YIELD AND NUTRITIONAL QUALITY ASSESSMENT OF FORAGE SPECIES AS AFFECTED BY HARVEST FREQUENCY AND LAND TYPE

A THESIS

BY

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DEDICATED

TO

MY

BELOVED PARENTS

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ABSTRACT

The study was conducted to determine the effects of days interval on the growth parameters and nutrient composition of four varieties of forage genotype at different land types. The experimental was laid out in a factorial randomized complete block design (RCBD) with three factors e.g. Factor A-days interval (D1= 60days, D2 =75days); Factor B- land type (L_1= Agricultural land, L_2= Fallow land) and Factor C four varieties (V_1=Red Napier, V_2 =3rd Gen. Napier, V_3 =1st Gen. Napier, V_4 =Pakchong) with 3 replications at Dacope Upozilla, Khulna. The interaction effects of day interval, land type and verity had significant effects (p<0.05) on leaf length, leaf number and biomass. The findings of the study revealed that highest leaf length and biomass were 116.40 cm and 132.14t ha^{-1} respectively obtained the interaction effect of $D_2L_1V_4$. Highest leaf number (11.30) was found in the interaction of D_2L1V2. These interactions were highly significantly differed (p<0.001). Highest plant height, tiller number per hill and leaf width was found in the interaction effect of $D_2L_1V_4$, $D_2L_1V_2$ and $D_2L_1V_4$, respectively which did not significantly differ. Highest ash (16.57%) and Ether Extract (2.39%) were obtained with the interaction effect of $D_2L_2V_3$ and $D_2L_1V_4$ respectively. These interactions were highly significantly differed (p<0.001). Highest Crude Protein (9.10%) and moisture content were found in the interaction effect of $D_1L_1V_4$. It might be concluded that biomass production of Pakchong is highest at 75 days after planting in agricultural land while the CP content was highest at 60 days after planting.

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CHAPTER I

INTRODUCTION

Livestock is an integral component of the complex farming system in Bangladesh as it is not only a source of meat protein but also a major source of farm power services as well as employment. The livestock sub-sector provides full time employment for 20% of the total population and part-time employment for another 50%. The Department of Livestock Services reported that the contribution of livestock in the Gross Domestic Product (GDP) of Bangladesh is 1.6% and 14.31% of agricultural (BBS 2017).

The major feed resources for livestock animals are natural pasture and crop residue which are mainly in poor quality and provide inadequate nutrients such as energy, protein, vitamin, minerals etc. In Bangladesh total green grass was production 83.16 million tons (DM basis) where demands in fodder production was 60.40 tons (DM basis) (Sarker *et al.*,2021). On the other hand, the present total demand in DM, crude protein (CP) and metabolizable energy (ME) is 60.40 million metric tons, 6.00 million metric tons and 545633 million MJ, respectively (Kanti, P. G. 2022). The fodder production gets momentum but at present, the country faces a net deficit more than 40% dry matter, 65% crude protein and 60% metabolizable energy (Sarker *et al.* 2021). As a result, the status of health and productivity of our livestock is very poor. In order to minimize the fodder shortage, it is necessary to improve fodder production per unit land. So, increased livestock production can only be achieved through the cultivation of high-quality forages with high yielding ability that are adapted to biotic and abiotic environmental stresses (Muia *et al.*, 2001; Tessema *et al.*, 2002; Kahindi *et al.*, 2007). Abiotic stressors, particularly water and salinity stress, play a key role in preventing forages, especially grains, from growing and developing normally (Tester and Bacic, 2005). The harmful effects of Na^+ and Cl^- ions on plants restrict plant development and production, resulting in ionic abnormalities, osmotic and oxidative tension (Munns and Tester, 2008). On the other hand, native forages, display varying degrees of NaCl tolerance, particularly those belonging to the Panicoideae and Chloridoideae sub-families (Bromham and Bennett, 2014; Roy and Chakraborty, 2014). Salinity tolerance is a complicated characteristic regulated by a number of physiological and biochemical variables, all of which have a significant impact on plant growth and advancement (Zhu, 2000).

The southern part of Bangladesh is particularly vulnerable to saltwater intrusion because of its long coastline. Land and water in coastal locations are most affected by salinity. In Dacope salinity level (SL) ranging from 10.4 to 13.1 dSm^{-1} (Kanti, P. G. 2022). It gradually spreads to inland water and soil as a result of climate change. Napier and Pakchong are currently the most popular fodder grass in dairy production systems. Napier has been the promising and high yield grass, giving dry matter yield that surpasses most other tropical grasses, like Guinea grass (*Panicum maximum*) and Rhodes grass (*Chloris gayana*) and higher nutritive value compared to *Brachiaria sp.* and *Panicum sp.* (Gomez *et al.* 2011). It's also called Elephant grass and a species of perennial grass which is native to subtropical Africa (Kebede *et al.*, 2016).

The assessment of yield and nutritional quality of forage species in relation to harvest frequency and land type is a crucial aspect of sustainable agricultural practices. By investigating the impact of harvest frequency on forage yield, we can identify the most effective harvesting strategies to maximize productivity. Understanding how different land types influence forage yield provides valuable insights for optimizing land use and resource allocation in forage production. Efficient utilization of forage resources contributes to sustainable agriculture, reducing the environmental footprint associated with livestock production and farmers can make decisions about crop selection, harvest frequency, and land use based on the economic returns associated with different forage species and management practices. Very scanty information regarding different aspects of forage cultivation like suitable forage cultivars, land type, salinity etc. are available in literature about Dacope upozilla of Khulna district in southwest costal Bangladesh. Considering this crucial issues the present study was undertaken with the following objectives.

OBJECTIVES OF THE STUDY

1. To investigated the growth performance and yield of some selected forage cultivars in different land types and harvesting frequencies.
2. To investigate the nutritional composition of selected forage in coastal environment of Bangladesh.

CHAPTER II

REVIEW OF LITERATURE

The quality of green forage is a very important factor for optimum livestock production. There are many factors which directly or indirectly affect the quantity and quality of forage. Quantity in terms of yield such as DM and CP yields are important parameters. Similarly, quality in terms of chemical composition and the macro mineral concentration in forage are eventually considered. Many works have been done in this connection in home and abroad. Studies of many researchers in many countries corresponding to yield of different fractions of Napier grass, chemical composition and different mineral concentration of Napier grass are discussed in the following section.

2.1 Napier grass

Origin and characteristics

Napier grass (*Pennisetum purpureum*) was named after Colonel Napier of Bulawayo in Zimbabwe who early in last century urged Rhodesia's (now Zimbabwe) Department of Agriculture to explore the possibility of using it for commercial livestock production (Boonman, 1993). Napier grass (*Pennisetum purpureum*) which is robust perennial forage with various root systems, sometimes stoloniferous with a creeping rhizome is very native to most tropical and sub-tropical countries. Its natural habitat is damp grassland, forest margins and riverbeds.

Mature plants normally reach up to 4 m height and have to 20 nodes (Henderson and Prestson, 1977). Boonman (1997) found 10m height in riverbeds and recorded a harvest at kitale of 29 tones/ha DM taken in one cut on a very mature stand (more than 2 years overdue). On the tableland at Walkamin Research Station in Queensland Australia, Napier grass which had grown to a height of over 10m (Orodho, 2006). Napier grass (*Pennisetum purpureum*) is propagated vegetative because seeds have low genetic stability and viability (Humphreys, 1994).

Distribution of Napier grass

Napier grass (*Pennisetum purpureum*) is widespread in the tropical and sub-tropical regions of the world. Napier is the dominant grass species in Uganda, and is mostly found around the shores of Lake Victoria. Napier is native to tropical sub-Saharan Africa (i.e. southern Ethiopia, Kenya, Tanzania, Uganda, Cameroon, Ivory Coast, Ghana, Guinea, Liberia, Nigeria, Sierra Leone, Togo, Angola, Malawi, Mozambique, Zambia and Zimbabwe). This species is widely naturalized in the coastal districts of northern and eastern Australia, coastal Queensland and north-eastern New South Wales. Also present in the coastal districts of south-western and northern Western Australia, in the northern parts of the Northern Territory and on Norfolk Island.

Napier grass (*Pennisetum purpureum*) is also naturalized in tropical Asia (Bangladesh, China, Philippines, Cambodia, Indonesia, Malaysia, Thailand and Papua New Guinea), Southern USA (California, Texas and Florida), Mexico, Central America, South America (Colombia and Peru), the Caribbean, and in Oceania (New Zealand, the Cook Islands, Micronesia, French Polynesia, Fiji, Guam, Kiribati, New Caledonia, Hawaii, Niue, Palau, the Marshall Islands and the Galapagos Islands) (Bostock and Holland, 2007).

