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Research Article

Assessing Various Accessions of Napier (Pennisetum Purpureum) Grass in North Western Ethiopia

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Abstract

One of Ethiopia's the chief uncertainties with the livestock industry is the year-round scarcity of optimum quality animal feed. To overcame the supply of quality feed cultivation of tropically adapted forage species, which gives a reasonable yield under rain deficit and unstable climatic conditions. Napier grass accessions were evaluated at Pawe and Jawi localtions for their adaptionn and yield performance. Ten Napier accessions with three replications were used in the randomized complete block design of the study. Mean comparisons between accessions were made using the least significant differences and the general linear model was used to analyze data for growth parameters and nutritional quality traits, such as tillering performance, plant height, forage dry matter, leaf and stem fractions, and nutritional quality. Sixty days following the establishment, in September, the first cut was made; forty days later, in October, the second cut was made. For most variables, there was a substantial (P<0.05) difference between accessions, locations, cuts, years, and the interaction impact of location by accessions. While the leaf-to-stem ratio is significant at p<0.05 and the combined mean square for the number of tillers per plant, fresh biomass yield t/ha, and nutritional quality parameters did indicate substantial (p<0.001) variation among Napier accessions, plant height is not significant (p>0.05). In terms of fresh and dry matter yield t/ha, accessions 14984, 15743, and 16791 perform better. Accessions 14984 and local responses (64.72 and 64.95) were the most significant (p<0.001) differences in in vitro dry matter digestibility, followed by 16813 and 15743 (63.5 and 63.3). According to the findings, the ILRI-14984, 15743, and 16791 accessions produced results that were comparable to the standard checks for superior yield and nutritional quality. So we recommended the demonstration of selected accessions for Metekel and Awi mid and low land areas and other comparable agro-ecologies in the country at farmer level was essintal.

Keywords

Morphology, Nutritional, Quality, Trait, Parameter, Performance

1. Introduction

The livestock feed problem in quality, as well as quantity, is the fundamental challenge for livestock production and productivity in Ethiopia. Natural pasture and crop residue are the major feed resources, but they are poor in quality and provide inadequate protein, energy, vitamins, and minerals [1, 2]. Ethiopian roughages don't meet the needs of rumen microbes since their crude protein (CP) level is less than 7%. These feeds can't even meet livestock's maintenance needs

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when fed alone [3].

For that reason, the feed supply to livestock can be improved by the cultivation of tropically adapted forage species, which gives a reasonable yield under rain deficit and unstable climatic conditions. One such forage is the Napier (*Pennisetum purpureum)* grass; it is a well-performed grass species amongst different forage crops that are advised for various agro-ecological zones [4, 5]. It is a tall perennial grass well adapted to altitudes of up to 2500m and 600-1000mm rainfall [4] and occurs naturally throughout tropical Africa and particularly in East Africa According to Fekede et al. [6] Napier grass grows best at high temperatures but can tolerate low air temperatures under which the yield can be reduced and ceases to grow at a temperature below 10 ℃. It is propagated vegetatively by using stem cuttings, root splits, or shoot tips which usually vary across agroecologies [7]. Its leafy nature, considerable plant height, high tiller, and re-growth ability made it a highly productive fodder crop per unit area of land as compared to other grass species [8]. According to multiple publications, there are only few Napier accessions that have been studied and suggested for lowland agroecology.

Hence, evaluation of the adaptability and yield potential of promising Napier accessions for lowland agroecological zones is very important. Therefore, the study aimed to evaluate the forage yield and quality performance of agronomic and management recommendations for different Napier grass accessions in the lowlands of northwestern Ethiopia.

2. Materials and Methods

2.1. Experiment Locations

The experiment was conducted in rain feed by Pawe agricultural research centers at Pawe on-station and Jawi district for two years from 2020 to the 2022 cropping season. The trial locations represent mid areas ranging in altitude from 1100 to 1300 m.a.s.l. The farming system of the study area is a mixed crop-livestock production system. The description of the test environments is presented in Table 1.

