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Effect of harvesting interval on the proximate composition of super Napier fodder in irrigated system

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Abstract
Cultivation of high yielding quality fodders is need of the hour to meet the demand of high yielding dairy animals. Super Napier (SNF) is the one of the high yielding perennial fodder verity well accepted by the formers for cultivation. A crucial factor in producing high-quality fodder is the harvesting interval. In the present study, samples were analysed for their chemical composition in fodders harvested at different intervals. Among the five harvesting stages, the first cut was significantly (p<0.01) higher in dry matter (DM) content with lower crude protein (CP) percent. The EE, NFE and AIA content of the SNF did not differ significantly between the harvesting intervals. First cut appears to be more mature with a higher portion of the stem part yielding higher dry matter. Fodder harvested after 90 days of plantation may yield higher protein containing quality fodder.

Keywords: Harvesting interval, super Napier, chemical composition

Introduction
The lack of high-quality green fodder and grazing resources in India has caused livestock to consistently produce at below-optimal levels compared to many developed countries. In order to meet the demand of the current livestock green fodder requirement and ensure that nutrient-rich green fodder could be made available throughout the year, cultivation of newer varieties of perennial fodders with higher biomass per unit area is an immediate solution (Khaing *et al*., 2015) [7]. The “Super Napier (*Pennisetum purpureum* x *Pennisetum glaucum*) is known to be high yielder (500 t/ha/yr), showing relatively high crude protein of about 16 to 18 percent (Kiyothong, 2014) [8].

The feeding value of fodder is determined by its chemical composition and palatability. Factors like harvesting age, soil mineral profile, fertilizer application, and agricultural practices affect the composition of fodder (Muhindo *et al*., 2018) [11]. The stage at harvest is crucial, as plant matures, structural components of plant and stems/leaves ratio increases with decrease in CP content (Wadi *et al.*, 2004; Kassi *et al*., 2000) [15, 9]. The present study was aimed to evaluate the effect of harvesting interval on chemical composition of Super Napier fodder, about which the information is scanty.

Materials and Methods
The present experiment was conducted at the Department of Animal Nutrition, Veterinary College, Nandinagar, KVAFSU, Bidar, Karnataka. The experiment included chemical analyses.

Preparation of land: Plot of 16 m^2 (4m x 4m) was prepared for plantation, with manual weed removal, ploughing, and harrowing. Dried cow dung was applied to improve soil productivity at a rate of 2 kg/m^2 (Roos, 1975) [12]. Plot was planted with Super Napier in February. Weed control was done monthly, and irrigation was provided once a week. On the last day of each harvesting interval (the 90^{th} day of plantation and four subsequent harvests at the 45^{th} day of re-growth), forage was harvested from the plot. Cutting was done at 10 cm above the ground level. Triplicate samples were collected from the harvested fodder at three different locations, and pooled samples of fodder were analyzed for proximate (AOAC, 2016) and forage fibre constituents (Van Soest *et al.*, 1991) [14].

Statistical analysis

The results were expressed as mean ± SE (n=3). Significance was tested by employing analysis of variance (Two way ANOVA).

Results and Discussion

In the present study, among the five harvesting stages, the first cut was significantly (p<0.01) higher in DM content (Table1). This could be due to the maturity of the plant. With increasing maturity, the absorption capacity of water by the plant decreases. As a result, dry matter concentrates more in plant cells (Muhindo *et al.*, 2018) [11]. The first cut, was made after 90 days of plantation in the present study, found to be the mature one compared to the other four cuts, which were harvested after 45 days of re-growth. However, no significant difference observed among the third, fourth and fifth cutting.

The OM content of plant material will decrease with an increased concentration of total ash (Muhindo *et al*., 2018) [11]. A similar tendency was observed in the present study. The OM content in the first cut was significantly (p<0.01) lower than 2nd cut. On the other hand, TA content was significantly (p<0.01) higher in the first cut compared to other cuts (Table1). However, no significant difference was observed between the different cuts (except first cut) in the OM and TA, as all were harvested after 45 days of re-growth.

The second cut had significantly (p<0.01) higher percent CP than the first cut. Even though there was no significant difference (p<0.01) between the first, third and fourth cuts, the CP content of the first cut was relatively lower (Table1). The lower CP content in the first cut could be due to the maturity of the plant (Jagadeesh *et al*., 2017; Nurul *et al.*, 2018) [5, 10]. Susma (2020) [13] observed lower CP content in the first cut (90 days after plantation) than the other subsequent two cuts (45 days of re-growth) in Taiwan Super Napier-1. Jagadeesh *et al.* (2017) [5] reported a decrease in CP content from 15.72 to 11.34% with the increasing stage of harvesting from the 30th to 60th day in APBN1, a variety of hybrid Napier. Similarly, Haryani *et al*. (2018) [2] reported the CP content of Napier grass cut at the ages of 35 and 42 days of plantation ranged from 17.07-19.43 and 13.47-15.27 percent, respectively and lower value was observed in cutting made after 42 days plantation. With the advancement of maturity, the stems/leaves ratio becomes higher, the cell wall content increases, while the CP content decreases (Kassi *et al*., 2000) [6]. This results in a dilution of the CP content of forage crops by the rapid accumulation of cell wall carbohydrates at the advanced stage of growth (Humphreys, 1991) [4].

