

Theme 3: Fodder management and conservation

# NAPIER GRASS MANAGEMENT



*A publication sponsored by the ICSIAPL project*



## Learning objectives:

- Varieties of Napier grass
- Conditions needed to grow Napier grass
- Planting Napier grass from root splits and stem cuttings
- Best practices for fast re-growth and production of Napier grass
- Cutting stages of Napier grass
- Feeding Napier grass
- Ensiling Napier grass

# Introduction

Napier grass is native to East Africa

Napier grass is also known by other common names such as; Elephant grass, Barner grass, Merker grass or Uganda grass.

The scientific name of Napier grass is known as *Pennisetum purpureum* synonym *Cenchrus purpureus*.

Napier grass is a perennial grass that grows tall to a height of 3 meters and above with erect stems with leaves that are flat, long with a strong midrib tapering to a fine point and white hairy structure at the base of the leaves.

Napier grass is a tufted perennial grass with rhizomes, that means that it has a mass of elongated outgrowths attached together at the base of the plant which are free at the opposite ends (clump).



*Napier grass*

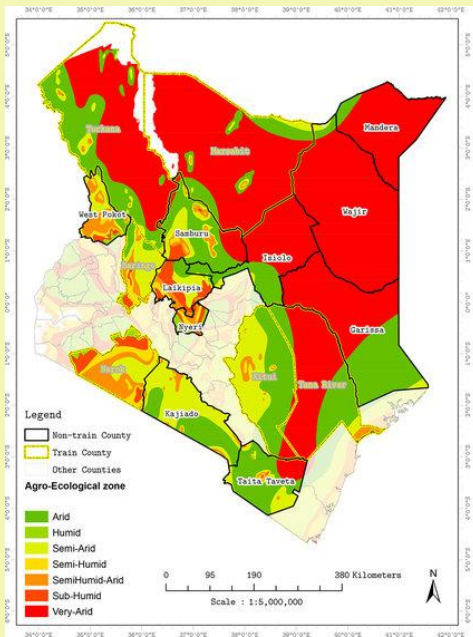
# Agro ecological zones to be considered when planting Napier grass

Napier grows in low to medium altitudes.

Napier grows in an altitude of up to 2000 m above sea level. However, altitudes of 2000m and above cause slow regeneration of Napier.

Napier performs best if rainfall is above 950mm per year.

Napier performs well in annual temperatures ranging between 18.3 °C to 26.6°C . In highland areas where morning frost occurs it should be noted that Napier grass is sensitive to frost which affects growth.



Kenya maps showing Agro-Ecological zones



Soil prepared for Napier establishment

It is advisable to plant Napier in areas that it will receive adequate sunlight, avoid shaded areas.

Napier does well in a wide range of soils.

Soil pH should range between 4.5-8.4.

Soils need to be well drained. Napier grass does not like waterlogged soils

# Napier grass varieties

There are many napier grass cultivars that have been developed to make them adaptable to local environment.

Napier varieties have different characteristics such as;

- Number of tillers,
- Plant geometry (shape of the plant),
- Plant height,
- Hairiness of leaf and stem,
- Flowering and,
- Resistance to fungal disease.

Some of the common Napier grass varieties in Kenya are for example;

- Napier French Cameroon
- Napier Bana grass
- Napier Clone 13
- Napier Ouma II
- Napier Kakamega 1
- Napier Kakamega 2 (KK2)
- Napier South Africa
- Napier Gold Coast
- Super Napier Pakchong 1 hybrid
- Giant Juncao grass hybrid



*Napier with several tillers in the red circle*

} The first 3 early varieties



Some varieties of Napier grass in East Africa

# Implements needed before and during planting

- Hoe/Jembe
- Machette/Panga
- Wheelbarrow
- Rope
- Tape-measure or measuring stick (marking the measurements needed).
- Healthy and mature Napier root splits or Napier stem cutting
- Manure (from any livestock), compost or inorganic fertilizer



*A wheelbarrow, Hoe, panga and Napier cuttings*



*Soil mixed with manure*

## Site selection and preparation

Identify portion of land close or centrally located to the cow barn for easy transportation, feeding of cows and easy fertilization from the manure storage area.

