

# Potentiality of Litchi-Fodder Based Agroforestry System in Bangladesh

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**Abstract** A field experiment was conducted at the Agroforestry and Environment Research Field, Hajee Mohammad Danesh Science and Technology University, Dinajpur during 2013 to investigate the potentiality of three napier fodder varieties under Litchi orchard. The experiment was consisted of 2 factors RCBD with 3 replications. Among the two factors, factor A was two production systems;  $S_1$ = Litchi + fodder and  $S_2$  = Fodder (sole crop); another factor B was three napier varieties:  $V_1$ = BARI Napier -1 (Bazra),  $V_2$ = BARI Napier - 2 (Arusha) and  $V_3$ = BARI Napier -3 (Hybrid). The experimental results revealed that there were significant variation among the varieties in terms of leaf growth and yield. The maximum number of leaf plant<sup>-1</sup> was recorded in variety Bazra ( $V_1$ ) whereas the minimum number was recorded in hybrid variety ( $V_3$ ). Significantly the highest (13.75, 14.53 and 14.84  $tha^{-1}$  at 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> harvest, respectively) yield was also recorded in variety Bazra whereas the lowest (5.89, 6.36 and 9.11  $tha^{-1}$  at 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> harvest, respectively) yield was in hybrid variety. Again, in case of production systems, there were also significant differences between the two production systems were found. The maximum number of leaf plant<sup>-1</sup> was recorded under Litchi based agroforestry system ( $T_1$ ) whereas the minimum was recorded in open condition ( $T_2$ ). Similarly, significantly the highest (12.00, 12.35 and 13.31  $tha^{-1}$  at 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> harvest, respectively) yield of napier was recorded under Litchi based agroforestry system where as the lowest (9.73, 10.47 and 11.66  $tha^{-1}$  at 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> harvest, respectively) yield was recorded in open condition i.e. napier in sole cropping. Furthermore, the interaction effect of napier variety and production systems were also gave significant deviation result in terms of growth and yield. The maximum number of leaf plant<sup>-1</sup> was recorded under Litchi based agroforestry systems with Bazra variety whereas the minimum was recorded in open condition with hybrid variety. The highest yield (14.42, 16.14 and 16.15  $tha^{-1}$  at 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> harvest, respectively) of napier was found under Litchi based agroforestry systems with Bazra variety. Significantly the lowest (5.33, 5.79 and 8.48  $tha^{-1}$  at 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> harvest, respectively) yield was found in open condition i.e. sole cropping with hybrid variety. In case of the quality perspective, the highest nutritive value (DM, ASH, CP, CF, EE, and NFE) was found in Bazra ( $V_1$ ) and the lowest value was found in hybrid variety ( $V_3$ ). Therefore, the suitability of napier production under Litchi based AGF system may be ranked as Bazra > Arusha > Hybrid variety. Finally, the economic analysis showed that maximum BCR (5.20) was found in the Litchi based agroforestry systems over sole cropping (BCR=4.38). From the findings of the taken investigation, it may be concluded that the cultivation of Bazra napier variety in the floor of Litchi orchard ensures higher revenue to the farmers compared to its sole cropping.

**Keywords:** potentiality, litchi, fodder and agroforestry

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## 1. Introduction

*Pennisetum purpureum* (Napier Grass) is a species of grass native to the tropical grasslands of Africa. It is generally grown as a pure pasture. However, it has been sown in alternate rows with such legumes as *Pueraria phaseoloides* in Puerto Rico, *Centrosema pubescens* (Venezuela) and *Neonotonia wightii* in Uganda. Cutting or grazing management will have to be adjusted to favor the legume to maintain a satisfactory mixed sward. In Bangladesh, due to increasing burgeoning bovine population,

which turned, to be 170 millions in 2020 poses a big challenge to existing agriculture system for their fodder requirements. Horizontal expansion of fodder production is not possible with available land source, Emebir and Nwufu [1]. Because, due to the rapid expansion of population the available per capita land areas is decreasing at an alarming rate. Traditionally, farming practices and monoculture production system that are prevalent in Bangladesh often results in subnormal production from the farmland and homestead. Therefore, development of appropriate and satisfactory safeguards against such situations should be the primary concern for optimal utilization of marginal lands. It is possible to bring

