Brachiaria Grass Production Manual

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Preface

Brachiaria grass is a new forage option with a high potential to improve livestock productivity in Sub-Saharan Africa. The manual provides information on major attributes of Brachiaria grass and guidelines to farmers and development partners on how to establish, manage and utilize the grass for ruminant feeding to improve the livestock productivity and livelihoods of farmers.

Abbreviations and acronyms

BecA	Biosciences eastern and central Africa
CAN	Calcium ammonium nitrate
CIAT	International Centre for Tropical Agriculture
CP	Crude protein
cv.	Cultivar
DAP	Di-Ammonium Phosphate
ILRI	International Livestock Research Institute
KALRO	Kenya Agricultural and Livestock Research Organization
NARS	National Agricultural Research Systems
RAB	Rwanda Agriculture and Animal Resources Development Board
Sida	Swedish International Development Cooperation Agency
SSP	Single Super Phosphate
TSP	Triple Super Phosphate

1. Introduction

Livestock is one of the most important sub-sectors of African agriculture. They are source of food, incomes, employment, and livelihoods for over 70 percent of smallholder farmers in sub-Saharan Africa. Moreover, they provide manure and draft power and are commodity for social functions and symbol of social status. Despite high economic and social importance, livestock productivity in Africa is low, mainly attributed to short supply and low nutritive quality of available feed resources. Feed shortage is severe during the dry seasons and leads to a sharp decline in livestock productivity. Feed associated challenges can be minimized significantly by planting improved forages because they produce high above ground biomass of high nutritive quality than local pastures.

Brachiaria grass is one of the few tropical forages with these qualities and is suitable to tropical and sub-tropical regions of Africa. Evaluations of Brachiaria grass for pasture improvement started as early as 1950s in Africa but its use for pasture improvement is very recent. Introduction of improved Brachiaria grass cultivars in Africa started in early 2000 primarily for research, and there have multiple introductions thereafter for research and development purposes. In 2014, some improved Brachiaria grass cultivars from South America were introduced to Kenya and Rwanda through the Climate-smart Brachiaria Program. They were evaluated in multiple locations involving farmers and four superior cultivars were identified for ruminant feeding. The cultivars have been integrated into mixed crop-livestock farming system; and the significant benefits of Brachiaria grass on livestock productivity (milk and meat production) documented. Since then Brachiaria grass has been an important component of many livestock development projects and initiatives implemented by various

National Agricultural Research Systems (NARS) organizations, non-governmental organizations, and private sectors across Sub-Saharan Africa.

As stated earlier, improved Brachiaria grass is a relatively new forage to African smallholder farmers and therefore, information on establishment and management of the grass is limited. This manual aims at providing information to farmers on establishment, management, and utilization of Brachiaria grass for improved livestock productivity and sustainable livestock production.

2. Importance of Brachiaria grass

Brachiaria grass is one of the important tropical forages found in Africa. There are about 100 species of Brachiaria grass of which seven perennial species have been used for pasture improvement. Brachiaria grass has several attributes of agricultural and environmental significance. Some of key attributes of Brachiaria grass are as follows:

A. Production and adaptability:

- High biomass production potential (30 t of dry matter/ha per year).
- Drought, flood and shade tolerance.
- Adapted to low fertility and acidic soils.

B. Benefits to livestock:

- Palatable and nutritious to livestock.
- Improves livestock health and performance (milk and meat production)

C. Environmental and ecological benefits:

- Fixes atmospheric carbon-dioxide into soils, improves soil health and reduces greenhouse gas emission (especially methane and nitrous oxide
- Minimizes nitrogen loss from soils.
- Protects soils from erosion.
- Support wildlife

D. Social economic benefits:

- Potential for new agri-business e.g. sale of hay, silage, feedblocks, seeds and vegetative planting materials (splits/rooted tillers).
- Improves income and livelohood of livestock farmers

Evaluations carried out in tropical Africa have shown a broad adaptation of *B. brizantha*, *B. decumbens*, *B. mutica* and *B. ruziziensis* in different agro-ecological zones. Moreover, various cultivars of *B. brizantha*, *B. decumbens*, and hybrids derived from crosses of *B. brizantha* × *B. decumbens* × *B. ruzuziensis* have been evaluated in Africa for adapatation, biomass production and for livestock productivity. Details on the Bracharia cultivars suitable for forage production in Africa are provided in the subsequnt section.

