



Varietal Performance of Napier Fodder (*Pennisetum purpureum*) Influenced by Nitrogen Fertilizer under Mango Based Agroforestry System

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Authors' contributions

This work was carried out in collaboration between all authors. Author MHR performed the field experiments. Author MMR performed statistical analysis, wrote the protocol and the first draft of the manuscript. Author MSB designed the study. Authors MRI and MAQ managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Aims: To observe the varietal performance of Napier fodder influenced by nitrogen fertilizer application under mango tree based agroforestry system.

Study Design: The experiment was consisted of two factors RCBD with three replications.

Place and Duration of Study: The experiment was carried out at the Agroforestry and Environment Research Farm, Hajee Mohammad Danesh Science and Technology University, Dinajpur, Bangladesh during June 2014 to December 2014.

Methodology: Among the two factors, one factor like A was three Napier variety viz. V₁= Bazra, V₂= Arusha and V₃= Hybrid; another factor B was three nitrogen fertilizer doses viz. N₁=150 kg/ha, N₂= 100 kg/ha and N₃= 50 kg/ha. So, there were nine treatment combinations; V₁N₁= Bazra + 150 kg/ ha, V₁N₂ = bazra + 100 kg/ha, V₁N₃= bazra + 50 kg/ha, V₂N₁= Arusha + 150 kg/ha, V₂N₂ = Arusha + 100 kg/ha, V₂N₃= Arusha + 50 kg/ha, V₃N₁ = Hybrid + 150 kg/ha, V₃N₂ = Hybrid + 100 kg/ha and V₃N₃ = Hybrid + 50 kg/ha.

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Results: The experimental results revealed that the growth, yield and yield contributing character of Napier were varied significantly due to varietal effect and different nitrogen doses and also for their interaction at different DAP and different harvesting time. The tallest plant of Napier grass (146.20 cm, 200.00 cm and 228.40 cm) was recorded from V_1N_3 (Bazra + 150 kg/ha N) treatment and the dwarf plant (113.20, 167.10 cm and 197.40 cm) was recorded from V_3N_1 (Hybrid + 50 kg/ha N) treatment at 30, 60 and 90 DAP, respectively. Similarly the highest yield (13.40, 14.14 and 14.15 ton/ha) was recorded from V_1N_3 (Bazra + 150 kg/ha N) treatment where as the lowest (5.20, 5.80 and 5.90 t/ha) was recorded from V_3N_1 (Hybrid + 50 kg/ha N) treatment at 1st, 2nd and 3rd harvest, respectively. Therefore, the suitability of Napier production with different doses of nitrogen fertilizer under mango based agroforestry system may be ranked as $V_1N_1 > V_2N_1 > V_3N_1 > V_1N_2 > V_2N_2 > V_3N_2 > V_1N_3 > V_2N_3 > V_3N_3$.

Conclusion: It may be decided that the cultivation of Bazra Napier variety with 150 kg urea under the floor of mango orchard provide higher yield of Napier fodder.

Keywords: Fodder; nitrogen; mango and agroforestry.

1. INTRODUCTION

Bangladesh is basically an agricultural country. The important and crucial role played by livestock in the traditional and subsistence rural agro-economy of Bangladesh. Livestock contributes 2.79% of the Gross Domestic Products (GDP) and 13.7% of the agricultural GDP of Bangladesh [1]. Moreover, Livestock by-products namely hides and skins, leather and leather products are important export items of the country and contribute about 13% total foreign exchange earning of the country. Shortage of animal feed is the major constraint of animal production and is likely, in turn, to increase the predisposition of animal disease and mortality. In Bangladesh, unfortunately, about 90% of the ruminants diet consists of low quality roughage i.e., rice straw and moreover, the amount available is far less than the requirement [2]. Virtually Bangladesh has no arable land for feed and fodder production exclusively for animals. At present, cattle, buffaloes, sheep and goats subsist mainly on rice straws, weeds, roadside and fallow land grazing and tree leaves with limited supplementation of cereal bran and oilcakes. As a result growth rate or milk production of the animal consuming rice straw alone are generally low and often only about 10% of the genetic potentiality of the animal [3]. On a straw-based diet, supplementation of small amount of green grass is often recommended for optimization of rumen environment [4] or even to meet the maintenance requirement of animal.