unutilized land like the floor of different orchard under fodder production by using latest technologies. The utilization of the floor of litchi orchard by planting fodder grasses i.e. fodder grass-litchi based agroforestry system may be an alternative avenue to overcome the increasing demand of fodder, Gill, et. al. [2]. Moreover, there are different varieties of Napier fodder which has different response against different management and production systems. We should find out which variety gave maximum benefits under agroforestry land use systems. Keeping in view the manifold advantages associated with integration fodder grass like Napier and litchi into agroforestry production system, the investigation was conducted.

## 2. Materials and Methods

A field experiment was carried out at the agroforestry farm, Hajee Mohammad Danesh Science and Technology University (HSTU), Dinajpur, on 2013 to evaluate the performance of three Napier fodder varieties in Litchi tree based agroforestry system. The experiment was conducted in newly established five years old Litchi orchard where the spacing of tree saplings was 8 m×8 m. The experiment included three recommended modern Napier varieties viz; Bazra, Arusha and Napier hybrid. The experiment was laid out in RCBD with 3 (three) replications. There were 2 factors in this experiment. Among the two factors, factor A was two production systems; S<sub>1</sub>= Litchi + Napier fodder and S<sub>2</sub> = Napier fodder (sole cropping); another factor B was three Napier varieties: V<sub>1</sub>= BARI Napier -1 (Bazra), V<sub>2</sub>= BARI Napier - 2 (Arusha) and V<sub>3</sub>= BARI Napier -3 (Hybrid). So, the treatment combinations of the experiment were V<sub>1</sub>S<sub>1</sub> = Litchi + Bazra, V<sub>1</sub>S<sub>2</sub>= sole cropping of Bazra, V<sub>2</sub>S<sub>1</sub> = Litchi + Arusha, V<sub>2</sub>S<sub>2</sub>= sole cropping of Arusha, V<sub>3</sub>S<sub>1</sub> = Litchi + napier hybrid variety, V<sub>3</sub>S<sub>2</sub> = sole cropping of napier hybrid variety. Before planting the seedlings of napier, the land was fertilized by using fertilizer as per required doses. Seedlings of napier were planted 01<sup>th</sup> August 2013 in to the main plots. For collecting data on several plant characters, 10 (2 from each orientation) randomly selected plants were uprooted from each plot before harvesting. Data were collected on the following parameters - plant height (cm), number of leaf, number of tiller plant<sup>-1</sup>, leaf length, leaf breadth, fresh weight plant<sup>-1</sup>, fresh weight plot<sup>-1</sup> total, yield, air dry weight, oven dry weight and chemical analysis of napier grass. Napier

fodder was harvested above the ground level (3-4 cm) after 30days of planting. After 30 days of 1<sup>st</sup> 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 are weighted for measuring yield and sample was taken for chemical analysis also. Sample of each treatment were subjected to chemical analysis for determination of organic matter following the methods of AOAC [3]. The collected data were analyzed statistically and means were adjusted by DMRT (Duncan's Multiple Range Test), [4].