3. Brachiaria grass cultivars

Improved Brachaira grass cultivars have been introduced and evaluated in Africa since the beginning of 2000 initially as a component of pull-push technology for controlling pests on food crops, and very recently for animal nutrition. The major characteristics of commonly grown Brachiaria grass species and their cultivar(s) in Africa are introduced in this section. All five Brachiaria grass cultivars illustrated in this manual have a perennial growth habits with productive life of up to 20 years. These cultivars were selected through the participatory evaluations involving farmers in Kenya and Rwanda.

3.1. Brachiaria decumbens cv. Basilisk

Brachiaria decumbens cv. Basilisk, commonly known as Signal grass was the first improved Brachiaria grass cultivar. It was developed in Australia from the germplasm collected from the native grasslands of Uganda. It is low-growing, sward forming perennial grass with decumbent or semi-erect growth habit and plant height ranges between 50 – 150 cm. It produces thick swards thus highly

persistence to grazing. Basilisk has a broad agro-climatic adaptation and can be grown in areas with an average annual rainfall of 700 mm and above, with a dry season of no longer than 5 months, tolerates acidic soils and has stable biomass production. It is highly palatable and nutritious and thus gives good animal performance. It has annual dry matter (DM) yield potential of 30 t/ha.

3.2. Brachiaria brizantha

Brachiaria brizantha is a tufted perennial grass commonly known as Breard grass or Palisade grass. The plant height ranges from 60 -120 cm with deep roots of upto 200 cm. It can be grown on a wide range of soils of medium to high soil fertility with pH range of 4 - 8. It can be grown in areas receiving annual rainfall of around 1,000 mm and can withstand dry seasons of 3 to 6 months. The annual dry matter yields range from 8 to 20 t/ha depending on the cultivar. The characteristics of three *B. brizantha* cultivars - MG4, Piatã, and Xaraes that have been promoted in Africa are described below.

3.2.1. Brachiaria brizantha cv. MG4

The cv. MG4 was developed in Brazil from the germplasm collected from tropical Africa. It is adapted to poor soils and perform well in the areas receiving annual rainfall even below 800 mm due to its deep root system.

3.2.2 Brachiaria brizantha cv. Piatã

The cv. Piatã was developed in Brazil from germplasm initially collected from Ethiopia. It is highly productive up to 2,000 m above sea level with annual rainfall of 700 mm and above. It is drought and cold tolerant. It is suited to soils of average fertility and may be cultivated in sandy soils.

3.2.3. Brachiaria brizantha cv. Xaraes

The cv. Xaraes also known as Toledo was originally collected from Burundi. It is suited to soil of medium fertility with annual rainfall of over 800 mm and elevation of up to 2,300 m above sea level. It holds the soil firmly and can be used for erosion control on hilly areas. It has a long flowering cycle than Piatã and MG4 cultivars and produces high biomass yield. Xaraes is less tolerant to drought than MG-4 and Piata.

3.3. Brachiaria hybrid cv. Mulato II

Mulato II is a product of three way crosses of *B. ruziziensis*, *B. decumbens* and *B. brizantha*. It is a leafy, semi-decumbent perennial grass of medium height in between 80 to100 cm. It has short hairs on the leaf blade and leaf sheaf. Mulato II is known for high in crude protein (CP) of up to 16%. It grows well from sea level to 1,800 m above sea level, with annual rainfall of above 700 mm but it is tolerant to prolonged period of drought of up to 4 months. In Kenya, Mulato

II is most suited for growing in the coastal lowlands because in other parts it is suscetiple to red spider mites attack whereas it is grown across Rwanda. Its annual dry matter yield potential is as high as 35 t/ha.