Prepare the land by clearing weeds and other crop residues from the previous season.

Cultivate the land using a hoe, ox plough or a tractor pulled chisel plough to aeration the soil, weed control and prepare the land for planting. Do this well before the onset of rains.

This makes it easy to make furrows or tumbukiza holes.



*Land preparation for Napier establishment*

## Planting

Napier can be planted using seeds; however, the production of seeds is not that consistent, the collection part is tough, and regeneration is slow using this method hence the use of vegetative methods to propagate it.

Napier grass is easily planted either using root splits or stem cuttings.

Napier grass can grow very fast.

Napier grass is deep rooted and therefore fairly drought-tolerant.

Napier grass if harvested at a young vegetative stage has soft leaves and stems that are palatable and nutritious to cows

Napier grass yield is high if adequately fertilized and rainfall or irrigation is sufficient.



*Napier seed placing during planting*

### Splitting Napier grass roots (clump) before planting

First cut off the stem and leaves of the entire plant for feeding cows leaving behind at least 2 nodes (at least 10cm) at the top of the soil.

Split and dig out part of the Napier plant using a hoe.

If the clump is too big you may split the roots further to get planting material for propagation elsewhere.

Splitting Napier roots is quite tough hence force will be needed, use a sharp implement like a machette or hoe.

Trim the roots to about 5cm long and if purchasing Napier root splits check that the splits have roots.



*Napier splits*

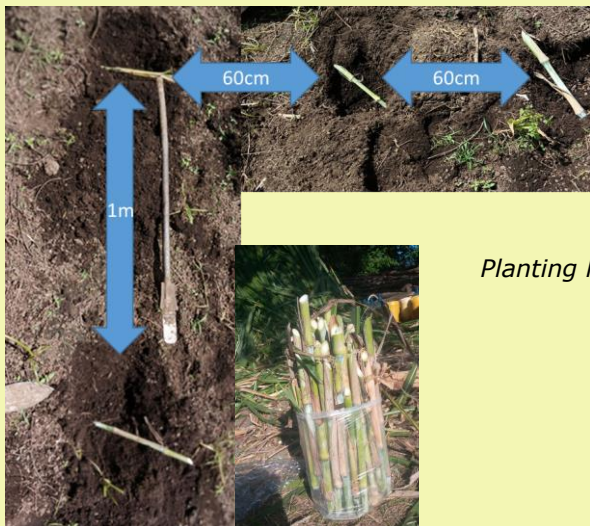
## Steps to follow when planting Napier grass from root splits

On the land that is now well prepared (this includes application of manure before planting), free of weeds and the soil is moist enough to encourage immediate growth.

Measure the distance of the holes from one plant to the other should be at least 60-75cm apart in the line and between one row to the next around be 90 cm-1 meter apart.

Note: Distance between rows is influenced by the growth habit of Napier grass plus the possibility to intercrop with leguminous forage crops in between the rows.

Dig deep holes of 20 cm deep and 20cm wide to accommodate the roots of the Napier grass splits.



*Planting Napier cuttings*

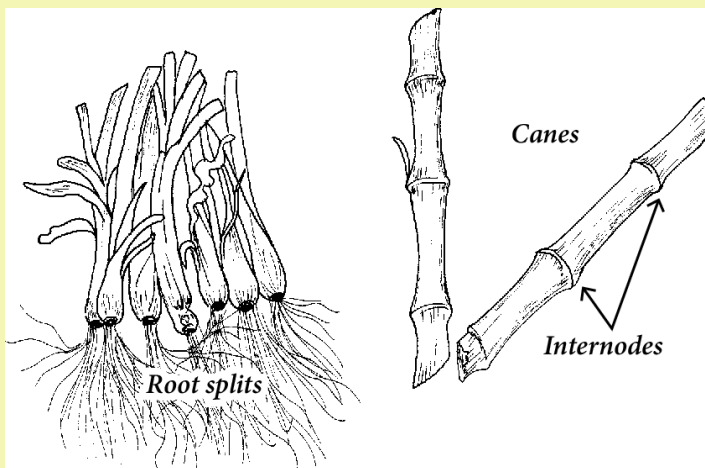
If using inorganic fertilizer when planting place a handful of NPK fertilizer or one teaspoon of triple superphosphate or DAP fertilizer per hole.

