



On-farm Demonstration of Improved Napier Grass Varieties as Livestock Feed at Irrigation Schemes in the Central Zone of Tigray Region, Northern Ethiopia

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The demonstration was conducted at Ahsea and Adwa districts in central zone of Tigray, Northern Ethiopia, from 2019-2020 G.C. The Aim of the study was demonstrate the effectiveness of improved Napier grass varieties, specifically Bana grass and ILRI #16791, as livestock forage. The Napier grass varieties were distributed to a total of 180 farmers and 90 farmers in Ahsea and Adwa districts, respectively, and practical training was provided to the participating farmers. The demonstration was conducted for two consecutive years, and data on agronomic and yield parameters, such as plant height, fresh biomass yield, dry biomass yield, and leaf to stem ratio, were collected from representative sample farmers in each district. The data analysis result showed

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that there was significant differences ($p < 0.001$) in plant height, fresh biomass yield, dry biomass yield and leaf to stem ratio among the demonstrated Napier grass varieties at Ahsea district. There were also significant differences ($p < 0.001$) in plant height and dry biomass yield but not in fresh biomass yield and leaf to stem ratio at Adwa district. Overall, Bana grass performed significantly better than ILRI#16791 in terms of plant height (233.27cm), fresh biomass yield (42.17), dry biomass yield (15.08ton/ha) and leaf to stem ratio (1.60). The farmers' perception data indicated that the participants highly preferred Bana grass due to its good survival rate, high biomass yield, palatability to animals, and fast regeneration rate. However, ILRI#16791 was perceived positively for its contribution to soil conservation and resistance to moisture stress. Therefore, based on the yield performance and farmer's perception data, Bana grass is recommended for wider popularization, dissemination and cultivation in the demonstration area and similar agro-ecologies of the region.

Keywords: Napier grass; plant height; fresh and dry biomass yield; leaf to stem ratio, farmers perception.

1. INTRODUCTION

The Tigray region of Northern Ethiopia has a substantial livestock population, including 4.9 million cattle, 4.8 million goats, 2.1 million sheep, 901,002 donkeys, 2558 horses, 8078 mules, 46436 camels, and 7 million poultry [1]. However, despite the large number of animals, their productivity is hindered by various factors, with feed scarcity being a major issue in terms of both quantity and quality especially in the dry season [2]. The available feed resources for livestock include natural pasture, crop residues, agro-industrial by-products, cultivated pasture and forage crop species [3]. To improve the efficiency of feed utilization and animal production, supplementation with protein and energy-rich forage grasses, particularly during the dry season, is preferred.

Napier grass varieties, such as Bana grass and ILRI #16791, have been recently released from agricultural research centers. Napier grass (*Pennisetum purpureum*) is a tall, perennial bunch grass that originated from sub-Saharan tropical Africa [4] and is known for its high-yielding forage, primarily used in cut and carry feeding systems [5]. It performs well in low, mid, and highland areas of Ethiopia [6] and [7]. Bana grass (*Pennisetum purpureum* x *Pennisetum americanum*) is a perennial hybrid grass of South African origin. It is highly popular and drought-resistant, commonly used as a major feed for ruminants [8,9]. ILRI #16791 is a recently released Napier grass variety with rapid regeneration potential, higher tillering ability, and a dry matter yield of 12.11 tons per hectare [10].

Given the current feed shortage challenges in Tigray region, it was crucial to demonstrate the released Napier grass forage varieties in the

irrigation schemes of the central zone. Therefore, the objective of the demonstration was to address the feed scarcity problem and provide farmers with sustainable solutions to improve livestock productivity in the study site and similar agro ecologies of the region.

1.1 Objectives

- To address the feed scarcity problem in the study area and similar agro-ecologies by evaluating and selecting the most suitable Napier grass varieties based on their agronomic and yield performance, as well as their acceptability by the local farmers.

2. MATERIALS AND METHODS

2.1 Description of the Study Area

The demonstration of Napier grass varieties was conducted during 2019-2020 at Ahsea and Adwa districts (Sebaha and Maitahlo) and (Maitoum and Addis Alem) irrigation schemes, respectively. The demonstration was conducted by the Axum Agricultural research center with the financial support of the IFAD /PASSDIP-II Project. Ahsea district is located at a latitude of $14^{\circ} 40' 38''$ N and longitude of $38^{\circ} 35' 45''$ E in semi-arid lowlands with an altitude of 1390 m.a.s.l. The mean annual temperature of the areas ranges from 12.13°C to 27.88°C and the annual rainfall 700mm. Adwa is also located at $14^{\circ} 15'$ N and $38^{\circ} 52'$ E with an elevation ranging from 1500-2700 m.a.s.l annual temperature ranges from 7.8°C to 30.9°C . Mean annual rainfall is 799mm (National metrological service agency unpublished, 2018). The soil type of the study areas is predominantly sandy loam, and the irrigation water was applied once a week.