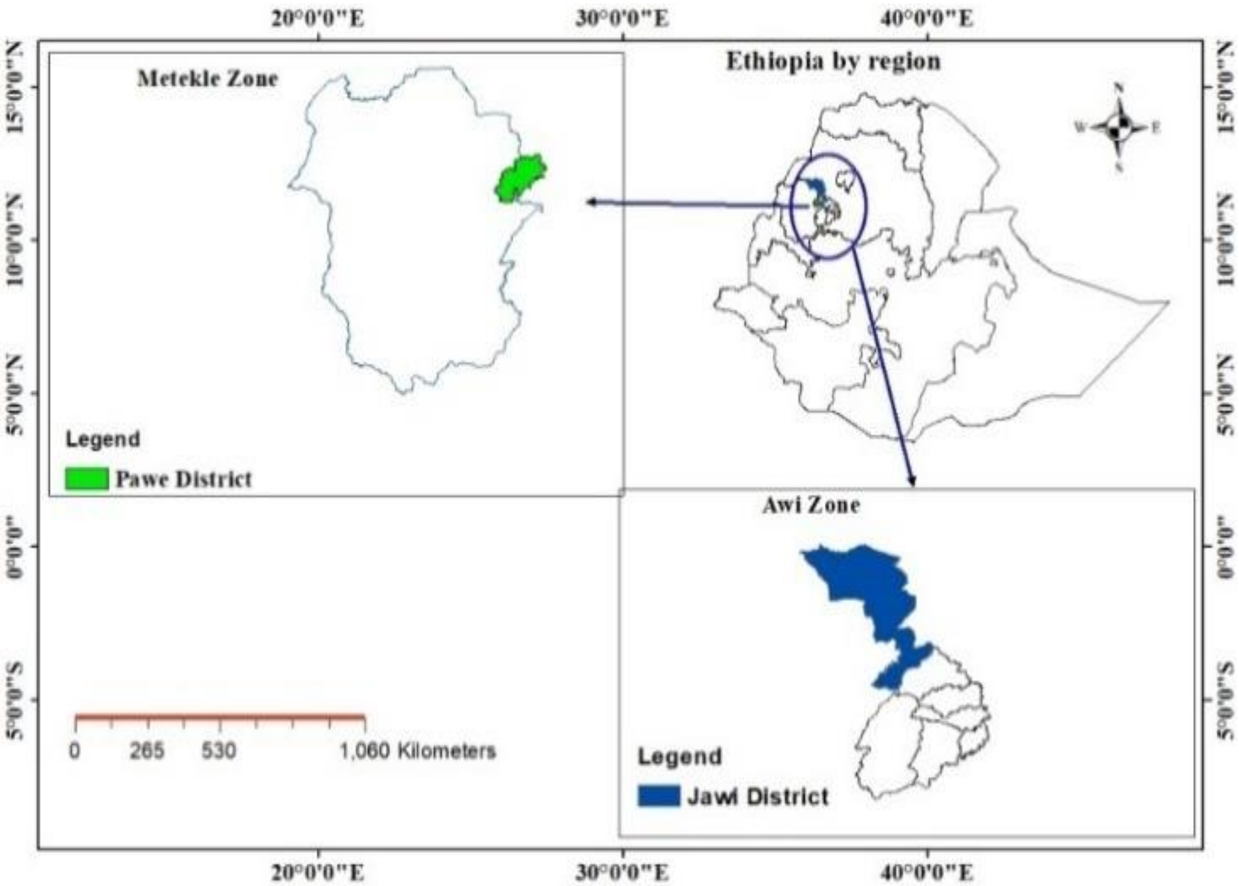

Figure 1. *Map of study locations.*

Table 1. *Description of the test locations for the physiographic location and physicochemical soil properties.*

