-growth potential.
 - ✓ 2. Ease of establishment or propagation.
 - ✓ 3. Palatability

- ✓ 4. Length of vegetative stage of growth
- ✓ 5. Response to applied fertilizers
- ✓ 6. Persistency
- ✓ 7. Tolerance to drought, grazing, cutting and burning
- ✓ 8. Seeding habit
- ✓ 9. Ease of eradication
- ✓ 10. Ability to associate with other species.

B. Other points are:

- 1. Adaptation – to the general region and local conditions**
- 2. Intended use – continuous or rotational grazing, hay, silage, greenchop, rotation grazing, soiling.**
- 3. Availability of seed or planting material**
- 4. Value of land-especially if the new grazing land is to be intensively used**
- 5. Topography of land –mechanizable or steep**
- 6. Type or quality of animals to be grazed or fed**
- 7. Managerial skills of cattleman**

Approaches to plant introduction

1. Through correspondence with other research institution or agencies
2. Evaluation of existing species and cultivars by major institutions in regions with similar environmental conditions
3. Assess the climatic comparisons or the phytogeographical distribution of species in the areas.

Organization of plant introduction

Plant introduction group has a number of functions, the basic ones are:

Acquire new plant accession and organize their introduction into the country

Organize the documentation of all introduction

Provide initial screening, description, and evaluation

Build up seed stocks and planting materials and to maintain seed stocks for future testing or breeding programmes

In larger organizations, will be involved in toxonomic studies, phytogeographical studies of species distribution, and plant collecting expeditions.

- Primary evaluation stage –
- 1. Provide a quarantine check of introductions
- 2. Build up seed stocks or vegetative planting materials
- 3. Describe the morphology, phenology and growth characteristics of the accession.
- Records kept throughout the growing season must include: Growth habit, Leafiness, Vigour, Time of flowering- length of flowering period, Seed set- amount harvested, Effect of low or high temperatures, Regeneration, Incidence of pests and diseases, Nodulation in the case of legumes.

Second stage of evaluations aimed to examine the agronomic characteristics under field sward conditions

- Competition
- -Stress
- -Productivity
- -Vigour of the sward- through estimation of botanical composition
- -Persistence- plant counts at establishment and subsequent survival
- -Potential feeding value- *in-vitro* digestibility studies, intake studies with penned sheep.

Scheme of pasture and forage crop characterization (adapted from Mott and Morr, 1969)

1. Introduction	Observation	Breeders lines
	Selection	
2. Small plot clipping	Varietal tests	Regional tests
	Chemical analyses	Advances selection
	<i>in-vitro</i> digestibility	
3. Agronomic management	Sowing densities	Cultivars
	Fertilizer studies	
	Grass-Legume mixtures	
	Cutting treatments	
4. Animal response	<i>in-vitro</i> digestibility	Product per animal
	<i>in-vivo</i> digestibility	Product per animal
	Stocking rate	Economic returns
5. Feeding systems	Pasture sequences	Animals output
	Hay and silage	
	Supplementary feeds	Economic return

METHODS OF PROPAGATION

- Tropical grasses are established vegetatively or from seed.
- Vegetative: if it is simple or cheaper, or when the purity and uniformity of hybrid clones or clones of cross-polluting grasses should be maintained as example in clone cultivars or hybrids of Bermuda grass(*Cynodon dactylon*).

Stoloniferous and rhizomatous species can be propagated by pieces of stolons or rhizomes spread on the ground and buried in by subsequent harrowing or discing.

Large tufted grasses, such as elephant grass (*Pennisetum purpureum*), *Tripsacum laxum*, large varieties of *Panicum maximum* etc are planted in rows by splits or sprigs.

When planting, the top portions of grass should be cut off as the splits with uncut stems and leaves would almost invariably die because of the loss of water through the leaves.

Long roots should also be cut short because the old roots would any how die out and the plants develop new roots and live on them.

