# EFFECT OF VARYING LEVELS OF ORGANIC FERTILISERS ON DRY MATTER YIELD AND CHEMICAL COMPOSITION OF NAPIER GRASS (*PENNISETUM PURPUREUM*) GROWN AT UNISWA FARM, LUYENGO CAMPUS

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## ABSTRACT

*Planted pastures are essential in dairy production. They ensure constant supply of high quality feed supply. They, however, require high inputs of fertilisers and most small scale farmers cannot afford the high prices of commercial fertilisers. Thus it is essential to explore the use of relatively cheaper organic fertilisers. This study was conducted to determine the dry matter yield and chemical composition of Napier grass using varying levels of cattle manure from grazing dairy cows supplemented with silage and dairy meal and chicken manure from layers. A randomized complete block design (CRBD) was used. There were 12 treatments replicated four times. Treatments consisted mainly the use of different levels of cattle manure used as basal fertiliser and of two levels of chicken manure, 5 t/ha and 10 t/ha used as topdressing fertiliser. Treatment one -negative control where neither cattle manure was added as basal fertiliser nor chicken manure added as topdressing fertiliser; treatment two- no basal fertiliser added but 5 t/ha of chicken manure added as topdressing fertiliser; treatment three – no addition of cattle manure as basal fertiliser but addition of 10 t/ha of chicken manure as topdressing fertiliser; treatment four - addition of 5 t/ha of cattle manure as basal fertiliser and 5 t/ha of chicken manure as topdressing fertiliser; treatment five - addition of 5 t/ha of cattle manure as basal fertiliser and 10 t/ha of chicken manure as topdressing fertiliser; treatment six - addition of 10 t/ha of cattle manure as basal fertiliser and 5 t/ha of chicken manure as topdressing fertiliser; treatment seven - addition of 10 t/ha of cattle manure as basal fertiliser and 10 t/ha of chicken manure as topdressing fertiliser; treatment eight - addition of 15 t/ha of cattle manure as basal fertiliser and 5 t/ha of chicken manure as topdressing fertiliser; treatment nine - addition of 15 t/ha of cattle manure as basal fertiliser and 10 t/ha of chicken manure as topdressing fertiliser; Treatment ten- addition of 20 t/ha of cattle manure as basal fertiliser and 5 t/ha of chicken manure as topdressing fertiliser; treatment 11 - addition of 20 t/ha of cattle manure as basal fertiliser and 10 t/ha of chicken manure as topdressing fertiliser; treatment 12 was the positive control where 500 kg/ha of commercial fertiliser was used as basal fertiliser and 800 kg/ha of limestone ammonium nitrate (LAN) was added in three splits as* *topdressing fertiliser. Dry matter yield of Napier grass was significantly (P<0.05) higher in the treatment that used recommended fertiliser and in the treatment with 15 t/ha of cattle manure added as basal fertiliser and top-dressed with 5 t/ha of chicken manure. Chemical composition was significantly higher (P<0.05) in treatments that received 20 t/ha cattle manure added as basal fertiliser with topdressing of 5 t/ha chicken manure, and also 20 t/ha cattle manure basal fertiliser with topdressing of 10 t/ha chicken manure. In Napier grass production, to receive dry matter yields from organic fertilisers comparable to commercial fertilisers, farmers must apply at least 15 tonnes per ha of cattle manure as basal and top-dress with 5 tonnes per ha of chicken manure.*

## INTRODUCTION

Dairy farming plays an important role in the production of milk and income generation. Milk is essential for human nutrition and health; it is a nutritious and cost effective source of proteins, minerals and vitamins (Bayly, 2011). Milk production from the national dairy herd is about 6 million litres of milk in comparison to 61 million litres that is required in the country annually (Swaziland Dairy Board, 2003). The deficit stands at 42.65 million litres of milk. One major constraint in dairying is less availability of forage together with its poor quality resulting in low productivity of dairy animals (Premaratne and Premaral, 2006). In order to maximise milk production, it is essential to feed dairy animals with high quality green fodder. Thus it is necessary for a farmer to first secure a well-established cultivated pasture. Cultivated pastures provide forage during periods of greatest feed shortage in the forage flow programme and also high quality green forage during winter months (Tainton, 2000). Although it is expensive to establish and maintain cultivated pastures, especially land preparation, buying the necessary inputs such as seed, fertiliser, fences, and maintenance, the farmer benefits from high returns.

