EFFECTS OF AGE ON NUTRIENT COMPOSITION OF NAPIER GRASS (UGANDA HAIRLESS AND HAIRY NAPIER GRASS) VARIETIES.

BY

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Project Abstract.

The purpose of the study is to determine how the nutrient composition changes with age in the two Napier grass varieties (Bana grass and Sudan hairless) under natural condition without fertilizer application.

The nutrients under study through proximate analysis included; Ash, Moisture, Ether extract, Crude protein, Crude fibre and nitrogen free extract.

This study therefore aims at providing relevant information to the farmer on the appropriate harvesting dates after establishment when the nutrients are at the optimum level.

The study was conducted at the University of Nairobi College of Agriculture and Veterinary sciences (Kabete Soils).

The grasses were first established then cut at 20cm above the ground and harvesting done at an interval of three weeks for a period of 12 weeks.

The samples were weighed at harvesting, dried and ground for laboratory analysis.

The study results revealed that moisture content decreases with age i.e. Hairy Napier contained 8.0394% moisture at 3 weeks, 5.940% moisture at 6 weeks, 5.76% moisture at 9 weeks and 4.948% at 12 weeks.

The studies showed that Ash decreases with age i.e. Hairy Napier showing 17.25% at 3 weeks, 10.56% at 6 weeks and 10.415% at 9 weeks.

The studies also revealed that crude protein decreases with age i.e. Hairy type Napier grass contained 5.79% crude protein at 3 weeks and 2.17% crude protein. While Hairless contained 4.552% at 3 weeks and 3.12% at 12 weeks.

Based on the results above with consideration to crude protein, Napier grass should be harvested at a period between 5-7 weeks when the protein content is at the optimum level and this helps in the cost reduction as the protein is the most expensive nutrient required by the animals.-

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1.0 INTRODUCTION

1.1 General Introduction

Napier Grass (pennisetum purpuium) is also as "elephant grass." It was named after colonel Napier of Bulawayo in Zimbabwe who early in the last century urged Rhodesia's (Now Zimbabwe) Department of Agriculture to explore the possibility of using it for commercial livestock production (Boon man, 1993)

It is grown extensively in Africa and Asia as a feed crop. High yielding clones for bio energy have been bred from the 1970's onwards in the US. It is the best suited to the production urged of a wet feedstock, for conversion into ethanol, biogas and animal feed (www.newenergyfarms.com/site/Napier.html)

It is also known as Elephant grass or Uganda grass. It is a tall perennial plant growing to about 2- 4.5metres tall and can reach up to 7.5 metres. Some of the higher DM yields reported are 19 MT/ha in Australia, 66 in Brazil, 58 in Costa Rica, 85 in El Salvador, 48 in Kenya, 14 in Malawi 64 in Pakistan, 84 in Pu erto Rico, 76 in Thailand and 30 in Uganda (Duke,1981)

Napier grass produces high biomass yields in most tropical and sub-tropical climates. The leaves of the plant have hairs as a distinctive characteristic with Uganda hairless being an exception.

The plant bare the following characteristics that makes it be a major source of forage to most of the small and medium scale farmers all over the world. (1) Low water and nutrient requirement (2) Can be incorporated into pest management strategy i.e. repelling pests such as stem borer moth, (3) Improve soil fertility, (4) Protects arid land and soil from erosion, (5) Utilized for fire and wind breaks, (6) Utilized in paper pulp production, (7) Recently used in

production of bio-oil, biogas and charcoal (8) High yielding (9) Ease of propagation and management

The importance of Napier grass can be attributed to the role it plays as the major livestock feed in smallholder dairy production systems in Kenya and other parts of the world. Due to high population pressure and average land holding capacity of 0.9-2.0 ha (Gitau et al., 19994) Animals are therefore taken care of under zero grazing and Napier grass mostly used (Staal et al., 1998) Napier grass is the main fodder grown by over 70% of smallholder

Farmers in Kenya and normally provides over 40% of feed (Stots, 1983: Potter, 1987 Bayer, 1990 and Staal et al., 1998).

1.2 OBJECTIVES.

Main objective.

- Evaluation of the effects of age on the nutrient composition of the two varieties of Napier grass (Uganda hairless and hairy Napier varieties)

Other objectives.