Place one napier root split in each hole in an upright manner.

Before adding soil if using dry manure or composted manure add 1-2 handfuls of manure and mix with soil evenly.

Add the soil-manure mixture into the hole while fastening the soil around the root base as you top up the soil continuously. Do this for all the holes.

If the soil is not wet enough and/or has not rained add water to each of the holes to enhance establishment.



*Difference between Napier root splits and Napier canes/cuttings*

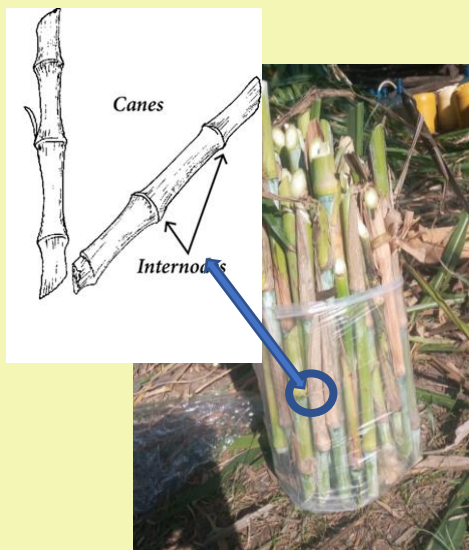
### Preparing stem cuttings from Napier grass before planting

Stem cuttings should be harvested from crops that are 20-28 weeks old (young stems). To enable fast regeneration.

Cut Napier grass stems at ground level and remove all green material

Cut using a sharp panga sections of the stem in slanting position around 30 degree.

Each cutting should have at least 3 nodules and above.



*Napier cuttings*

## Steps when planting Napier grass from stem cuttings

Dig deep holes to accommodate the napier stem cutting of about 20cm deep and 20cm wide.

The distance of the holes from one crop to the other should be at least 60-75 cm apart and between one row to the next around be 90 cm-1 meter apart.

If using inorganic fertilizer when planting place one teaspoon of triple superphosphate or DAP fertilizer per hole.

If using manure or compost mix 1-2 handfuls with soil.



*Preparing harrow line to plant cuttings*

The first thing to confirm is that the stem cuttings should have at least 3 nodes and above

At the tip of the stem cuttings, they should be cut at about 45° slanting angle.

When placing on the ground the nodules (shoots) should be facing upwards, to confirm this you can check to see the direction of dead leaves on the stems. The leaves should be facing upwards.

Place the stem cuttings inside the hole with 2 nodules staying inside the hole and one nodules above the soil in the right manner (nodules facing up) and cover with soil

The two nodules left inside and covered with soil will form roots for the crop while the nodules left outside the hole will turn into shoots for the crop.



*Cutting germinating from a internode*

## Tumbukiza method explained

This methods involves creating pits or basins in which a crop can be planted, this method is commonly used when planting banana trees.

The pit can be circular or rectangular in design.

Dig out pits to a depth of 60cm-1meter with a diameter of 60 cm and the pits should be 60-90cm apart (60cm for circular pits and 90 cm for square pits). The number of pits is depending on land available.

While digging, keep the topsoil separate from the sub soil. Place manure (e.g. a wheelbarrow) in the bottom of the pit. Mix the topsoil with 2 shovels of dry manure and place this on top of the manure in the pit.