## 3. Results

### 3.1. Main Effect of Variety on the Growth, Yield and Quality of Napier Fodder

#### 3.1.1. Growth

The tallest plant (141.0 cm, 193.2 cm, and 220.3.8 cm at 30 DAP, 60 DAP and 90 DAP, respectively) was observed in Bazra (V<sub>1</sub>) which was statistically identical with Arusha (V<sub>2</sub>) at 30 DAP and 60 DAP. The dwarf plant (106.6cm, 129.1 cm and 148.8 cm at 30 DAP, 60 DAP and 90 DAP, respectively) was found in Hybrid napier (V<sub>3</sub>) (Table 1). Similarly, maximum number of leaf (46.65, 54.65 and 66.98 at 30 DAP, 60 DAP and 90 DAP respectively) was recorded in Bazra which was statistically identical with Arusha at 60 DAP and 90 DAP. Once more, minimum number (27.20, 34.20 and 46.20 at 30 DAP, 60 DAP and 90 DAP respectively) of leaf was recorded in napier hybrid variety i.e in V<sub>3</sub> (Table 1). On the other hand, maximum number of tiller (6.63) was observed in Bazra (V<sub>1</sub>) and minimum (3.48) was experienced in hybrid napier grass (V<sub>3</sub>). Therefore, the longest leaf (75.28 cm, 84.85 cm and 89.11cm at 30 DAP, 60 DAP and 90 DAP, respectively) was observed in Bazra followed by in Arusha (V<sub>2</sub>). Consequently, the shortest leaf (50.73 cm, 55.84 cm and 66.98 cm at 30 DAP, 60 DAP and 90 DAP, respectively) was found in hybrid variety (Table 2). Significantly, the maximum leaf breadth (1.761cm, 2.313cm and 2.453 cm at 30 DAP, 60 DAP and 90 DAP, respectively) was recorded in Bazra (V<sub>1</sub>). On the other hand, minimum leaf breadth (1.383 cm, 1.583cm and 1.778 cm at 30 DAP, 60 DAP and 90 DAP respectively) was recorded in hybrid variety (Table 2).

Table 1. Main effect of variety on the growth parameters of napier grass

Treatments	Plant height (cm) at			Number of tiller at			Number of leaf at		
	30DAP	60 DAP	90DAP	30 DAP	60 DAP	90 DAP	30 DAP	60 DAP	90DAP
V <sub>1</sub>	141.a	193.2a	220.3a	6.63a	7.85a	9.16a	46.65 a	54.65a	66.98a
V <sub>2</sub>	127.9a	172.4b	197.4b	4.16b	4.91b	5.23b	31.45ab	39.45a	52.48a
V <sub>3</sub>	106.6b	129.1c	148.8c	3.48b	4.05 b	4.75b	27.20 b	34.20	46.20a
CV (%)	10.18	6.94	4.58	16.88	18.30	7.59	12.99	36.30	33.15

Table 2. Main effect of variety on the yield and yield attributing characters of napier grass

Treatments	Leaf length (cm) at			Leaf breadth (cm) at			Fresh yield (tha <sup>-1</sup> ) at		
	30 DAP	60 DAP	90 DAP	30 DAP	60DAP	90DAP	1 <sup>st</sup> harvest	2 <sup>nd</sup> harvest	3 <sup>rd</sup> harvest
V <sub>1</sub>	75.28a	84.85a	89.11a	1.76a	2.31a	2.45a	13.75 a	14.53 a	14.84a
V <sub>2</sub>	58.58b	74.73b	81.98b	1.52b	1.90b	2.32a	12.96a	13.33 b	13.51 a
V <sub>3</sub>	50.73c	55.84c	66.98c	1.38c	1.58c	1.77b	5.89b	6.36 c	9.11 b
CV (%)	6.86	2.40	3.69	6.40	7.16	10.41	20.31	7.29	8.39

### 3.1.2. Yield

The highest yield (13.75 tha<sup>-1</sup>, 14.53 tha<sup>-1</sup> and 14.84 tha<sup>-1</sup> at 30 DAP, 60 DAP and 90 DAP, respectively) was recorded in V<sub>1</sub> i.e. in Bazra. However, lowest yield (5.89 tha<sup>-1</sup>, 6.36 tha<sup>-1</sup> and 9.11tha<sup>-1</sup> at 30 DAP, 60 DAP and 90 DAP, respectively) was recorded in napier hybrid variety (V<sub>3</sub>) (Table 2). Consequently, maximum air dry weight (2.188 kg) was recorded in V<sub>1</sub> (Bazra). On the other hand, minimum dry weight (1.073 kg) was recorded in hybrid variety (V<sub>3</sub>). Similarly, maximum oven dry weight (43.76 gm) was recorded in V<sub>1</sub> (Bazra) and minimum dry weight (35.46gm) was recorded in napier hybrid variety (V<sub>3</sub>).