Biomass yield of Napier grass

Paikar (2010) observed highest fresh yield of Napier fodder among various perennial fodder germplasm. He found fresh and dry yield 42-45 MT/ha and 7-8 MT/ha, respectively in the experimental field laboratory of Bangladesh Agricultural University.

Osman *et al.* (2019) found that there were significant differences in the dry matter yields (6196.44, 12113.6, 19125.4) kg/ha for the 3 different harvesting dates (60, 90, 120 days) which increased linearly with increase in maturity. A similar trend has been reported by Minson (1990) who indicated that generally as grass ages, biomass yield is increased due to the rapid increase in the tissues of the plant.

Osman *et al.* (2019) observed that the total biomass yields for the three harvesting dates were all lower than the high yields of 22,489.7, 36,121.2 and 46,012.5g/kg DM for 60, 90 and 120 days, respectively (Ansah *et al.*, 2010).

Yields of Napier grass can range from 12 to 19 MT/ha/year on unfertilized soils and 55 MT/ha/year on fertilized soils with adequate water supply (Williams, 1980). However, Khan (2009) reported that, from Napier about 170-250 ton green fodder/ha/year can be found with 8-10 cuttings.

John (2008) worked with Napier and observed that number of tillers per plant showed a significant positive relation with plant height and green fodder yield. It also showed a highly significant and positive relation between fresh yield and plant height, leaf width, number of tillers per plant and crude fiber content.

Sreenivasan *et al.* (1986) reported that plant height and number of tillers per plant have to exert greater direct influence on fodder yield in Napier grass. The indirect effects of plant height through leaf width and number of tillers per plant contributed more towards green fodder yield. Similarly, indirect effects of leaf width through stem thickness, leaf length and plant height were also considerable.

Osman *et al.* (2019) stated that plant height and total stem and leaf yield increased linearly with increasing harvesting days. Rambau *et al.* (2016) reported that the highest number of tillers in his study was more than the study of Osman *et al.* (2019) for late maturity in Napier grass but that plant height for late maturity (58.5cm) was much lower than the 202cm.

Ansah *et al.* (2010) mentioned that plant height was 191cm, 724cm and 761cm for three harvesting dates which was comparatively higher than the study of Osman *et al.* (2019) for (130.8cm, 180.76cm and 202cm for 60, 90 and 120 days, respectively).

Number of tillers also followed a similar trend. The number of tillers per plant increased significantly (6.67, 7.67 and 9.00) as the tillers developed with grass maturity (60, 90 and 120 days).

Boonman (1994) reported that Napier grass has been the most promising and high yielding fodder than any other tropical grasses. A yield of 85.4 MT/ha without fertilizer application and a record high yield of 130 MT/ha with 1320 kg/ha of nitrogen fertilizer application have been recorded. According to Boonman (1994), Napier requires 100, 22 and 22 kg/ha of N, P and K respectively, in order to grow well. When cutting and feeding it to cattle, large amounts of nutrients are transferred from the soil to the feeding stall.

Robertson *et al.* (1976) stated that the increase in biomass yield with an increase in harvesting days could be attributed to the increase in tiller number, leaf formation, leaf elongation as well as stem development.

Srivas and Singh (2004) found that, Napier grass's DM yield and nutritive quality depend on rainfall amount and distribution, soil fertility, ambient temperature and the level of management such as, manuring, cutting management, and weeding. The longer the cutting interval, the higher the DM yields but less the nutritive quality

Srivas and Singh (2004) observed that the characters like plant height, number of tillers and leaf length were found to be positively correlated with green fodder yield in Napier grass. The association of these characters with green fodder yield was also positive and significant indicating the importance of these traits for improving the green fodder yield.

Sarwar *et al.* (2002) conducted an experiment on fodder crop where he explained that fodder crops play vital role in the agricultural economy of developing countries by providing cheapest source of feed for livestock. The area under fodder crops in Punjab (Pakistan) has been estimated to be 2.7 million hectares, which is about 14- 16% of the total cropped area with annual fodder production of 57 million tones, giving a national average of 21.1 tons per hectare due to low per acre yield and minimum area under fodder production, the available fodder supply is 54-60% less than that actually needed. This shortage in supply is being coupled with the reduction in area under fodder crops by 2% after each decade.

Sarwar *et al.* (2002) also said that in many developing countries because of ever growing human need for food, only limited cultivated land can be allocated to fodder production. Moreover, in our region, low per acre fodder yield and fodder scarcity periods, one is during summer months, further aggravated the situation.

Sanusi *et al.* (1997) observed that the high level of manure input is expected to obtain high level of forage yield in Napier grass.

In Florida, Napier grass achieved the highest yield and the fresh biomass was 54.4 MT/ha, 62 MT/ha and 44.5 MT/ha from the three individual plot respectively (Mielenz, 1997).

Napier grass accumulated a large quantity of DM (29 mg DM/ha/year) in a single cut per year when grown uninterruptedly for 3 years in Kenya while the yield varied from 10 to 40 mg DM/ha/year depending on soil fertility, climate and management (Schreuder *et. al.*, 1993).

Devarathinam and Dorairaj, (1992) reported positive correlation between green fodder yield and plant height in Napier grass. The genotypic correlation coefficients of green fodder yield with the other character were further partitioned into direct and indirect effects.

Fakir (1979) cultivated various grass in the Savar Dairy Farm, Dhaka and found the yield of Napier, guinea and splendida were 143.55, 125.03 and 157.46 MT/ha, respectively.

Grant *et al.* (1974) observed that without supplementation, Napier could support daily production of 8-10 kg of milk per cow, and that it has been successfully used as sole feed for ruminants.

Chemical composition at different stages of harvesting

Rambau *et al.* (2016) assessed that the DM increased as the grass matured and highest DM (330.5 gm/kg) was noticed during late stage of maturity. Kramberger & Klemencic (2003), Bayble (2007) and Ansah *et al.* (2010) reported that the DM content increased as Napier grass maturity increased.

CP was highest in the early stage (158.0 gm/kg) compared with the intermediate stage (140.4 gm/kg) and late stage (131.6 gm/kg). Van Soest. (1994) mentioned that this could be attributed mainly to dilution of the CP contents of the forage crops by the rapid accumulation of cell wall carbohydrates at the later stages of growth.

Kramberger & Klemencic. (2003); Bayble. (2007); Sultan *et al.* (2007); Ansah *et al.* (2010); Jusoh *et al.* (2014) also mentioned that the CP content of Napier grass decreased with maturity.

Jusoh *et al.* (2014) noticed that despite the decline in CP content with increasing stage of maturity, the final concentration exceeded the minimum CP level (7.5%) required for rumen function. This indicated the possibility of improving the feeding of animals in tropical regions by planting Napier grass, thus enhancing the quality of nutrients supplied to animals.

Rambau *et al.* (2016) showed that fat content decreased (36.3, 34.3 and 32.5 gm/kg) with maturity (early, intermediate, late stage, respectively). Similar results were observed by Karabulut *et al.* (2006). Conversely, studies by Kamalak *et al.* (2005) and Kanak *et al.* (2012) showed increased fat content with progressing stages of maturity.

Generally, ash content gives an indication of the minerals present in the sample. Rambau *et al.* (2016) mentioned that ash content increased (75.4 gm/kg) in early stage and (77.1 gm/kg) in medium stage of maturity and decreased (75.4 gm/kg) in late stage of maturity. In contrast with the findings of this study, Aganga *et al.* (2005) and Kanak *et al.* (2012) reported increased ash content with stage of maturity.

Rambau *et al.* (2016) also reported that NDF (709.6 to 685.6 gm/kg) and ADF (384.2 to 370 gm/kg) contents decreased from early to intermediate and then increased (696.7 gm/kg in NDF and 381 gm/kg in ADF) at the late stage. Results for this study were higher than the NRC recommendations for NDF and ADF contents of 300 and 190 g/kg DM for a ration, respectively.

Nutritional Value of Napier grass

Khan (2009) stated that, Napier grass is highly relished by all type of cattle and buffalos and contains 6-8% CP, 8-10% ash, 28-35% CF, 32-36% NFE and 8-9 MJ ME/ kg DM.

Haque *et al.* (2009) reported that Napier grass contains 250 g DM/ kg green grass, 25 g P/ kg green grass and 2.0 MJ/ kg green grass.