Farmers digging pits for Tumbukiza method

Leave out about 15-20 cm of unfilled space at the top of the pit so as to allow water to accumulate and drain to the bottom of the pit.

This method allows better nutrient and water supply to the Napier grass once established.

Place 5-10 stem cuttings or root splits in the pit uniformly to fill out the entire space.

Add some of the remaining soil into the hole covering two nodules of the stem cutting in the hole, compact the soil lightly to ensure the nodules or root splits are in contact with the moisture.

If the soil is not moist or it has not rained enough add water to each of the pits to enhance germination.



*Napier growing under Tumbukiza system*



## Weeding

Weeding of Napier grass can be done in two ways depending on size of the farm and farmers preference, that is:

- Manual weeding
- Chemical weeding

Weeding is done to remove undesirable plants and remove dry root-bound Napier in order to promote re-growth.

In the process soil cover is also provided by the mulch from the uprooted or dead plants after weeding. This will improve water infiltration and reduce soil nutrients and water loss.



*Napier planting with weeds*

## Manual weeding

Manually remove weeds in between Napier grass plants 30-45 days after planting, when weeds start to emerge.

Ensure to hand pick the weeds and remove them from the plot. Before doing so remove all soil particles held by the roots, this helps to avoid the weeds from re-emerging again.

A second weeding is done when the grass is still at young vegetative stage (leaves are 20-40 cm).

After weeding ensure to clean the hoe and other tools used, before keeping the tools in a shaded storage to prevent spread of diseases and maintain tools from rusting, in good shape for a longer period.



*Manual weeding*

## Chemical weeding

Herbicide selected should target broadleaved weeds only. For examples; pig weed and blackjack.

Take caution before buying herbicides from agrovet shops to identify the right herbicide to be used in Napier grass. If the farmer has intercropped Napier grass with other crops such as desmodium, velvet "mucuna" beans or lablab beans the farmer should not use herbicides.

When purchasing herbicides ensure you read the label or inquire from the shop attendant how to use the herbicide (e.g. how to mix, which water to herbicide ratio to use).

The person spraying the Napier grass with the herbicide should wear personal protective equipment (PPE) to protect oneself from exposure to the chemicals, and the chemical mist in the air when spraying.



*Chemical weeding outfit  
(Personal protective equipment)*

# Common diseases affecting Napier grass

Some of the common diseases affecting Napier grass growth are for example:

- Headsmut disease
- Napier stunt disease
- Snow mould fungal disease
- Helminthosporium spp.

We will look at the three most common diseases affecting Napier grass in Kenya that being; headsmut diseases, Napier stunt disease and snow mould fungal disease



*Common diseases affecting Napier grass*

## Headsmut disease

Headsmut which causes *Ustilago kamerunensis* is caused by a fungus. It is a serious problem in central and eastern Kenya regions.

The fungus causing headsmut attack some varieties of Napier like Bana grass, French Cameroon and Clone 13.

Headsmut disease is spread by wind, farm tools, infected plants, water and manure.

Affected crop tend to be thinner, stems are shorter, shoot becomes hard and head turns into a smut.

Plant flowers prematurely and tends to get uprooted easily.



*Napier with a smut head*

## Management of Headsmut disease

Plant resistant Napier varieties against Headsmut disease like Kakamega 1 & 2.

Plant Napier using clean, healthy vegetative materials.

Plant single canes of 3 nodes or root splits in holes in the right spacing. Topdress with 2-3 teaspoons of CAN per stool or with a handful of manure and follow recommended practices to enhance plant vigour of crops for healthy growth.

Weed regularly and uproot diseased Napier grass from the field. After cutting the Napier grass at a minimum residual height of 5 cm avoid the surface of the cut from getting in contact with soil or manure to avoid infection of the plant with fungal diseases.

Avoid feeding cows with Napier grass infected by Headsmut disease and also using manure from cows that have eaten Headsmut infested Napier grass.