Parameter	Research location	
	Pawe	Jawi
Latitude	11 °19'N	11o33’22.68”
Longitude	36 °24'E	36o29’17.58”
Altitude (m.a.s.l)	1100	700-1500
Distance to Addis Ababa (km)	567	602
Annual rainfall (mm)	900-1587	1250mm
Daily minimum temperature (℃)	16.3Co	16Co
Daily maximum temperature (℃)	32.6Co	32C0
Soil type	Loam	Loam
Texture class	Clay	Clay loam
PH (1:2.5 H_2O)	5.51	5.79
Organic matter (%)	3.58	3.57
Total nitrogen (%)	0.149	0.153
Organic Carbon (%)	2.079	2.075

Sources: Pawe metrological station data

2.2. Experimental Design and Accessions

Twelve Napier accessions including the standard check (ILRI-16819) and local check were brought from Holetta Agricultural Research Center. The accessions were evaluated at the Pawe and Jawi locations to select the paramount-performing varieties. The following Napier accessions were used 14983, 14984, 15743, 16783, 16791, 16792, 16794, 16783, 16813, 16815, 16817, standard check (16819), and local check for evaluation. A randomized complete block design with three replications was used to evaluated these accessions in a 3 x 4 m plot size. The accessions were then allocated at random among the plots in the block. Twelve root splits were planted in each plot, with a 45 °angle, 0.5 and 1 m between plant and row, and a depth of 15 to 20 cm. There was a spacing that was one meter wide between plots and two meters wide between blocks. All plots were evenly treated with nitrogen phosphate and sulfur (NPS) fertilizer at a rate of 100 kg/ha.

2.3. Data Collection and Measurements

Counts were taken from the bottom of the main stem of five plants per plot to determine the number of tillers per plant (TPP). Using plastic tape, the height of five randomly selected plants from each plot was measured from ground level to the tree's tip. In order to calculate the biomass yield, each accession was picked from the plot 5–10 cm above ground level at 60 days of planting and 40 days for the first harvest. The weight of the total fresh biomass yield was recorded from each plot in the field and an estimated 300g sample was taken from each plot to the laboratory. The samples were fractioned into leaf and stem parts to determine the proportion of leaf and stem in forage. The sample taken from each plot was weighed to determine the total sample fresh weight using a sensitive table balance.

2.4. Laboratory Analysis

The sample was used for laboratory examination to ascertain the chemical composition and in-vitro dry matter digestibility of the treatments after being oven-dried for 72 hours at 65 ℃. In order to test nutritional parameters (ash, CP, NDF, ADF, ADL, and IVDMD), the dried samples were pulverized until they passed through a 1-mm sieve. The samples were oven-dried for a full night at 105 ℃ and then burned for six hours at 550 ℃ in a muffle furnace to calculate the total ash content [9]. The micro-Kjeldahl digestion, distillation, and titration processes were used to calculate the nitrogen (N) content. The N content was then multiplied by 6.25 to estimate the crude protein (CP) level. According to Van Soest and Robertson's [10] method of determine the structural plant ingredients (NDF, ADF, and ADL) was used. Invitro organic matter digestibility (IVDMD) was determined according to the Tilley and Terry procedure [11]

2.5. Statistical Analysis

Differences between accessions were tested using analysis of variance procedures of the SAS general linear model to compare treatment means [12]. Means of significant variation were separated using the least significant difference (LSD) at a 95% probability level. The data was analyzed using the following model: $Yijk = \mu + Gi + Ej + Cj + (GE)\,ij + Bk(j) + eijk$; Where Yijk = measured response of genotype i in block k of environment j; μ = grand mean; Gi = effect of genotype i; Ej = effect of environment j; Cj=effect of cut j; GE= genotype and environment interaction; Bk (j) = effect of block k in environment j; eijk = random error effect of genotype i and in block k of environment j.

3. Results

3.1. Analysis of Variance

The combined mean square of growth and yield performance of the Napier grass accessions are presented in Table 2. A year had a significant effect on a leaf-to-stem ratio and dry matter yield t/ha, but, a non-significant effect on the number of tillers per plant, plant height and fresh weight. On the other hand, cuts had a significant effect on all growth parameters except plant height, ash and NDF content.

Table 2. The combined mean analysis of variance of measured morphological features of Napier genotype's.