Andrade *et al.* (2003) studied with Napier forage in two seasons (rainy season and dry season) and reported that in the rainy season nitrogen fertilizer positively influenced leaf dry matter production. Neutral detergent fibre and acid detergent fibre concentration reduced with the potassium fertilizer addition in the rainy season.

Campos *et al.* (2002) studied with Napier grass and cut the grass from 45 to 105 days, with intervals of 10 days between cuts. A decrease was noticed in the Napier grass fraction degradability with the stage maturity progress.

Clatworthy, (1998) found the average annual herbage yield of improved grasses varies from 5-15 t DM/ha under dry land conditions, to 10-40 ton DM/ha under fertilized and irrigated conditions. He also reported that protein content is highest in November (8-15%) and lowest in

May/ June (1-5%). Fibre content increases from 25-30% in early growing season to 50% in late growing season. The low protein content causes low digestibility (total digestibility declines from about 65% in late November to about 40% in late June).

Schreuder *et al.* (1993) stated that in Kenya, the average dry matter yields vary between 10 to 40t DM/ha/yr depending on soil fertility, climate and management. Islam *et al.* (2003) observed that Napier grass on average contains 20% DM, 7 to 10% CP, 70% NDF and 45% ADF. The growth character as well as forage quality are variable depending on the growth stage of herbages (Hsu *et al.*, 1989; Woodard *et al.*, 1991; Sanusi *et al.*, 1997; Ishii *et al.* (1999).

2.2 Pakchong Fodder

Origin and characteristics of Pakchong fodder

Napier or elephant grass (P. purpureum) was first introduced to Malaysia in the 1920s and several cultivars had been introduced since the conditions there is Napier grass is fast growing and has high annual productivity that depends on climatic and soil conditions (Rusdy, 2016). The Super Napier grass also known as Pakchong or Hybrid Napier is an interspecific hybrid of two species native to Southeast Asia. It was first developed in Thailand in the late 1960s by culturing the tissue of the pearl buckwheat tree with the African Napier grass. The resulting hybrid has a number of advantages over its parent species, including higher yields, better resistance to pests and diseases, and greater tolerance of drought and flooding. The origin of Super Napier is attributed to the efforts of Thai researchers who were looking for ways to increase food production in the region. This hybrid has since become widely used as a fodder crop in many parts of the world. The Super Napier grass is a highly productive grass with a long leaf length of 6-8cm, capable of producing up to 20 tons of dry matter per hectare which can be harvested 7-8 times a year. Once planted, the grass can provide high yield for 7-8 years continuously with a harvest of 180-200 metric tons of green succulent grass per acre annually. The yield is twice that of ordinary Napier grass. The Super Napier grass is resistant to pests and diseases. The grass is also very palatable to livestock, making it an ideal choice for animal feed. In addition, this hybrid grass is more tolerant of both drought and flooding than either of its parent species, making it well suited for cultivation in areas prone to extreme weather conditions.

Soil type: Super Napier grows best in well-drained soils with a pH range of 5.5 to 7.0. It prefers full sun and warm temperatures, but can tolerate some shade. It is drought tolerant, but will produce more biomass if irrigated.

Land preparation: Before planting, the soil should be plowed and harrowed to a depth of at least 20 cm. If the soil is very dry, it should be irrigated before planting. The seedbed should be kept moist until germination occurs.

Growing from cuttings: Super Napier grass can be propagated from cuttings. Cuttings should be taken from healthy plants having been collected from 90-120 day old Napier grass with three nodes and planted directly into the soil at an angle of 45 degrees. The cuttings should be planted about 10 cm apart in rows spaced 30 cm apart, with an average of 6000-8000 cuttings required per acre. The cuttings should be watered regularly until they are established

Nutritional attributes

Napier Pakchong is a new hybrid crossing of *P. purpureum* (the ordinary Napier grass) and *P. glaucum* known as Pearl Millet Napier. Napier Pakchong grass has been introduced due to its high nutritional contents, particularly in terms of crude protein compared to other Napier grass varieties, which is likely to positively impact the milk quality of dairy ruminants. It is claimed to contain 16% to 18% of crude protein, which is considered very high and great for milk-producing animals (Premaratne & Premalal, 2006). It is very fast-growing and high yielding. Malaysia is expected to grow more Napier Pakchong grass by focusing on supplying feed, especially for dairy ruminants. It provides nutritive and palatable green fodder all year round, which contains 10 - 12 % of crude protein, 14.9 % dry matter (DM), 16.5 % protein, 35.8% Neutral Detergent Fibre (NDF), 14.5% ash and 36.5% soluble carbohydrate at the harvest time of 45 days (Pitaksinsuk *et al.,* 2010). Napier Pakchong is smooth, juicy and very consumable grass high in moisture content, making this Napier one of the preferred ingredients for animal food producers. The Napier Pakchong is highly demanded from many countries as a significant food source to be consumed as animal feed. However, Napier Pakchong (*P. purpureum x P. glaucum*) which is reported to grow over 3-meter-tall in less than two months, gives high yields and can be harvested after 45 days with a crude protein concentration of 16-18% (Berentsen et al., 2000). Nevertheless, forage crop performances are positively correlated with the area, location, and season (Tessema et al., 2010).

CHAPTER III

METHODOLOGY

The experiment comprises into two phases, such as field experiment and laboratory analysis. Detailed experimental activities as well as methodology for the investigation are presented in this chapter.

3.1 Experimental site

Dacope upazila, Khulna district.

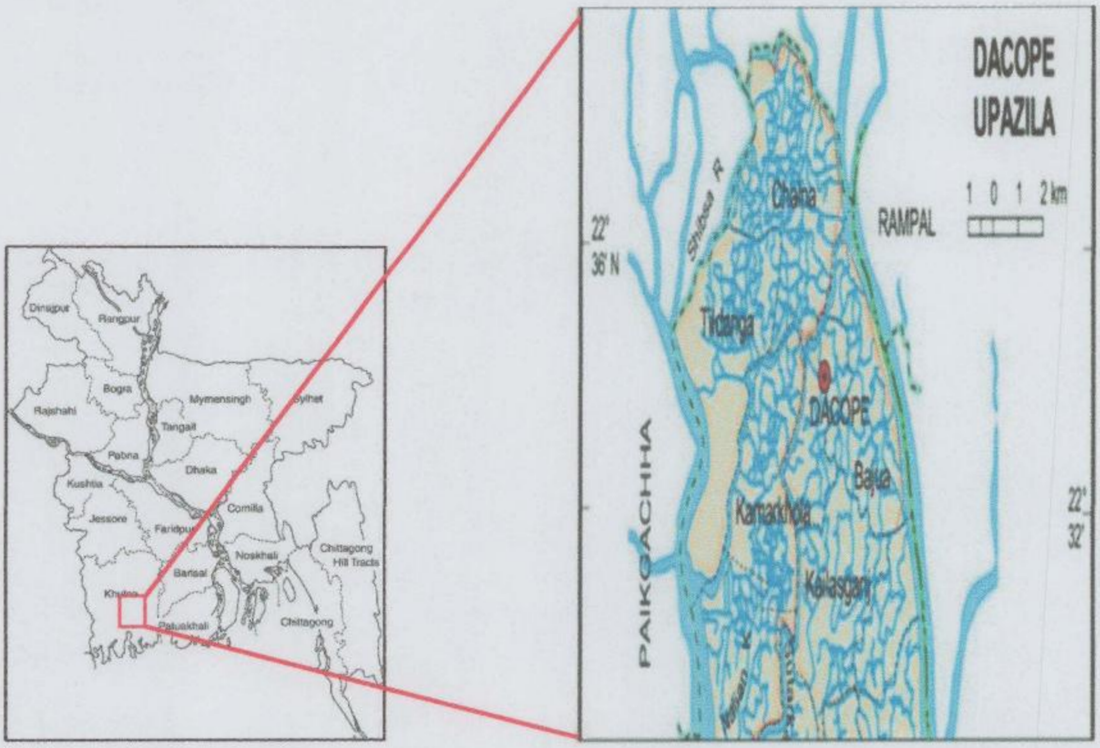

Figure 3.1.1 Location of the experimental site

3.2 Climatic condition:

The climatic condition like temperature and rainfall of Dacope upozilla, Khulna district are shown in (Figure 3.2.1).