4. Establishment and management

Proper establishment and management of pastures leads to high yield and good quality grass that results in high livestock productivity. In this section, we will discuss about the establishment and management procedures for Brachiaria grass as a pure stand to enable smallholder farmers to produce high amount of quality biomass in their farms for enhanced livestock productivity and economic benefits. However, it can also be established in mixtures or intercropped with forage legumes. Like other forages, Brachiaria grass establishment success and productivity depend on various factors including cultivars, local agro-climatic conditions, and agronomic practices such as land preparation, sowing rates, time of planting, spacing, fertilization and weed management.

4.1. Land preparation

As the grass seeds are small, a well-prepared seedbed is required for good establishment of Brachiaria grass that subsequently reduces weed infestation, as well as the cost of weed control. The land should be cleared from bushes and perennial weeds before ploughing. If tractor or oxen-plough are used for land preparation, the land should be ploughed and then harrowed twice to a fine tilth. If hand hoe is used, the large soil boulders should be broken down.

4.2. Seed rate

Brachiaria grass can be propagated by seeds and vegetative materials i.e. rooted tillers. Planting using seeds is convenient for large scale production. About 5 to 7 kg of good quality seeds are required for one hectare. Higher seed rate is required if planting is carried out by broadcasting. Alternatively, seeds can be sown in the nursery bed then transplanted into main field when seedlings are 8 to 10 weeks old. In this case seed rate can be reduced to 2.5 to 3.5 kg per hectare. The use of rooted tillers (root splits) is the best option to establish Brachiaria grass, especially when seeds are not available. Root splits can be obtained from an old stand of Brachiaria grass pastures. About 2 to 3 tillers/root split are good for planting per hole. It is important to ensure that the root splits are in good condition with actively growing roots to develop into new plants.

4.3. Spacing

For establishing pure stand from seeds, seeds are sown in rows with spacing of 50 cm apart and drilled by hand or mechanized planter. Roots tillers should be spaced 20 - 30 cm within a rows and 50 cm between rows to maximize on yield. Planting the grass in rows facilitates weed control and other intercultural operations.

Table 1: Recommended Brachiaria root splits spacing and rates

Between rows spacing	Within row spacing	Root splits/hectare
50 cm	20 cm	100,000
50 cm	30 cm	67,000

Figure 1: Brachiaria grass seeds (left) and rooted tillers (right)

4.4. Sowing depth

Figure 2: Spacing and sowing depth of Brachiaria grass

Appropriate depth of sowing is very important with small and light seeded forages like Brachiaria grass for successful seedling emergence and establishment. Brachiaria seeds can be sown by drilling the seeds within a depth of 0.5 to 1 cm and lightly covered with soil. Where the seeds are broadcasted, covering of seeds can be achieved by light harrowing and rolling. Alternatively, seeds can be covered by pulling a tree branch over the area planted. Proper covering protects the seeds from direct exposure to rain and sun, as well as from harvester ants and birds.

Root splits are planted in holes. The size (depth and width) of holes should be sufficient to accommodate roots splits. After planting holes should be covered with soil and well pressed to bring a good contact between roots and soil.

4.5. Sowing time

The sowing time determine successful establishment of Brachiaria grass particularly where forages are planted under rainfed conditions. Sowing of seeds and planting of root splits should be carried out at the onset of rainy seasons to ensure soil has adequate moisture for seed emergence and seedling establishment. Due to different rainfall patterns across Africa, different sowing times have been recommended for the different regions, therefore, the sowing time vary within a country. Brachiaria plants are slow to establish and there should be sufficient moisture in the soil for about 2 months for the successful establishment. For example, in Kenya and Rwanda, Brachiaria grass establishment is successful when seeds are sown during the March/May long rains and October/December short rains in humid and sub-humid regions such as western and central highlands. In the semi-arid region such as eastern midlands, the most suitable sowing time is during the October/November short rains.

5. Soil fertility management

Brachiaria grass like any other cultivated forage grasses requires nitrogen, phosphorus, potassium, and micro-nutrients for optimal growth, development, and yields. Depending on the availability of resources, soil fertility can be managed by application of either organic fertilizers or inorganic fertilizers to maximize yield.