- To evaluate the regeneration rate of the two varieties of Napier grass under study (Uganda hairless and Hairy Napier Variety)

2.0 LITERATURE RIVIEW

2.1 Description of Napier grass.

Napier grass (2n – 28) is a robust perennial bunchgrass which can form dense clumps; has large flat leaves that may be 30-90 cm long and up to 3cm broad. It seed yields are usually very low rarely more than 1-2kg/ha Pure Germination Seed. It is therefore established vegetative from stem cutting or crown division. It is heterozygous giving rise to a very heterozygous population of seedlings which are not true to type and the seeds have low genetic stability and viability (Humphrey, 1994) which fostered research efforts to shelve the seeds (Van Gastel, 1978). Seeds are not usually available to farmers, whoever seedling progenies offer opportunities for selection and this is how many famous Napier grass varieties have emerged.

Pennisetum Perpureum is a monocot C4 perennial grass in the Poaceae family, It's tall and forms in a robust bamboo- like clumps. It has high biomass production i.e. 40 tonnes/ha/year and harvested 4-6 times per year, planted through stem cutting of the stolon which are planted by inserting them along furrows 75cm apart both a long and between rows. It is used for stem borer control for various reasons which include (1) Cheap method of control (2) insecticides are infective (3) Insecticides are expensive (4) Chemicals are carried in food. This is generally referred to as push and pulls strategy. Not all varieties of Napier varieties functions as a trap, in a study of eight varieties only two i.e. bana and Uganda Hairless Napier varieties significantly attract female moths for egg placement over maize. Of the two, only bana significantly decreases egg survival rates.

(http://www.push.pull.net).

Description of Napier Grass .

Napier grass varieties available in Kenya for use include (1) French Cameroon, (2) Bana grass, (3) Kakamega I,II,III, (4) Uganda hairless (5) Clone 13 and (6) Pakistan hybrid.

I French Cameroon.

- Has thin stems and not very hairy.
- It is a high yielding variety.

II Ban Grass

- Have a characteristic thick hairy stem.
- It is high yielding variety

III Kakamega I, II, III

- Thin stem
- Tolerant to head smut.

IV Uganda hairless

- Have a characteristic thin hairless stem and narrow leaves.
- It is less yielding
- High susceptible t frost and diseases.

V Clone 13

- Resistant to snow mold and fungal disease.

2.2 Napier Grass establishment

2.2.1 Sources of planting material.

Before the Napier grass is established disease free planting materials should be sourced from KARI – Kakamega, Kitale, Alupe and Muguga. Farmers should contact the nearest Livestock extension officer for further advice while sourcing for planting materials.

2.2.2 Planting.

Planting of the Napier grass should be at the onset of the main rainy season (either canes or splits can be used for propagation. Canes requires less labour and planting materials while splits are labour intensive and requires a lot of planting materials.

2.2.3 Establishment.

The recommended time for establishing Napier grass is at the onset of the long rains while in the medium potential production area it is recommended that they plant during the seasons when they receive reliable rainfall. Land to be used for planting should be well prepared before the planting time. The soil clodes should be pulverised and free from weeds.

2.2.4 Methods of propagation.

2.2.4.1 Cane cutting

2.2.4.2 Root splits

2.2.4.3 Whole cane.

2.2.4.2 Cane Cutting.

This refers to a stem consisting of 3-4 nodes obtained from mature stems; the stems should have grown over 2m high. The middle part should be used and the buds should not be damaged during handling.

2.2.4.2 Root splits.

This refers to uprooted parts of a Napier stool after the leaves/stem have been cut back to 10-15cm, care should be taken during establishment not to damage the roots and the splits should have some roots and soils. Root splits establish faster and require regular rainfall.

2.2.4.2 Whole Cane

This involves utilization of an entire stem as the planting material, the cane is laid end to end in shallow furrows and covered with soil and active buds should be present in the cane.

2.3 Field Practises.

Land should be well prepared before the planting season, the soil clodes should be pulverised and free from weeds at the time of planting, farmyard manure should be worked into the soils as these results to fertile soil and intern increases the Napier grass yield

2.3.1Planting Styles.

Napier grass should be planted in rows; moisture availability and rainfall determine the spacing. Recommendation for high rainfall areas is 90cm by 60cm to 100cm by 50cm while that of low rainfall areas should be 100cm by 100cm or 100cm by 120cm.Planting wholes should be 15-20cm deep for the use of splits and cuttings. Whole canes are to be planted in furrows of 10-15cm deep.

a) **Cuttings**

Cane cutting are placed at an angle of 450 degrees inside the planting holes, at least two nodes should be within the soil, buds of the cutting should face up and not be damaged.

b) **Splits.**

Plantings are placed within the planting holes and firmly covered with the soil.

c) **Cane.**

Canes are laid end to end in the furrow and covered with the soil.

d) Tumbukiza method.