In the present study, the EE, NFE and AIA content of the SNF did not differ significantly between the harvesting intervals. The EE content ranged from 1.96-2.17%, and the lowest content was obtained in the fourth cut. These variations could be due to the conjunction and interaction of many factors within lipid synthesis by the plant. Previous research has also revealed that as the plant ages, the lipid content decreases (Jagadeesh *et al*., 2017; Muhindo *et al*., 2018) [5, 11]. Similar tendency of decreasing with maturity was also observed with NFE and AIA, which were numerically lower in the first cut compared to second and third cut.

The CF, NDF and hemicellulose content of SNF were numerically varied among the different harvesting stages. However, no significant difference (p<0.01) was observed. A similar trend of zigzag way variation was also observed by Muhindo *et al.* (2018) [11] between different harvesting stages. In contrast, decrease in CF with plant maturity was also observed by Nurul *et al*. (2018) [10] in Taiwan Napier grass. However, ADL content were significantly higher in the first cut than all subsequent cuts except fourth cut. The higher fibre fraction in the first cutting may be due to maturity (Jagadeesh *et al*., 2017; Himani *et al*., 2019) [5]. As the plant matures, structural components of the plant (NDF, ADF and ADL) increase (Lounglawan *et al*., 2014) [9].

The nutritive quality of fodder harvested at 90 days (first cut) was found to be inferior than subsequent cuts. First cut appears to be more mature with a higher portion of the stems, higher cell wall components (ADL and cellulose) and lower cytoplasmic compounds (protein, lipids).

Table 1: Chemical composition (% on DMB) of Super Napier fodder at different harvesting interval

Composition	Super Napier Fodder					
	1st Cut	2nd Cut	3rd Cut	4th Cut	5th Cut	P
DM	32.46^{a}±0.32	23.31^{c}±0.14	24.76^{b}±0.09	24.32^{b}±0.11	24.11^{bc}±0.13	<0.01
OM	89.00^{b}±0.17	90.05^{a}±0.11	90.49^{ab} ±0.23	90.32^{ab}±0.19	90.95^{ab} ±0.06	<0.01
CP	8.17^{b} ±0.06	9.24^{a} ±0.12	8.64^{b} ±0.16	9.08^{ab} ±0.14	9.32^{a} ±0.14	<0.01
EE	1.96±0.06	2.17±0.08	1.97±0.11	1.85±0.15	1.91±0.18	NS
CF	29.93±0.44	28.99±0.33	30.35±0.39	31.22±0.51	29.61±0.42	NS
NFE	48.93±0.60	49.64±0.53	49.53±0.87	49.17±0.49	50.11±0.57	NS
TA	11.00^{a} ±0.17	9.95^{b} ±0.11	9.51^{b} ±0.23	8.68^{b} ±0.24	9.05^{b} ±0.44	<0.01
AIA	5.16±0.22	5.29±0.08	5.65±0.23	5.81±0.16	5.34±0.32	NS
NDF	70.59±0.38	69.46±0.76	68.95±1.03	68.82±0.87	69.42±1.04	NS
ADF	36.40^{ab}±0.70	34.15^{b} ±0.54	37.26^{a} ±0.38	38.27^{a} ±0.44	37.59^{a} ±0.27	<0.01
ADL	7.47^{a} ±0.13	6.99^{b} ±0.12	7.03^{b} ±0.08	7.12^{ab} ±0.19	6.82^{b} ±0.16	<0.05
Cellulose	28.93^{b} ±0.73	27.15^{b} ±1.16	30.23^{a}±0.46	31.35^{a} ±1.21	30.77^{a}±0.39	<0.01
Hemicellulose	34.19±0.91	35.32±1.02	31.68±1.09	30.55±1.15	31.83±1.18	NS

Note: Each value is the mean of six observations

Mean values bearing different superscript in a row differ significantly (p<0.01, p<0.05), and with at least on common superscript they don't; NS: Non significant (1st cut- After 90th d of plantation, four subsequent cuts after 45th day of re-growth)

Conclusion

This study's findings reveal that SNF harvested 90 days after planting under irrigation offers excellent DM yields but relatively poor crude protein yields when compared to successive cuts made after 45 days of regrowth. This demonstrates that if harvested earlier than 90 days after cultivation, SNF can produce high-quality feed with higher percent crude protein. With the exception of the first cut, harvesting intervals had no impact on the chemical makeup of the various cuts. Additional research in more extended field conditions is necessary to confirm whether these preliminary results are indicative in a commercial environment.

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