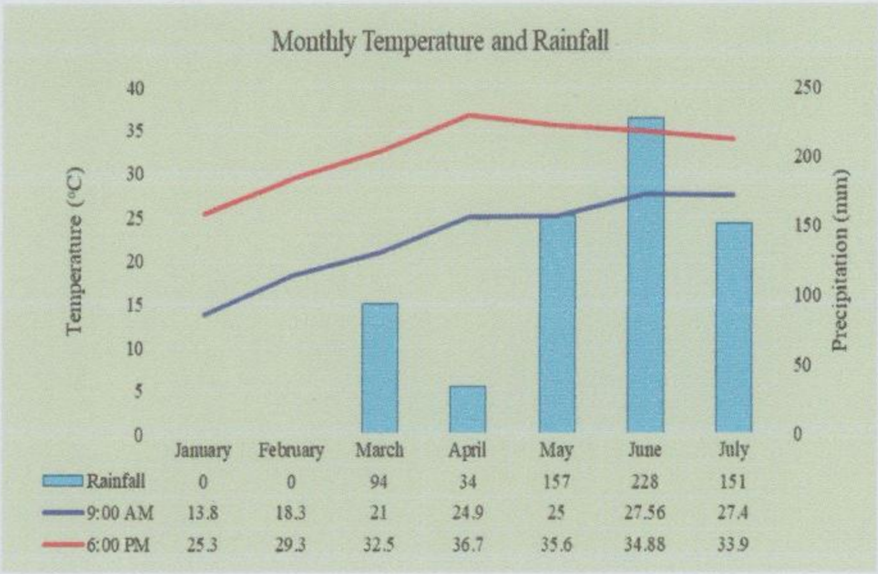

Figure 3.2.1 Monthly temperature and rainfall at Dacope upazila during the study period

3.3 Treatment and design of the experiment

The design of experiment was factorial RCBD with three factors having three replications. The factors were

i. Factor-1: Forage variety (V_1= Red Napier, V_2= 3rd Generation Napier, V_3= 1st Generation Napier, V_4 = Pakchong)

ii. Factor-2: Harvest frequency (D_1= 60 days age , D_2= 75 days age)

iii. Factor-3: Land type (L_1= Agricultural land, L_2= Fallow Land)

Layout of the experiment

The experiment was laid out with factorial randomize complete block design (RCBD) having three replications.

Layout of the experiment:

Varieties	Day	Land	R_1	R_2	R_3
V_1	D_1	L_1	$V_1 D_1L_1R_1$	$V_1 D_1L_1R_2$	$V_1 D_1L_1R_3$
V_2	D_2	L_2	$V_1 D_1L_2R_1$	$V_1 D_1L_2R_2$	$V_1 D_1L_2R_3$
V_3			$V_1 D_2L_1R_1$	$V_1 D_2L_1R_2$	$V_1 D_2L_1R_3$
V_4			$V_1 D_2L_2 R_1$	$V_1 D_2L_2R_2$	$V_1 D_2L_2R_3$
			$V_2D_1 L_1 R_1$	$V_2 D_1 L_1R_2$	$V_2 D_1 L_1R_3$
			$V_2D_1L_2R_1$	$V_2D_1L_2R_2$	$V_2D_1L_2R_3$
			$V_2D_2L_1R_1$	$V_2D_2L_1R_2$	$V_2D_2L_1R_3$
			$V_2D_2L_2R_1$	$V_2D_2L_2R_2$	$V_2D_2L_2R_3$
			$V_3D_1L_1R_1$	$V_3D_1L_1R_2$	$V_3D_1L_1R_3$
			$V_3D_1L_2R_1$	$V_3D_1L_2R_2$	$V_3D_1L_2R_3$
			$V_3D_2L_1R_1$	$V_3D_2L_1R_2$	$V_3D_2L_1R_3$
			$V_3D_2L_2R_1$	$V_3D_2L_2R_2$	$V_3D_2L_2R_3$
			$V_4D_1L_1R_1$	$V_4D_1L_1R_2$	$V_4D_1L_1R_3$
			$V_4D_1L_2R_1$	$V_4D_1L_2R_2$	$V_4D_1L_2R_3$
			$V_4D_2L_1R_1$	$V_4D_2L_1R_2$	$V_4D_2L_1R_3$
			$V_4D_2L_2R_1$	$V_4D_2L_2R_2$	$V_4D_2L_2R_3$

V_1 = Red Napier, V_2= 3rd Generation Napier, V_3= 1st Generation Napier, V_4 = Pakchong. D_1= 60 days , D_2= 75 days. L_1= Agricultural land, L_2= Fallow Land

3.4 Preparation of plot

Forty eight (48) plots having the same dimension of 2m×3m= $6m^2$ area for each plot was arranged for this experiment.

3.5 Collection of plant Cutting

Cutting of BLRI Napier-3 (*Pennisetum purpureum*), BLRI Napier-1 (*Pennisetum purpureum*), Pakchong (*Pennisetum purpureum*), Red Napier (*Pennisetum purpureum*) forage genotype were collected from the BLRI Sub station, Faridpur, Bangladesh.

3.6 Planting of cuttings

Cuttings were planted on 20th January, 2023. Napier grass cutting had 2 nodes a piece and placed at 45° angle with 2 pieces in a hole. The spacing was 60 cm x 60 cm and each plot contains 20 cuttings (Nabllah Jalal *et al.,* 2016).

3.7 Irrigation and fertilizer application

At the time of land preparation, a basal dose of cow dung (14 t ha^{-1}) was applied. Before planting, urea and TSP was applied at a rate of 100 and 50 kg ha^{-1} respectively (Nabllah Jalal *et al.,* 2016). All plots were irrigated when necessary after plantation of cutting.

3.8 General management

All plot was watered once per week to ensure adequate soil moisture for plant growth. The weeds were cleared with local weeding equipment.

3.9 Data Collection

After 60 days and 75 days after planting (DAP) on 22 March and 6 April 2023, 1st and 2nd cuttings were done and data were collected. The sample was weighed and processed for chemical analysis.

3.9.1 Agronomic data collection

Plant height

Five plants were selected randomly for determination of plant height. The height of each plant was measured from the ground to the top of the upper most leaf of the plant and mean value of plant height was recorded.

Number of tillers per hill

Numbers of tillers of the hills were counted. Tillers, which had at least one leaf visible, were counted and recorded.

Number of leaves per plant

Total numbers of leaves of each sample plant were counted and recorded.

Leaf length (cm)

Leaf length was measured by using a measuring tape and recorded.

Leaf width (cm)

Leaf width was measured by using a measuring tape and recorded.

Biomass production

Randomly five plants were harvested from each plot and their mean shoot weight was recorded. The values were converted into t ha^{-1}.

3.10 Proximate Analysis

3.10.1 Crude Protein Analysis

Test Procedures

Digestion

Digestion was completed by using DK 8 Heating Digester VELP SCIENTIFICA. 1 g of sample was weighted with an accuracy of ±0.1 mg. For each sample 2 catalyst and 12 ml H_2SO_4 (98%) were added and then placed into digestion block. The temperature of the digestion block was maintained at 420°C and sample was heated for 60 minutes until the fumes stopped. Then the sample was taken to cool at 50-60°C.

Distillation

Distillation process was conducted by using UDK 129 Distillation Unit VELP SCIENTIFICA. After cooling the sample, it was mixed with 50 ml distilled water. 50 ml NaOH was added with the solution. The digestion flask was then given into the distillation chamber. 30 ml Boric acid solution was taken in a conical flask and 3 drops of indicator were added into it. The water flow was previously adjusted. The distillation process was done until the colour of indicator mixture solution did not turn into green colour.

Titration

The sample of the flask was then taken for titration. Then 0.1% H_2SO_4 was taken in burette pipe and added drop wise. The procedure was continued until the colour of the solution of the conical flask turn from green to blue. When the solution colour had changed the titration procedure ended. The strength of titrate was then recorded.

Calculation

$$CP=\frac{(\text{ml H2SO4 sample}-\text{ml H2SO4 blank})\times \text{conc.H2SO4 } 14.007\times 100}{\text{Wight of sample}\times 1000}$$

3.10.2 Ether Extract Analysis

Test procedure

Ether extract analysis was conducted by using VELP SCIENTIFICASER 148 Solvent Extractor.

Sample: 3 g of grounded and homogenized material was weighed in an extraction thimble with 1 mg approximation. Total weight- thimble weight = wet sample weight.

Chemicals: petroleum ether 40-60° C with an evaporation of residue not higher than 10 mg/l.

Sample drying dried the thimble one hour in a 125° C oven.

Immersion: sample containing thimble or the glass crucible containing dry hydrolysed sample were introduced into the extraction equipment. After weighing extract collecting vessel, 40 ml of petroleum ether was added. Thimble with sample, assembled with thimble connector to extraction unit. After closing the extraction unit, the cooling water flow started and the heating. When the solvent started boiling, the thimble or glass crucibles were placed into "Immersion" position for 30 minutes.