2.2 Treatments and Data Collection

Two Napier grass varieties Bana Grass [*Pennisetum purpureum* (L.) X *Pennisetum americanum* (L.)] In addition, ILRI 16791 obtained from Holleta Agricultural Research Center, were demonstrated at Ahsea (Sebaha and Maitsahlo) and Adwa (Maitoum and Addis Alem) irrigation schemes. From each irrigation scheme, 45 farmers were selected and a total of 180 farmers were participated on the demonstration and grouped on a FREG (Farmers Research and Extension Group) approach. A total of 100 cuttings of Bana grass and 100 cuttings of ILRI#16791 was provided per farmer. More than 18000 cuttings of Bana grass and 18000 cuttings of ILRI #16791 were distributed and planted at the irrigation schemes, mostly on border of farmlands, grazing land, and gully areas. Practical training was given to the participant farmers organized on FREG. The demonstration was conducted in the irrigation season for a consecutive of two years (from 2019-2020). Planting was made with a spacing of 50cm between cuttings and 1m space between rows. Generally, from the demonstration trial, data on agronomic and yield parameters such as plant height, fresh biomass yield, dry biomass yield, leaf stem ratio and farmer's perception data were collected from 20 representative sample farmers of each irrigation schemes through individual interview and focus group discussion based on the settled ranking criteria. The representative farmers were asked to respond to give score 1-5 for each preference criteria very good (5), good (4), satisfactory (3), poor (2) and very poor (1).

2.3 Data Analysis

Both yield performance and perception data was analyzed using SPSS Version 20 independent samples T-test and Likert scale method respectively.

3. RESULTS AND DISCUSSION

3.1 Agronomic and Forage Yield Performance of Napier Grass Varieties

The agronomic and forage yield performance of the demonstrated Napier grass varieties was shown in Table 1. The results indicated that there is a higher significant difference ($P<0.001$) on plant height, fresh biomass yield, dry biomass

yield and leaf-to-stem ratio among the demonstrated varieties at Ahsea district. Moreover, there is also significant difference on plant height and dry biomass yield of the Napier grass varieties at Adwa district, but there is no significant difference on the other parameters of fresh biomass yield and leaf to stem ratio among the demonstrated varieties. Overall, Bana grass shows significantly higher ($p<0.001$) in plant height (233.27cm), fresh biomass yield (42.17 t/ha), dry biomass yield (15.08), and leaf-to-stem ratio (1.6) in Ahsea district. Similarly, Bana grass also shows significantly higher in plant height and dry biomass yield over ILRI#16791 at Adwa district.

The Plant height of Bana grass in this study is in agreement with the report results of [10] which is 233.5 cm. and higher than the results reported by [11] which is 128.7cm. The dry biomass yield result in this study is lower than the results of [12,13] on the evaluation of perennial grasses under supplementary irrigation which is 28.04 t/ha.

The leaf-to-stem ratio of Bana grass was 1.48 and 1.60 at Ahsea and Adwa districts, respectively, which is in line with the study results of (Berihun, 2005) that harvested at 120 days of planting date with leaf-to-stem ratio of 1.57 and dry matter yield of 14.88t/ha. Conversely, it is higher than the results of [11] which is 1.07. Thus, the higher leaf proportion enables the nutritive value and palatability of the feed is good.

The variation in plant height, fresh biomass yield, dry matter yield, and leaf-to-stem ratio among the demonstrated varieties (Table 1) might be due to varietal difference, soil type, moisture, stage of maturity at the time of harvest, and environmental factors.

3.2 Farmers Perception Result of the Demonstrated Napier Grass Varieties

The results of farmers' perception data were depicted on Table 2. The participant farmers highly preferred the improved Napier grass variety (Bana grass) by its good survival rate, high biomass yield, palatability to animals, and fast regeneration rate. On the other hand, the participant farmers expressed positively to ILRI #16791 variety on its' contribution to soil conservation and perceived positive regarding its resistance to moisture stress.

Table 1. Plant Height, Forage Biomass Yield and Leaf-to-Stem Ratio of Napier Grass Varieties at Ahsea (Sebaha and Maitisahlo) and Adwa (Maitoum and Adiselim) Districts

Variables	Bana grass		ILRI #16791		SE		T -Value		P-Value	
	Ahsea	Adwa	Ahsea	Adwa	Ahsea	Adwa	Ahsea	Adwa	Ahsea	Adwa
Plant height at harvest (cm)	233.27	206.03	206.30	162.40	7.11	3.25	1.123	6.613	0.001	0.000
FBMY (ton/ha)	41.36	42.17	30.80	31.79	1.15	0.78	4.503	7.42	0.000	0.080
DBMY (ton/ha)	14.99	15.08	8.40	10.65	0.55	0.33	5.563	5.838	0.045	0.006
LSR	1.48	1.60	1.05	1.35	0.44	0.28	3.415	3.556	0.002	0.109