### 3.1.3. Quality

The highest DM, ASH, CP, CF, EE and NFE (23.98%, 11.05%, 9.03%, 39.42%, 3.65% and 47.48% ) was found in napier Bazra variety (V<sub>1</sub>).On the other hand, minimum DM, ASH, CP, CF, EE and NFE (17.40%, 9.81%, 7.75%, 30.98%, 2.165% and 38.38%) was found in napier hybrid variety (Table 7).

## 3.2. Main Effect of the Production System on the Growth, Yield and Quality of Litchi with Napier Fodder

### 3.2.1. Growth

The tallest plant (132.5 cm,174.9cm and 197.7cm at 30 DAP,60 DAP and 90 DAP, respectively) was observed in Litchi based agroforestry system (S<sub>1</sub>) whereas the shortest plant (117.8 cm,154.9cm and 180.0cm at 30 DAP,60 DAP and 90 DAP ,respectively) was observed in open condition

(S<sub>2</sub>) (Table 3). Consequently, The maximum number of leaf (60.09, 73.34 and 80.71at 30DAP, 60DAP and 90 DAP, respectively) was recorded in Litchi based agroforestry system (S<sub>1</sub>) whereas the minimum number of leaf (25.44, 37.10 and 42.36 at 30 DAP, 60 DAP and 90 DAP, respectively) was observed in open condition. On the other hand, the maximum number of tiller plant<sup>-1</sup> (6.765) was recorded in Litchi based agroforestry system (S<sub>1</sub>) whereas the minimum (2.767) was recorded in open condition (S<sub>2</sub>). Similarly, the maximum leaf length (76.59 cm, 85.31cm and 98.82cm at 30 DAP,60 DAP and 90DAP, respectively) was recorded in Litchi based agroforestry system (S<sub>1</sub>) and the minimum leaf length (46.03 cm,73.41 cm and 84.38 cm at 30 DAP,60 DAP and 90 DAP, respectively) was observed in open condition (S<sub>2</sub>) (Table 4). But, breadth of leaf do not significantly differ at 30 DAP and 60 DAP. In this period highest leaf breath (2.10 cm and 2.37 cm at 30 DAP and 60 DAP, respectively) was recorded in Litchi based agroforestry system (S<sub>1</sub>) whereas the minimum leaf breath (1.63 cm and 1.87 cm at 30 DAP and 60 DAP respectively) was observed in open (S<sub>2</sub>).

### 3.2.2. Yield

The highest yield (13.31 tha<sup>-1</sup>) was obtained from Litchi based agroforestry system (S<sub>1</sub>) whereas the lowest yield (11.66 tha<sup>-1</sup>) was recorded from open condition (S<sub>2</sub>) (Table 4). In case of oven dry weight of napier, it was significantly influenced by different production system. Significantly, maximum dry weight (56.67 gm) was recorded in Litchi based agroforestry system (S<sub>1</sub>) and the minimum (43.14 gm) was recorded in sole cropping i.e. open condition (S<sub>2</sub>).

Table 3. Main effect of production system on the growth parameters of napier fodder under litchi orchard

Treatments	Plant height (cm) at			Number of tiller at			Number of leaf at		
	30 DAP	60 DAP	90 DAP	30DAP	60DAP	90DAP	30DAP	60DAP	90 DAP
Litchi+Napier (S <sub>1</sub> )	132.5a	174.9a	197.7a	6.75a	7.60a	8.70a	60.09a	73.34a	80.71a
Open (S <sub>2</sub> )	117.8b	154.9b	180.0b	2.76b	3.61b	4.06b	25.44b	37.10b	42.36b
CV (%)	10.18	6.94	4.58	36.88	38.30	37.59	32.99	36.30	33.15

Table 4. Main effect of production system on the yield and yield attributing characters of napier grass under litchi orchard