*Farmers planting disease-resistant Napier varieties*

## Napier stunt disease (NSD)

Napier stunt disease caused by a bacteria called phytoplasma and transmitted by a leafhopper.

The bacteria stop the grass from taking up nutrients it needs to be able to grow.

The leafhopper feeds from the Napier infected by the bacteria and it is spread through the practise of propagating splits of Napier roots.

Signs of the diseases are seen after harvesting, the grass starts yellowing, stunted growth, unhealthy regrowth and eventually death of the grass.



*Image of a leafhopper on Napier grass*

## Management of Napier stunt disease (NSD)

Grow resistant varieties, for example use of Napier cv South Africa and cv Ouma II.

Use clean and healthy planting materials.

Remove and destroy infected plants.

Practice crop rotation (do not plant a new crop of Napier grass that was previously infected by NSD).

In this case, as an alternative use *Brachiaria* hybrid Mulato II which is resistant to NSD and can be used as a drought-tolerant crop which traps/attracts the leafhopper to avoid infecting the Napier grass.

This method is known as push-pull technology.



*Image of Napier grass with yellow leaves and stunted growth*

## Snow mould fungal disease

This a disease caused by a fungus, this fungus is adapted to cold regions that can experience snow, the fungus stays in the unfrozen soil to be spread when it gets cool.

It is a common disease affecting Napier grass varieties except for the variety Clone 13 causing damage to grass.

The leaves get covered with a fluffy grayish-white mold and the mould later turns brownish-black.

The diseases can be managed with balanced fertilization and when using organic fertilizers or mulch avoid excessive accumulation at the base of the crop.

Cut grass at recommended height and avoid contact with soil.

Apply fungicides before the cold season.



*Image of snow mould fungus*

## Intercropping with leguminous crops

Napier can be intercropped by a number of leguminous crops, like; desmodium, lab lab, cow peas, velvet "mucuna" beans and stylo between the rows of Napier grass.

The function of leguminous crop is multipurpose, to cover the bare soil between the row of Napier plants to avoid evaporation, reduce frequency of weeding, in case of legumes to fix nitrogen from air to benefit Napier grass and prevent soil erosion.

Napier can also be planted along alleys in combination with leguminous fodder trees and shrubs like leucaena, calliandra, sesbania and gliricidia.

Planting Napier grass along contour lines or in alleys, with or without agroforestry trees and shrubs helps in keeping soil erosion under control.



*Example of a legume (Desmodium) that can be intercropped with Napier*

## Harvesting Napier grass

Napier grass is ready for harvesting between 3-4 months after planting when the crop has developed a strong root system.

After the first cut harvesting can continue at 6-8 weeks (50-60 days) interval for 5 years at least.

On average during the rainy season one can harvest:

- 2-3 times during the wet season.
- 1-2 times during the dry season depending on severity of drought.

This is possible under good management which means proper weeding, fertilizer application, right residual height and right stage of harvesting.

If the crop is irrigated the Napier grass can be harvested continuously without growth slowing down during the dry season.



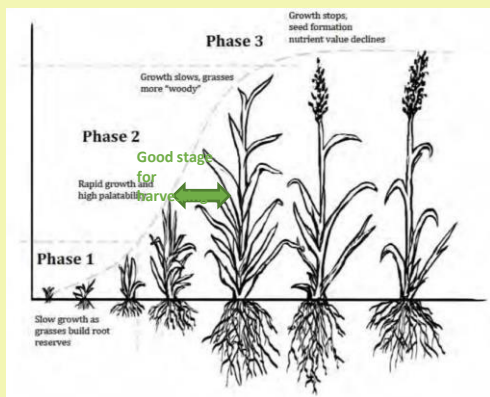
*A farmer harvesting Napier at the vegetative stage*

When harvesting leave behind a stubble height of between 5-10 cm height from the ground for best forage recovery and regrowth.

Harvest Napier grass during the young vegetative stage, when the crop is 60cm- 90cm high.