Pennisetum purpureum (Napier Grass) is a species of grass native to the tropical grasslands of Africa. It is an important fodder in Bangladesh because of its excellent growth character, quick re-growth, and economic source of dietary

energy and capability of its various uses such as green fodder, straw, hay or silage. So, more emphasis should be concentrated on the production technology of such potential fodder, particularly in the situation of Bangladesh. It is a high yielding fodder, best suited in Bangladesh condition. The plants produce tiller freely and a single clump may produce up to 50 tillers under favorable climatic and soil conditions. The plant is succulent, leafy, fine textured, palatable, and fast growing and drought resistant. It has also good characteristics of giving both quality of hay and silage. However, the yield of this forage like others may vary under different fertilizer treatments. The plant growth, yield and yield contributing character of forage varies due to many factors such as the soil quality, variety, plant density, fertilizer doses, growing season etc. [5,6].

Nitrogen fertilization is an important factor for production of Napier grass. The response of N fertilization on growth, yield and yield contributing character is highly co-related. Nitrogen is also essential for different physiologically important compounds such as chlorophyll, nucleotide, enzyme, hormones nucleoprotein, DNA and RNA. Nitrogen enhances the growth of shoot and makes the fodder juicy. Application of N also increases the positive ion exchange of the root that enhances the absorption of Ca, P and, K. [7]. Application of Nitrogen fertilizer may improve yield and nutritive value of such fodder. Nitrogen from urea is an important nutrient in increasing productivity of forage biomass. The response of N fertilizer on green forage yield and protein content and also enhances the growth of shoot and makes the fodder juicy that is essential for fodder crop. So, the appropriate level of Nitrogen application in Napier grass cultivation is needed

to know. Keeping this view in mind, this research was done to evaluate the effect of different levels of nitrogen fertilizer on growth and yield of three Napier varieties under the floor of mango orchard.

2. MATERIALS AND METHODS

2.1 Experimental Site Description

The experimental site was selected in the existing mango orchard of the Agroforestry Research Farm, Hajee Mohammad Danesh Science and Technology University, Dinajpur, Bangladesh. The geographical location of the site was between 25° 13' latitude and 88° 23' longitude, and about 37.5 m above the sea level.

2.2 Experimental Design and Crop Husbandry

The experiment was laid out following a factorial Randomized Complete Block Design (RCBD) with three replications. There were 2 factors in this experiment. Among the two factors, factor A was three Napier varieties; V_1 = Bazra (*Penicium peripurium* Var. 1), V_2 = Arusha (*Penicium peripurium* Var. 2), V_3 = Hybrid (*Penicium peripurium* Var. 3) and Factor B were three nitrogen doses; N_1 = 150 kg N/ha urea, N_2 = 100 kg N/ha urea, N_3 = 50 kg N/ha urea. So, the treatment combinations of the experiment were; V_1N_1 = Bazra + 150 kg N/ha, V_1N_2 = Bazra + 100 kg N/ha, V_1N_3 = Bazra + 50 kg N/ha, V_2N_1 = Asura + 150 kg N/ha, V_2N_2 = Asura + 100 kg N/ha, V_2N_3 = Asura + 50 kg N/ha, V_3N_1 = Hybrid + 150 kg N/ha, V_3N_2 = Hybrid + 100 kg N/ha, V_3N_3 = Hybrid + 50 kg N/ha urea. Total number of experimental plot was 27. Plant to plant distance= 35cm, Line to line distance= 70 cm and plot size= 5m x5m. Napier cuttings were collected from Bangladesh Livestock Research Institute, Savar, Dhaka.

2.3 Data Collection

Data were collected on the following parameters - plant height (cm), number of leaf, number of tiller plant⁻¹, leaf length, leaf breadth, fresh weight plant⁻¹, fresh weight plot-1 total, yield, and air dry weight and oven dry weight. Napier fodder was harvested above the ground level (3-4 cm) after 30 days of planting. After 30 days of 1st harvest, the green fodder was harvested again after 60 days of planting. Then third time green fodder

was harvested after 90 days of planting and in every cutting, sample was weighted for measuring.