Washing: after 30 minutes extracted, thimble or glass crucible were placed into "Washing" position for 60 minutes.

Recovery: after washing, the stopcock located under the water, was closed and cooled in condenser and evaporated completely the solvent from the extraction vessel.

Weighing: the extract containing cups were dried in oven at 125°C for 30 minutes and weighed it after cooling a desiccator.

Calculation:

$$\text{Ether Extract (\%)} = \frac{W3-W2}{W1}\times 100$$

Where,

W_1 = Weight of sample in gram

W_2 = Weight of empty vessel in gram

W_3 = Weight of vessel and ether extract in gram

3.10.3 Dry matter

Test procedure

At first envelopes were weighted (W_1). After harvesting, fresh shoot weight (W_2) of forage was taken and the envelope was filled with sample and dried in oven for 24 hours at 105°C. Thereafter the dried sample containing envelope (W_3) is weighted.

Calculation:

Dry Matter (%) = $\frac{W3-W1}{W2} \times 100$

Where,

W_1 = Weight of envelope in gram

W_2 = Weight of fresh sample in gram

W_3 = Weight of envelope and dried sample in gram

3.10.4 Ash Analysis

Test Procedure

Crucibles were placed in muffle furnace, allowing 30 minutes to reach 600°C. Weight of crucible was recorded (W_1). About 3 g sample was weighted into a crucible which had been tarred. Weight of sample was recorded (W_2). Crucibles were placed into muffle furnace at 600°C for 6 hours. Crucibles were allowed to cool in furnace to less than 20°C and crucibles were placed in desiccator with a vented top. Crucibles were cooled in desiccator to room temperature and were weighed immediately and the weight was recorded (W_3). Ash% was calculated and reported to one decimal place.

Calculation

Ash (%) = $\frac{W3-W1}{W2} \times 100$

Where,

W_1 = Weight of crucible in gram

W_2 = Weight of sample in gram

W_3 = Weight of crucible and ash in gram

3.11 Statistical method and analysis

Statistical analysis of the data was performed using the SPSS (version 22). DMRT was used to compare the treatment means with significance consider at $p<0.05$.

CHAPTER IV

RESULTS AND DISCUSSION

4.1 Agronomic growth parameters of forages

4.1.1 Interaction effect between harvest frequency and variety on agronomic parameters

It is shown in Table 4.1.1 that highest tiller number per plant and leaf width (7.45) and (3.75 cm) were found both in the interaction of D_2V_2 which was not significantly differed. The highest leaf length (95.91 cm) and biomass (99.44 t ha^{-1}) was found in the interaction of D_2V_1, both which were both significantly ($p<0.001$) differed. Highest leaf number (8.55) was found in the interaction of D_2V_2 and the lowest (6.0) value was found the interaction of D_1V_4 which was not significantly differed. Highest plant height (138.06 cm) was found in the interaction of D_2V_2 and the lowest (109.50) was found in the interaction of D_1V_3 which had significant effect ($p<0.05$). Lounglawan *et al.* (2014) said that there is a positive relationship between harvest frequency and biomass production. There is also a negative relationship between CP and biomass production. This study aligns with the statement.

Table: 4.1.1 Interaction effect between harvest frequency and variety on agronomic parameters

Day	Variety	Plant Height (cm)	Tiller Number	Leaf width (cm)	Leaf Length (cm)	Leaf Number	Biomass (tha^{-1})
	V_1	122.76^{c}	6.40	3.20	88.575^{bc}	7.40	90.49^{cd}
	V_2	119.46^{c}	6.20	3.15	79.215^{d}	7.15	81.94^{e}
D_1	V_3	109.50^{d}	5.15	2.86	67.260^{e}	6.70	72.69^{f}
	V_4	122.02^{c}	4.90	3.12	76.695^{d}	6.00	80.14^{e}
	V_1	133.31^{ab}	6.75	3.43	95.910^{a}	7.70	99.44^{a}
	V_2	138.06^{a}	7.45	3.75	86.015^{c}	8.55	94.69^{b}
D_2	V_3	123.51^{c}	6.10	3.34	86.980^{c}	7.70	88.69^{d}
	V_4	131.01^{b}	5.20	3.58	90.580^{b}	6.75	92.44^{bc}
SEM		0.978	0.365	0.082	0.667	0.194	0.700
P value		0.001	0.508	0.467	0.0001	0.073	0.001

**$p<0.05$ and **$p<0.01$. NS = non-significant. D1 = 60 days; D2 = 75 days; V1 = Red Napier; V2= 3rd Gen. Napier; V3 =1st Gen. Napier; V4 = Pakchong, Means with different superscript letters in a column differ significantly.*

Table: 4.1.3 Interaction effects of harvest frequency, variety and land type on agronomic parameters

Day	Land Type	Variety	Plant Height (cm)	Tiller Number	Leaf width (cm)	Leaf Length (cm)	Leaf Number	Biomass (T/ha)
		V_1	146.66±0.6	7.40±0.2	3.27±0.29	108.29^{cd}±0.67	7.80^{cd}±0.4	102.94^{d}±0.4
		V_2	154.20±0.6	8.10±0.5	3.32±0.12	105.17^{d}±0.41	8.60^{bc}±0.2	108.94^{c}±0.4
D_1	L_1	V_3	140.28±0.8	6.30±0.1	2.91±0.08	90.76^{e}±0.16	7.90^{cd}±0.1	100.54^{d}±1
		V_4	157.12±1	5.30±0.1	3.35±0.01	106.53^{d}±0.15	6.50^{efg}±0.3	111.64^{c}±2.1
		V_1	98.86±1.26	5.40±0.2	3.13±0.15	68.86^{g}±1.3	7.00^{def}±0.2	78.04^{f}±1.1
		V_2	84.72±0.6	4.30±0.1	2.98±0.04	53.25^{i}±0.7	5.70^{g}±0.5	54.94^{h}±0.2
D_1	L_2	V_3	78.72±0.8	4.00±0.2	2.81±0.13	43.76^{j}±1.6	5.50^{g}±0.3	44.84^{j}±1.7
		V_4	86.92±0.8	4.50±0.1	2.89±0.07	46.86^{j}±0.7	5.50^{g}±0.1	48.64^{ij}±0.5
		V_1	160.20±1.2	7.80±0.2	3.65±0.01	114.86^{ab}±1.3	7.90^{cd}±0.3	114.34^{c}±1
D_2	L_1	V_2	176.30±0.5	10.0±1.2	3.93±0.13	113.07^{abc}±0.01	11.30^{a}±0.3	126.04^{b}±1.3
		V_3	161.50±3.3	7.90±1.5	3.69±0.07	109.30^{bcd}±0.9	9.40^{b}±0	122.86^{b}±0.9
		V_4	171.50±1.3	5.70±0.1	4.12±0.02	116.40^{a}±0.02	7.60^{cde}±.2	132.14^{a}±0.6
		V_1	106.42±1.7	5.70±0.1	3.22±0.1	76.96^{f}±0.6	7.5^{cde}±0.3	84.54^{e}±0.6
		V_2	99.82±1.9	4.90±0.3	3.22±0.1	58.96^{h}±0.4	5.8^{fg}±0.4	63.34^{g}±0.6
D_2	L_2	V_3	85.52±1	4.30±0.1	2.97±0.15	64.66^{g}±1.3	6.0^{fg}±0.2	54.54^{h}±0.6
		V_4	90.52±1.8	4.70±0.1	3.04±0.02	64.76^{g}±2	5.90^{fg}±0.1	52.74^{hi}±0.8
SEM			1.38	0.51	0.11	0.95	0.28	0.99
P value			0.16	0.74	0.66	0.01	0.01	0.01

**$p<0.05$ and **$p<0.01$. NS = non-significant. D_1 = 60 days; D_2 = 75 days; L_1 =Agricultural land; L_2 = Fallow land; V_1 = Red Napier; V_2 = 3rd Gen. Napier; V_3 =1st Gen. Napier; V_4 = Pakchong, Means with different superscripts letters in a column differ significantly.*

