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PROXIMATE AND CELLWALL COMPOSITION OF SUPER NAPIER GRASS (*PENNISETUM PURPUREUM*) HARVESTED AT DIFFERENT GROWTH STAGES

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ABSTRACT

The investigation was conducted to find out and compare the proximate composition of Super Napier grass harvested at different growth stages which were 45 days, 60 days and 75 days during the months of January and February, 2022. The plant samples were collected at fodder unit of LFC, CVSc, Tirupati. Then, the samples were dried and ground before being analyzed for proximate composition (Moisture, Ash, Crude protein, Crude fiber, Ether extract and Nitrogen free extract) and fibre fractions (Neutral detergent fibre, Acid detergent fibre, Hemicellulose, Cellulose and Acid detergent lignin). Results of the present study indicated that, increasing the cutting interval (*i.e.,* advancing age of maturity) increased drymatter and nutrient yields significantly ($P < 0.05$). In terms of nutrient content, it also increased the per cent of crude fiber (23.5, 27.1 and 30.2), acid detergent fiber (39.22, 40.08 and 41.32), neutral detergent fiber (67.12, 71.01 and 73.84), Hemicellulose (27.9, 30.93 and 32.52), Cellulose (33.52, 35.7 and 37.11) and acid detergent lignin (5.12, 5.94 and 6.62) in the plant. However, per cent of crude protein (9.78, 8.32 and 7.05) and ash (11.92, 9.56 and 7.99) was markedly decreased as the cutting interval increased. Therefore, the Super Napier at 45 days age growth is the best for harvesting which provides high nutritive value of the animal feed.

keywords: Cell – wall fractions, Growth stages, Proximate composition,Super Napier grass

INTRODUCTION

India has the highest number of livestock (536.76 million) in the world and the population of buffalo, cattle, sheep, and goat is 109.85, 193.46, 74.26 and 148.88 millions, respectively (20th Livestock census, 2019). Fodder is an essential component for livestock production, its demand increases with increasing population of livestock. For ages usually constitute the major portion of the ruminant feeds and high quality nutritious green fodder is required to realize the productive potential of ruminants in our country. The critical constraint in profitable animal production in developing countries is the inadequacy of quality forage. Currently, India is facing a net deficit of green fodder by 35.6%, dry fodder (straw) by 10.95% and concentrates by 44% (Kushwaha *et al*., 2018).

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Deficiency of quality fodder and feed for livestock leads to decrease in production level, and has impact on their health, which ultimately influences return from livestock sector. There are many alternatives to overcome the shortage of quality forage and one among them is the introduction of high yielding forage varieties. Napier grass (*Pennisetum purpureum*) is currently the most popular fodder grass in dairy and feedlot production systems due to high productivity and good nutritive value. The Napier grass also known as Elephant grass is a species of perennial grass which is native to sub-tropical Africa. The Napier grass provides a high phytomass in most tropical and sub-tropical climates and well-known grassas a livestock fodder (Kebede *et al.,* 2016).

Hence, the Department of Livestock Development in Thailand has come out with a new hybrid Napier called Super Napier developed by Dr. Krailas Kiyothong, an animal nutritionist and plant breeder, by crossing *Pennisetum purpureum* (the ordinary Napier grass) and *Pennisetum glaucum* (better known as Pearl Millet). Super Napier grass is an improved fodder grass, that is highly nutritious, easy to grow, more adaptable and productive which is suitable for Indian conditions. It is smooth, juicy and very consumable grass, high in moisture content, making this grass as one of the preferred ingredients for animal food producers (Lounglawan *et al*., 2014). It has large, thick leaves that are dark green and the blades of the leaves were serrated, and the leaf margins are slightly hairy. This is the fast-growing perennial grass that can group up to 6-8 feet height, which typically takes about 60 days to reach the full height. Super Napier can be harvested multiple times throughout the growing season.

Selecting the right fodder grass species is most important for cultivation and must take into consideration the yield, digestibility and chemical composition of the grass. Proximate analysis provides meaningful information and also helpful in assessing the samples quality. It was reported that the Napier grass has a good nutritive value as well as the chemical compositions (Lounglawan *et al.,* 2014). However, chemical composition of forages is highly variable and affected by type of species, variety, soil composition, climate, and season, stage of growth and application of manure. According to Lounglawan *et al*., (2014), a young plant is characterized by their high protein content, ether extract, and ash, while the maturing plant have high of crude fiber content.

The main objective of the study is to analyze and compare the proximate composition and cell-wall fractions of super Napiergreen fodder harvested at different growth stages which were 30 days, 45 days and 60 days.