This is a farmer found method appropriate for marginal areas with moisture stress, it can be used in areas that receive high amounts of rainfall.

Advantages of using Tumbukiza methods.

- High yielding than other conventional methods.
- Low weeding frequency.
- High moisture retention.
- Easier to irrigate
- Support higher stocking rate.
- Ideal for dry areas
- Good for water conservation.

Disadvantage of the Tumbukiza Method.

- High initial labour requirement.

2.4Fertilizer use and management

2.4.1Planting time.

One bag of 50kgs of NPK (20:20:0) is applied at planting per acre, one spade full of farmyard manure applied in the planting holes at planting time.

2.4.2 Top dressing.

Apply two bags of 50kg of NPK (20:20:0) per acre in the middle of the long rains, alternatively 30kg of CAN can be applied at the beginning and another 30kg in the middle of the long rains, 40kg of CAN should be applied in the course of the short rains. Slurry (Mixture of dung and urine) can be applied immediately after harvesting in a furrow along the rows of Napier and covered with soil as weeding is also done

2.4.3 Weed control.

After planting a new crop of Napier grass is kept clean of weeds by carrying out a minimum of two weeding (three weeks after planting then 3-4 after the first weeding) before first harvest.

2.5 Diseases and Control.

Napier grass diseases affect the biomass productivity of the grass and this therefore affects farmers by reducing their level of dairy and beef production. The diseases include; (1) Head smut, (2) Napier Stunting disease and (3) snow mould fungal disease.

2.5.1 Head smut.

This is a disease caused by a smut pathogen (Ustilago kamerunensis P & H Sydow).

Infected plants have a characteristic precocious flowering and smutted heads, the infected stems harden and shoot to premature flowering, becoming thin and fibrous rather thin than normal thick and juicy.

Emerging plant stem then become smaller and the total dry matter of the affected crop is drastically reduced.

After 2-3 cutting, the entire stool dries leading to catastrophic decline in biomass.

Control of Head smut.

- Use of resistant varieties (Kakamega I, II, III)
- Obtaining planting materials from crop free from the disease i.e. KARI centres.
- Improvement health of the crop by applying manure and fertilizer.
- Avoid using manure from livestock fed on smut infected plants.
- Observation of routine agronomic measures.

2.5.2 Napier Stunted Disease.

This was a new disease that was first observed in western Kenya in the mid 1990's in Kandayi Division.

The disease has widely has widely spread to other parts mainly the sugarcane growing areas . The disease causes stunting of the grass (hence Napier grass stunting disease –NSD) it is caused by a phytoplasm, 16SrXI strain, a member of the bacteria class Mollicutes (ICSB, 1997). The biomass loss exceeds 70% in the infected plants which is severe constrain to the dairy industry.

The disease is characterised by yellowing of leaves, tiny leaves, shortening of the internodes, proliferation of tillers, decline of vigour, stunting and death of plant. The spread of the disease is caused by leaf and plant hoppers.

Control of Napier stunting Disease.

- Use of clean planting material.
- Uprooting and burning of affected materials.
- Utilization of alternative fodder crops and pastures

2.5.3Snow Mould Fungal Disease

This is a fungal disease caused by Beniowsia spheroidea; it causes white mould on attacked leaves and stems of most Napier grass varieties.

Clone 13 develops from French Cameroon is resistant to the snow mould fungal disease.

The affected Napier grass does not lose the vigour of the plant and feeding the livestock on the diseased leaves has no adverse effect.

Control of Snow mould fungal disease in Napier.

- Use of disease resistant variety
- Use of clean planting materials obtained from KARI
- Observation of routine agronomic practices.
- Avoid using manure from livestock fed on smut infected plants
- Improvement of the crop health by applying manure and fertilizer.

2.6 Harvesting, Utilization and Conservation.

2.6.1 Harvesting.

The first cutting is expected 3-4 months after planting (1m height), at first harvesting it is recommended that the cutting be done at a height of 5cm from the soil to allow for more growth of new shoots.

Cutting intervals usually depends on rainfall availability and the level of management.

Successive harvesting should be done when the crop is 1.5 m. Napier should be cut 5cm from the ground. Expected yields are 20,000 to 40,000 kg of fresh Napier per acre (The yield depends on the level of management).

2.6.2 Utilization.

Napier grass is fed under the cut and curry system, freshly cut Napier grass is left to wilt for a period of 12 hours under shade before chopping is done, The material is chopped into pieces about 5cm long to avoid wastage during feeding.

Requirements for a dairy cow of average live weight of 400kg should be given about 60 kg of fresh chopped Napier grass per day.