On average Napier grass can yield between 12,000-25,000 Kgs per hectare of dry matter (this is equivalent to 48,000-100,000 Kgs fresh material per ha.

If harvesting Napier for silage making (ensiling) harvest the grass at young vegetative stage (60-120cm high), to balance the work load and get the optimum ratio between yield per acre and nutritional quality of grass.



*Napier vegetative stages/phases. Recommended to harvest at phase 2*

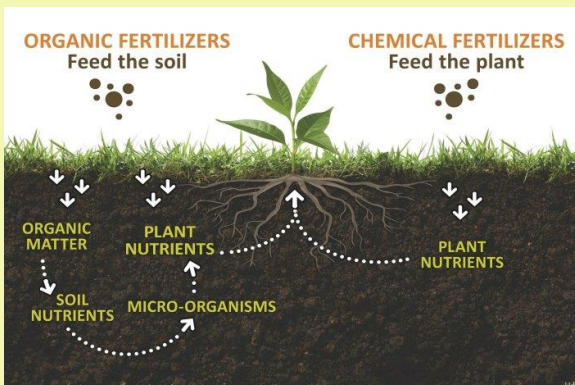
# Fertilizer application and maintaining soil fertility after harvesting

After harvesting Napier the next step is re-fertilization (top dressing) of the Napier grass.

Farmers should not assume that the initial fertilizer application during planting is enough to support re-growth of the Napier grass in years to come. Napier grass after all is a perennial crop.

Fertilizer applications (with organic or inorganic fertilizer) are needed to support the crop to actively regrow at a fast rate as well as depositing minerals that the soil lost because they were absorbed by the plants to support growth.

All fertilizer application should be done when the soil is wet or when rain is expected.



*Relation between the organic and chemical fertilizer*

## Quantities used in Fertilizer application

Topdressing can be done after every second harvest with Nitrogen based fertilizers like CAN. CAN can be applied at a rate of 100 Kg/ha.

Apply manure or compost at a rate of one shovel per hole thoroughly mixed with soil, this is done to avoid losing nitrogen in manure to the environment.

Or dig trenches between the rows of grass and pour liquid manure into the trenches and cover with soil this will be taken up by Napier plant roots.



Example of synthetic fertilizer



Bioslurry being re-directed into the farm using furrows

## Feeding fresh Napier grass

Chop Napier grass into 1-2 cm pieces using a machete, chaff cutter or chopper to encourage feed intake and reduce selection and wastage by animals.

It is not advisable to have animals graze on Napier grass because it grows tall and there is big probability that animals will selectively graze on the grass and damage the crop, after all Napier grass is grown in rows and is not allowed to develop a swath.

Napier grass can be fed fresh or be converted to silage and fed to livestock. Older stems and leaves, grass harvested at late vegetative stage are less palatable for livestock.

Feeding Napier grass cut at the right stage can provide a basal diet with enough forage for livestock.



A Chaff cutter chopping Napier grass into 1-2 cm size chops

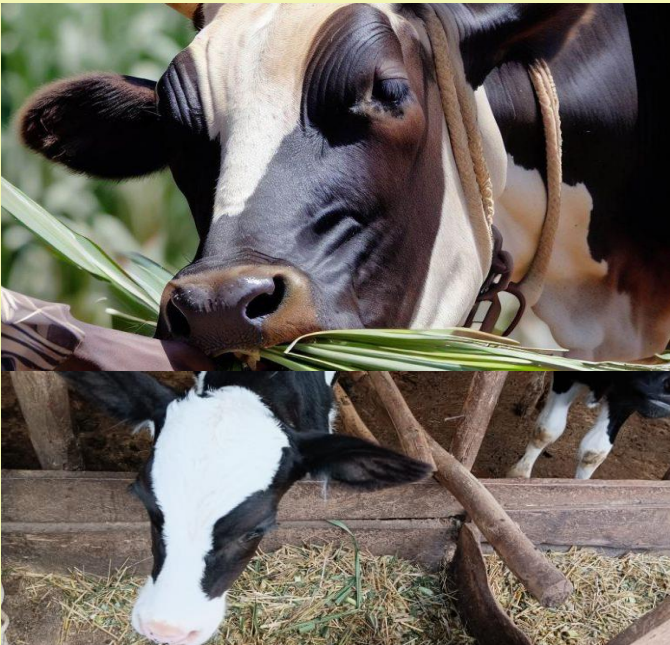
Napier grass is said to contain crude protein between 8-12% and NDF of 575 g/kg DM (early vegetative) and 750 g/kg DM (late vegetative).