FBMY; Fresh biomass yield, DBMY; Dry biomass yield, LSR; Leaf to stem ratio

Table 2. Perception of participant farmers on improved forage the Napier grass varieties (Bana grass & ILRI #16791 N=34)

Attributes of the variety	Average score	
	Bana grass	ILRI#16791
Survival rate	5.00	4.14
Biomass yield	4.69	3.74
Palatable by animal	5.00	3.56
Regeneration rate	4.48	4.86
Invasive to farmland as weed	1.97	2.69
Soil conservation contribution	3.76	4.06
Resistance to moisture stress	3.83	4.68
Total score	28.76	27.73
Mean score	4.10	3.96
Rank	1st	2nd

4. CONCLUSION AND RECOMMENDATION

Napier grass is a well-known perennial grass for its high yielding and mainly used in cut and carry systems. A statistically significant difference was observed in DBM yield and LSR parameters among the Napier grass varieties. Bana grass results in better biomass yield and LSR as compared to ILRI #16791; therefore, based on the yield performance and farmer's perception data Bana grass is recommended for wider popularization, dissemination, and cultivation at the demonstration area and similar agro ecologies of the region.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during writing or editing of this manuscript.

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COMPETING INTERESTS

The authors have not declared any competing of interests.

REFERENCES

1. Central Statistical Agency. Agricultural Sample Survey. Report on Livestock and Livestock Characteristics (Private peasant holdings). Statistical Bulletin 589. Central Statistical Agency Federal Democratic Republic of Ethiopia, Addis Ababa; 2020.
2. Berihun Melakie (). Effect of planting patterns and harvesting days on yield and quality of Bana grass (*Pennisetum purpureum* (L.) X *Pennisetum americanum* (L.)) MSc thesis at Haramaya University. Ethiopia. 2005;92.
3. Alemayehu Mengstu. Country pastures/ forage resource profiles. Ethiopia. FAO Food and Agricultural Organization of the United Nations; 2006
4. Clayton WD, Govaerts R, Harman KT, Williamson H, Vorontsova M. World checklist of Poaceae. Richmond, UK: Royal Botanic Gardens, Kew; 2013.
5. FAO. Grassland Index. A searchable catalogue of grass and forage legumes. FAO, Rome, Ital; 2015.
6. Seyoum Bediye, Zinash Sileshi, Tadesse Tekletsadik and Liyusew Ayalew. Evaluation of napier grass (*Pennisetum purpureum*) and pennisetum hybrids (*Pennisetum purpureum* x *Pennisetum typhoides*) in the central highlands of Ethiopia. In: Fifth National Conference of Ethiopian Society of Animal Production. Addis Ababa, Ethiopia. 1997;15-17.
7. Tessema Zewdu. Variation in growth, yield, chemical composition and in vitro dry matter digestibility of Napier grass varieties (*Pennisetum purpureum*). Trop. Sci. 2005;45:67-73.

8. Bogdan AV. Tropical pasture and fodder plants (Grass and Legumes) Longman, London. 1977;475.
9. Karanja GM. Bana grass. Kenya Farmer. 1981;51-52.
10. Teshale Jabessa, Ketema Bekele, Getacho Tesfaye and Zinash Amare. Evaluation of elephant grass (*Pennisetum purpureum* L) accessions for their agronomic performances in lowland areas of guji zone, Southern Oromia, Ethiopia. American Journal of Biological and Environmental Statistics. 2022;8(1):31-35.
11. Habtie Arega, Mezgebu Getnet, Esubalew Shitaneh, Bainesagn Worku. Screening of napier grass (*Pennisetum purpureum*) accessions tolerant to acid soils in some areas of Ethiopia. International Journal of Scientific Engineering and Science. 2020;4(4):1-6. ISSN 2456-7361. Available:<http://ijses.com/>
12. Mulisa Faji, Gezahagn Kebede, Fekede Feyisa, Kedir Mohammed, Gezahagn Mengistu. Yield, yield components, and nutritive value of perennial forage grass grown under supplementary irrigation, Hindawi Advances in agriculture. 2022;2022, Article ID 5471533,11. Available:<https://doi.org/10.1155/2022/5471533>
13. Fatokun AC, Tarawali BB, Singh PM. Breeding cowpea for resistance to insect pests. Attempted crosses between cowpea and *Vigna vexillata*. In: Challenges and opportunities for enhancing sustainable cowpea production; 2002.

APPENDIX-1



Fig. 1. Napier grass (Bana grass Variety) at Sebaha irrigation scheme Ahsea District



Fig. 2. Napier grass (Bana grass Variety) at Mai Toun irrigation scheme Adwa District



Fig. 3. Napier grass (ILRI #16791 Variety) at Sebaha irrigation scheme Ahsea District

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