2.6.3 Conservation and storage.

Conservation is done when there exists some surplus forage at the right stage of harvesting, ideal method of conservation is by silage making, and it can also be left as standing hay. Methods of silage making include (1) Trench silo (2) Pit silo (3) Tower silo (4) Tube silo. The commonly used methods by most small scale dairy farmers are trench and tube silo.

3.0 MATERIALS AND METHODS.

The study was conducted at the University of Nairobi College of Agriculture and Veterinary Sciences Upper Kabete field station farm where the two Napier grass varieties were established by cutting the existing varieties at 5cm above the ground for regeneration.

The harvesting was done at an interval of three weeks i.e. from 17th October 2013 to 21st January 2014 and samples weighed and field weight determined. The samples were then subjected to oven drying at 60°C equivalent to sun drying for field moisture elimination.

After which the samples were ground using grinding machine ready for the feed analysis process by proximate (manual used was Standard Operation for Proximate Analysis by Dr. Maina) analysis method for determination of various nutrient composition within the different samples.

The total samples analysed were 24 for the hairy Napier and 23 for the Hairless as one sample in one the plots was destroyed at 6th week of age.

Napier grass was established under natural conditions and no treatment was accorded to the grass while at the field i.e. fertilizer application or manure application as this would have affected the nutrient composition.

The obtained data was transferred to excel and graphs showing the results drown.

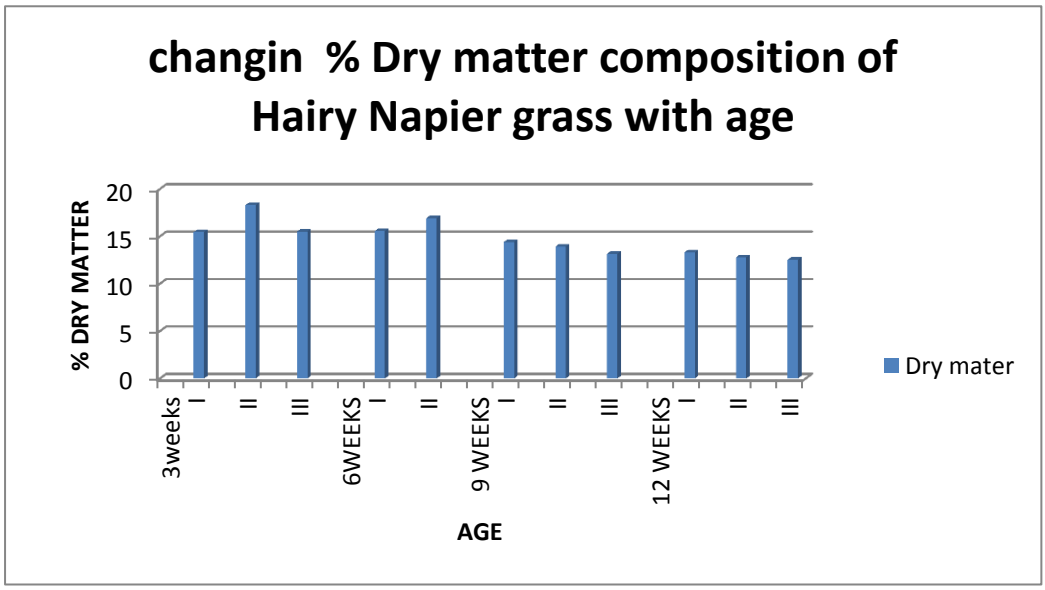
4.0 RESULTS

The samples analysed were 23 and showed different composition of nutrients as the plant ages increases i.e. from three weeks to 12 weeks.

4.1 Effects of age on dry matter composition of hairy Napier grass variety.

Age of the plant	Dry mater
3weeks	
I	15.43359931
II	18.28865469
III	15.50383763
6WEEKS	
I	15.5463941
II	16.9096552
9 WEEKS	
I	14.39813928
II	13.90871159