Sources		Mean square for parameters				
	DF	NT	PH	LSR	FBY t/ha	DMY t/ha
Year	1	74	931	9.5***	0.63	551.8***
Location	1	13749***	4047***	2*	8865.8***	343.3***
Cut	1	31519.5***	326.8	0.45	7011.9***	3414***
Genotype	11	1521***	5293.3***	0.34	819.36***	23.9**
Genotype*location	23	1024.5***	3569***	0.34	25.8***	5.87***
Error	273	102.2	541.6	0.32	104.3	6.9
Grand Mean		30.7	136.5	1.18	25.8	5.87
LSD		5.7	13.2	0.32	5.8	1.5
R^2		0.67	0.33	0.15	0.43	0.38

PH=plant height; DMY=dry matter yield; LSR=leaf to stem ratio; G=genotype; L=location; NT=number of tillers; Y=year; G*L=genotype by location interaction; G*C=genotype by cut; interaction; NS = non-significant; * = significant at 0.05; ** = significant at 0.01; *** = significant at 0.001.

The genotype*environment (G×E) interaction effects were highly significant (p<0.001) differences for tiller per plant, height, fresh biomass, and DM yield with an expectation of leaf-to-stem ratio.

Table 3. Napier grass accessions' mean morphological and qualitative characteristics for two consecutive cuts made over the area and in 202/021 and 2021/22.

Year	Parameters											
	NT	PH cm	LSR	FBY t/ha	DMY t/ha	DM	Ash	CP	NDF	ADF	ADL	IVDMD%
2020/21	27.3[b]	138.69	1.38[a]	24.4	7[a]	93.4[a]	7.78[a]	14.3[a]	66.2[b]	34.3[b]	2.49[b]	63.27[a]
2021/22	34.1[a]	134.37	0.98[b]	27.2	4.73[b]	93.2[b]	5.69[b]	12.4[b]	67.3[a]	34.8[a]	2.63[a]	62.49[b]
GM	30.7	136.5	1.18	25.8	5.87	93.3	6.7	13.3	66.7	34.5	2.5	62.8
LSD	3.9	6.4	0.13	0.36	0.71	0.14	0.56	0.38	0.65	0.45	0.12	0.61
P-value	***	NS	***	NS	***	*	***	***	**	*	*	*

PH=plant height; DMY=dry matter yield; LSR=leaf to stem ratio; NT=number of tillers; CP=crude protein; NDF=neutral detergent fiber; ADF=acid detergent fiber; ADL=neutral detergent lignin; IVDMD=invitro dry matter digestibility; NS = non-significant; * = significant at 0.05; ** = significant at 0.01; *** = significant at 0.001.

3.2. Combined Effects of Location on Morphological and Nutritional Qualities of Napier Accession

The effects of tested location on the tillering ability of plants, plant height, leaf-to-stem proportion and dry matter yield of *Pennisetum purpureum* grass accessions were presented in Table 4. The results from this study revealed that except ADL the other tiller numbers, plant height, leaf proportion, fresh forage yield, dry matter yield, and other nutritional quality parameters were significantly (p>0.001) affected by the tested location.

3.3. Combined Effects of Cuts on Morphological and Nutritional Qualities of Napier Accession

Table 4. *The morphological and qualitative characteristics of Napier grass accessions were examined over location for two successive cuts between 2020 and 2021.*

Locations	Parameters											
	NT	**PH cm**	**LSR**	**FBY t/ha**	**DMY t/ha**	**DM**	**Ash**	**CP**	**NDF**	**ADF**	**ADL**	**IVDMD%**
Pawe	35^{a}	143.4^{a}	1.2^{a}	30.2^{a}	6.7^{a}	92.9^{b}	5.1^{b}	13^{b}	67.4^{a}	34.2^{b}	2.5	64.6^{a}
Jawi	26.4^{b}	129.5^{b}	1.08^{b}	21.4^{b}	5^{b}	93.6^{a}	8.3^{a}	13.6^{a}	66.1^{b}	34.8^{a}	2.6	61.1^{b}
GM	30.7	136.5	1.18	25.8	5.87	93.3	6.7	13.3	66.7	34.5	2.5	62.8
LSD	2.3	5.4	0.31	2.3	0.69	0.11	0.47	0.4	0.6	0.4	0.11	0.4
P-value	***	***	*	***	***	**	***	***	***	***	NS	***