In Swaziland, the commonly grown warm season perennial grass species include Kikuyu grass (*Pennisetum clandestinum*), Guinea grass (*Panicum maximum*), Rhodes grass (*Chloris gayana*), Weeping love grass (*Eragrostis curvula*), Star grass (*Cynodon nlemfuensis*) as well Turf Bahia grass (*Paspalum notatum*). On the other hand, winter season grass species are Rye grass (*Lolium multiflorum*) and Oats (*Avena sativa*). Napier grass (*Pennisetum purpureum*) is another perennial warm season grass species that dairy farmers can grow. The cultivation of this grass species is not extensively practised in the country yet it can provide fodder for dairy animals throughout the year. Napier grass is palatable and high yielding. It can yield up to 73 tonnes dry matter per hectare per year in the third season following establishment (Chandy, 2012). It is most popular in Kenya and is intensively managed for smallholder crop-livestock system where 80% of the national milk output is produced (Nyambati *et al.*, 2012). It can be intercropped with forage legumes such as Greenleaf Desmodium (*Desmodium intortum*), Silverleaf Desmodium (*Desmodium uncinatum*) and Lablab (*Lablab purpureus*) to meet animal nutrient requirements (Bayle, 2007). Napier grass is a heavy feeder, that is, it requires a lot of inorganic fertiliser and adequate irrigation to produce high yields. However, smallholder farmers cannot afford the high prices of commercial fertilisers.

In other countries, dairy farmers grow Napier grass using organic farming. According to Nawa (2005), organic farming involves recycling nutrients and strengthening natural processes that help to maintain long term soil fertility and ensure successful production. In this type of agriculture, dairy farmers can utilise the different types of organic manures such as poultry, sheep, goat, and cattle manure. In Swaziland almost every household keeps these types of animals, thus farmers have access to organic manure. Organic fertilisers are readily available to most farmers if not all, and are relatively cheaper and affordable. The use of organic fertilisers to produce Napier grass can ensure that farmers have adequate feed for their animals throughout the year. This has a potential of improving and increasing milk production both at farm and national level at relatively low production cost. Studies by Dlamini (2010) and Ndlandla (2011) indicate that the use of organic fertilisers can significantly increase dry matter yield of Napier grass. If this type of agriculture can be practised by small-holder farmers, it can be a breakthrough in their effort to minimise production costs and at the same time increasing milk yield. It has the potential to solve the problem of shortage of fodder during the dry season (Swaziland Dairy Board, 2009).

The main purpose of this study was to explore the use of organic fertilisers which are cheaper and affordable to most dairy farmers in order to rectify the problem of high prices of commercial fertilisers. The use of cattle and chicken manure to successfully cultivate Napier grass was investigated in this study. The study sought to identify the optimum level of organic fertiliser application that would produce the highest yield of Napier grass and chemical composition, and also increase and maintain milk yield at minimum production cost possible throughout the year. The specific objectives of the study were to determine the dry matter yield of Napier grass and nutrient content in terms of crude proteins (CP), crude fibre (CF), ether extract (EE), ash and (OM) in three successive cuttings.

## MATERIALS AND METHODS

### Experimental site

The study was conducted during the growing season of November 2012 and March 2013 at the UNISWA Farm, Luyengo campus. It is in the Middleveld agro ecological zone, $20^{0}$34'S, $31^{0}$12'E, at an altitude of 750 m above sea level. The mean annual rainfall is 980 mm, and the rainy season usually occurs from October to March. The average minimum and maximum temperatures are $11^{0}$ C and $23^{0}$ C respectively. The area has sandy loam soils (Ministry of Agriculture and Cooperatives, 2004).

### Research design and procedure

The experimental design was a complete randomized block design (CRBD) with four replications. There were 12 treatments, and a total of 48 plots. Each treatment was randomly assigned to a plot of 9 $m^2$ (3 m X 3 m), and the plots were 0.5 m apart. Treatments that were used in this study were mainly the use of different amounts of cattle manure as basal fertiliser, from grazing dairy cows supplemented with silage and dairy meal, and two levels of chicken manure from layers as topdressing fertiliser. The disposed cattle manure heaps were found next to the silage feeding shed. The chicken manure was disposed next to the piggery unit. There was also a negative control (no form of any fertiliser) and a positive control which consisted of the recommended commercial fertiliser application rate (Table 1).