III	13.15065836
12 WEEKS	
I	13.29929611
II	12.77703679
III	12.51820707



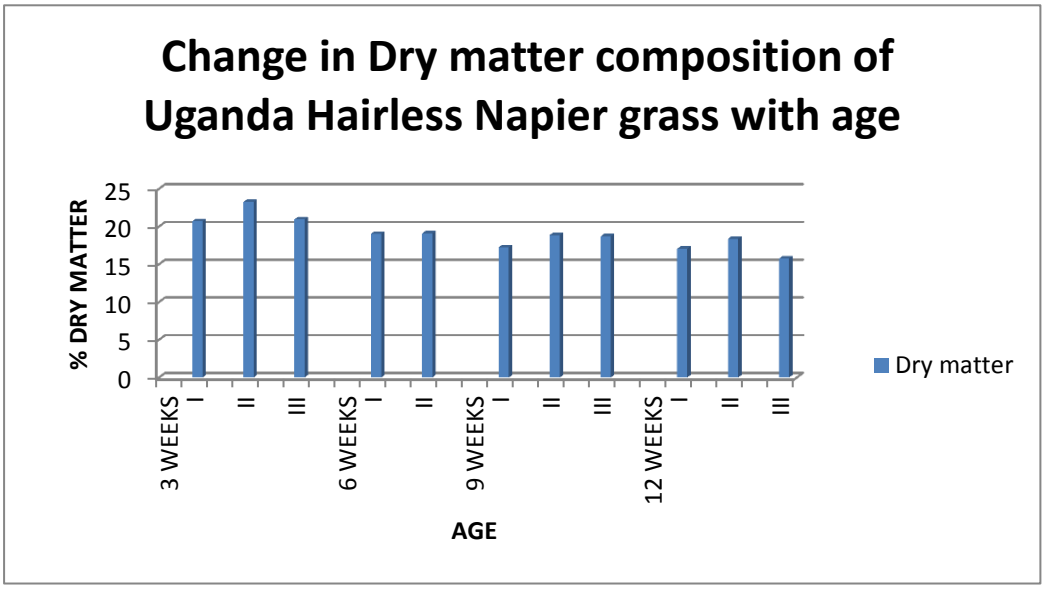
The above table and the bar graph indicated that the dry matter decreased with age.

4.2 Effects of age on dry matter composition of Uganda hairless Napier grass.

The table and the bar graph below indicates the effects of age on the dry matter composition.

Grass Age	Dry matter
3 WEEKS	
I	20.68637275
II	23.24561404
III	20.94291212
6 WEEKS	
I	19.03006239
II	19.07035976
9 WEEKS	
I	17.23408104
II	18.86627907
III	18.68670369

12 WEEKS	
I	17.03197265
II	18.36634674
III	15.7472978



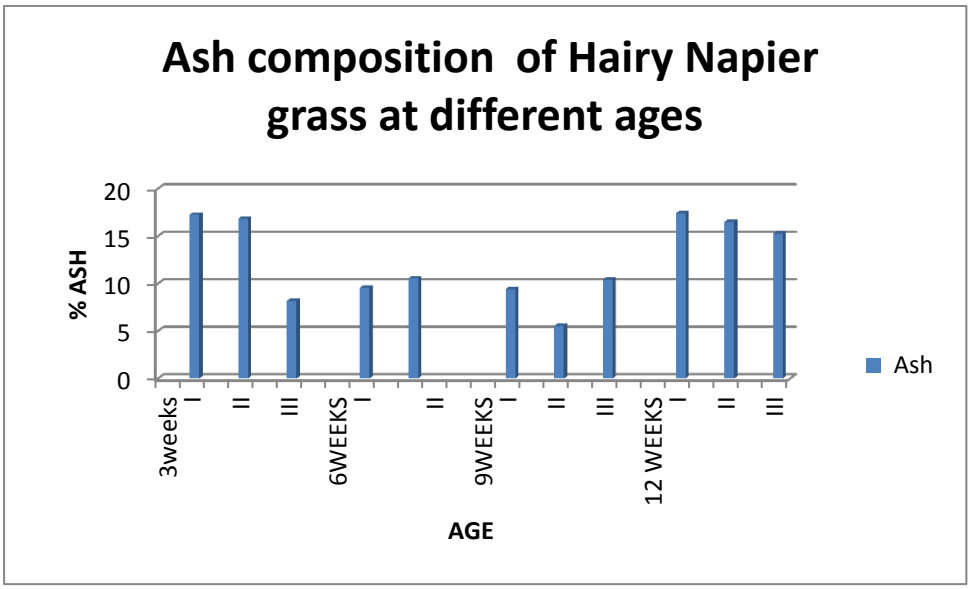
The table and the bar graphs above also indicate the same trend as indicated by the hairy Napier grass i.e. the decrease of dry matter with age increase.

4.3 Effects of age on ash composition of hairy Napier grass.

This is as illustrated by the figure and bar chats below.