PH=plant height; DMY=dry matter yield; LSR=leaf to stem ratio; NT=number of tillers; CP=crude protein; NDF=neutral detergent fiber; ADF=acid detergent fiber; ADL=neutral detergent lignin; IVDMD=invitro dry matter digestibility; NS = non-significant; * = significant at 0.05; ** = significant at 0.01; *** = significant at 0.001.

Table 5. *Morphological and quality traits of Napier grass accessions tested over location from 2020 to 2021 for two consecutive cuts.*

Cuts	Parameters											
	NT	**PH cm**	**LSR**	**FBY t/ha**	**DMY t/ha**	**DM**	**Ash**	**CP**	**NDF**	**ADF**	**ADL**	**IVDMD%**
Cut-I	18.4^{b}	136.8	1.33^{a}	20.8^{b}	5.2^{b}	93.2^{b}	6.66	14^{a}	66.9	34.98^{a}	2.64^{a}	63.5^{b}
Cut-II	38.1^{a}	136.3	1.08^{b}	28.7^{a}	6.2^{a}	93.37^{a}	6.7	12.9^{b}	66.6	34.33^{b}	2.5^{b}	62.5^{b}
GM	30.7	136.5	1.18	25.8	5.87	93.3	6.7	13.3	66.7	34.5	2.5	62.8
LSD	2.4	5.5	0.14	2.4	0.7	0.11	0.49	0.41	0.64	0.42	o.11	0.42
P-value	***	NS	*	***	**	*	NS	**	NS	**	**	**

PH=plant height; DMY=dry matter yield; LSR=leaf to stem ratio; NT=number of tillers; CP=crude protein; NDF=neutral detergent fiber; ADF=acid detergent fiber; ADL=neutral detergent lignin; IVDMD=invitro dry matter digestibility; NS = non-significant; * = significant at 0.05; ** = significant at 0.01; *** = significant at 0.001.

As shown in Table 5 cuts had a significant effect on measured growth parameters and percentage of all the nutritional quality components. The number of tillers per plant and fresh weight had a highly significant ($p<0.001$) difference for each cut.

3.4. Combined Effects of Accessions on Morphological Parameters of Napier Accession

As shown in Table 6. the number of tillers varied significantly ($p< 0.001$) across accessions in the present study. Accession-14983 (47.4) and 16794 (42.98) followed by 16819 (34.6) constantly produced a higher number of tillers, but accession 15743 (20.4). The combined mean of plant height among Napier accessions significantly differed ($p<0.05$), which ranged from 115.29 to 168.1cm with a mean of 136.5 cm. The response of Napier accessions for dry matter yield performance at the forage harvesting stage across locations and over years showed significant ($p<0.01$) variation in the combined analysis as indicated in Table 6. In combined mean analysis, the DM yield of analysis ranged from 4.68 to 7.9 t/ha with a mean of 5.87 t/ha.

Table 6. Morphological traits of Napier grass accessions tested over two locations from 2020 to 2021 for two consecutive cuts.

Accessions	Parameters				
	NT	PH cm	LSR	FBY t/ha	DMY t/ha
14983	47.4[a]	132.7cde	1.16ab	24.94d	5.57cd
14984	31.1[bc]	121.9ef	1.11b	30.89bc	6.4abc
15743	20.4e	123.1ef	1.46a	31.3abc	6.3abcd
16783	31.7bc	149.2b	0.97b	17.97e	4.68d
16791	23.2de	151.8b	1.22ab	31.9ab	7.4ab
16792	23.5de	168.1a	1.1b	25.53cd	5.79bcd
16794	42.98a	139bcd	1.14ab	24.77d	5.68cd
16813	29.6bc	115.29f	1.25ab	20.9de	4.72cd
16815	29.9bc	129.5de	1.25ab	21.23de	5.11cd
16817	26.4cd	131.2de	1.13ab	20.5de	5.33cd
16819	34.6b	131.59cde	1.23ab	22.48de	5.48cd
Local	26.6cd	144.6bc	1.12b	37.4a	7.9a
GM	30.73	136.5	1.18	25.8	5.87
LSD	5.7	13.2	0.33	5.79	1.7
P-value	***	NS	*	***	**