It is advisable to pile the splits loosely , water the pile and cover them with sacks for a few days, until the new roots begin to appear. Planting is normally done in rows the distance between the rows depending on plant size and local custom; Planting is done by hand or by special machines as those for planting sugar cane or adapted for tobacco planters.

Elephant grass is normally planted by stem cutting; the stem should not be very young and cut to pieces each having about three nodes. The stems are stuck into the soil with two nodes underground. Establishment from seed is usually more difficult in the tropics than under temperate conditions because:

- 1. Seeds are often not in ready supply**
- 2. Mostly small**
- 3. Drought can kill small weak seedlings**
- 4. A clean, not too fine seedbed as free from weeds as possible should be prepared**
- 5. Seed is then broadcast or drilled in rows.**

Seed rates vary and can be recommended with some certainty only if the quality of seeds i.e. its purity and germination is known. Seed quality can be expressed as percentages of PGS (pure germinating seed), PVS (pure variable seed) or PLS(pure live seed). It can generally recommended not to plant seed immediately after harvesting but after some six months of storage, but seeds stored for 2 or more years should be re-examined for germinability.

Fertilizers are given before, during and after sowing; phosphorus in form of double or single super phosphate is usually given before and during the sowing; N is given in its nitrate form, ammonium form or as urea.

Time of application is a controversial issue; some recommend about the sowing time and some during the dry season to be released at onset of rains. Nitrogen is often applied after each grazing or cutting.

If weeds are a problem, the early management includes mowing before the weeds get to flowering stage, at a time when grass plants are still weak and this may reduce grass-weed competition and result in a better establishment; if the weeds include palatable species, early grazing can replace or supplement mowing.

LEGUMES

are established almost exclusively from seed although growing some creeping species from roots cuttings had been attempted and in perennial species of Arachis, this is a normal method of establishment.

- Stem cutting of a number of perennial leguminous species can root and produce vegetative progenies of cross-pollinated plants, for examining the effects of environment on genetically identical material, etc.

Seed bed- for farm sowing is prepared in the usual way and seed is sown preferably in rows, especially in grass/legume mixtures in which the two components are often sown in alternate rows.

Seed rates differ widely depending mainly on seed size: the number of seeds/kg ranging from 2-2.5 thousand in species of *Mucuna* to over 3million in *Lotononis bainesii*.

Similarly considerable proportion of hard seeds i.e. seeds which remain viable in the soil for months to several years without germination.

The presence of hard seed is normally an inheritable character, it can be reduced by selection and in species or cultivars grown for a number of generations, the percentage of hard seed is usually negligible; on the other hand it can be very considerable, especially in recently introduced species.

The presence of hard seeds is apparently an adaptive feature which prevents all seeds from germination at the first opportunity and then dies if a sudden drought occurs.

Water cannot penetrate through the seed skin or testa of hard seeds and remain unimbibed .

- **Methods of removing hard seed**
- **1. Soaking in water for some 24hours or longer can reduce the proportion of hard seeds but the reduction is relatively small.**
- **2. Mechanical scarification (seed scratching)**
 - -using hammer mill
 - -Rubbing seeds with sand paper if the amount to be treated is small.
- **3. Soaking in concentration Sulphuric acid is perhaps more reliable and efficient method of reducing the percentage of hard seed, duration of time take 2 to 20- 25minutes to determine experimentally. Then thoroughly wash with water.**

- hard seed should be treated before inoculation with Rhizobium, if seed is inoculated it should be sown as soon as possible after the inoculation but delays in sowing are much less harmful if seed has been pelleted, Rhizobium bacteria of the Cowpea group lose their ability to grow and can die at a temperature of 400c and above, during or after sowing, Hot weather is harmful to Rhizobium inoculated small seeds which require shallow sowing.

Fertilizers used for the legumes include mainly phosphorus in the form of double or single super phosphate; the latter is preferred as it contains Sulphur, the deficiency of which can be reducing the vigour and productivity of the legume. Potassium is another nutrient commonly used as fertilizer.