MATERIAL AND METHODS

Location of Study

Study was conducted at College of Veterinary Science, Tirupati.Tirupati has a tropical wet and dry climate and the temperature during the experiment period ranged from 28! to 32! and relative humidity ranged from 66 to 74%. Rainy season usually starts in July and ends in September, while the summer season begins in March and ends in June, whereas winter occupy from October to February. The geographical location of experimental site was 79.42°E longitude and 13.65 N latitude.

Procurement of Green Fodder

The green fodder (Super Napier) was procured from the fodder unit of Livestock Farm Complex (LFC), College of Veterinary Science, Tirupati during January and February of year 2022. First cut was done on 90th day of plantation. Subsequently, the fodder was

Figure 1

Figure 2

Figure 3

harvested on 45th, 60th and 75th day (Figure 1, 2 and 3, respectively) and evaluated for proximate analysis and fiber fractions. Fodder was harvested on 45th, 60th and 75th day by cutting the stubble 5 cm above the ground level using knife, and fresh stems and leaves were then put in zipper plastic bags and transferred for further analysis.

Sample Preparation

The fodder samples were detached from plastic bags and washed with deionized water to remove soil and dust particles. Then, the sample was chopped into small pieces and was dried in an oven at 60°C for 48 hours. The dried samples were ground in a hammer mill (2 mm screen) and were kept in the zip lock plastic bag and stored under cool and dry conditions at room temperature. Thereafter, the samples were analyzed for proximate composition and fibre fractions.

ANALYTICAL TECHNIQUES

Proximate Analysis

The method was used for the analysis of crude protein (CP), crude fibre (CF), moisture content, ether extract (EE), total ash and NFE content. Proximate components were determined based on themethod of AOAC (2012).

Determining the Moisture Content

For determining the moisture, 200 g of Super Napier grass sample was taken and chopped into short length (2-5 cm). The samples were then placed in an oven at 60-80 °C for 24-48 h (AOAC, 2012). The loss in weight after drying is the moisture content

Determining the Drymatter Content

The amount of dry matter was calculated by using the formula given below. % Drymatter = 100 – Moisture Content.

Determining the Crude Protein Content

Crude protein was assessed by weighing 0.5g sample in the Kjeldahl flask and digested it with sulphuric acid with added digestion mixture and the total organic nitrogen is converted to ammonium sulfate. Ammonia is formed and distilled into boric acid solution under alkaline conditions. The solution was thentitrated with 0.1 N sulphuric acid until light pink color appeared. The amount of protein is measured by the amount of acid used and obtained nitrogen content was multiplied with a factor of 6.25 to obtain crude protein content.

Determining the Crude Fibre Content

It was determined by boiling the sample with 1.25% of diluted sulfuric acid followed by

1.25% of sodium hydroxide. Taken 2g sample in a beaker and added 125 ml of 1.25% sulfuric acid. The sample was boiled for 45 mins, cooled and filtered by using muslin cloth. The material was washed 3 times by using distilled water and then transferred in to the beaker and again 125 ml of 1.25% sodium hydroxide was added, boiled for 45 minutes, cooled and then filtered to obtain residues of the sample. The material was then again washed three by distilled water and dried by putting it in to the oven, cooled and record the weight. The difference between the weights of the sample was the crude fiber content.

Determining the Crude Fat or Ether Extract Content

About 2 g of dried sample was extracted with petroleum ether (80^0 C) in Soxhlet apparatus to remove the ether soluble components present in it. The material was then dried to a constant weight in an oven at 105^0C and record the weight to determine the fat content.

Determining the Total Ash Content

The ash component was determined by igniting 5-10 g of grass sample in a muffle furnace at 500 °C for 3 h to burn all the organic content. The residue after burning in the furnace is the ash which contain in organic matter. Ash content was determined by using formulae given below.

Ash % = (weight of ash × 100) / weight of sample

Determining the NFE Content

Nitrogen Free Extract (NFE) is actually not a determined value, but a calculated value. NFE was calculated by the formula given below.

NFE (%) = 100 - (% Crude protein + % Total ash + % Ether extract + % Crude fiber)

Van Soest Analysis

The fibre fractions (NDF, ADF, Hemi cellulose, Cellulose and ADL) were determined according to the procedures given by Van Soest *et al.* (1991).

Statistical Analysis

One-way Variance (ANOVA) was used to analyze the data in order to determine significant differences in proximate composition and fibre fractions harvested at different growth stages (45^{th} day, 60^{th} day and 75^{th} day) of Super Napier by using version 23.0; SPSS (2015) statistical software. The value of $p < 0.05$ was considered a significant difference.

