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Environmental Requirement and Management of Some Important Forage Species in the Philippines

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Foreword

Due to illegal logging which is normally followed by shifting cultivation, several parts of what was once a Philippine natural forest, are now open degraded grasslands. According to various studies in 1976, the grassland area was estimated at about 3.4 M ha. This further expanded to about 6.5 M ha (or 22% of the country's total land area) in 1995. The magnitude of transformation is more than 163T ha per year from 1976 to 1995.

Out of these grassland areas, there are areas which have been declared as Pasture Lease Agreement. These areas, when properly managed and utilized, have the potential to increase the country's livestock production, quantity - and quality-wise. Thus, the issues on food insufficiency and malnutrition due to animal protein gap have to be addressed. Consequently, this will help boost the country's economy.

This issue presents the environmental requirements and management of important forage species that are adaptable under Philippine condition. It provides knowledge and information, for the ranchers and livestock raisers, on the optimum habitat for better forage production and management, in turn, contributing to improved meat production (in quantity and quality) from the Philippine grasslands.

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Introduction

Production of high quality and large quantity of forage is very important in the animal production industry. The fast rising demand and cost of animal meat and milk products has put more pressure on the industry to come up with better forage production. Forages are the most important plant resource that can be efficiently converted to animal protein. Management of these crops, however, requires technical information and operational skill in order to fully maximize production and utilization. Successful forage production requires combined management of climatic, edaphic factors and the physiological characteristic of each species to be planted. This is important because different species require different treatments and management for the successful establishment of forage crops to provide sustained forage production.

The following species are recorded as forage species suitable for raising under grassland conditions.

Grasses

1. Napier [*Pennisetum purpureum* (Schum)]

Descriptions

Napier or Elephant grass is the most popular improved pasture species in the Philippines. It is a robust, tall, erect cane-like perennial species, reaching a height of 2 - 5 m when mature. It spreads by short stout underground stems to give stools up to 1 m across. Leaves broad and tapering with a strong midrib; flower cylindrical, golden yellow ranging from 10 - 25 cm long. Napier is long-lived which can survive more than 3 years. (See Fig. 1.)

Figure 1. Napier *[Pennisetum purpureum* (Schum.)]

Environmental requirement and management

Napier is a tropical species that grows best under warm conditions, but very adaptable. It is drought resistant, and quickly produces feed after the dry spell breaks. It is highly rated because of its relative ease of establishment, vigor, and productivity.

Napier could attain its maximum development when grown under the most favorable conditions of soil fertility and moisture. Deep loams are ideal for this highly productive grass, but being a vigorous grower, it has a strong demand for soil nutrients. Soil fertility can be maintained by regular application of nitrogen or by intercropping legumes such as centro and kudzu. Fertilized napier/centro pastures can support 3 animals per hectare per year producing a liveweight gain of about 500 kg. It also responds to abundant moisture and performs best under irrigation.

As a tall growing perennial, Napier presents formidable problems in efficient utilization if allowed to grow more than a meter tall. It is advised to adjust the stocking rate and grazing frequency so that Napier stands are grazed whenever the grass reaches the height of 75 - 100 cm. A period of recovery is allowed between grazings. A one-month interval would assure production of forage of desired quality.

Apart from being a very useful grass for supplementary grazing, Napier is also utilized as green-chopped feed. Surplus growth of intensively managed fertilized stands are sometimes conserved as silage.

2. Guinea Grass [*Panicum maximum* (Jacq.)]

Description

Guinea grass is a coarse, leafy, deep rooted perennial with a typical stool forming habit. It is tall, erect grass which forms distinct clumps which is suitable for regular cutting. Leaves long, broad and well distributed along the stems. Stalks, 1.5 - 2.0 m long carry the seeds, in open, drooping panicles. Seeds small enclosed in hulls or glumes which are smooth and hairless. Flowering and seed setting extend over a long period both in terms of the succession of panicles being produced and of variation in degree of ripening within the panicle. The seeds shatter and this makes harvesting difficult. It can survive more than 3 years. (Fig. 2)

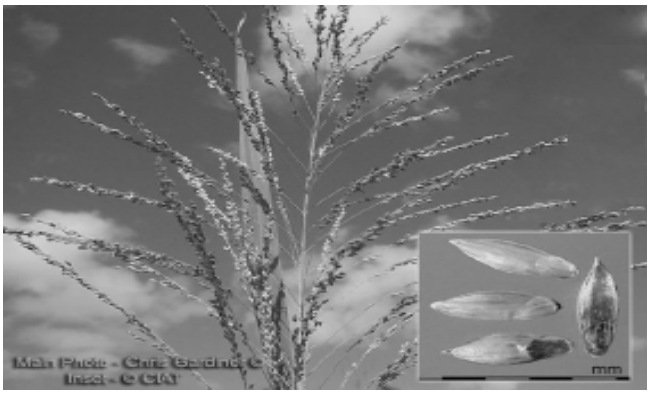

Figure 2. *Guinea Grass [Panicum maximum* (Jacq.)]