Organic fertilizers/manure

Soils that are low in nutrients should be supplemented with well decomposed manure. Farmyard manure and/or compost can be applied at the rate of 10 - 15 t/ha at the time of land preparation before planting. Thereafter about 4 - 6 t/ha at every alternate year can be applied between the rows and incorporated into the soil.

Inorganic fertilizer

Phosphorus is an important element for root development in young plants and therefore it is essential for good establishment of the grass. About 40 to 50 kg phosphorus (200 to 250 kg of Triple Super Phosphate (TSP) or 6 to 7 bags of Single Super Phosphate (SSP) is required for one hectare at planting and should be mixed thoroughly with soil before the seeds are sown. Nitrogen fertilizers should be applied in split doses during the production of the grass and when soil is moist. Normally about 100 kg of nitrogen (8 bags each 50 kg of Calcium Ammonium Nitrates (CAN) in 2 to 3 splits per hectare every year are recommended during the wet season. Higher rates can be used if farmers target higher forage production. Application of fertilizers with ammonium such as Di-Ammonium Phosphate (DAP) and CAN at planting should be avoided as they may scotch the seeds and affect germination.

In the acid prone soils, the soils should be supplemented with lime following recommendation of the soil testing laboratory and should be applied and incorporated into the soil at the time of land preparation.

6. Weed management

Brachiaria seedlings are slow to establish and may be outcompeted by weeds for water, light and nutrients if not weeded. Thus, a good weed control is essential during the seedling establishment period. Weeds can be controlled effectively using cultural methods and option for herbicides use are also available mainly to control broad leaf weeds. To minimize the competition with weeds, a pre-emergence herbicide may be applied prior sowing of the seeds to eliminate perennial grasses such as couch grass. At least one to two weeding are required after seedling emergence. After the establishment, Brachiaria grass grows vigorously and the stand can out-compete weeds and may not require further weeding.

Figure 3: Weeded Brachiaria grass

′. Pests and diseases

Brachiaria grass is affected by pests and diseases which often cause losses, and significant reduction in herbage yield and nutritive quality. The major

insects of Brachiaria grass observed in East Africa are red spider mite and shoot fly.

Red spider mite: Red spider mite is a serious threat to Brachiaria grass production affecting both quality and quantity of herbage. In Kenya, it is widespread in all the region except the coastal lowlands. Mite infestation is common when the grass is stressed particularly during the dry season and begins with a few mites underneath of leaves with isolated chlorotic patches on the upper surface of leaves. The mite feeds by sucking grass leaf tissue cell sap leading to plant withering and eventual drying. Mite infestation can be reduced by irrigation, harvesting grass at the beginning of dry season, and growing the Brachiaria cultivars that are less susceptible to mite attack like Basilisk and MG-4.

Figure 4: Red spider mite infestation in the Brachiaira grass. Initial symptom of mite infestation (left) and symptoms of severe infestation (right) and red colored mites (inset)

Shoot fly

Shoot fly attack is observed at early stages of seedling development and on developing young tillers during the production. The larvae eat through the leaf sheath, cut the growing point of Brachiaria seedling which results in shoot wilting, yellowing and the death of the seedlings or tillers of older stand. Shoot fly can be controlled by planting treated seeds and spraying systemic insecticides.

Figure 5: Brachiaira grass with Shoot fly infestation

Diseases

The most common diseases of Brachiaria grass reported in East Africa are leaf rust, leaf spot, leaf blight, honeydew or ergot and smuts. Among them leaf rust, leaf spot and leaf blight are widespread in Kenya and Rwanda, whereas the prevalence of ergot and smut diseases is low in both countries. There is also a report on presence of virus like symptom on Brachiaria grass. A recent study has shown difference among the Brachiaria cultivars against leaf rust, leaf spot and leaf blight diseases.

Figure 6: Rust disease symptom and damage of Brachiaira grass

Figure 7: Leaf spot symptoms (A) and symptom of leaf blight (B) in Brachiaria grass.