RESULTS AND DISCUSSION

Proximate Composition

Proximate composition of Super Napier grass at different growth stages has a considerable effect on the percentage content of all components measured as shown in Table 1. The crude fiber percentage increased linearly ($P < 0.05$) with increase in age of the fodder grassfrom 45 days to 75 days. While the percentage of moisture, ash, crude protein and crude fat decreases ($P < 0.05$) with increase in age of fodder.The dry matter content depicts the actual amount of nutrients present in the fodder. Results in the present study revealed that the DM of forage harvested at 45, 60 and 75 days of growth was 20.03, 22.19 and 24.85%, respectively. The DM content of fodder increased linearly ($P < 0.05$) with delay in day of harvest. This agrees with the results of Lounglawan *et al*. (2014), who reported a progressive increase in DM content with the advancement of maturity of fodder (13.37% at 30 days to 18.39% at 60 days) in Napier grass.

The CP content of fodder harvested at 45, 60 and 75 days of growth was 9.78, 8.32

Table 1. Proximate composition of Super Napier harvested at different growth stages

Nutrient	Days of harvest		
	45	60	75
Dry matter (%)	20.03±0.99^{c}	22.19±0.81^{b}	24.85±0.92^{a}
Organic matter (%)	88.08±1.01^{c}	90.44±1.11^{b}	92.01±1.23^{a}
Crude protein (%)	9.78±0.52^{a}	8.32±0.33^{b}	7.05±0.42^{c}
Crude fibre (%)	23.5±0.33^{c}	27.1±0.23^{b}	30.2±0.20^{a}
Ether extract (%)	2.52±0.11^{a}	2.27±0.10^{b}	1.97±0.22^{c}
Nitrogen free extract (%)	52.1±0.63^{c}	52.78±0.52^{b}	52.99±0.61^{a}
Total ash (%)	11.92±0.32^{a}	9.56±0.41^{b}	7.99±0.27^{c}

Figures in a column followed by the same letters are not significant at P=0.05 level of significance.

Table 2. Cell-wall fractions of Super Napier harvested at different growth stages

Nutrient	Days of harvest		
	45	60	75
Neutral detergent fibre (%)	67.12±1.20^{c}	71.01±1.23^{b}	73.84±0.52^{a}
Acid detergent fibre (%)	39.22±0.60^{c}	40.08±0.66^{b}	41.32±0.75^{a}
Hemicellulose (%)	27.9±0.20^{c}	30.93±0.27^{b}	32.52±0.25^{a}
Cellulose (%)	33.52±0.05^{c}	35.7±0.03^{b}	37.11±0.02^{a}
Acid detergent lignin (%)	5.12±0.04^{c}	5.94±0.06^{b}	6.62±0.03^{a}

Figures in a column followed by the same letters are not significant at P=0.05 level of significance.

and 7.05%, respectively. The decrease in CP content with growth advancement of the fodder in the study is in comparison with observations made by Lounglawan *et al.* (2014) and Jagadeesh *et al.* (2017) in Napier grass varieties. As one would expect, the crude fat of Super Napier grass decreased with increase in maturity of fodder. Similar observations of progressive decrease in EE content with advancement of maturity of fodder were made by Lounglawan *et al.* (2014) and Jagadeesh *et al.* (2017).

The crude fibre content of forage increased (P < 0.05) as the age of fodder get advanced. Lounglawan *et al.* (2014) and Jagadeesh *et al.* (2017) also reported similar progressive increase in CF content with advancement of maturity of fodder in Napier grass varieties.

The ash content of the grass showed a significant differenced (P < 0.05) pattern, as the age advances. The mean value of ash at 45 days of age was higher (11.92%) compared to cutting interval of 60 days (9.56%) and 75 days (7.99%). Lounglawan *et al.* (2014) who reported similar findings that ash content gets decreased as the cutting interval increased. In general, higher ash content is indicative of higher minerals in the plants. In the present study, as the ash content was significantly higher (P < 0.05) during 45 days of harvest, proportionately the mineral content was also expected to be higher in early cut than in the late cuts.

Cell-wall Fractions

The cell wall compositions of fodders (per cent on DMB) are summarized in Table2. The NDF and ADF are most common measure of fibre used for animal feed analysis; it measures the structural components viz., hemicellulose, cellulose, lignin and pectin in plant cells.

In the study, the per cent NDF, ADF, Hemicellulose, Cellulose and Lignin contents of fodder increased progressively ($P < 0.05$) as the age of the supernapier fodder grass advances. These results were in agreement with the results of Lounglawan *et al.* (2014) and Jagadeesh *et al.* (2017) in Napier grass varieties, who reported that the cell wall constituents increases with advancement in age. As the fodder matures, forage quality declines because of translocation of soluble carbohydrates from the stem and leaves to the inflorescence, leading to increase in the relative proportion of lignified cell-walls in the leaves and stems.

CONCLUSIONS

The cutting interval had a marked effect on the chemical composition. Super Napier grass harvested at 45 days age has better nutrient content in terms of more crude protein content and less cell-wall fractions. This finding is useful as baseline data that provides information on Super Napier's nutritional composition grown at a particular cropping site.

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