Grass age	Ash
3weeks	
I	17.25008
II	16.82305
III	8.18366
6WEEKS	
I	9.557442
	10.55745
II	
9WEEKS	
I	9.411598
II	5.543448
III	10.41545
12	

WEEKS	
I	17.38572
II	16.49371
III	15.2544



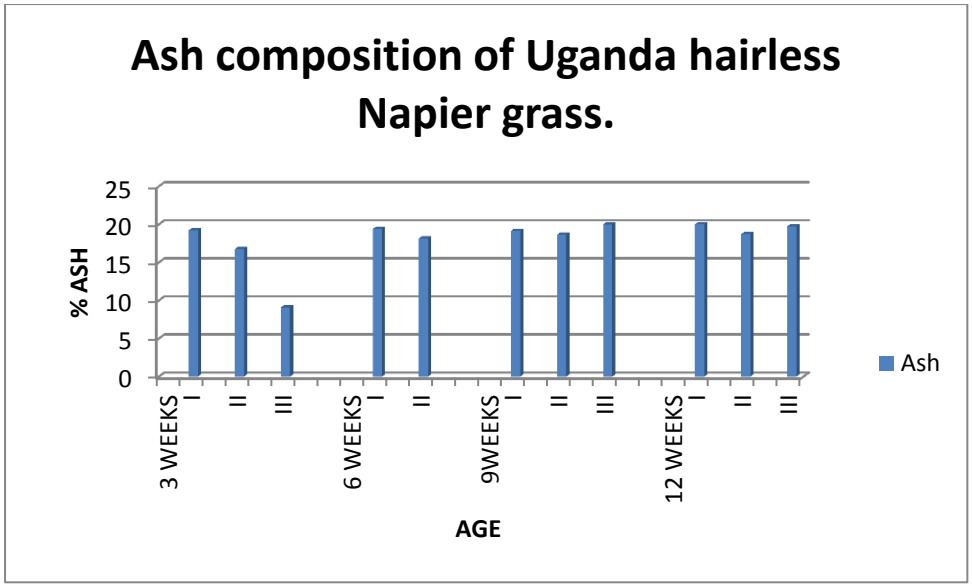
Ash composition was observed to decrease as the plant age increase and high levels at 12th week as a result of the rain experienced at the time of the harvest.

4.4 Effects of age on ash composition of Uganda hairless Napier grass.

The table and the bar graph bellow illustrate the relationship of age and ash composition of Uganda hairless Napier grass variety.

Grass age	Ash
3weeks	

I	17.25008
II	16.82305
III	8.18366
6WEEKS	
I	9.557442
II	10.55745
9WEEKS	
I	9.411598
II	5.543448
III	10.41545
12 WEEKS	
I	17.38572
II	16.49371
III	15.2544



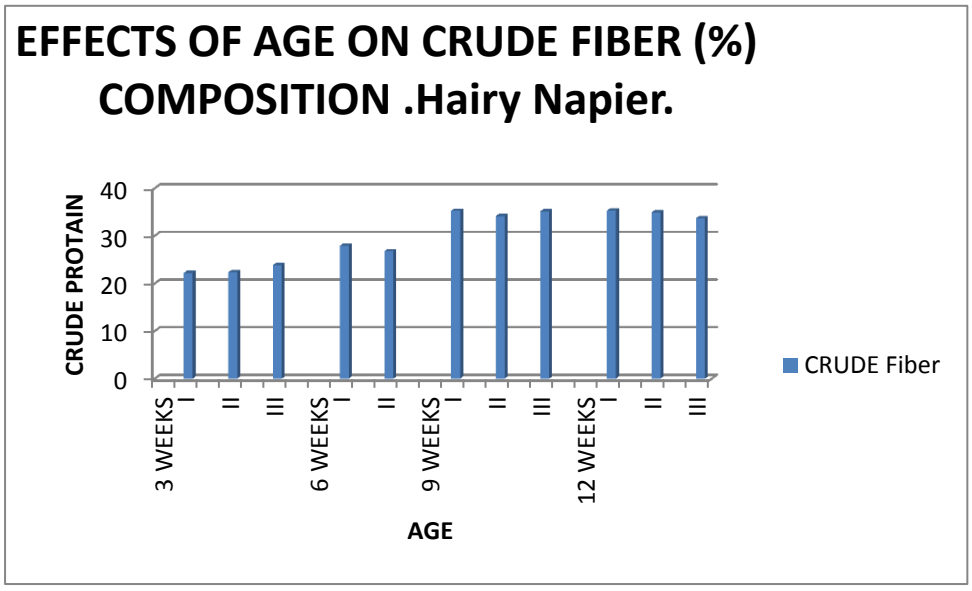
The results above illustrated those ash level decreases with an increase in age.

4.5 Effects of age on crude fiber composition of hairy Napier grass.

The table and the bar graph illustrate the results of the study.

