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49

Urochloa (syn. *Brachiaria*) grass production manual

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Urochloa (syn. Brachiaria) grass production manual

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Preface

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

Abbreviations and acronyms

CAN	Calcium Ammonium Nitrate
CP	Crude protein
cv.	Cultivar
DAP	Di-Ammonium Phosphate
SSP	Single Super Phosphate
TSP	Triple Super Phosphate

1. Introduction

Livestock is one of the most important sub-sectors of agriculture in sub-Saharan Africa. They are source of food, incomes, employment, livelihoods and earns foreign exchange. Moreover, they provide manure and draft power for crop production 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 more forage of high nutritive quality than local pastures.

Urochloa grass is one of the few tropical forages with these qualities and is suitable to tropical and sub-tropical regions of Africa. Evaluations of *Urochloa* grass started as early as 1950s in Africa but its use for pasture improvement is very recent. In 2014, some improved *Urochloa* grass cultivars from South America were introduced to Kenya and Rwanda. Through evaluation in multiple locations across distinct agro-ecological zones (areas with different climate, landform and soils) involving farmers, four suitable cultivars were identified for ruminant feeding. The cultivars have been integrated into mixed crop-livestock farming system; and the significant benefits of *Urochloa* grass on livestock productivity (milk and meat production) were documented. Since *Urochloa* grass is a relatively new forage to smallholder farmers in Africa knowledge on establishment and management of the grass is limited. This manual aims at providing information to farmers on establishment, management, and utilization of *Urochloa* grass for improved livestock productivity and sustainable livestock production.

2. Importance of *Urochloa* grass

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

A. Production and adaptability:

- High biomass production potential (30 tonnes 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:

- Stores 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 as source of feed and habitat

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 livelihood of livestock farmers

Evaluations carried out in tropical Africa have shown a broad adaptation of *U. brizantha, U. decumbens, U. mutica* and *U. ruziziensis* in different agro-ecological zones. Moreover, various cultivars of *U. brizantha, U. decumbens* and hybrids derived from crosses of *U. brizantha* × *U. decumbens* × *U. ruziziensis* have been evaluated in Africa for adaptation, biomass production and for livestock productivity. Details on selected *Urochloa* cultivars planted in tropical and sub-tropical region of Africa are provided in the subsequent section.

3. Characteristics of *Urochloa* grass cultivars

Improved *Urochloa* grass cultivars were introduced and evaluated in Africa since the beginning of 2000 initially as a component of pull-push technology (way of controlling pest by use of repellents 'push' plants and trap 'pull' plants) for controlling pests on food crops, and very recently for animal nutrition. The major characteristics of commonly grown *Urochloa* grass species and their cultivar(s) in Africa are introduced in this section. *Urochloa* grass cultivars illustrated in this manual have a perennial (several seasons) growth habits. These cultivars were selected through the participatory evaluations involving farmers in Kenya and Rwanda, and are registered for commercilization in Kenya.

3.1 *Urochloa decumbens* cv. Basilisk

Urochloa ***decumbens*** cv. Basilisk, commonly known as Signal grass was the first improved *Urochloa* grass cultivar (Figure 1). 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 50–120 cm. It produces thick swards thus highly persistence to grazing. It is relatively easy to harvest using machete or panga, dries rapidly and is suitable for hay making. 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 four months. It can grow in soil of medium to low fertility, tolerates acidic soils and has stable biomass production. It is highly palatable and nutritious and thus gives good animal performance.

Figure 1: Photo of *Urochloa* decumbens cv. Basilisk.

Photo credit: KALRO/Elias Gichangi)

Annual production potential	8–15 tonnes dry matter/ha
Crude protein (CP) content	8–14% of dry matter
Dry matter digestibility	54–65%
Palatability	High
Metabolisable energy	5.5–8.8 MJ/kg dry matter

3.2 *Urochloa brizantha*

Urochloa brizantha is a tufted perennial grass commonly known as Breard grass or Palisade grass. The plant height ranges from 60–150 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 3–6 months. The annual dry matter yields range from 8–14 t/ha depending on the cultivar. The characteristics of three *B. brizantha* cultivars: MG-4, Piata, and Toledo that have been promoted in Africa are described below.