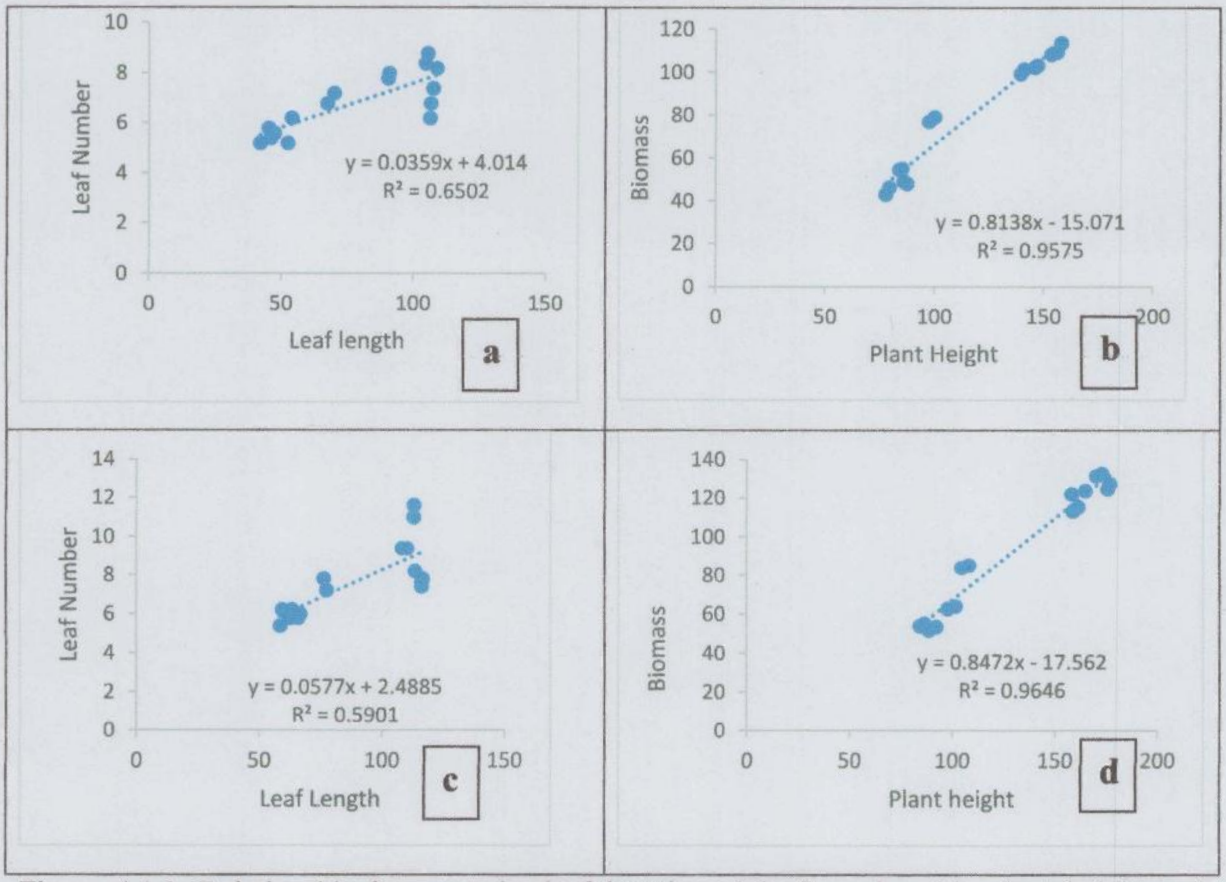

Figure 4.1.1, Relationship between the leaf length and leaf number (a), plant height and biomass (b) at 60 days and relationship between leaf length and leaf number (c), plant height and biomass (d) at 75 days.

It is shown in Figure 4.1.1, regression coefficient between leaf length and leaf number (a) plant height and biomass (b), were described, it were highly positive correlation between leaf length and leaf number ($R^2 = 0.65$), plant height and biomass ($R^2 = 0.95$). Regression coefficient between leaf length and leaf number (c), plant height and biomass (d), were describe. It were positive correlation between leaf length and leaf number (R^2=0.59), plant height and biomass (R^2=0.96) were highly positive correlation.

4.2 Nutritional parameters of forages

4.2.1 Interaction effect of harvest frequency and variety on nutritional parameters

It is shown in Table 4.2.1 that highest DM (21.80%) and moisture (83.95%) were found in the interaction of D_2V_3 and D_1V_4, respectively and lowest DM (16.04%) and moisture (78.20%) were found in the interaction of D_1V_4 and D_2V_3, respectively which were both significantly (p<0.001) differed. The highest ash (15.27%) and fat (2.08%) content were found in the interaction of D_1V_4 and D_2V_4, respectively which were both significantly (p<0.001) differed. Highest CP (7.37%) was found in the interaction of D_1V_4 and lowest (3.98%) was found in the interaction of D_2V_1 which was not significantly differed.

Table 4.2.1 Interaction effect of harvest frequency and variety on nutritional parameters

Day	Variety	DM%	CP%	Ash %	Moisture%	Fat%
	V_1	18.19^b	4,59	6.89^e	81.80^b	1.48^f
D_1	V_2	19.32^b	5.72	11.84^c	80.68^b	1.52^f
	V_3	18.61^b	6.29	14.35^{ab}	81.38^b	1.72^{de}
	V_4	16.04^c	7.37	15.27^a	83.95^a	1.80^{cd}
	V_1	21.27^a	3.98	8.35^d	78.72^c	1.67^e
	V_2	21.79^a	4.78	13.75^b	78.20^c	1.90^{bc}
D_2	V_3	21.80^a	5.43	14.37^{ab}	78.20^c	1.98^{ab}
	V_4	21.57^a	6.46	15.02^a	78.43^c	2.08^a
SEM		0.270	0.125	0.191	0.270	0.023
P value		0.0001	0.527	0.0001	0.0001	0.009

**p<0.05 and **p<0.01. NS = non-significant. D_1 = 60 days; D_2 = 75 days; V_1= Red napier; V_2 = 3rd Gen. Napier; V_3 = 1st Gen. Napier; V_4 = Pakchong. Means with different superscript letters in a column differ significantly.*

4.2.2 Interaction effect of land type and verity on nutritional parameters

It is shown in Table 4.2.2 that highest CP (8.66%) and moisture (82.46%) were found in the interaction of L_1V_4 and lowest CP (2.68%) and moisture (78.67%) were found in the interaction of L_2V_2, respectively which both were significantly (p<0.001) differed. Highest ash (15.82%) and fat (2.25%) were found in the interaction of L_2V_3 and L_1V_4, respectively which were both significantly (p<0.001) differed. Highest DM (21.32%) was found in the interaction of L_2V_2 and lowest (19.31%) was found in the interaction of L_1V_3 which was significantly (p<0.04) differed.

Table: 4.2.2 Interaction effect of land type and verity on nutritional parameters

Land Type	Variety	DM%	CP%	Ash%	Moisture%	Fat%
	V_1	19.31^{b}	5.80^{c}	7.27^{d}	80.69^{b}	1.90^{c}
	V_2	19.78^{b}	7.82^{b}	12.12^{c}	80.21^{b}	1.97^{bc}
L_1	V_3	19.31^{b}	8.03^{b}	12.91^{bc}	80.68^{b}	2.06^{b}
	V_4	17.54^{c}	8.66^{a}	15.08^{a}	82.46^{a}	2.25^{a}
	V_1	20.16^{ab}	2.77^{f}	7.97^{d}	79.84^{bc}	1.25^{f}
	V_2	21.32^{a}	2.68^{f}	13.46^{b}	78.67^{bc}	1.44^{e}
L_2	V_3	21.09^{a}	3.69^{e}	15.82^{a}	78.90^{c}	1.64^{d}
	V_4	20.07^{ab}	5.18^{d}	15.22^{a}	79.92^{c}	1.62^{d}
SEM		0.270	0.125	0.191	0.270	0.023
P value		0.047	0.0001	0.0001	0.047	0.0001

**$p<0.05$ and $**p<0.01$. NS = non-significant. L_1 = Agricultural land; L_2 = Fallow land; V_1= Red Napier; V_2 = 3rd Gen. Napier; V_3 = 1st Gen. Napier; V_4 = Pakchong. Means with different superscripts in a column differ significantly.*

4.2.3 Interaction effects of harvest frequency, variety and land type on nutritional parameters of fodder cultivars

It is shown in Table 4.2.3, that highest DM (23.10%) was found in the interaction of $D_2L_2V_4$ and lowest (15.04%) was found in the interaction of $D_1L_1V_4$ which was not significantly differed. Highest CP (9.10%) was found and lowest CP (2.02%) was found in the interaction of $D_2L_2V_2$ which was not significantly differed. Highest ash (16.57%) and fat (2.39%) were found in the interaction of $D_2L_1V_3$ and $D_2L_1V_4$ respectively and lowest ash (6.44%) and fat (1.15%) were found in the interaction of $D_1L_1V_1$ and $D_1L_2V_1$ which both were significantly ($p<0.05$) differed. Highest moisture (84.96%) was found in the interaction of $D_1L_1V_4$ and the lowest (76.90%) was found in the interaction of $D_2L_2V_4$ which was not significantly differed.