Table 1. Treatments that were used in this study.

| Treatments | Cattle manure (tonnes/ha) | Chicken manure (tonnes/ha) |
|---|---|---|
| 1 (Negative control) | 0 | 0 |
| 2 | 0 | 5 |
| 3 | 0 | 10 |
| 4 | 5 | 5 |
| 5 | 5 | 10 |
| 6 | 10 | 5 |
| 7 | 10 | 10 |
| 8 | 15 | 5 |
| 9 | 15 | 10 |
| 10 | 20 | 5 |
| 11 | 20 | 10 |
| 12 (Positive control) | 500 kg/ha 2:3:2(22) | LAN 800 kg/ha (28%N) |

## Soil and manure testing and fertiliser application

Soil samples from the study field and manure samples from storage heaps, were collected for chemical analysis and sent to the soil testing unit (Soil Testing Laboratory) at the Malkerns Research Station.

Varying levels of cattle manure were uniformly broadcasted in different plots and were incorporated into the soil at a depth of 15-20 cm. This was done two weeks before planting to allow the manure to decompose and release nutrients into the soil for plant uptake. The compound basal fertiliser was applied at the rate of 500 kg /ha on the day of planting.

For topdressing of Napier grass, limestone ammonium nitrate (LAN) and chicken manure were applied using a side dressing method. In case of chicken manure, application rates of 5 and 10 tonnes per hectare were applied in different treatments except for the negative and positive control treatments. In side dressing using chicken manure, a 10 cm deep trench was dug along one side of the row, taking care not to disturb roots (Griffiths, 2011). Manure was applied and gently mixed with the soil to minimise burning effect; it was covered and this was followed by irrigation. Limestone ammonium nitrate was only applied in the commercial fertiliser treatment (positive control) at the rate of 800 kg/ha. The N fertiliser application was split into three, the first split at four weeks after planting, the second and third splits soon after first and second cuttings respectively.

## Planting and harvesting

Stem cuttings consisting of three nodes with active buds were used as planting materials. Two nodes were buried underground while one remained above ground. The inter-row and intra-row spacing were 0.5m. Sprinkler irrigation of Napier grass plots was done soon after planting.

First cutting was performed on the $9^{th}$ week of planting and subsequent cuttings were at five-week interval. A sickle was used to cut the fresh grass sample within a 1 m X 1 m metal quadrat. The stubble height for regrowth was 15cm (Ansah *et al.*, 2010). Herbage yield was determined by drying the plant material at 105 $^{o}$C (AOAC, 1990) to a constant weight and then weighing. Sub-samples of about 500 g from each of the three cuttings were kept and eventually pooled together for dry matter determination and nutrient analysis.

## Laboratory analysis

Dried samples were ground and allowed to pass a 2 mm sieve using a Wiley laboratory mill. Nitrogen was analysed using the Kjeldal method as outlined in AOAC (1990). The nitrogen percentage was then multiplied by 6.25 to get a protein content of the feed. Ash was determined by ignition of known weight of feed at 600°C until all carbon was removed. The residue was ash (McDonald *et al*., 2002). Organic matter value was calculated by subtracting ash percentage from 100. Crude fibre was determined by boiling in dilute acid and base, filtering, drying and burning in a furnace. The weight difference in weight before and after burning was the crude fibre. Ether extract was determined by subjecting the feed to continuous extraction with petroleum ether for a defined period. The residue after solvent evaporation was the ether.

### Statistical analysis

Data on dry matter and chemical composition were subjected to analysis of variance (ANOVA) using the generalised linear models (GLM) procedures of SAS (1990). The probability difference (pdiff) in the least squares means statements of the GLM was used to separate means. The statistical model used in this experiment was as follows:

$Y_{ij} = \mu + T_i + B_i + e_{ij}$

Where:

$Y_{ij}$ is the dependent variable (dry matter yield, dry matter content, crude protein and crude fibre), $\mu$ is the overall mean, $T_i$ is the treatment effect, $B_i$ is the block effect, and $e_{ij}$ is the residual error.

## RESULTS AND DISCUSSION

### Soil and manure analysis

Results of soil and manure analysis are shown in Table 2. The soil was analysed for nitrogen, phosphorous and potassium, pH and exchangeable acidity.