A beef cow (East African zebu breed) of average 350 kgs can consume between 30-70 kgs of fresh Napier grass, (the amount as fed depends on fibre content and moisture content) that is;

- Late vegetative Napier grass : 30 kgs
- Early vegetative Napier grass : 70 kgs

During the rainy season Napier grass harvested is more leafy, juicy and nutritive (early vegetative) as compared to the dry season when the Napier is more stemmy and of lower nutritive quality (late vegetative).

Remember that feed intake will even reduce as quality of feed lowers.



*A cow and a calf feeding on Napier grass*

# Harvesting and transportation when ensiling Napier grass

Make sure all equipment's and inputs are readily available( such as; chopper, polythene sheet, molasses, labour force)

Sharpened knives and cutting edges of equipment's enables all the grass to be evenly chopped.

Allow Napier grass, cut at 60-90cm height to pre-wilt between 12-24 hours.

Transport the pre-wilted Napier grass to the area close to the pit for further processing (chopping). The Napier grass field and silage pit should not be far from the homestead/zero grazing unit for ease of transportation when feeding, cost purposes and to facilitate fast ensiling.



*Donkey pulling a cart as a means of transporting Napier*

# Ensiling Napier grass after harvesting

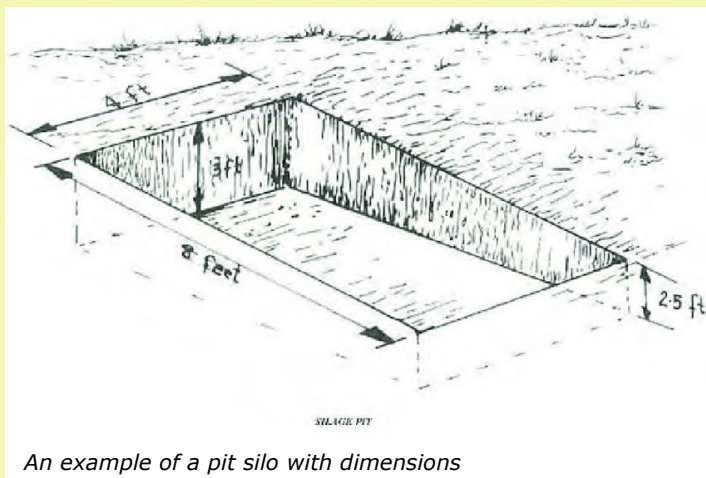
Clear the area where the pit will be made.

## Pit location

The pit location should be dry with no stagnant water, away from animals and/or wildlife, be on a sloping area to avoid water being stagnant near the pit plus it should be near the cow barn for easy feeding.

## Pit dimensions

It is recommended that the pit is narrow and long. The dimensions are influenced by the quantity of grass harvested to be ensiled.



## Chopping Napier grass

Chop the pre-wilted Napier grass into 1-2 cm pieces using a chaff cutter to get finely chopped and sizeable chops, this will aid in compaction and reduce leftovers in the feeding trough.

Inside the silage pit place old polythene sheets at the bottom before to place chopped grass. This is done to avoid mixing chopped grass with soil and old polythene sheet ensures water from chopped grass is lost into the ground

While chopping fill the pit evenly while compacting the chopped grass in intervals after refilling the pit with more chopped grass. At this stage you can add molasses.