Varieties of Guinea grass

Green Panic - Common Guinea - short and fine stem, produce high quality feed leaf a adaptable to varied condition;

Hamil Guinea - robust, produce better seed and easier to establish and grow in moderately poor drainage; and

Creeping Guinea - propagates asexually by rooting at the nodes thus, facilitating establishment.

Environmental requirement and management

Guinea grass is noted for its ability to produce large quantities of highly nutritious feeds under a wide range of conditions. It can survive long drought periods, but shows its best performance in a humid environment. It is shade tolerant, and could withstand vigorous legume growth and grows well under coconuts. It can withstand burning and can tolerate heavy continuous grazing for long periods.

Guinea grass is adapted to a wide range of soils, shallow or rocky but is better suited to well drained soils of medium to high fertility. It cannot tolerate poorly drained soils. Regular appreciation of fertilizer enhanced growth of the species

Rotational grazing or cutting helps in keeping Guinea grass pasture to a more uniform height. Management of Guinea grass is most important. If left ungrazed or uncut, it becomes coarse, stemmy and unpalatable. Guinea grass grows well with legumes like centro, stylo and kudzu.

3. Para Grass [*Brachiaria mutica (*Forssk.) Stapf.]

Description

Para grass is a creeping perennial with stout above the ground runners which root fully at the nodes. It attains a height of 1 m., sparingly branched, globrous, ascending from decumbent or prostrate base, rooting at the lower nodes. Leaf blades are flat, linear to linear lanceolate, 15-30 mm. x 5-15 mm, more or less hairy, with rough with margins. Generally leaves are broad, erect and hairy. (Fig. 3.)

Figure 3. Para Grass [*Brachiara mutica* (Forssk.) Stapf.]

Panicles, 10-20 cm long, branched, numerous, solitary, distant or approximate, 20-70 cm long, racemosely arranged along the main axis. Pedicels solitary or paired, glabrous or with few soft spreading hairs. Spikelets dorsiventrally compressed, 2-flowered, broadly lanceolate, 3-3.5 mm long, glabrous; glumes unequal, the lower about 1/3 as long as the spikelets, facing the axis of the raceme, 3 - 5 nerved, the upper equaling the spikelet 5-7-nerved. The root system is shallow and fibrous.

Environmental requirement and management

Para grass grows well under warm moist conditions. Its greatest virtue is being tolerant to water logging, under which it makes very rapid and vigorous growth and gives high yields of nutritive and palatable fodder. Found to be most suitable grass for the lower flat lands and any area where poor drainage is a problem. It is a common weed in irrigation channels and drainage ditches. Usually observed growing with bean in waterlogged situations. It is extensively used in the low coastal cattle/coconut farms in Davao as well as in the Bukidnon highlands up to 760 m.

Para grass is very easy to establish from stem cuttings. Once established, it can be stocked fairly heavily. However, it is not as resistant to grazing as Guinea grass.

4. African Star Grass (*Cynodon plestostachyus*)

Description

African star grass (Fig. 4) is a recent introduction which has given impressive results under cutting and grazing conditions. It is a spreading perennial with stout, rapidly-growing stolons forming dense sward. It is similar to *C. dactylon* but coarser and distinguished by inflorescence of 3 - 20 spikes arranged on common axis. Leaves are narrow and 2-8 cm long.