Figure 8: Honeydew/Ergot disease (left) and Smut disease (right) of Brachiaria grass.

Figure 9: Virus infected Brachiaria plant with chlorosis and stunting symptoms with adjoining healthy plants on the sides

8. Utilization of Brachiaria grass

Young Brachiaria grass is highly palatable and nutritious and decline with age. The green forage can be harvested for cut-and-carry feeding system or grazed directly in the field. Brachiaria can also be harvested and preserved as hay or silage for feeding during the dry season. Brachiaria grass can be harvested multiple times (up to 5 times) a year. Newly established Brachiaria stand should be allowed adequate period to establish and develop robust root systems for anchorage in soil and for absorbing soil water and nutrients before grazing or harvesting. The first harvesting should be made between 3 to 4 months after seedling emergence. However, for the direct grazing this period should extended by 1 to 2 months to maximize ground coverage and to minimize trampling effects. The grass should be cut at a height of around 5 cm above the ground to ensure fast re-growth. Subsequent harvests can be carried out at 8 to 12 weeks (2 to 3 months) interval depending on the forage need. Harvesting may be done using sickles or machetes while mechanical harvesters are also available for harvesting. Table 2 shows the chemical composition for different cultivars when harvested at 8 weeks. The values are indicative of the quality and vary depending on management and agro-ecological conditions.

Table 2: Chemical composition (%) of Brachiaria grass cultivars in Kenya harvested at 8 weeks intervals.

Cultivars	Ash	†CP	‡NDF	±ADF	+ADL	₸IVDMD	Ca	P
Xaraes	12.6	12.9	61.7	39.5	3.95	48.4	0.45	0.40
Piata	11.4	13.5	61.4	41.2	4.04	50.2	0.36	0.32
MG4	12.5	12.6	59.4	36.8	4.05	52.2	0.40	0.41
Basilisk	11.4	14.0	59.8	40.8	3.59	51.1	0.38	0.38
Mulato II	15.0	16.2	59.1	39.7	3.79	65.0	0.36	0.35

Ca=Calcium; P=Phosphorus; †CP=Crude protein; ‡NDF=Neutral detergent fibre; ±ADF=Acid detergent fibre; +ADL=Acid detergent lignin; ₸IVDMD=*in-vitro* dry matter digestibility

Figure 10: Manual harvesting Brachiaria grass

Figure 11: Dairy cattle grazing Brachiaria grass

9. Economic analysis

The gross margin analysis for Brachiaria grass production in Kenya is presented below (Table 3). The production cost is high in the first years largely due to the costs for seeds, land preparation, planting, weeding and application of phosphatic fertilizer. The profits in the first year is USD 1384/ha and it increased to USD 1899 /ha in the subsequent years.

Table 3: Gross margin analysis for Brachiaria grass production per hectare (in United State Dollars)

Parameter	Year 1	Year 2	Year 3
Inputs cost			
Fertilizer TSP (200kg)	120		
Fertilizer CAN	80	160	160
Seeds (5-7 kg)			
Labor cost			
Ploughing	75	-	-
Harrowing	50	-	-
Opening furrows	50	-	-
Planting	100	-	-
Weeding (twice)	200	-	-
CAN application	16	16	16
Harvesting	125	125	125
Baling cost	300	300	300
Total production cost	**1116**	**601**	**601**
Products			
Yield (kg/ha)	15000	15000	15000
No. of bales (15 kg/bale)	1000	1000	1000
Total sale (2.5/bale)	2500	2500	2500
Profit	**1,384**	**1,899**	**1,899**

Note: The cost of seed was discounted in this calculation as seed price varies greatly. Labor cost is US $ 4/day, and KSh. 100 = US $ 1.00

Further readings

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Website: http://innovafrica.eu/

Knowledge Platform: http://kp-innovafrica.africabiosciences.org/

Disclaimer

Some of the information presented in this manual is general. Farmers should consult with extension agent for specific information regarding growing Brachiaria grass in their farm. All persons using the information in this manual assume full responsibility for application of the recommendation made. The authors views expressed in this publication do not necessarily reflect the views of EU Horizon 2020.