3.2.1 *Urochloa brizantha* cv. MG-4

The cv. MG-4 was developed in Colombia from the germplasm collected from tropical Africa (Figure 2). It has semi-erect growth habit and plant height ranges between 50–110 cm. It is adapted to poor soils and perform well in the areas receiving annual rainfall above 800 mm. It is easy to make into hay. Since the stems are thin, it is easy to harvest, dries rapidly thus maintain a high nutritive quality.

Figure 2: Photo of *Urochloa brizantha* cv. MG4.

Photo credit: ILRI/Collins Mutai.

Annual production potential	10–14 tonnes dry matter/ha
Crude protein content	8–14% of dry matter
Dry matter digestibility	57–64%
Palatability	High
Metabolisable energy	6.0–8.5 MJ/kg dry matter

3.2.2 *Urochloa brizantha* cv. Piata

The cv. Piata was developed in Brazil from germplasm initially collected from Ethiopia (Figure 3). It is highly productive up to 2,000 m above sea level with annual rainfall of 700 mm and above. It is drought tolerant but in cold tempreture growth is reduced. It is suited to soils of average fertility and may be cultivated in sandy soils. It is stemmy and hard to harvest using panga or machete.

Figure 3: Photo of *Urochloa brizantha* cv. Piata.

Photo credit: KALRO/Elias Gichangi.

Annual production potential	8–13 tonnes dry matter/ha
Crude protein content	9–14% of dry matter
Dry matter digestibility	53–67%
Palatability	Good
Metabolisable energy	7.5–9.2 MJ/kg dry matter

3.2.3 *Urochloa brizantha* cv. Toledo

The cv. Toledo was originally collected from Burundi (Figure 4). 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 Piata and MG-4 cultivars and produces high biomass yield. Toledo is less tolerant to drought than MG-4 and Piata. Although it is stemmy as Piata it is relatively easier to harvest.

Figure 4: Photo of *Urochloa brizantha* cv. Toledo.

Photo credit: ILRI/Collins Mutai.

Annual production potential	8–14 tonnes dry matter/ha
Crude protein content	9–15% of dry matter
Dry matter digestibility	56–62%
Palatability	Good
Metabolisable energy	6.4–8.0 MJ/kg dry matter

3.3 *Urochloa hybrid* cv. Mulato II

Mulato II is a product of three way crosses of *U. ruziziensis, U. decumbens and U. brizantha* (Figure 5). 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 CP of up to 18%. 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. It is slightly more tolerant to cold temperatures compared to Piata and Toledo. In Kenya, Mulato II is most suited for growing in the coastal lowlands because in other parts it is susceptible to red spider mites attack whereas it is grown across Rwanda. The stem is soft and easy to harvest.

Figure 5: Photo of *Urochloa hybrid* cv. Mulato II.

Photo credit: ILRI/Joyce Njuguna.

Annual production potential	5–8 tonnes dry matter/ha
Crude protein content	11–18% of dry matter
Dry matter digestibility	58–65%
Palatability	High
Metabolisable energy	6.3–8.0 MJ/kg dry matter

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 *Urochloa* 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 such as Desmodium and Glycine. Like other forages, *Urochloa* grass establishment success and productivity depend on various factors. These include cultivars, local agro-climatic conditions and agronomic practices such as land preparation, sowing rates, time of planting, spacing, fertilizer and manure application and weed management. Where water is available, irrigation can increase yield during the dry season.

4.1 Land preparation

As the grass seeds are small, a well-prepared seedbed is required for good establishment of *Urochloa* grass that subsequently reduces weed infestation, as well as the cost of weed control. The land should be cleared of 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 a hand hoe is used, the large soil boulders should be broken down.

4.2 Seed rate

Urochloa 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 and then transplanted into the 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 *Urochloa* grass, especially when seeds are limited. Root splits can be obtained from an old stand of *Urochloa* grass pastures. An actively growing rooted split with about 2 to 3 tillers is recommended for planting per hole.

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 (Figure 6) should be spaced 20–30 cm within a rows and 50 cm between rows to maximize on yield. Recommended spacings and number of root splits required per hectare is presented in Table 1. Planting the grass in rows facilitates good weed control and other intercultural operations.

Table 1: Recommended *Urochloa* 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 6: *Urochloa* grass seeds treated with agrochemicals (left) and rooted tillers (right).

Photo credit: ILRI/Sita Ghimire and ILRI/Collins Mutai

4.4 Sowing depth

Appropriate depth of sowing is very important with small, and light seeded forages like *Urochloa* grass for successful seedling emergence and establishment. *Urochloa* seeds can be sown by drilling the seeds at a depth of 0.5 to 1 cm and lightly covering with soil (Figure 7). 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.