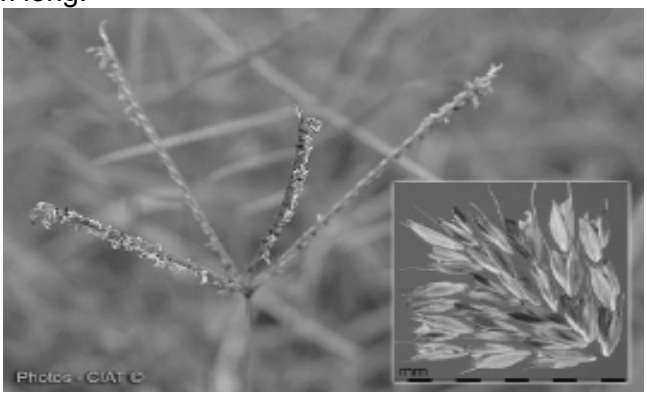

Figure 4. African Star Grass *(Cynodon plestostachyus)*

Environmental requirement and management

Star grass is typically tropical in climatic adaptation and productive in dry areas with an annual rainfall of 500 - 750 mm. It is propagated by cuttings. Star grass spreads readily and has been found effective in holding sandy soils along waterways and embankments. Likewise it is very tolerant to grazing and trampling and useful in alleys and paddocks near the corral which are frequently overstocked.

5. Pangola Grass [*Digitaria decumbens* (Stent.)]

Description

Pangola grass is a low growing creeping perennial which is similar in appearance to couch grass but has thicker stems and longer leaves (Fig. 5). The presence of a

prominent membrane or ligule at the base of the leaf blade indicates Pangola. The grass flowers, but does not produce viable seeds. It spreads by means of numerous stolons which root readily from the nodes.

Figure 5. Pangola Grass (*Digitaria decumbens*)

Environmental requirement and management

Pangola grows well in areas receiving more than 1000 mm of annual rainfall. It is fairly tolerant to drought; but not very productive under this condition. It grows on a wide range of soils, wet, occasionally waterlogged soils and responds well to high fertility level.

It is palatable and nutritious and withstands heavy grazing.

6. Kikuyu (*Pennisetum clandestinum*)

Description

Kikuyu is a low growing, deep rooted perennial. It forms a dense turf and spreads by numerous long rhizomes and stolons which have short internodes and roots readily at the nodes creeping both above and below ground. The flowering stems are very short which arise in the angle of the leaves close to the stem and are practically enclosed by the leaves. Seeds are difficult to harvest but seedlings are often seen in the paddocks. (Fig. 6)

Figure 6. Kikuyu (*Pennisetum cladestinum*)

Environmental requirement and management

Kikuyu is specially suited to upland areas and fertile soils. It can withstand relatively long periods of dry weather but not productive in areas having less than generally 900 mm. Its nitrogen requirement is high and it grows best on fertile hilly areas. It prefers light soils of good depth and drainage. This species is resistant to trampling and difficult to eradicate from temporary pastures. Found to performs well in the Philippine highlands – Mountain Province (1500 m), Bukidnon (610 m), and in South Cotabato (760 m). It grows well with centro, stylo, glycine and desmodium. However, establishing and maintaining the legume is difficult because of the tight sod it forms. Propagation is usually by vegetative means (runners or cuttings).

Kikuyu is an excellent grass for erosion control, and also very palatable and nutritious.

7. Alabang X (*Dicanthium aristatum*)

Description

Alabang X is a perennial, rather low growing grass that is naturalized in the Philippines. It is a local selection which is popularized as a grazing type grass. It was first observed at Alabang Station and the X probably stood for its lack of identification at that time. The species is a tuffed grass useful for grazing and commercially propagated by cuttings and rootstocks and once established spreads easily by seeds. (Fig. 7).

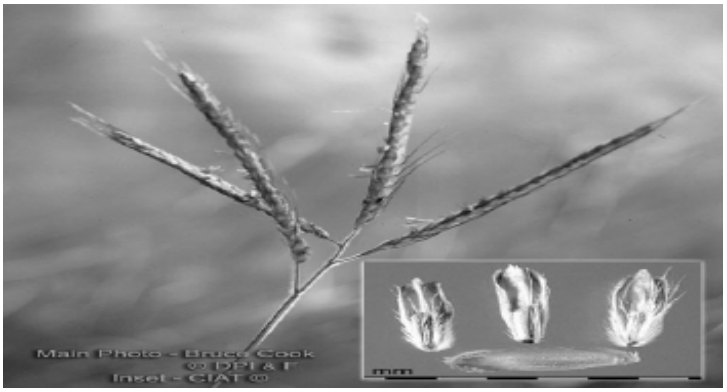

Figure 7. Alabang X (*Dicanthium aristatum*)

Environmental requirement and management

The value of Alabang X is not shown on fertile soils in as much as it is readily dominated by the more productive grasses. On poor soils in Masbate and Bohol with little fertilizers, it has held its own against cogon and less productive native species.