Grass age	Crude Fiber
3 WEEKS	
I	22.2094988
II	22.36787761
III	23.85998506
6 WEEKS	
I	27.91597516
II	26.78539715

9 WEEKS	
I	35.27079806
II	34.13147821
III	35.14706489
12 WEEKS	
I	35.31580175
II	34.92315391
III	33.70603482

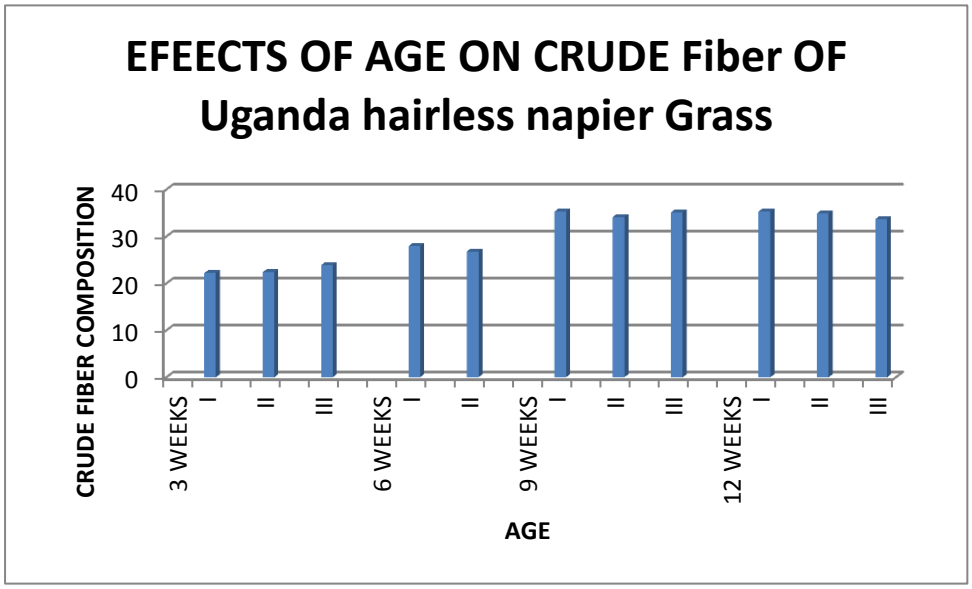


The above results indicate that crude fiber increases with age.

4.6 Effects of age on crude fiber composition of Uganda hairless Napier grass.

Grass age	Crude Fiber
3 WEEKS	
I	25.43135432
II	26.19884031
III	26.59381691
6 WEEKS	
I	26.65969534
II	26.83227112
III	26.33168821
9 WEEKS	
I	31.50955874
II	32.67484698
III	31.34297194
12 WEEKS	
I	40.82790324
II	39.15747242

III	33.52329039



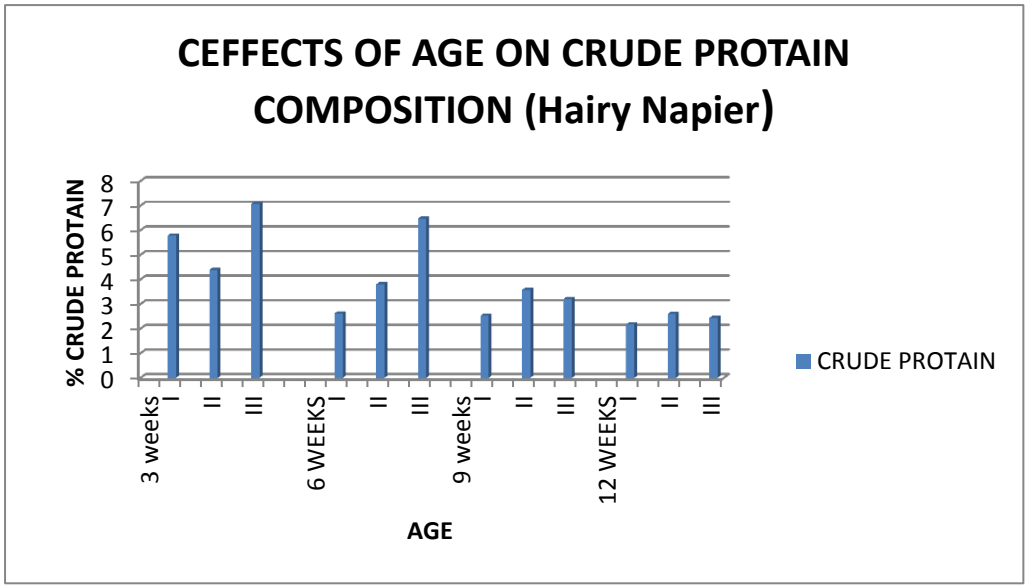
The above results also indicate that ash increases with age.