2.4 Data Analysis

Data collected from different parameters were compiled and tabulated in proper form. The statistical analysis ANOVA was done following RCBD design with the help of computer package MSTAT-C program. The means were adjudged by Duncan's New Multiple Range Test [8].

3. RESULTS

3.1 Growth

The tallest plant (146.20 cm, 200.00 cm and 228.40 cm at 30 DAP, 60 DAP and 90 DAP, respectively) of Napier grass was recorded in V_1N_1 where as the shortest plant (113.20 cm, 167.10 cm and 197.40 cm at 30 DAP, 60 DAP and 90 DAP, respectively) was recorded in V_3N_3 (Table 1). On the other hand, the maximum number of tiller plant-1 (6.90, 7.89 and 9.20 at 30 DAP, 60 DAP and 90 DAP, respectively) was recorded in N_1 (150 kg/ha) nitrogen dose whereas the minimum (2.55, 4.11 and 5.60 at 30 DAP, 60 DAP and 90 DAP, respectively) was recorded in V_3N_3 (Table 1). The maximum number of leaf per plant (50.20, 65.83 and 75.20 at 30 DAP, 60 DAP and 90 DAP, respectively) of Napier grass was recorded in V_3N_1 and minimum (40.10, 52.10 and 60.80 at 30 DAP, 60 DAP and 90 DAP, respectively) was recorded in V_2N_3 (Table 1). However, the maximum length of leaf (90.20cm, 97.10 cm and 105.23 cm at 30 DAP, 60 DAP and 90 DAP, respectively) was recorded in V_1N_1 and minimum (56.00 cm, 59.20 cm and 78.10 at 30 DAP, 60 DAP and 90 DAP, respectively) was in V_3N_3 (Table 2). In case of leaf breadth, the maximum (2.25cm, 2.66cm and 2.95 cm at 30 DAP, 60 DAP and 90DAP, respectively) was recorded in V_1N_1 and minimum (1.63 cm, 1.74 cm and 2.24 cm at 30 DAP, 60DAP and 90DAP, respectively) was recorded in V_3N_3 (Table 2).

3.2 Yield

The highest yield (13.42 t/ha, 14.14 t/ha and 14.15 t/ha at 1st, 2nd and 3rd harvest, respectively) was obtained from V_1N_1 and lowest yield (5.20 t/ha, 5.80 t/ha and 5.90 t/ha at 1st, 2nd and 3rd harvest, respectively) was recorded from V_3N_3 (Table 2).

Table 1. Interaction effect of variety and nitrogen dozes on the growth parameters of Napier grass

Treatments	Plant height (cm) at			Number of tiller/plant			Number of leaf/plant		
	30DAP	60DAP	90DAP	30DAP	60DAP	90DAP	30DAP	60DAP	90DAP
V ₁ N ₁	146.20a	200.00a	228.40a	6.90a	7.89a	9.20 a	46.20bcd	58.20bc	69.29bc
V ₂ N ₁	132.00b	190.10b	218.10b	4.13b	6.20b	6.80b	43.20def	54.00c	63.20de
V ₃ N ₁	118.20c	180.00c	212.30c	3.73b	5.90bc	6.30b	50.20a	65.83a	75.20a
V ₁ N ₂	138.10cd	175.20cd	207.60c	3.45b	5.80bc	6.20c	45.20ef	57.90bc	68.20cd
V ₂ N ₂	130.60cd	173.30cd	206.10d	3.00b	5.70c	6.00d	42.10de	53.10c	62.11e
V ₃ N ₂	128.20cd	169.30cd	205.50cd	2.80b	4.45de	6.26d	48.10ab	63.20ab	74.20ab
V ₁ N ₃	120.10d	174.20d	200.10d	2.70b	4.60d	5.80e	44.10cde	55.10c	67.30cd
V ₂ N ₃	118.30d	170.20d	198.40de	2.60b	4.50d	5.70de	40.10f	52.10c	60.80e
V ₃ N ₃	113.20de	167.10de	197.40de	2.55b	4.11e	5.60de	47.20abc	64.20ab	62.20e
CV (%)	5.57	5.74	6.28	5.99	2.3	9.29	5.6	8.9	4.15