Alabang X is commercially established by cuttings and rootstocks and spreads rapidly thereafter due to its prolific seeding ability.

8. Buffel Grass (*Cenchrus ciliaris)*

Description

The species has a large strong root system and more of the roots are found at deep soil depth. Stem bases swollen which accumulate carbohydrates. It has a characteristic foxtail head, the seeds being enclosed in fine bristles. And each cluster of bristles may contain more than one seed. It is an unusual plant that continues to shoot strongly during flowering. (Fig. 8).

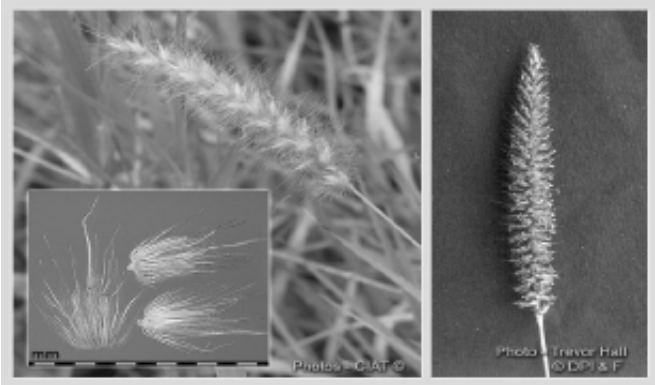

Figure 8. Buffel grass (*Cenchrus ciliaris*)

Envinronmental requirement and management

This perennial grass is very variable in habit but it is drought resistant and cab withstands very heavy grazing once established. It grows tremendously during summer months and can be grown in regrows with 12-25 inches annual rainfall.

9. Paspalum (*Paspalum dilatatum*)

Description

Paspalum is a creeping grass which spreads by short rootstocks. This accounts for its resistance to over-grazing. Leaves are long, broad, soft and very palatable; stems are erect and may grow to five feet. The flowering stems bear seed beads with three to ten branches, which can produce rows of hairy oval seeds (Fig. 9).

Figure 9. Paspalum (*Paspalum dilatatum*)

Environmental requirement and management

Paspalum grows best on heavier textured alluvial soils or red loams but not well adopted to sandy soils. It has high fertility requirements, and if fertility is not maintained, the pasture is invaded by inferior grasses and weeds. It responds well to nitrogeneous and phosphatic fertilizers.

10. Rhodes Grass (*Chloris gayana*)

Description

Rhodes grass is a tufted, runnering in this similar to runners??? perennial. It is a plant which forms strong bunch type stools and above ground surface, anchoring at the nodes. The leafy, erect stems may reach a height of four to five feet, and bear at the top 10-12 radiating brownish-green seed spikes. (Fig. 10).

Environmental requirement and management

Rhodes grass is fire tolerant. Once well established, its creeping habit assists its capacity for withstanding heavy grazing. It is an essential species for inclusion in pasture mixtures where brigalow sucker control is required. The grass has a smothering action which reduces the growth rate and incidence of the suckers. It has an important place in erosion control, and is one of the best grasses for sowing on earthworks.

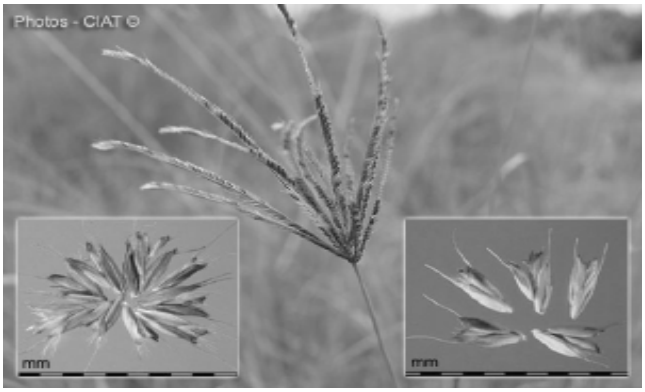

Figure 10. Rhodes Grass [*Chloris gayana* (Kunth.)]

11. Signal Grass (*Brachiaria decumbens*)

Description

It is a creeping and trailing perennial, a relative of para grass and ruzi grasses. Leaves are short and dark green. Branches of the seed bead are attached at right angles to the stalk. Fig. 11).

Figure 11. Signal Grass [*Brachiaria decumbens* (Stapf.)]