Table 2. Soil and manure analysis results.

| | Values | | |
|---|---|---|---|
| Parameter | Soil | Chicken manure | Cattle manure |
| N (%) | 0.68 | 2.6 | 2.2 |
| P (mg/kg) | 10 | 14 | 19 |
| K (mg/kg) | 297 | 1654 | 1800 |
| pH ($H_2O$) | 6.0 | 8.5 | 8.3 |
| Exchangeable acidity (meq./100) | 0.1 | 0.1 | 0.1 |

## Dry matter yield and chemical composition

Table 3 shows the effect of varying levels of cattle manure and chicken manure on dry matter yield and chemical composition on three consecutive cuttings of Napier grass.

Table 3. Effects of varying levels of cattle manure and chicken manure on dry matter yield and chemical composition of Napier grass.

| Treatment[1] | DMY (t/ha) | DM (%) | CP (%) | CF (%) | EE (%) | ASH (%) | OM (%) |
|---|---|---|---|---|---|---|---|
| 1 | 8.25$^{f}$ | 90.98$^{b}$ | 8.79$^{e}$ | 29.62$^{ab}$ | 2.37$^{ab}$ | 14.78$^{a}$ | 85.22$^{e}$ |
| 2 | 9.59$^{ef}$ | 91.94$^{a}$ | 9.07$^{de}$ | 29.39 $^{ab}$ | 2.39$^{ab}$ | 13.91$^{b}$ | 86.11$^{d}$ |
| 3 | 9.52$^{ef}$ | 92.07$^{a}$ | 9.24$^{cde}$ | 30.21$^{ab}$ | 2.48$^{ab}$ | 13.05$^{ed}$ | 86.96$^{abc}$ |
| 4 | 10.99$^{cd}$ | 91.98$^{a}$ | 10.18$^{ab}$ | 30.28$^{ab}$ | 1.72$^{c}$ | 13.44$^{cbd}$ | 86.56$^{bcd}$ |
| 5 | 11.80$^{bc}$ | 92.48$^{a}$ | 10.14$^{b}$ | 30.43$^{a}$ | 2.08$^{bc}$ | 13.71$^{bc}$ | 86.30$^{cd}$ |
| 6 | 10.24$^{de}$ | 92.23$^{a}$ | 10.15$^{b}$ | 30.66$^{a}$ | 2.38$^{ab}$ | 13.33$^{cbd}$ | 86.68$^{bcd}$ |
| 7 | 10.66$^{cde}$ | 92.18$^{a}$ | 10.19$^{ab}$ | 28.92$^{b}$ | 2.21$^{ab}$ | 13.25$^{cbd}$ | 86.75$^{bcd}$ |
| 8 | 12.65$^{b}$ | 91.94$^{a}$ | 9.78$^{bcd}$ | 30.45$^{a}$ | 2.01$^{bc}$ | 12.88$^{cde}$ | 87.13$^{ab}$ |
| 9 | 11.64$^{bc}$ | 92.60$^{a}$ | 10.00$^{b}$ | 29.38$^{ab}$ | 2.24$^{ab}$ | 12.66$^{de}$ | 87.38$^{ab}$ |
| 10 | 10.56$^{cde}$ | 92.23$^{a}$ | 10.25$^{ab}$ | 30.23$^{ab}$ | 2.28$^{ab}$ | 13.10$^{bcd}$ | 86.90$^{bcd}$ |
| 11 | 11.48$^{cd}$ | 91.03$^{a}$ | 9.88$^{bc}$ | 30.28$^{ab}$ | 2.48$^{ab}$ | 12.27$^{e}$ | 87.73$^{a}$ |
| 12 | 14.92$^{a}$ | 92.40$^{a}$ | 10.88$^{a}$ | 30.32$^{ab}$ | 2.58$^{a}$ | 12.62$^{de}$ | 87.36$^{ab}$ |
| SEM[2] | 0.499 | 0.310 | 0.259 | 0.259 | 0.175 | 0.296 | 0.295 |