PH=plant height; DMY=dry matter yield; LSR=leaf to stem ratio; NT=number of tillers; NS = non-significant; * = significant at 0.05; ** = significant at 0.01; *** = significant at 0.001.

3.5. Combined Effects of the Nutritional Characteristic of Napier Accessions

The mean DM, ash, crude protein, NDF, ADF, ADL, and in-vitro dry matter digestibility (IVDMD) contents of Napier accessions harvested at 60 days to planting and 40 days to first harvest for the first and second cut are indicated in Table 7. The result revealed that DM, ash, CP, NDF, ADF, ADL, and IVDMD varied significantly ($P<0.001$) among Napier accessions.

Table 7. Nutritional quality traits of Napier grass accessions tested over two locations from 2020 to 2021 for two consecutive cuts.

Accessions	Parameters						
	DM%	Ash%	CP%	NDF%	ADF%	ADL%	IVDMD%
14983	93.45ab	7.56a	14.37a	66.06de	34.53bc	2.59bcd	62.44cd
14984	93.13c	7.02abc	13.59abcd	65.57e	33.29d	2.25e	64.72a
15743	93.22bc	7.48a	13bcde	66.34cde	35.12ab	2.56cd	63.3bc
16783	93.38abc	5.93c	12.62de	68.86a	35.64a	2.87a	61.1f
16791	93.25abc	6.3bc	12.66cde	67.93ab	34.66ab	2.33de	63.04bcd
16792	93.4abc	6.09bc	13.75ab	67.36abcd	34.8ab	2.85ab	62.75bcd
16794	93.38abc	7.03abc	13.89ab	67.33bcd	35.4ab	2.7abc	62.76bcd
16813	93.19bc	7.18ab	13.64abc	65.28e	34.49bc	2.39de	63.55b
16815	93.25abc	5.88c	12.48e	66.09cde	33.59bc	2.78abc	62.37cde

Accessions	Parameters						
	DM%	Ash%	CP%	NDF%	ADF%	ADL%	IVDMD%
16817	93.5a	7.12ab	13.34bcde	66.08cde	35.31ab	2.74abc	61.43ef
16819	93.38abc	6.78abc	13.29bcde	67.59abc	34.75ab	2.5cd	62.15de
Local	93.13c	6.48abc	13.67ab	66.73bcde	33.35d	2.21e	64.95a
GM	93.31	6.74	13.36	66.77	34.58	2.5	62.88
LSD	0.28	1.17	0.99	1.52	1	0.28	0.99
P-value	***	***	***	***	***	***	***

DM=dry matter; CP=crude protein; NDF=neutral detergent fiber; ADF=acid detergent fiber; ADL=neutral detergent lignin; IVDMD=invitro dry matter digestibility; NS = non-significant; * = significant at 0.05; ** = significant at 0.01; *** = significant at 0.001.

4. Discussion

4.1. Analysis of Variance

The leaf-to-stem ratio and dry matter yield t/ha were significantly differnt by the year, while plant height, fresh weight, and the number of tillers per plant were not. All growth characters, however, with the exception of plant height, ash, and NDF content, were significantly impacted by cuts. According to our findings, which were in agreement with those of Ansa and Garjila [13], cutting frequency for Pennisetum purpureum grasses had observable impacts on fresh weight and dry matter yield t/ha. But the results contradict to those of Wen and Jiang [14], who found that ryegrass produced more leaves when cutting more frequently, or at shorter intervals. This reduction in growth rate and shoot development might be an indication that high cutting frequency may suppress grass regeneration and reduce re-growth potential. This result shows that each genotype is affected by cutting frequency positively and negatively, so classifying accessions under cutting frequency is necessary.