Environmental requirement and management

Signal grass grow best in wet tropical coast. It produces significantly more dry matters than other grasses tested, 33,000 lb. per acre being recorded in one year. Under a grazing regime of 0.5 acre per beast, 920 lb liveweight gain per acre per annum was recorded from signal grass pastures receiving 175 lb elemental nitrogen per acre. It is recommended for high rainfall areas, and responds well under heavy stocking.

Best performance occurs under intensive use, where the pasture materials are not allowed to accumulate and age. Early grazing encourages stooling out and spreading. This plant competes well with less desirable plants under conditions of heavy use.

A seeding rate of 4-6 lb. per acre has been suggested.

Legumes

1. Centro (*Centrosema pubescens* Benth)

Description

Centro is a creeping, twining and climbing perennial forage found throughout the Philippines. Legumes, trifoliate shining bright green and sparsely hairy, leaflets ovate to elliptical, measuring about 4 cm x 2 – 2.5 cm. Stems e long and vigorous growing, rooting moderately at the nodes and capable of extending 14 feet. Flowers pen type are long and showy which give rise to dark brown pods about five inches long with 20 branches to black seeds (Fig. 12)

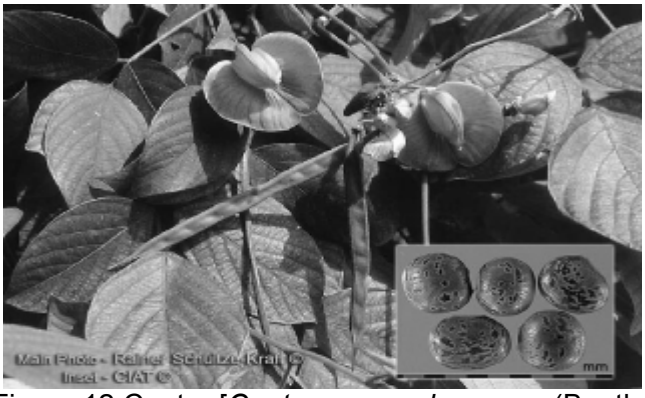
Figure 12.Centro [*Centrosema pubescems* (Benth.)]

Environmental requirement and management

Centro occupies the largest area among the legumes both as a cover crop in coconut and citrus plantations and in mixed pasture with improved grasses. It is adapted to warm humid areas with an annual rainfall of 1300 mm or more. It has a good root system and can withstand a long dry season, but is not adapted in areas receiving less than 1020 mm of rainfall. It grows on a variety of soils and responds significantly to superphosphate on the poorer soil types. Centro grows on acid soils and moderately tolerant a poorly drained conditions. Initial establishment is rather slow but subsequent growth is rapid; can grow suitably with other pasture grasses depending on nutrients availability. It climbs on anything it encounters and can be seen growing up on trees. It can withstand heavy grazing.

In the Philippines, it is by far the most successful among the pasture legumes. Excellent centro-based pastures are found in coastal areas in Davao, in the Bukidnon. It can grow in mixture of grasses for better forage nutrition. Para centro pastures produce three times as much beef as the native cogon pastures.

Centro, has the ability to fix atmospheric nitrogen. It provides organic fertilizer that improves the soil fertility and moisture conditions. It also acts as a natural fire and weed control agent.

2. Ipil-ipil (*Leucaena leucocephala* (Lam.) de Wit formerly *L. latisifolia*)

Description

Ipil-ipil or leucaena is a deep rooting leguminous tree or shrub widely distributed throughout the tropics. It is an erect, summer-growing perennial which may develop to a small tree 3 - 9 m tall. Leaves smooth and bipinnate. Leaflets narrow, and the flowers are borne as yellow/white ball-like cluster which give rise to long brown pods. Ipil ipil forage has a high protein content and is relished by all kinds of livestock (Fig. 13).

Environmental requirement and management

Ipil-ipil is suited to well drained soils in warm regions receiving more than 760 mm annual rainfall. The long tap root enables the plant to persist under dry conditions. When cut or grazed, it continue to produce new shoots from the woody stem. Careful

management of pasture containing this legume is required. Overgrazing permits the plants to grow higher than what is necessary for effective grazing cutting of the old stem should not exceed to 1-1.5 m in height for effective grazing. For best results ipil-ipil should be grown lower and open to provide undercover grasses to grow and establish underneath. A combination of ipil-ipil and guinea grass was found desirable.