**[1]**The results are from analysis of pooled data from three successive cuttings

**[a-g]** Means within the same column followed by different superscripts differ significantly($P<0.05$).

[1]Treatments: 1- Negative control (no form of fertiliser applied). 2- Zero cattle manure with 5t/ha chicken manure. 3- Zero cattle manure with10 t/ha chicken manure. 4- 5t/ha cattle manure with 5t/ha of chicken manure. 5- 5t/ha cattle manure with 10t/ha chicken manure 6- 10t/ha cattle manure with 5t/ha chicken manure. 7- 10t/ha cattle manure with10t/ha chicken manure 8- 15t/ha cattle manure with 5t/ha chicken manure. 9- 15t/ha cattle manure with 10t/ha chicken manure. 10- 20t/ha cattle manure with 5t/ha chicken manure. 11- 20t/ha cattle manure with 10t/ha chicken manure. 12- Positive control (commercial fertiliser, 500 kg/ha of 2:3:2 [22] compound fertiliser applied at planting and 800 kg/ha LAN for topdressing in three splits)

SEM-Standard error of the mean

DMY=Dry matter yield CP=Crude protein CF=Crude fibre OM=Organic matter. EE=Ether extract.

LAN= Limestone Ammonium Nitrate.

**Dry matter yield (DMY)**

There were significant (P<0.05) differences in dry matter yields among treatments. The treatment that received recommended amount of commercial fertiliser (500 kg 2:3:2 [22] per ha of basal fertiliser and topdressed with 800 kg/ha of LAN had a significantly (P<0.05) higher dry matter yield (14.9 t/ha) than all the other treatments. It was closely followed by the treatment in which 15 tonnes per ha of cattle manure was applied at planting and top-dressed with 5 tonnes per ha of chicken manure (12.65 t/ha). However, this treatment did not differ significantly from the treatment in which 5 tonnes per ha of cattle manure was applied at planting and top-dressed with 10 tonnes per ha of chicken manure, and the treatment in which 15 tonnes per ha of cattle manure was applied at planting and top-dressed with 10 tonnes per ha of chicken manure. The treatment that did not receive any form of fertilizer (negative control) had the lowest (P<0.05) dry matter yield of 8.25 t/ha. The treatment that had the lowest dry matter yield was the one in which no form of fertiliser was added (the negative control). This treatment did not differ from treatments in which no cattle manure was applied at planting but only received 5 and 10 tonnes per ha of chicken manure as topdressing fertiliser.

The treatment that received 20 t/ha of cattle manure at planting and top-dressed with either 5 t/ha or 10 t/ha of chicken manure (10.56 and 11.48 t/ha) respectively, did not result in higher Napier grass dry matter than the treatment in which 15 t/ha of cattle manure was applied at planting and top-dressed with 5 t/ha of chicken manure (12.65 t/ha). This needs to be verified in another study if this is an indication of fertiliser toxicity at 20 t/ha. Topdressing Napier grass either with 5 or 10 tonnes per hectare without the addition of basal fertiliser did not result in significant increase in dry matter yield. This may be an indication that a farmer needs both basal and topdressing fertiliser to significantly increase dry matter yield of Napier grass. In cases where a farmer cannot afford commercial fertlisers, the rate of 15 tonnes per ha of cattle manure as basal fertiliser and top-dressed with 5 tonnes per ha of chicken manure can be used to produce dry matter yield close to that obtained from the use of commercial fertilisers. In cases where farmers have insufficient amounts of organic fertilisers, rates of at least 5 tonnes per ha of cattle manure basal fertiliser, top-dressed with 5 tonnes per ha of chicken manure can be used to significantly increase dry matter yield. Bayble *et al*. (2007) stated that in a well-established crop the first cut is ready in 60 days, and subsequent cuttings are taken approximately at an interval of 30-45 days, that is about 8 cuttings/ year for 3-5 years. They further reported that with good management, 12-25 tonnes/ha of dry matter yield can be harvested per year. In this study, dry matter yield ranged from 8.25 to 14.9 t/ha in three cuttings. With eight cuttings per year the values might have been higher; this needs to be verified in other studies.