The legumes are sensitive to deficient in micronutrient and Molybdenum is particularly important for Rhizome activity. On soil deficiency in boron and copper these nutrients have to be added. The tolerance of legume to Aluminum and Manganese varies. *Stylosanthus humilis* and *Lotononis bainesii* are more tolerant than many others.

PHYSIOLOGY OF PASTURE PLANTS

- The majority of tropical grasses are either indifferent to day length (*Tripsacum dactyloides*, *Acroceras macrum*) or are short day plants and flower earlier under short than long photoperiods (*Hyparrhenia hirta*, *Sorghum halepense*); there are however, tropical spp. (*Paspalum dilatatum*) which flower easier and earlier under longer than shorter photoperiods.
- Herbage production follow the pattern of flowering but in the majority of grasses long photo periods stimulate herbage growth and production.

For temperate grasses, the productivity of photosynthesis in terms of amounts of synthesis organic matter increases with the increase in light intensity up to 15,000-25,000 lux above which, productivity of photosynthesis do not increase further.

However, in tropical grasses, photosynthetic productivity increases further and reaches its maximum at 50,000-60,000 lux and sometimes even at higher light intensity, and can be much greater than in temperate grasses provided that light intensity is sufficiently high.

The tropical grasses that response in the above way to light intensity belong to the tribes- Panicoid and Chloridiod.

While, Festucoid grasses differs and the above differences can be linked with leaf anatomy.

In Panicoid and Chloridiod grasses, the cells are known as Kranz-type cells while those of Festucoid are known as non-Kranz cells.

In Festucoid grasses, the photosynthetic process is of the so-called Calvin or C₃ cycle while that of Panicoid and Chloridiod is known as C₄ pathway.

In C₃ cycle, the initial products of Carbon assimilation are 3-phosphoglyceric (3-carbon) acids or hexophosphates are further utilized for formation of carbohydrates with optimum temperatures of 15-20°C while for C₄ the initial products of photosynthesis are 4carbon acids- malate, asparaginate, oxalo-acetate with optimum temperature of 30-40°C.

Grasses tend to be more aggressive than legume in mixture due to the differences in their photosynthetic pathways. Most tropical grasses are C4 plants while the legumes are C3 plants. Hence grasses utilises sunlight energy better than legumes which leads to higher structural carbohydrate formation and this forms the reason grasses are higher in fibre than legumes.

The importance of legumes in agriculture as arable fodder and pasture crops and as components of natural grasslands and perhaps also their wide spread throughout the world depends as it is universally known on their ability to fix atmospheric nitrogen in symbiosis with rhizobium bacteria found in the legume root nodules.

Some rhizobium bacteria are highly specialized and can enter into symbiotic relationship only with certain specie of legume; some are less selective and live and work actively in a few species, usually closely phylogenetically related and there are also promiscuous or indiscriminating bacteria which can innoculate a large number of species which belong to the so called cowpea type;

they can be in an active symbiosis with a number of tropical legumes, one widely spread in poor and acid soils of the tropics and conversely, most of the tropical legumes can be inoculated and the same cowpea rhizobium.

There are not much differences in the physiology of legumes and they adapt to lots of climatic conditions. Rainfall is the only major climatic factor affecting legumes in the tropics while temperature can have effects on temperate legumes.