Figure 13. Ipil-ipil [*Leucaena leucocephala* (Lam.) de Wit]formerly *L. latisfolia*

3. Townsville stylo or Magsaysay [*Stylosanthes humilis* (Kunth.)]

Description

Townsville stylo, locally known as Magsaysay stylo, is a rather low growing plant with narrow, fibrous stems. Leaves trifoliate narrow, elongated and pointed, while the flowers are small and inconspicuous. Seeds are grouped together in small balls. Each seed is grooved and bears a stiff hooked bristle at one end, which facilitates seed spread. It is a self-regenerating annual that grows in dense stands and varies from prostrate to semi-erect in habit. At an early stage of establishment its plant is erect, but as the plant grows, the stems and branches become fibrous and semi-prostrate. (Fig. 14)

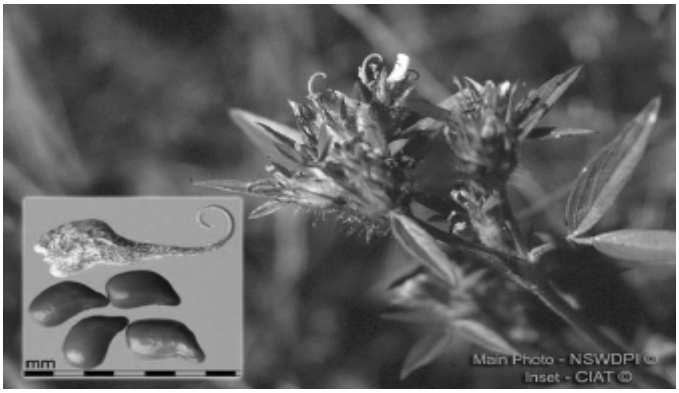

Figure 14 .Townville Stylo [*Stylosanthes humilis* (Kunth)]

Environmental requirement and management

Townsville stylo is more suited to areas with 900 - 1140 mm annual rainfall. It is well adapted to sandy soils of low fertility where there is less competition from companion grasses but it is also found on the heavier soil types. It is also adapted to soils of low pH and nodulates at pH 4.5 or even pH 4 if the calcium supply is adequate. The species has been found to absorb greater quantities of phosphorous per unit of root tissue per unit of time than other species both at low and high phosphorous concentrations. but application of phosphorous fertilizer can increase productivity.

4. Stylo (*Stylosanthes guyanensis*)

Description

Stylo is a vigorous, bushy perennial 0.5-1.5 m high which may become more prostrate under grazing pressure. Varieties are usually erect to semi-erect, generally not richly branched at the base, but some layering stems can occur. It can grow up to five feet in height; stems are coarse and hairy. Leaves trifoliate long, rather narrow and pointed. Stylo is a late flowering shrub, and does not flower freely in sub-tropical latitudes. Flowers small and yellow, producing single seeded pods with yellow seeds. The seeds are yellow. (Fig. 15).

Figure 15. Stylo [*Stylosanthes guyanensis* (Stent.)]

Stylo possesses a deep-root system and is drought resistant.

1) Schofield – is a semi-erect perennial with shorter, more rounded green to dark green leaves. Stems usually green with short brown hairs and stipules flushed with red. Flowers light cream, with light yellow wings with purple streaks.

2) Endeavor - is a semi-erect, dense branching perennial with usually light green stems with light green hairs. Leaves long and narrow and light green in color. Flowers are canary yellow.

Environmental requirement and management

Stylo is widely distributed. It is propagated by seeds but needs presowing treatment such as soaking in boiling water for 3-4 minutes and in tap water overnight to enhance germination. The species can thrive on many types of soil but grows better in sandy soil both in dry and wet localities. It can also tolerates acidic and soils by low fertility and observed to produce more in their conditions. In the presence of adequate soil moisture, fire does not affect the left over seeds in the field instead it improve the rate of germination. The species can thrive for 2-3 years.

Stylo grows well in pasture mixture containing para grass. Guinea grass, Pangola, Napier and Kikuyu. It compete well with cogon on native pastures. The seedling grow slowly in the early stage of establishment due to shading by competing grasses. The species is unpalatable at early stage and becomes palatable when matures and fully established.

Stylo tolerates heavy grazing. Stylo pastures are scarcely damaged if they are grazed too closely or are trampled too heavily. It can be fed fresh or dried.