Treatments	Leaf length (cm) at			Leaf breadth (cm) at			Fresh yield (tha <sup>-1</sup> ) at		
	30 DAP	60 DAP	90 DAP	30DAP	60DAP	90DAP	30DAP	60DAP	90DAP
Litchi+Napier (S <sub>1</sub> )	76.59 a	85.31 a	98.82 a	2.10 a	2.37a	3.23 a	12.00 a	12.35a	13.31a
Open (S <sub>2</sub> )	67.03b	73.41b	84.38 b	1.63 b	1.87 b	2.71 b	9.73a	10.47 b	11.66b
CV (%)	6.86	2.40	3.69	6.40	7.16	10.41	20.31	7.29	8.39

### 3.2.3. Quality

The highest DM, ASH, CP, CF ,EE and NFE (24.60, 10.52, 8.43, 36.12, 3.00 and 44.11) was found in Litchi based agroforestry system content in (S<sub>1</sub>).On the other hand, minimum DM, ASH, CP, CF, EE, and NFE (22.93, 10.13, 8.20, 34.37, 2.81 and 41.92) was found in S<sub>2</sub> i.e. in sole cropping of napier grass (Table 8).

## 3.3. Interaction Effect of Variety and Production System on the Growth, Yield and Quality of Napier-fodder

### 3.3.1. Growth

The tallest plant (145.1 cm, 205.8 cm and 230.3 cm at 30 DAP,60 DAP and 90 DAP ,respectively) of napier grass was recorded in V<sub>1</sub>S<sub>1</sub> where as the shortest plant

(94.81 cm,120.3 cm and 138.9 cm at 30 DAP, 60 DAP and 90 DAP, respectively) was recorded in V<sub>3</sub>S<sub>2</sub> (Table 5). The maximum number of leaf per plant (78.07, 84.07 and 91.73 at 30 DAP,60 DAP and 90 DAP, respectively) of napier grass was recorded in V<sub>3</sub>S<sub>1</sub> and minimum (22.17,27.21 and 33.53 at 30 DAP, 60 DAP and 90 DAP, respectively) was recorded in V<sub>1</sub>S<sub>2</sub> (Table 5). Consequently, The highest (6.37 and 8.31 at 30 DAP and 90 DAP, respectively) number of tiller plant<sup>-1</sup> of napier grass was recorded in V<sub>3</sub>S<sub>1</sub> and lowest (2.50 and 2.26 at 30 DAP and 90 DAP, respectively) number was observed in V<sub>1</sub>S<sub>2</sub>. Number of tiller at 60 DAP was found non-significant. However, the maximum length of leaf (90.35 cm, 94.86 cm and 102.0 cm at 30 DAP, 60 DAP and 90 DAP, respectively) was recorded in V<sub>1</sub>S<sub>1</sub> and minimum (38.07 cm, 51.29cm and 59.50cm at 30 DAP, 60DAP and 90 DAP, respectively) was in V<sub>3</sub>S<sub>2</sub>. (Table 6). In case of

leaf breadth, the maximum (1.74 cm, 2.63cm and 2.76cm at 30 DAP, 60 DAP and 90DAP, respectively) was recorded in V<sub>1</sub>S<sub>1</sub> and minimum (1.04 cm, 1.24 cm and

1.39cm at 30 DAP, 60DAP and 90DAP, respectively) was recorded in V<sub>3</sub>S<sub>2</sub> (Table 6).

**Table 5. Interaction effect of variety and production system on the growth parameters of napier grass under litchi orchard**

Treatments	Plant height (cm) at			Number of tiller at			Number of leaf at		
	30 DAP	60 DAP	90 DAP	30DAP	60DAP	90DAP	30 DAP	60 DAP	90 DAP
V <sub>1</sub> S <sub>1</sub>	145.1a	205.8a	230.3a	2.66 b	3.93 b	3.73b	22.93c	29.17 b	35.53b
V <sub>1</sub> S <sub>2</sub>	136.9ab	181.0b	210.3 b	2.50 b	2.733b	3.26b	22.17 c	27.93 b	33.53b
V <sub>2</sub> S <sub>1</sub>	134.0ab	180.5b	204.1bc	4.467b	5.36 b	6.23b	46.23bc	49.23ab	58.87ab
V <sub>2</sub> S <sub>2</sub>	121.8ab	163.8b	190.7 c	3.133b	4.16 b	5.20b	31.23bc	36.23b	42.23b
V <sub>3</sub> S <sub>1</sub>	118.5 b	137.9c	158.7 d	6.37a	7.53a	8.13a	78.07 a	84.07a	91.73a
V <sub>3</sub> S <sub>2</sub>	94.81 c	120.3c	138.9 e	5.66 b	5.90 b	6.73a	55.97ab	59.97ab	69.43ab
CV (%)	10.18	6.94	4.58	16.88	18.30	37.59	12.99	36.30	33.15