In a column, figures having similar letter(s) do not differ significantly whereas figures bearing different letter(s) differ significantly (as per DMRT)

Table 2. Interaction effect of variety and nitrogen dozes on the yield and yield attributing characters of Napier grass

Treatments	Leaf length (cm) at			Leaf breadth (cm) at			Fresh yield (tha-1) at		
	30DAP	60DAP	90DAP	30DAP	60DAP	90DAP	1 st harvest	2 nd harvest	3 rd harvest
V ₁ N ₁	90.20a	97.10a	105.23a	2.25a	2.66a	2.95a	13.42a	14.14a	14.15a
V ₂ N ₁	83.53b	94.15b	100.15b	2.15b	2.40b	2.85b	12.50b	12.90b	12.80b
V ₃ N ₁	77.20c	82.00c	95.12c	2.00c	2.20c	2.60c	10.10c	10.90c	10.40b
V ₁ N ₂	71.20d	75.20d	90.32d	1.90d	2.00d	2.51d	9.89abc	10.71b	10.96b
V ₂ N ₂	67.70de	68.23d	86.60d	1.80d	1.90de	2.39e	9.80bc	9.93bc	9.93bc
V ₃ N ₂	62.20de	64.10de	84.20d	1.70e	1.80de	2.30ef	8.33c	8.79c	8.48c
V ₁ N ₃	60.10d	63.20de	83.20e	1.68ef	1.77e	2.27f	7.11c	7.80c	7.90c
V ₂ N ₃	58.10d	60.10de	80.12ef	1.65f	1.75ef	2.25f	6.10cd	6.70cd	6.80cd
V ₃ N ₃	56.00de	59.20de	78.10ef	1.63f	1.74f	2.24f	5.20d	5.80d	5.90d
CV (%)	7.73	5.66	8.69	9.84	1.73	4.23	20.31	7.29	8.39

In a column, figures having similar letter(s) do not differ significantly whereas figures bearing different letter(s) differ significantly (as per DMRT)

4. DISCUSSION

The research revealed that in case of main effect of variety the highest plant height, number of tiller, number of leaf, leaf length, leaf breadth and fresh yield were found on Bazra variety of Napier. It may be due to high genetic vigor than other variety like Ashura and Hybrid. This result is an agreement with the findings of Zaman et al. [9]. The research also revealed that in case of main effect of different nitrogen doses, the highest plant height, number of tiller, number of leaf, leaf length, leaf breadth and fresh yield was found on Napier grass when nitrogen applied at the rate of 150 kg/ha than other doses. This result is partially in agreement with the findings of Khan et al. [10] who conducted an experiment on oat fodder using different doses of N fertilizer at the rate of 0, 25, 50, 75, 100, 125, 150 kg/ha and observed that application of 150 kg N/ha resulted in significantly higher ($P>0.01$) yields of both green and dry fodder. They also observed that the application of 150 kg N/ha gave significantly higher ($P<0.05$) CP yield of oat grass compared to other doses. This result also similar with the result of [11,12,13]. The research also revealed that in case of interaction effect of variety and nitrogen doses on the plant height, number of tiller, number of leaf, leaf length and leaf breadth fresh yield highest were found on Bazra variety of napier at the rate of 150 kg/ha than other doses. It may be due to profuse tillering and higher genetic vigor than other variety and nitrogen doses. This result is partially in agreement with the findings of Sen et al. [14]. Jesmin [15] reported that dry matter content of Bazra and Arusha were 23.14 and 21.38 g 100g, respectively which is nearly close to this study. On the other hand, highest CP was found in Bazra (V1) whereas the lowest CP was found in hybrid (V3) and medium CP was found in Arusha (V2). Similar responses were also obtained in different fodder species by [15,16,17].

5. CONCLUSIONS

The findings of the present investigation indicate that diversification of farming system and growing Napier with optimum nitrogen doses as a ground layers crop in Mango tree orchard is a viable option for increasing fodder production in a land scanty country like Bangladesh. The Napier variety likes Bazra with 150 kg/ha nitrogen application can give the higher yield.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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