5. Siratro [*Macroptilium atropurpureum* (Moc. & Sesse ex, (DC) Urb]

Description

Siratro is a perennial legume with deeply penetrating roots and trailing stems which may produce root anywhere along their length. The root system is deep and well developed. Leaves pinnately trifoliate, dark green, broad and hairy on the upper surface and silvery and very hairy on the lower surface. Leaflets unsymmetrically lobed on proximal margin, central leaflet not lobed, lateral leaflets indented. Flowers dark red that changes to dark purple with age. Pods straight cylindrical and about 8 cm long. Pods when mature readily dehisce so collection should be done before the pods open. Seed light brown to black, flattened and ovoid in shape. The seed pods shatter readily. (Fig. 16).

Environmental requirement and management

The species is propagated by seeds. Soaking the seeds is boiling water to 3-4 minutes and let the seeds stay in tap water overnight enhance germination. It grows in a wide range of soils but not in a poorly drained condition. Siratro establishes easily grows fast, and nodulates freely with indigenous strain of rhizobium.

It prefers cultivated lands than from surface seeding into burnt or well grazed native pastures. It is effective in fixing N and combines well with most grasses except under high rainfall conditions and strong competition. The species is compatible with a range of grasses such as Rhodes, Buffel, Green Panic, common Guinea, and Nandi and Kasungula Setaria.

Siratro is a persistent pasture legume and gives high yields of palatable protein-rich fodder.

Figure 16. *Sitatro [Macroptilium atropurpureum* [(Moc. & Sesse ex. DC) Urb]

6. Calopogonium [*Calopogonium muconoides* (Desv.)]

Description

The species is a trailing or twining perennial vine used as a cover crop in tree plantations. Stems densely covered with stiff, spreading yellowish to brown hairs. Leaves roughly petiolate, hairy transversely divided into three leaflets which are elliptical to ovate and somewhat diamond shaped or round which measure 4-10 cm x 2.5 cm. Inflorescence axillary, with short to long stalked, headlike to racemose; flowers few, clustered at thickened nodes blue, purple to measuring 7-10 mm long. Fruit linear pod, straight, or curved, 2-4 cm x 3.5-5.0 mm, densely covered with brown hairs, dehiscent, containing 5-8 seeds. Seed yellow brown to dark brown and measures 2.4-4 mm x 2.5-3.0 mm (Fig. 17).

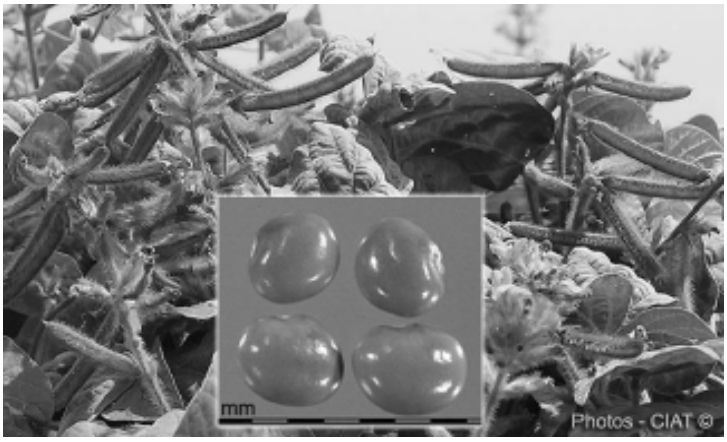

Figure 17. Calopogonium [*Calopogonium muconoides* (Desv.)]

Environmental requirement and management

Calopogonium is widely distributed in dryland field crops and with perennial crops. It thrives on any soil type and can withstand long dry season. It grows with pasture grasses as long as the soil's nutrient conditions are sufficient and climbs on anything around it. It is one of the perennial pasture legumes which are planted as plantation cover crops, intended to control weeds and erosion. Grazing capacity was not a primary consideration in its establishment since this species is poorly accepted by animals.

Propagation is generally by seeds and germination can be enhanced using physical scarification like the stylo and suration.

7. Greenleaf desmodium (*Desmodium intortum*)

Description

Greenleaf desmodium is a rather coarse spreading plant with thick hairy stems which root down well. It has more leaves and posses short internodes than silverleaf desmodium (*Desmodium uncinatum*). Leaves with fine hairs and often bear a characteristic reddish brown to purple flecking on the upper surface. (Fig. 18). Flowers lilac to pink in color and produce pods which curve back to the flowering stem and are constricted between seeds. The pod carries 8-12 seeds. In the absence of pollination like bees, the species produces aborted seeds. Vegetative propagation such as stem cutting can be used to establish green leaf. (Fig. 18)

Figure 18. *Greenleaf desmodium [Desmodium intortum* (Mill) Urb]

Environmental requirement and management

Greenleaf desmodium grows better in the highlands (over 600 m). It is more drought tolerant than *D. uncinatum* but not recommended for areas receiving less than about 900-1000 mm of annual rainfall. It grows on a wide range of soils and possesses some tolerance the waterlogged. The species has good nutritive value and well accepted by stock. It withstands heavy grazing once well established, combines well with a wide range of grasses and competes well with weeds. Vegetative propagation such as stem cutting can be used to establish Greenleaf.