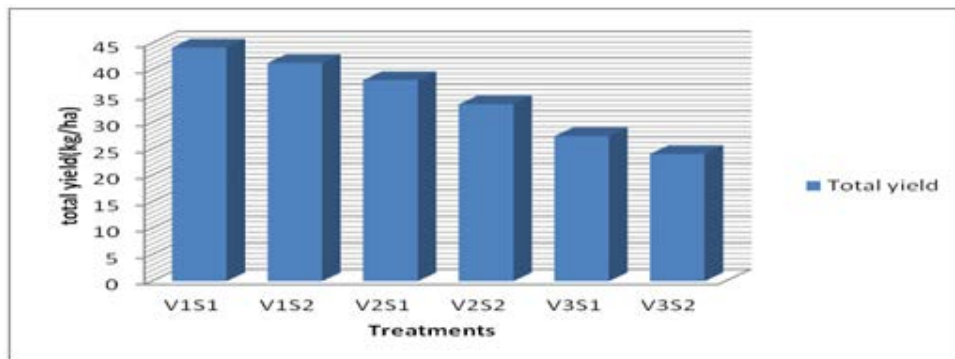
**Table 6. Interaction effect of variety and production system on yield and yield attributing characters of napier grass**

Treatments	Leaf length (cm) at			Leaf breadth (cm) at			Fresh yield (tha <sup>-1</sup> ) at		
	30 DAP	60DAP	90DAP	30 DAP	60 DAP	90 DAP	1 <sup>st</sup> harvest	2 <sup>nd</sup> harvest	3 <sup>rd</sup> harvest
V <sub>1</sub> S <sub>1</sub>	90.35 a	94.86a	102.0a	1.74a	2.63a	2.76a	14.42a	16.14a	16.15a
V <sub>1</sub> S <sub>2</sub>	76.73b	79.36b	86.60b	1.63b	2.16b	2.58ab	13.96ab	14.05b	14.13a
V <sub>2</sub> S <sub>1</sub>	63.40c	79.02b	83.37bc	1.55c	1.99b	2.14bc	12.08ab	12.92b	13.54b
V <sub>2</sub> S <sub>2</sub>	48.57d	70.44c	77.36cd	1.48d	1.65c	2.07bc	11.89abc	12.71b	12.96b
V <sub>3</sub> S <sub>1</sub>	40.42de	60.39d	74.47d	1.17e	1.52c	1.76cd	6.45bc	6.93c	9.73c
V <sub>3</sub> S <sub>2</sub>	38.07 e	51.29e	59.50e	1.04f	1.24d	1.39 d	5.33c	5.79c	8.48c
CV (%)	6.86	2.40	3.69	6.40	7.16	10.41	20.31	7.29	8.39

**3.3.2. Yield**

The highest yield (14.42 tha<sup>-1</sup>, 16.14 tha<sup>-1</sup> and 16.11 tha<sup>-1</sup> at 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> harvest, respectively) was obtained from V<sub>1</sub>S<sub>1</sub> and lowest yield (5.33 tha<sup>-1</sup>, 5.78 tha<sup>-1</sup> and 24.08 tha<sup>-1</sup>

at 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> harvest, respectively) was recorded from V<sub>3</sub>S<sub>2</sub> (Table 6). Similarly, sum of total highest yield (44.22 tha<sup>-1</sup>) was obtained from V<sub>1</sub>S<sub>1</sub> and lowest total yield (24.08 tha<sup>-1</sup>) was recorded from V<sub>3</sub>S<sub>2</sub> (Figure 1).