**Crude protein content**

There were significant (P<0.05) differences in crude protein content among treatments. The treatment that received recommended commercial fertiliser rate had a significantly (P<0.05) higher crude protein content (10.9 %) than all the other treatments but it did not differ from treatments in which 20, 10 and tonnes per ha of cattle manure was applied at planting and top-dressed with 5, 10 and 5 tonnes per ha of chicken manure respectively. On the other hand the treatment that did not receive any form of fertiliser had a significantly (P<0.05) lower crude protein content (8.8 %) than the other treatments. However, this treatment did not differ from treatments which only received 5 and 10 tonnes per ha of chicken manure for topdressing but no basal fertiliser at all during planting. Results of this study indicate that the use of at least 5 tonnes per ha of cattle manure as basal fertiliser and top-dressed with 5 tonnes per ha of chicken manure can significantly increase crude protein content in Napier grass. Crude protein values in this study are comparable with those found in other studies (Göhl, 1982). A study covering all main Napier grass growing areas in Kenya (FAO, 2012; Göhl, 1982) showed that the mean CP level on farms was 76 g/kg DM (7.6%). Results from other parts of the world as summarised by (Göhl, 1982) and from Kenya indicate that the CP values commonly recorded for Napier grass lie between 50 and 90 g/kg DM (5-9 %). Crude protein is one of the critical nutrients in dairy production. In all the treatments, crude protein content was above the critical value of 7 % which is necessary for voluntary feed intake in ruminants (Ansah *et al.,* 2010). The 20 t/ha cattle manure-5 t/ha chicken manure, and 10 t/ha cattle manure-10 t/ha chicken manure, contained about 10.2 % crude protein. These two treatments were much closer to CP content found in the recommended commercial fertilizer (Ansah *et al*., 2010). A farmer can use at least 5 t/ha of cattle manure basal fertiliser and top-dress with 5 t/ha chicken manure to significantly increase CP content. Crude protein content in this study was similar with values found by Ansah (2010) in a similar study with values around 10.9 % harvested at 60 days after planting. However, in this study crude protein content was lower than in a similar study by Ndlandla (2011) which ranged between 13.3 and 17.4 %.

**Crude fibre**

In general, treatments did not differ in crude fibre content. Treatments of 10 t/ha cattle manure basal fertiliser with 5 t/ha chicken manure for topdressing, 15 t/ha cattle manure as basal fertiliser and with 5 t/ha chicken manure used for topdressing, and 5 t /ha cattle manure at planting and 10 t/ha chicken manure for topdressing had a significantly ($P<0.05$) higher crude fibre content (29.4-30.7 %) than the other treatments. However, these two treatments did not differ significantly from the one in which no form of fertiliser was added together with the treatments that did not receive basal fertiliser but received 5 and 10 chicken manure topdressing, as well as the treatment that received 5 t/ha cattle manure basal fertiliser and with 5 t/ha chicken manure used for topdressing. The treatment that received 10 t/ha of cattle manure with 10 t/ha chicken manure had a significantly ($P<0.05$) lower crude fibre content (28.92 %) than the other treatments. Crude fibre values in this study are comparable to those reported by FAO (2012) and Göhl (1982) who found an average of 36.1 %.

**Ash content**

There were significant ($P<0.05$) differences in ash content among the treatments. The treatment without any form of fertilisation had a significantly ($P<0.05$) higher ash content (14.8 %) than all the other treatments including the commercial fertiliser treatment. This was probably an experimental error, which however, needs to be verified by further studies. The treatment that received 20 t/ha cattle manure with 10 t/ha chicken manure for top dressing had a lower ash content (12.3 %) which, however, did not differ from treatments that received the recommended commercial fertiliser, treatments in which 0, 15 and 15 tonnes per ha of cattle manure was applied at planting and top-dressed with 10, 5 and 10 tonnes per ha of chicken manure respectively. Ash content values in this study fall within those reported by Göhl (1982) who found an average of 12.9 %.

**Ether extract**

There were significant ($P<0.05$) differences in the ether extract among treatments. The commercial fertiliser treatment contained a significantly ($P<0.05$) higher ether extract (2.6 %) than all the other treatments.

Treatments with lower ether extract values were those that received 5, 15 and 5 tonnes per ha of cattle manure applied at planting and top-dressed with 5, 5 and 10 tonnes per ha of chicken manure topdressing manure respectively. All the other treatments did not differ significantly among each other; their range was 2.24 to 2.58 %. The 5 t/ha cattle manure-5 t/ha chicken manure had a significantly ($P<0.05$) lower ether extract (1.7 %) than the other treatments. The ether extract values in this study are comparable to those reported by Göhl (1982) who found an average of 2.0 % .

## CONCLUSION

Application of organic manure can significantly increase dry matter yield and chemical composition of Napier grass. Organic manure can be used successfully to cultivate Napier grass to address current problems of shortage of fodder during the dry season.