General Procedure for Forage Managemenr

A. Fertilizer application

Basically, it is accepted fact, that the Philippine pastures are unproductive. The practice of annual/prescribed burning provides nutritious, young, green grasses for the animals, yet, only during the early part of the rainy season. Hence, there is a need to introduce improved pastures in order to ensure an all-year-round supply of

nutritious pastures for the ruminants (goat, cattle or carabao). Such introduction, though, requires fertilization so that these improved pastures will respond well to the existing grassland environment, Given the optimum condition, improved pastures generally withdraw greater amount of nitrogen, phosphorous, potassium, calcium and magnesium from the soil, for their growth and developmental in turn, increasing the yield and producing good quality and quality herbage.

Requirements for NPK are substantial under intensive pastures, that is, when they are grown purposely for cut-and-carry system. Manure and urine are returned to the pasture to reduce requirement for chemical fertilizers.

The need for nitrogen and phosphorous is universal in tropical pastures. Nitrogen requirement with the application of chemical fertilizer or introduction of legumes is a matter of farm decision. Phosphorous, however, has to be applied through chemical fertilizer.

Kinds and amounts of fertilizer

The kinds and amounts of fertilizer applied are dependent on the pasture species, manner of utilization and nutrient supplying capacity of the soil. Open grazing pastures requires less fertilizer than those which are chopped or cut. Pure grass stands require high levels of nitrogen fertilizer which respond well up to 400 kg N/ha/yr, thereby producing high yields. Yet, nitrogen need not be applied on well established and balanced grass-legume pastures. Phosphorous application is very necessary to enhance the growth of the legumes; and the rate of application is in the range of 30-60 kg $P_2 O_5$ per ha/yr.

Time and placement of application

In areas of distinct wet and dry seasons, half of the nitrogen fertilizer requirement is applied after the early rainy season; the other half by the end of the rainy season. Under even rainfall distribution, application can be splitted into three or four in a year. On the other hand, phosphorous fertilizer is applied at the onset of the rainy season.

It is important that two-four tons of lime per hectare is applied to acidic soil (pH 5.0) in order to bring down the pH to 5.5, prior to phosphorous fertilizer application.

For newly planted pastures, fertilizers are better applied in furrows if row planting is employed. This promotes better fertilizer utilization by plants. Otherwise, for established pastures, fertilizer is broadcasted over the area.

Other related practices

Considering the scarcity and exorbitant cost of inorganic fertilizer, mixed grass/legume pastures are more desirable. The legume plant in association with the right kind of bacteria in the soil will fix nitrogen from the air.

When legume species are introduced, inoculation with the proper strain of rhizobia is the most effective way to ensure adequate nitrogen nutrition. The nitrogen fixed in the root nodules of the legume contributes to the nitrogen supply for succeeding

crops, thereby, reducing substantial nitrogen fertilizer application. Nitrogen fixed by tropical legumes ranges from 50-600 kg N/ha/yr.

B. Prescribed burning

Controlled/prescribed burning is one of the most important grassland management practices. It is a useful tool to rehabilitate a rangeland/grassland area to its proper use condition; to regenerate or rejuvenate grasses from its old and mature, high fibrous unpalatable form to its new and young, high nutritious and palatable form.

Burning, as prescribed, is normally done towards the end of the summer season and a few days prior to the onset of the rainy season. When rain comes, new shoots emerge. Such practice is done in grass species dominated areas, prominently in cogonal areas.

C. Grazeable age

Generally, forage legumes and grasses are exposed to animal grazing at age 30-60 days. For a rangeland/grassland area to become productive and sustainable, the rancher must then observe proper grassland management. He may have to divide his pastureland into paddocks and perform rotation grazing. It is also important that he pays closer attention on the characteristics of the forage legumes that are in the system, particularly the time and period of grazing exposure and their regenerative characteristics. Otherwise, he may loose the legume components.

When the grassland resource is designed for cut-and-carry system, just the same, the area will be subjected to a cutting interval of 30 days for proper management.

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