**Figure 1.** Intraction effect of variety and production system on the total yield of napier fodder (Kg/ha)

**3.3.3. Quality**

The highest DM, ASH, CP, CF, EE and NFE (26.00, 11.30, 9.10, 40.50, 3.73, and 48.30 %) was obtained from V<sub>1</sub>S<sub>1</sub> and lowest DM, ASH, CP, CF, EE and NFE ( 17.33, 9.56, 7.50, 30.47, 2.10 and 36.77%) was obtained from V<sub>3</sub>S<sub>2</sub>.

**3.4. Economic Analysis**

The values in Table 7 indicate that the total cost of production was maximum 67523 Tk. /ha in Litchi + napier

based agroforestry system (S<sub>1</sub>) whereas the minimum cost of production 43632 Tk. /ha was recorded from the sole cropping of napier (S<sub>2</sub>). The values in Table 7 also indicate that the highest value of gross return 351500 Tk. /ha was obtained from Litchi + napier based agroforestry system (S<sub>1</sub>). On the other hand, the lowest value of gross return 191200 (Tk. /ha) was obtained from sole cropping of napier (S<sub>2</sub>). So, the highest benefit-cost ratio 5.20 was recorded from Litchi + napier based agroforestry system (T<sub>1</sub>) and the lowest benefit-cost ratio 4.38 was observed in T<sub>2</sub> i.e. in sole cropping of napier.

**Table 7. Main effect of variety on the chemical analysis of napier grass**

Treatment	DM(%)	ASH(%)	CP(%)	CF(%)	EE(%)	NFE(%)
V1	23.98a	11.05a	9.03a	39.42a	3.65a	47.48a
V2	19.92b	10.12b	8.16b	35.35b	2.90b	43.18b
V3	17.40c	9.81b	7.75c	30.98c	2.16c	38.38c
CV (%)	3.54	4.85	3.28	2.73	7.10	3.53



Table 8. Main effect of production system on the chemical analysis of napier grass

Treatment	DM(%)	ASH(%)	CP(%)	CF(%)	EE(%)	NFE(%)
S <sub>1</sub> (Litchi+Napier)	24.60a	10.52a	8.43a	36.12a	3.00a	44.11a
S <sub>2</sub> (Open)	22.93a	10.13b	8.20b	34.37a	2.81b	41.92b
CV (%)	3.54	4.85	3.28	2.73	7.10	3.53

Table 9. Interaction effect of variety and production system on chemical analysis of napier grass

Treatment	DM(%)	ASH(%)	CP(%)	CF(%)	EE(%)	NFE(%)
V1S1	26.00a	11.30a	9.10a	40.50a	3.73a	48.30 a
V1S2	22.97b	10.80ab	8.96a	38.33b	3.56a	46.67ab
V2S1	20.47c	10.20bc	8.20b	36.37c	3.03b	44.03bc
V2S2	19.37c	10.07bc	8.13b	34.33d	2.76b	42.33cd
V3S1	17.47d	10.03bc	8.00b	31.50e	2.23c	40.00d
V3S2	17.33d	9.56c	7.50c	30.47e	2.10c	36.77e
CV (%)	3.54	4.85	3.28	2.73	7.10	3.53

\*\*DM=Dry Matter, CP=Crude Protein, CF=Crude Fibre, EE=Ether Extract, NFE=Nitrogen Free Extract.