Ansah *et al.* (2010) reported that the DM content increased as Napier grass maturity increased. Kramberger & Klemencic. (2003); Bayble. (2007); Sultan *et al.* (2007); Ansah *et al.* (2010) and Jusoh *et al.* (2014) mentioned that the CP content of Napier grass decreased with maturity. Jusoh *et al.* (2014) also noticed that despite the decline in CP content with increasing stage of maturity which is matched with the present findings.

Rambau *et al* (2016) showed that Fat content decreased (36.3, 34.3 and 32.5 gm/kg) with maturity. Generally, ash content gives an indication of the minerals present in the sample.

Khan (2009) stated that, Napier grass is highly relished by all type of cattle and buffalos and contains 6-8% CP, 8-10% ash, 28-35% CF, 32-36% NFE and 8-9 MJ ME/ kg DM. This study aligns with the statement.

Table: 4.2.3 Interaction effects of harvest frequency, variety and land type on nutritional parameters of fodder cultivars

Day	Land Type	Variety	DM (%)	CP (%)	Ash (%)	Moisture (%)	EE (%)
		V_1	17.94±0.165	6.04±0.07	6.44^{h}±0.32	82.05±0.16	1.81^{ef}±0.03
		V_2	18.63±0.315	8.15±0.18	11.29^{f}±0.06	81.36±0.31	1.85^{def}±0.03
D_1	L_1	V_3	17.96±0.37	8.59±0.27	13.64^{cde}±0.33	82.04±0.27	1.90^{de}±0.01
		V_4	15.04±0.61	9.10±0.12	16.16^{a}±0.19	84.96±0.61	2.12^{bc}±0.02
		V_1	18.45±0.33	3.13±0.01	7.35^{gh}±0.21	81.55±0.33	1.15^{k}±.05
		V_2	20.00±0.115	3.30±0.15	12.39^{ef}±0.06	79.99±0.11	1.18^{jk}±0.6
D_1	L_2	V_3	19.27±0.29	3.99±0.12	15.07^{abc}±0.1	80.73±0.29	1.55^{gh}±0.01
		V_4	17.05±0.07	5.65±0.20	14.39^{cd}±0.27	82.95±0.07	1.48^{hi}±0.02
		V_1	20.67±0.55	5.55±0.22	8.105^{g}±0.23	79.32±0.55	2.00^{cd}±0.03
D_2	L_1	V_2	20.94±0.49	7.49±0.37	12.95^{de}±0.26	79.06±0.49	2.09^{b}±0.004
		V_3	20.67±0.75	7.47±0.11	12.18^{ef}±0.2	79.32±0.75	2.23^{ab}±0.35
		V_4	20.04±0.27	8.22±0.10	14.00^{cd}±0.66	79.96±0.20	2.39^{a}±0.025
		V_1	21.87±0.33	2.42±0.1	8.600^{g}±0.06	78.13±0.33	1.35^{ij}±0.035
		V_2	22.64±0.47	2.07±0.05	14.54^{bc}±0.21	77.35±0.47	1.71^{fg}±0.02
D_2	L_2	V_3	22.92±0.05	3.39±0.16	16.57^{a}±0.4	77.07±0.05	1.74^{ef}±0.05
		V_4	23.10±0.13	4.71±0.15	16.04^{ab}±0.07	76.90±0.07	1.77^{ef}±0.02
SEM			0.381	0.176	0.270	0.381	0.033
P value			0.913	0.214	0.0001	0.913	0.002

****p<0.05* and ***p<0.01*. NS = non-significant. D_1 = 60 days; D_2 = 75 days; L_1 =Agricultural land; L_2 = Fallow land; V_1 = Red napier; V_2 = 3rd Gen. Napier; V_3 =1st Gen. Napier; V_4 = Pakchong, Means with different superscript letters in a column differ significantly.***

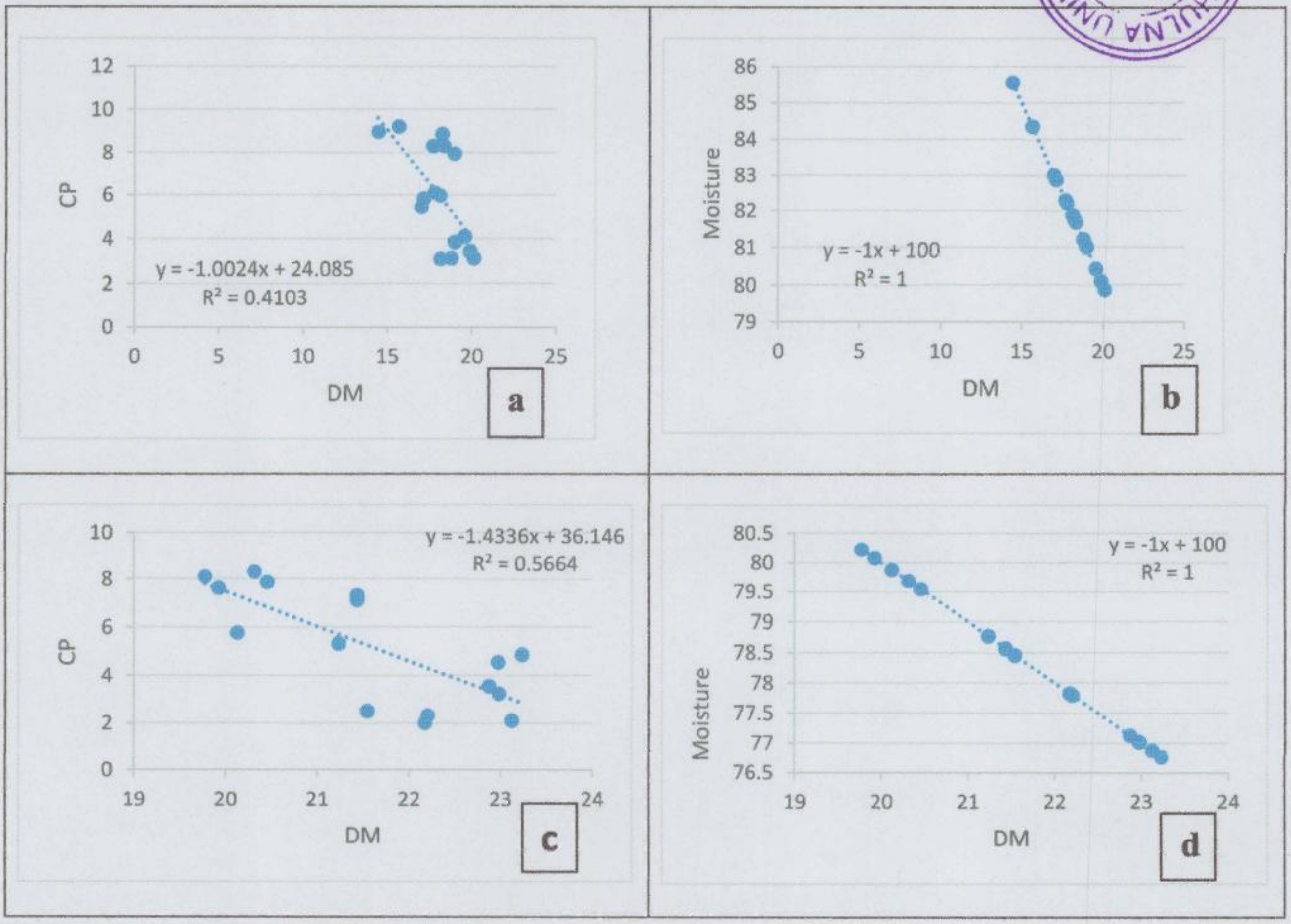

Figure:4.2.1 Relationship between the DM and CP (a), DM and moisture (b) at 60 days and relationship between DM and CP (c), DM and moisture (d) at 75 days.

It is shown in Figure 4.2.1, regression coefficient between DM and CP (a), DM and moisture (b), were described, it were highly negative correlation between DM and CP ($R^2 = 0.41$), DM and moisture ($R^2 = 1$). Regression coefficient between DM and CP (c), DM and moisture (d), were described. It were highly negative correlation between DM and CP ($R^2 = 0.56$), DM and moisture ($R^2 = 1$) were positive correlation.