Figure 7: Spacing and sowing depth of *Urochloa* grass.

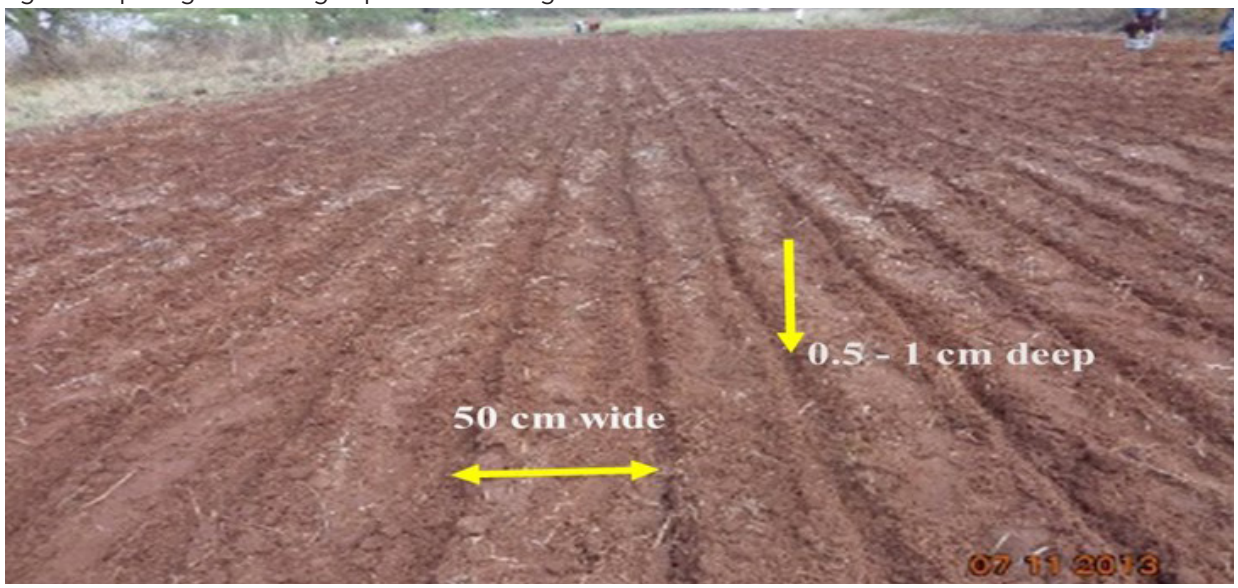

Photo credit: KALRO/Elias Gichangi.

Root splits are planted in holes. If the roots are long, they should be trimmed to about 3 cm. The stem and the leaves should also be trimmed. 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 *Urochloa* 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. *Urochloa* 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, *Urochloa* 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/December short rains.

5. Soil fertility management

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

5.1 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.

5.2 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, each 50 kg 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. Broadcasting the fertilizer is the most efficient way to cover evenly the area under the grass. Normally about 100–150 kg of nitrogen [8–12 bags each 50 kg of Calcium Ammonium Nitrates (CAN)] in 2 to 3 splits per hectare every year are recommended during the wet season. Application of fertilizers with ammonium such as Di-Ammonium Phosphate (DAP) and CAN at planting should be avoided as they may scorch 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

Urochloa grass 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 (Figure 8). Weeds can be controlled effectively using cultural methods and option for herbicides can be adopted mainly to control broad leaved weeds. To minimize the competition with weeds, a pre-emergence herbicide may be applied prior to 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, *Urochloa* grass grows vigorously, and the stand can out-compete weeds and may not require further weeding.

Figure 8: Recently weeded *Urochloa* grass.