## RECOMMENDATIONS

To significantly increase dry matter yield of Napier grass to yields closer to those obtained when using recommended commercial fertiliser, a farmer must apply at least 15 t/ha of cattle manure at least two weeks before planting and top-dress with 5 t/ha of chicken manure after establishment and after every cutting. If there is not enough manure, a farmer is better off applying at least 5 t/ha of cattle manure before planting and top-dressing with 5t/ha of chicken manure after establishment and after every cutting to significantly raise dry matter yield than not applying organic fertiliser at all. It is recommended that a similar study be carried out for three years which is the average life of Napier grass before replanting is done.

## LITERATURE CITED

A.O.A.C. (1990). Official Methods of Analysis of Association of Official Analytical Chemists. 16th Edition. Washington, DC.

Ansah, T., Osafo, E.L.K., and Hansen, H.H. (2010). Herbage yield and chemical composition of four varieties of Napier (*Pennisetum purpureum*) grass harvested at three different days after planting. *Agricultural and Biology journal of North America* 1(5): 923-929. hpp:// www.scihub.org/ABJNA.

Bayble,T., Melaku, S. and Prasad, N.K. (2007) Effects of cutting dates on chemical composition of Napier grass (*Pennisetum purpureum*) planted sole and in association with Desmodium (*Desmodium intortum*) or Lablab (*Lablab purpureus*). *Livestock Research for Rural Development* 19 (1): 442-449.

Bayly, F. (2011). Importance of milk in our diet. Demand Media. hpp:// www.livestrong.com/21/02/13.

Chandy, K.T. (2012). Napier grass. Booklet No122. Forage Crop Production. Agriculture and Environment. http://www.inseda.org Agriculture and Environment/44-forage crop production FCPS/Napier grass-122doc.

Dlamini, N.G. (2010). Effect of kraal manure on dry matter and chemical composition of Napier grass. (*Pennisetum pupureum*) grown at Luyengo Campus of the University of Swaziland. Unpublished BSc. Research Project Report. University of Swaziland.

FAO. (2012). Animal Feed Resource Information. FAO, Rome, Italy. http://www.fao.org/ag/aga/agap/frg/afris/default.htm.14/10/2013.

Göhl, B. (1982). Piensos tropicales: Resúmenes informativos sobre piensos y valores nutritivos, Producción y Sanidad Animal 12, FAO, Roma, Italy.

Griffiths, N. (2011). Best practice guidelines for using chicken manure on pastures. NSW DPI. hpp://www.dpi.nsw.gov.au/publications. 12/12/12

McDonald, P., Edward, R.A., Greenhalgh, M. and Morgan, C.A. (2002). Animal Nutrition. 6th Ed. Oliver and Boyd. Harlow, Essex, United Kingdom.

Ministry of Agriculture and Cooperatives. (2004). Land Use Planning Section. Mbabane. Swaziland.

Nawa, P.M. (2005). Development of organic farming in Zambia. Grand Valley Agricultural Research Trust (GART) 2005 Yearbook. Lusaka. Zambia.

Ndlandla, N.F. (2011). Effect of cattle manure and chicken manure on the dry matter yield and chemical composition of Napier grass grown at UNISWA, Luyengo Campus. Unpublished BSc. Research Project Report. University of Swaziland, Swaziland.

Nyambati, E.M., Lusweti, C.M., Muyekho, F.N. and Mureithi, J.G. (2012). Upscaling-Napier (*Pennisetum purpureum*. Schum.) production using "Tumbukiza" method in smallholder farming systems in Northwestern Kenya. *Journal of Agricultural Extension and Rural Development* l.3 (1): 1-7.

Premaratne, S. and Premalal, G.G.C. (2006). Hybrid Napier (*Pennisetum purpureum* X *Pennisetum americanum*) VAR.CO-3: A resourceful fodder grass for dairy development in SRI LANKA. *Journal of Agricultural Sciences* 2 (1): 200-219.

SAS (Statistical Analysis System) Institute Inc. (1990). Applied Statistics and SAS programming language. 2nd Edition. Cary, North Carolina, USA.

Swaziland Dairy Board. (2009). Overview of the Dairy Industry in Swaziland. Manzini. Swaziland.

Swaziland Dairy Board. (2003). Overview of the Dairy Industry in Swaziland. Manzini. Swaziland.

Tainton, N. M. (2000). Pasture management in South Africa. Shutter and Shooter, Pietermaritzburg in association with University of Natal press.