Leaf Anatomy of C₃ and C₄ plants

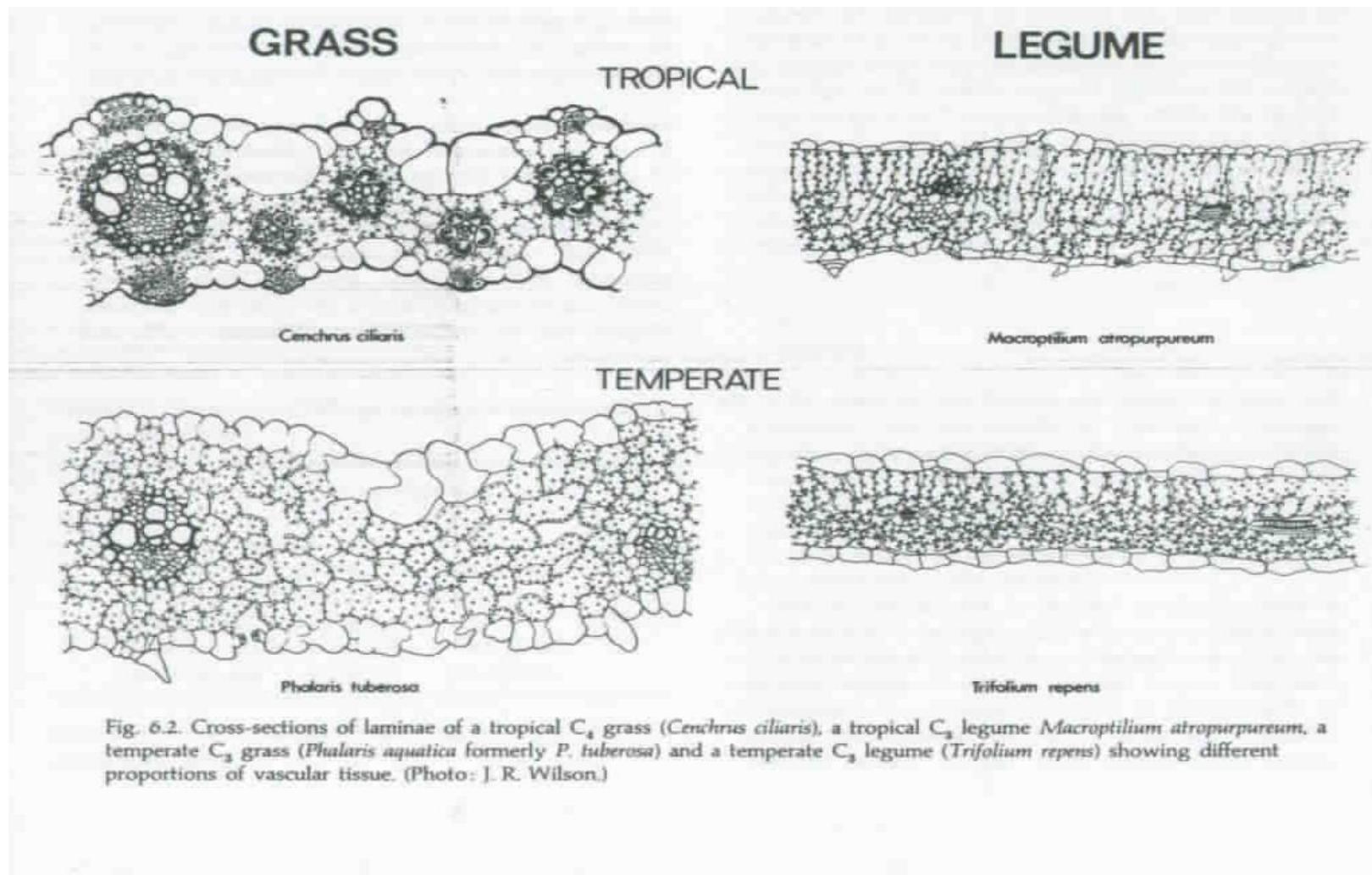


Fig. 6.2. Cross-sections of laminae of a tropical C₄ grass (*Cenchrus ciliaris*), a tropical C₃ legume *Macroptilium atropurpureum*, a temperate C₄ grass (*Phalaris aquatica* formerly *P. tuberosa*) and a temperate C₃ legume (*Trifolium repens*) showing different proportions of vascular tissue. (Photo: J. R. Wilson.)