4.7 Effects of age on crude Protein. (Hairy Napier Grass)

The table and the graph bellow illustrates on the results.

Grass Age	CRUDE PROTAIN
3 weeks	
I	5.785746227
II	4.387826867
III	7.062398145
6 WEEKS	

I	2.618572619
II	3.803073789
III	6.46691998
9 weeks	
I	2.518312273
II	3.572272036
III	3.206246078
12 WEEKS	
I	2.170626677
II	2.594616093
III	2.434502744



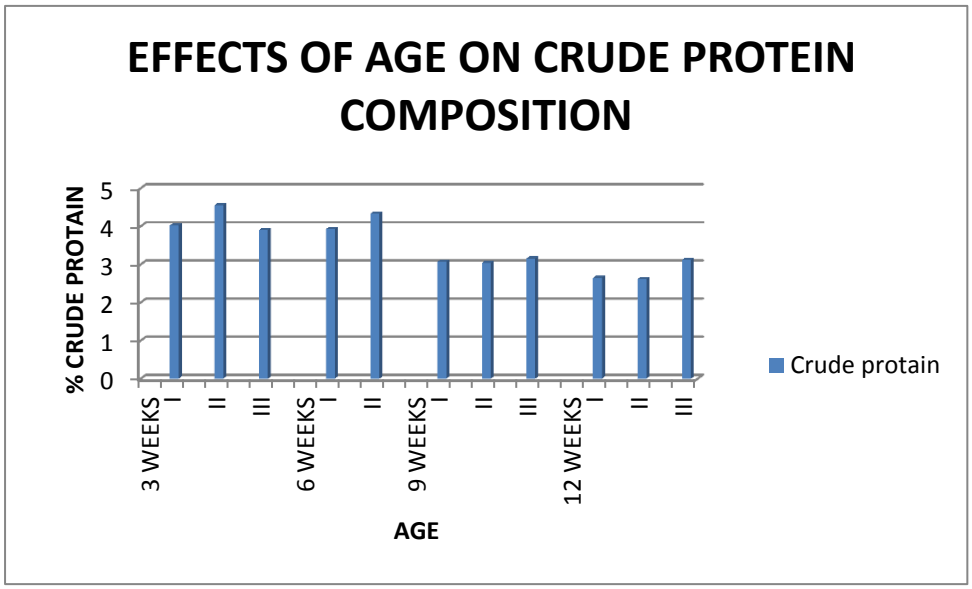
Protein level was observed to be high at the first week and decreased as the grass matures

4.8 **Effects of age on crude protein composition. Uganda hairless Napier**.

This is illustrated by the following table and the bar graph bellow.

Grass age	Crude protain
3 WEEKS	
I	4.022280081
II	4.551558818
III	3.903040048
6 WEEKS	
I	3.92855582
II	4.335071637
9 WEEKS	
I	3.070283284
II	3.036314598

III	3.154702769
12 WEEKS	
I	2.647866709
II	2.615597237
III	3.120689909



The above also illustrated that protein composition was high at the first week of grass growth and decreases thereafter

Discussion.

From the above illustrated results from the study Hairy Napier grass reported the highest protein content at the first three weeks this justifies why it's highly grown by farmer throughout the country.

Based on the results above, the best harvesting age should be 6 – 8 weeks when the nutrients are at the optimum concentration.

Uganda hairless was observed to have a higher regeneration power as compared to Hairy Napier grass variety.

CONCLUSSION

Napier grasses being the most source of feed to the zero grazing farming in Kenya where the animals are fed through cut and carry method should thus be well established and properly fertilised to increase its productivity which will intern increase the livestock production. This can be achieved through various means i.e. top dressing, use of organic manure and proper field establishment.

RECOMMENDATION

1. From the study which involved no fertilizer treatment, no irrigation and any other growth promoters indicated low herbage yield and this reduces the feed amount available to the livestock and this lowers productivity. Farmers are therefore encourages to apply either the organic and in organic fertilizers to enhance herbage yield which will intern increase animal productivity due to increases biomass production.
2. Napier grass should be harvested at the early stages of growth i.e. 6-8 weeks when the nutrients such as crude protein are at their optimum.
3. Sources of errors encountered in the laboratories during the analysis of the various proximate feed components should be minimised as much as possible as this may lead to unreliable and incorrect results. This can be achieved through the use of the chemicals at their correct concentration and correct amounts.

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