Table 4.2.4: Overall correlation matrix of growth parameters of four variety forage at 60 days in fallow land

	1	2	3	4	5	6	7	8	9	10	11
1	1										
2	0.95***	1.00									
3	0.70**	0.84***	1.00								
4	0.93***	0.88***	0.72**	1.00							
5	0.86***	0.82***	0.62**	0.91***	1.00						
6	0.94***	0.90***	0.72**	0.99***	0.90***	1.00					
7	-0.32	-0.36	-0.09	0.03	-0.01	-0.02	1.00				
8	-0.30	-0.30	-0.44	-0.61	-0.54	-0.58	-0.75	1.00			
9	-0.92	-0.89	-0.74	-0.99	-0.88	-0.99	-0.03	0.64**	1.00		
10	0.32	0.36	0.09	-0.03	0.01	0.02	-1.00	0.75**	0.03	1.00	
11	-0.68	-0.61	-0.62	-0.83	-0.67	-0.78	-0.35	0.71	0.82***	0.35	1.00

1.Planth height 2. Tiller number 3. Leaf width 4. Leaf Length 5. Leaf number 6. Biomass 7. Dry matter 8. Crude Protein 9. Ash 10. Moisture 11. Fat, **indicates $p<0.05$,*** indicates $p<0.01$.

The results of Pearson's correlation coefficients among the growth and nutritional parameters of overall four variety forages at 60 days in fallow land. It is shown Table 4.2.4. that highly positive significant ($p<0.01$) association was found between plant height and leaf length (r = 0.93***) plant height and tiller number (r = 0.94***), plant height and leaf width (r = 0.69**), plant height and leaf number (r=0.85***), plant height and biomass (r=0.94***) and leaf length and biomass(r=0.92***). There were positive significant ($p<0.05$) association between crude protein and ash (r = 0.71**), crude protein and fat (r = 0.71**) and leaf length and leaf number(r=0.90***), But dry matter and plant height , dry matter and tiller number, ash, fat, moisture are negative correlation.

However, DM yield of Napier grass is positively correlated with soil fertility (Bogdan, 1977). Islam *et al.*, (2003) observed that Napier grass on average contains 20% DM. The nutritive value of tropical grass is primarily determined by the CP content (Leng et al., 1993). An increase in the rate of N fertilization will increase the content of CP of napier grass, although the same effect does not occur with P and K (Pieterse and Rethman, 2002). A minimum CP of 15% is required for lactation and growth of cattle (Norton 1982; Van Soest 1982). We found DM and CP are same results content compare to this experiment.

Table 4.2.5: Overall correlation matrix of growth parameters of four variety forage at 75 days in agricultural land

	1	2	3	4	5	6	7	8	9	10	11
1	1.00										
2	0.29	1.00									
3	0.67**	-0.25	1.00								
4	0.28	-0.43	0.53**	1.00							
5	0.49*	0.71**	-0.07	-0.52	1.00						
6	0.73**	-0.27	0.80***	0.21	0.10	1.00					
7	-0.12	0.08	-0.28	-0.09	0.38	-0.26	1.00				
8	0.59**	-0.11	0.75**	-0.09	0.18	0.90***	-0.37	1.00			
9	0.71**	-0.10	0.74**	-0.02	0.28	0.95***	-0.24	0.95	1.00		
10	0.12	-0.08	0.28	0.09	-0.38	0.26	-1.00	0.37	0.24	1.00	
11	0.23	-0.64	0.65**	0.11	-0.29	0.82***	-0.40	0.82***	0.78**	0.40	1.00

1. Planth height 2. Tiller number 3. Leaf width 4. Leaf Length 5. Leaf number 6. Biomass 7. Dry matter 8. Crude Protein 9. Ash 10. Moisture 11. Fat, **indicates p<0.05*** indicates p<0.01.

The results of Pearson's correlation coefficients analysis among the growth and nutritional parameters of overall four forage variety at 75 days in agricultural land. It is shown in Table 4.2.5 that positive significant (p<0.05) association was found between plant height and leaf width (r = 0.67**) plant height and biomass (r = 0.73**), plant height and leaf number (r = 0.49*), plant height and CP (r=0.59**), plant height and ash (r=0.71**) and leaf width and fat (r=0.65**). Leaf width and CP (r=0.75**), leaf width and ash (r=0.74**).There was positive significant (p<0.05). There was highly positive significant (p<0.01) between Crude protein and ash (r = 0.95***), Crude protein and fat (r = 0.81***), and biomass and CP, ash, fat (r=0.90***), (95***) (82***) respectively. But Dry matter and plant height, Dry matter and CP, ash, fat, moisture are negative correlation.

Table 4.2.6: Overall correlation matrix of growth parameters of four variety forage at 75 days in fallow land

	1	2	3	4	5	6	7	8	9	10	11
1	1.00										
2	0.94***	1.00									
3	0.73**	0.68**	1.00								
4	0.49	0.69**	0.21	1.00							
5	0.64**	0.79**	0.41	0.87***	1.00						
6	0.90***	0.91***	0.58	0.76**	0.85***	1.00					
7	-0.80	-0.86	-0.47	-0.67	-0.79	-0.85	1.00				
8	-0.66	-0.47	-0.61	-0.11	-0.35	-0.65	0.59*	1.00			
9	-0.88	-0.92	-0.52	-0.81	-0.90	-0.98	0.84***	0.54*	1.00		
10	0.80***	0.86***	0.47	0.67**	0.79**	0.85	-1.00	-0.59	-0.84	1.00	
11	-0.77	-0.82	-0.40	-0.83	-0.92	-0.95	0.75	0.50	0.97***	-0.75	1.00

1. Planth height 2. Tiller number 3. Leaf width 4. Leaf Length 5. Leaf number 6. Biomass 7. Dry matter 8. Crude Protein 9.Ash 10. Moisture 11. Fat, **indicates p<0.05*** indicates p<0.01

The results of Pearson's correlation coefficients among the growth and nutritional parameters of overall four variety forage at 75 days in agricultural land. It is shown in Table 4.2.6 that positive significant (p<0.05) association was found between plant height and leaf width (r = 0.72**), plant height and leaf number (r = 0.63*), height and moisture (r = 0.79**). There was highly positive significant (p<0.01) between plant height and tiller number (r = 0.94***), tiller number and moisture (r = 0.86***), DM and ash (r = 0.83***), ash and fat (r=0.97***). But Dry matter and plant height, Dry matter and CP, ash, fat, moisture are negative correlation.

CHAPTER V

SUMMARY AND CONCLUSION

5.1 Summary

The findings of the study revealed that leaf length, leaf number and biomass were (116.40 cm, 11.30 and 132.14tha^{-1}) in the interaction of $D_2L_1V_4$, $D_2L_1V_2$, and $D_2L_1V_4$, respectively which were highly significantly (p<0.001) differed. Highest plant height, tiller number and leaf width was found in the interaction effect of $D_2L_1V_2$, $D_2L_1V_2$ and $D_2L_1V_4$, respectively. Highest ash (16.57%) and fat (2.39%) content were found in the interaction of $D_2L_2V_3$ and $D_2L_1V_4$ which were highly significantly (p<0.001) differed. Highest CP (9.10%), DM (23.10%) and moisture (84.96%) were found in the interaction effect of $D_1L_1V_4$, $D_2L_2V_4$, $D_2L_1V_2$, which were not significantly differed.

5.2 Conclusion

The results of the study indicated that the highest leaf number (11.30) and total biomass (132.14tha^{-1}) were found in Pakchong fodder while the highest leaf length (116.40 cm) was found in 3rd Generation Napier fodder at 75 days after planting in agricultural land. The highest ash content (16.57%) was found in 1st Generation Napier fodder at 75 days after planting in fallow land while the highest fat content (2.39%) was found in Pakchong fodder at 75 days after planting in agricultural. The highest CP content (9.10%) was found in Pakchong fodder at 60 days after planting in agriculture land. It might be concluded that biomass production of Pakchong was the highest at 75 days after planting in agricultural land while the highest CP content was found in the same forage at 60 days after planting. The experimental results will undoubtedly be helpful to the farmers in the costal region of Bangladesh

5.3 Recommendation

1. Government needs to address the upscaling of Pakchong forage cultivation in the costal saline zones of the country which may boost up milk production as well as alleviate livestock fodder deficiencies.
2. Further study is needed to increase yield and nutrition quality in fallow and agricultural land using organic fertilizer.

CHAPTER VI

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