*Napier cut to 1-2cm chops*

### Filling and compacting the silage pits

If using a polythene silage bag in the initial filling of the bag with grass use your feet to press/compact the grass evenly while adding more chopped grass.

As the silage bag continues to get filled up it becomes a bit hard to stand on top of the bag for compaction, you can place the bag near a wall or tree for support as you continue compacting the grass.

Compaction is necessary so that air (oxygen) can be removed out of the chopped material before it is sealed and covered.



*Compacting Napier using a drum with water to create pressure*

## Sealing and covering pits

When you seal the pit use a new polythene sheet that covers the pit all round, if a farmer has old polythene in the store use it to cover the new polythene sheet pit to protect the new polythene from accidental damage.

The second layer of old polythene sheet will help protect the new polythene sheet from wear and tear and make it usable for the next season of silage making.

On top of the polythene sheet add soil, this is done to add weight to further compress it, protect the polythene sheet from sunlight & animals and prevent heating up of the silage.

The soil should be evenly placed at around 20 cm of soil cover.



*The Left-hand side is a pit silage silo and the right-hand side is a tube silage silo*

## Feed out of Napier silage

- Silage is ready after 28-42 days, the longer the better so that the fermentation process has stabilized before feeding to livestock.
- Well prepared and sealed silage can be stored for several years without spoiling.
- Once the silage pit or bag is opened it needs to be utilized as fast as possible.
- When removing silage from the pit do this from one direction being the narrowest side of the pit.



*Add weights on top of the tubes to exact pressure silage*

## Feeding Napier grass silage

Maintain feeding speed at feed out and remove at least 1.5m per week, this to avoid heating of the silage face from which this is the area the silage is removed.

Remove all the silage until the bottom and do not leave behind any loose material because it will easily heat up to reduce spoilage.

Cover the opened area (silage face) to avoid rain water making the silage wet which will cause the silage to spoil faster and loose palatability.

A mature cow can feed on silage between 15-35 Kgs per day.



*A cow feeding on a ration with Napier silage*

## The 10 Key messages

1. Use clean and good variety of Napier grass from a known source, to ensure that they are disease-free for a good germination potential.
2. After the germination of the young Napier crops, take a walk through the farm to check any gaps in the rows and fill them with fresh cuttings.
3. Avoid using older stem cuttings as planting material since they will have poor germination.
4. Do not intercrop Napier grass with cereals since it will compete with Napier grass for nutrients and light.



*Young vegetative Napier less than a meter in height*

5. Weed out herbage, grass and other crops from the plot as needed to avoid competition of the weeds with Napier grass.
6. Cut and carry napier grass to feed cows to enable best re-growth of the grass after harvest. When cows graze directly on Napier they may damage and kill the crop.
7. Harvest Napier grass at when the grass is at it's vegetative stage, grass at above 120 cm tend to be more stemmy, with less sugar and leaves. The nutritive value of the grass lower as it continues to grow past mature stage.



*Overgrown Napier grass of over 120 cm of height*

8. When harvesting Napier grass cut grass from 5-10 cm above the ground. Cutting too low may damage the plant too much, causing death of main stem causing new outgrowths to take longer to develop on the sides.
9. Apply fertilizer after each cut and irrigate soil during dry period to support faster re-growth of Napier grass.
10. Napier grass should be controlled in a plot, due to it's rhizome growing characteristics it has the ability to invade crop fields and become aggressive and persistent just like a weed.



## About the ICSIAPL Project

The Integrated & Climate Smart Innovations for Agro-Pastoralist Economies and Landscapes in Kenya's Arid and Semi-arid Lands is (ICSIAPL) is a three-year (2021 –2023) project funded by the European Union (EU) and the Ministry of Foreign Affairs of the Kingdom of the Netherlands (DGIS). It is managed through a delegated cooperation with the Embassy of the Kingdom of the Netherlands (EKN) in Nairobi.

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