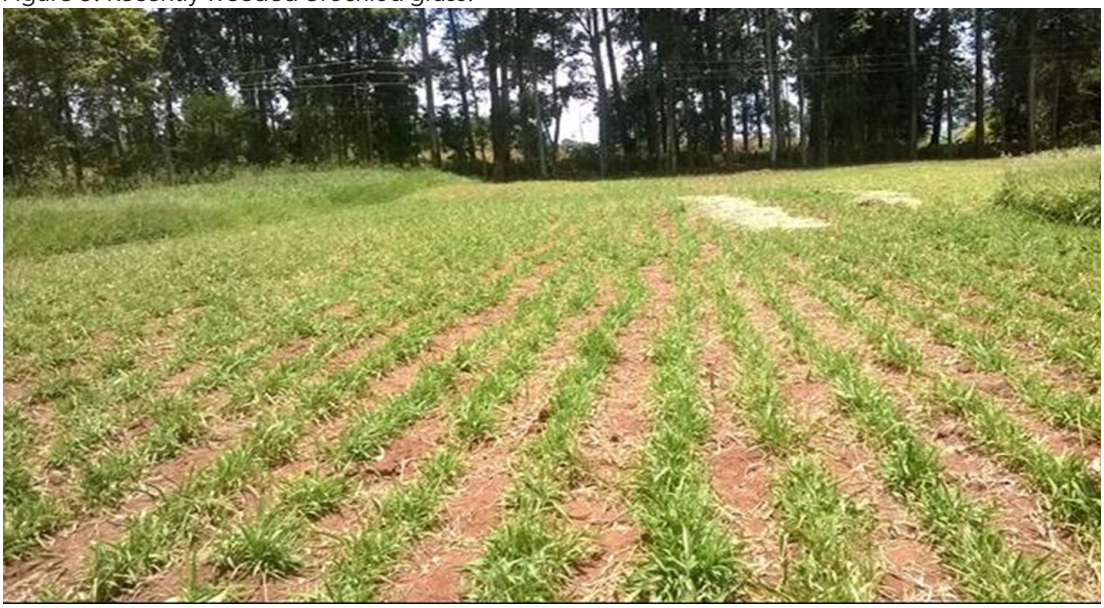

Photo credit: KALRO/Donald Njarui.

7. Pests and diseases

Urochloa grass is affected by pests and diseases which often cause losses, and significant reduction in forage yield and nutritive quality.

7.1 Insect pests

The major insects of *Urochloa* grass observed in East Africa are red spider mite and shoot fly.

7.1.1 Red spider mites

Red spider mite is a serious threat to *Urochloa* grass production affecting both quality and quantity of herbage. In Kenya, it is widespread in all the regions 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 (yellowish) patches on the upper surface of leaves (Figure 9).

Figure 9: Red spider mites' infestation in the *Urochloa* grass. Initial symptom of mite infestation (left) and symptoms of severe infestation (right) and red coloured mites (inset).

Photo credit: KALRO/Donald Njarui and ILRI/Sita Ghimire.

These mites feed 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 *Urochloa* cultivars that are resistant to mites attack like Basilisk and MG-4.

7.1.2 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 *Urochloa* seedlings which results in shoot wilting, yellowing and the death of the seedlings or tillers of older stand (Figure 10). Shoot fly can be controlled by planting treated seeds and spraying systemic insecticides.

Figure 10: *Urochloa* grass with Shoot fly infestation.

Photo credit: ILRI/Sita Ghimire.

7.2 Diseases

The most common diseases of *Urochloa* grass reported in East Africa are leaf rust, leaf spot, leaf blight, honeydew or ergot and smuts (Figures 11–14). 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 *Urochloa* grass. A recent study has shown difference among the *Urochloa* cultivars against leaf rust, leaf spot and leaf blight diseases.

Figure 11: Rust disease symptom and damage of *Urochloa* grass.

Photo credit: ILRI/Sita Ghimire.

Figure 12: Leaf spot symptoms (A) and symptom of leaf blight (B) in *Urochloa* grass.

Photo credit: ILRI/Sita Ghimire and RAB/ Bellancile Uzayisenga.

Figure 13: Honeydew/Ergot disease (left) and Smut disease (right) of *Urochloa* grass.

Photo credit: ILRI/Sita Ghimire and ILRI/Monday Ahonsi.

Figure 14: Virus infected *Urochloa* plant with chlorosis and stunting symptoms with adjoining healthy plants on the sides.

Photo credit: ILRI/Sita Ghimire.

8. Utilization of *Urochloa* grass

Young *Urochloa* grass is highly palatable and nutritious for livestock and the quality declines with age. The green forage can be harvested for cut-and-carry feeding system (Figure 15) or grazed directly in the field (Figure 16). *Urochloa* can also be harvested and preserved as hay or silage for feeding during the dry season. The grass can be harvested multiple times (up to 5 times) a year. Newly established *Urochloa* 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 and long-term productivity. Subsequent harvests can be carried out at 8 to 12 weeks (2 to 3 months) interval depending on amount of rainfall. The forage can be cut using sickles, machetes or by mechanical harvesters.