Table 10. Economics analysis of napier production under Litchi based agroforestry system (ha<sup>-1</sup>year<sup>-1</sup>)

Treatments	Return (Tk./ha)		Gross Return (Tk./ha)	Total cost of Production (Tk./ha)	Net Return (Tk./ha)	BCR
	Napier	Litchi tree				
Litchi + napier (T <sub>1</sub> )	225900	125600	351500	67523	283977	5.20
Open (T <sub>2</sub> )	191200	.....	191200	43632	153568	4.38

## 4. Discussion

The research revealed that the highest plant height, number of tiller, number of leaf, leaf length, leaf breadth fresh yield as well as chemical compositions were found on Bazra variety of napier under open condition. It may be due to that this variety may have high efficiency of using space, air, water and sunlight. It also may have high genetic vigor than other variety like Ashura and Hybrid. The research also revealed that the highest plant height, number of tiller, number of leaf, leaf length, leaf breadth fresh yield as well as chemical composition was found on Bazra variety of napier under litchi orchard. The result may be due to that Bazra variety remains more competitive growth capability than other two varieties under collective production system. The highest dry matter content was also recorded in napier Bazra variety and minimum in napier hybrid variety. This may be due to the absorbance capability of chemical is more in variety of Bazra as compare to the others two variety. This result is partially in agreement with the findings of Sen *et al.* [5]. Jesmin [6] reported that dry matter content of Bazra and Arusha were 23.14 and 21.38 g 100g DM, respectively which is nearly close to this study. On the other hand, highest CP was found in Bazra (V<sub>1</sub>) whereas the lowest CP was found in hybrid (V<sub>3</sub>) and medium CP was found in Arusha (V<sub>2</sub>). Verma and Singh [7] reported that significant increase in CP content might be due to rapid synthesis of carbohydrates and their conversion to protein and protoplasm leaving relatively smaller portion for cell wall synthesis. Similar responses were also obtained in different fodder species by Nair P.K. [8]. It was also found that the highest plant height was found on Bazra variety under litchi orchard. The result may be due to that this napier variety have genetically long height rather than other variety. Highest number of tillering was found on hybrid variety under litchi tree and it may be due to that under litchi orchard the fodder may have profuse tillering under shade condition. The highest CP content in under Litchi and minimum CP content in sole cropping napier grass. In the shading condition, chemical are absorbed

more and open condition more sunlight but chemical slighter then shade. This result were similar with the findings of Jesmin [6] who were working with the different non-legume fodder under mango orchard and found that CF content was higher than open field condition. Highest number of leaf also found on hybrid variety of napier under litchi orchard because of hybrid variety requires more food for its growth and development and this food come from leaf through photosynthesis, Jayachandran and Nair [9]. The research also revealed that the highest leaf length, leaf breadth, fresh yield and nutritive value were found under the combination of Bazra variety of napier under litchi orchard. This result may be due to that the Bazra variety of napier have genetically high morphological parameter under shade condition than other variety. The value of NFE was higher in Bazra under Litchi orchard and lower was found in hybrid in open condition, Kumar and Kumar [10]. However the present findings are nearly similar with the research conducted by Malak [11] who worked the Napier grass and found lower NFE content in hybrid variety under open condition. Similar results also observed by Mohiuddin [12] who worked with fodder. The highest gross return as well as benefit cost ratio was observed in the litchi napier based Agroforestry system rather than sole cropping system. The findings may be due to that in case of Agroforestry system more output was obtained as two crops produce more biological yield than single cropping.

## 5. Conclusions

The findings of the present investigation indicate that diversification of farming system and growing napier as ground layers crops in Litchi tree orchard is a viable option for increasing income of farmers. One napier variety like Bazra has been grown successfully as intercrops in the floor of Litchi tree orchard. The presence of tree canopies did not influence on the growth and yield of napier variety like Bazra significantly. Despite some minor negative effects of upper layer tree like litchi on the growth, yield and physiological attributes of napier fodder,

still litchi based agroforestry system is beneficial as it ensure higher returns because of diversified products in comparison to sole cropping. Data from the crude protein , crude fibre and other findings will help in further research and analysis to different researchers of the world. From an economic point of view, it was also pragmatic that napier variety Bazra found to be better in case of yield and more remunerative in comparison to other napier varieties like arusha and hybrid napier variety under Litchi based agroforestry systems in this study. From the results and foregoing discussion, it is clear that open field is so good for the production of napier but in avocation of MPTs like Litchi tree it could be grown well. The research will be helpful greatly to the researchers who has an interest to conduct research on fodder based agroforestry system and to develop different feed items of animal to supply nutrients.

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