Figure 15: Harvesting of *Urochloa* grass.

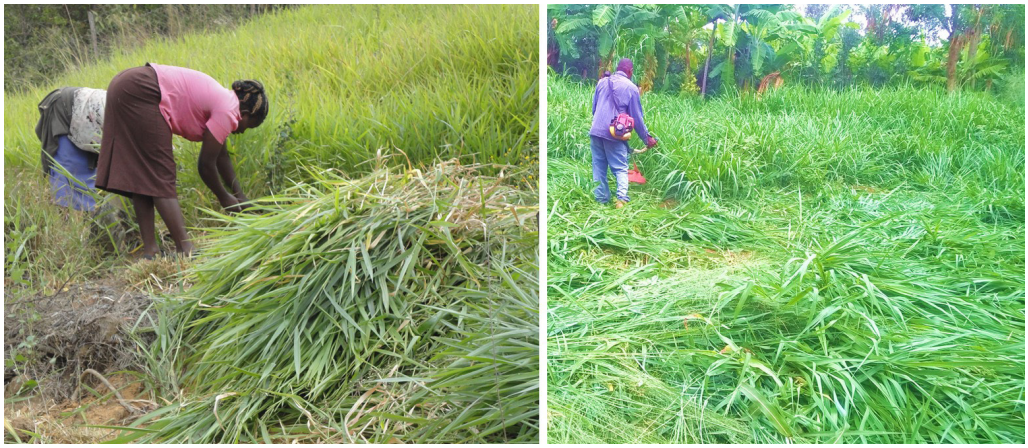

Photo credit: KALRO/Donald Njarui.

Figure 16: Dairy cattle grazing *Urochloa* grass.

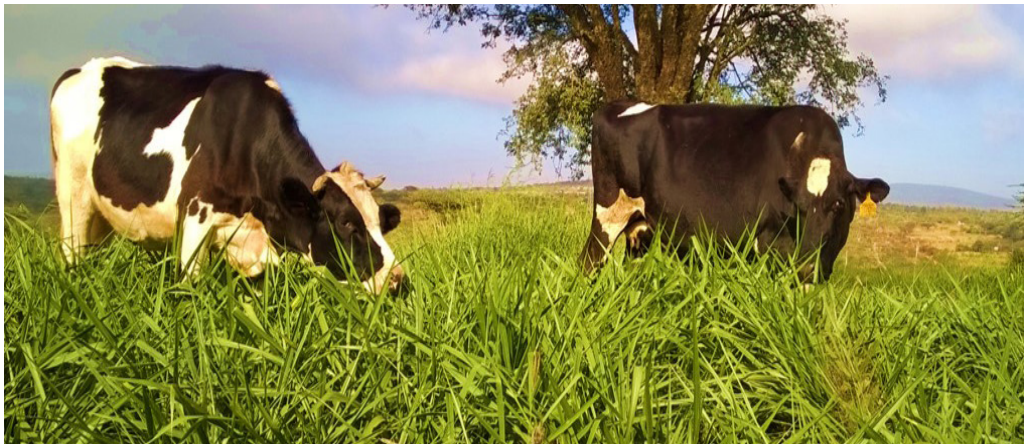

Photo credit: KALRO/Donald Njarui.

9. Economic analysis

The gross margin analysis for *Urochloa* grass production in Kenya is presented below (Table 2). 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 are USD 1384/ha and increased to USD 1899/ha in the subsequent years.

Table 2: Gross margin analysis for *Urochloa* grass production per hectare (in USD).

Parameter	Year 1	Year 2	Year 3
Costs of inputs			
Fertilizer TSP (200kg)	120		
Fertilizer CAN	80	160	160
Seeds (5–7 kg)			
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	1,116	601	601
Yield (kg/ha of dry matter)	15,000	15,000	15,000
No. of bales (15 kg/bale)	1,000	1,000	1,000
Total sale (USD2.5/bale)	2,500	2,500	2,500
Profit	1,384	1,899	1,899

Note: The cost of seed was discounted in this calculation as seed price varies greatly.

Further readings

InnovAfrica website: http://innovafrica.eu/

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Disclaimer

Some of the information provided in this manual is general. Farmers should consult with extension agents for specific information regarding growing ***Urochloa*** grass in their farm. All persons using the information in this manual assume full responsibility for application of the recommendations made.The farmers views expressed 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.

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