4.2. Combined Effects of Location on Morphological and Nutritional Qualities of Napier Accession

This supports earlier findings by Gemechu Keneni [15], who found that selecting accessions that perform better in one environment might not allow for the identification of accessions that can replicate almost the same performance in different environments. According to [16, 17], variety by environmental interaction changes the relative performance of a cultivar in different environments because different accessions react differently to different biotic, climatic, and edaphic factors. This helps determine which accessions are appropriate for a given location. Generally speaking, the location interaction effect meant that almost every measured morphological trait of Napier accessions was strongly influenced by genotype. For a certain setting, special registration is therefore necessary for the effective use of specific accessions.

4.3. Combined Effects of Cuts on Morphological and Nutritional Qualities of Napier Accession

There was a significantly significant ($p<0.001$) difference in fresh weight and the number of tillers per plant for each cut. With the exception of plant height, ash, and NDF values, all other growth and quality metrics between cuttings differed significantly ($p<0.01$). In comparison, the number of tillers per plant, fresh and dry matter yield, and crude protein or ADF and ADL content, as well as the leaf-to-stem ratio, were all higher at the first cut. Our results are consistent with the [18] report that as plants matured, the number of tillers per plant rose for Napier grass. By restoring lost photosynthetic area and preserving basal area, recurrent defoliation may be tolerated by a high number of tillerings [19]. The heights of plant, ash and NDF content were not affected by different cuts. Fresh and dry matter yield was negatively correlated with crude protein content. Hence, the dry matter yield variation among accessions for different harvesting intervals in the present study was due to the differences in the amount and distribution of rainfall received during the growth period. The moisture availability following the wetter season triggers the development of root, tiller and shoot of Napier grass and then dramatically increases the yield [20]. According to [21] cutting at the late maturity stage (42 days) given higher dry matter yields, the protein content and metabolizable energy are higher at the early maturity (35 days) stage because the degradation is directly proportional to the age of the grass.

4.4. Combined Effects of Accessions on Morphological Parameters of Napier Accession

The current result was greater than the result for accession 14983 (19.9) indicated by [22]. The variation in tiller number among accessions was due to the yielding ability of the genotype as the result of its interaction with the environment and environmental factors such as soil characteristics, moisture, and temperature [23]. Tillering performance is an important morphological characteristic to be considered during the selection of appropriate forage crops to improve production and productivity [19]. The variance in tillers produced per plant among the varieties of *Pennisetum purpureum* grass from this study might be exaggerated due to genetic variations among the varieties. The best three Napier grasses recommended for future promotion are shown in Figure 2.

Accession-14984 Accession-15743 Accession-16791

Figure 2. *The three Napier grass varieties.*

Accessions 16792, 16791, and 16783 typically had the highest mean plant height, while accession 14984 and 15743 had the lowest, with the remaining accessions falling in middle. This discrepancy might result from how different accessions' genetic potential reacts to the soil fertility and moisture content of the testing conditions. According to [24, 25], the height of the plant at cutting influences both the growth traits and the amount of forage yield produced by Napier grass. To increase DM yield and grass nutritive values, it is crucial to harvest Napier grass at the proper cutting height and frequencies [18]. Generally, the presence of genetic variation among the tested accessions, the response of accessions to environmental factors and their interactions are the major reasons for plant height differences in Napier accessions.

During the 2020 and 2021 cropping seasons, as well as in the combined study displayed in Table 6, there was a substantial ($p<0.05$) variation in the leaf-to-stem ratio of Napier accessions at both locations. According to the results, accession 15743 (1.46) had the highest leaf proportion, while accession 16783 (0.97) had the lowest. In two cuts at the Pawe location throughout both cropping seasons, the other accessions had an intermediate leaf-to-stem ratio value. The studied Napier grass accessions respond differentially to the leaf-to-stem ratio because of genetic differences. Plant height, cut age, and tillering performance all have an impact on the plant's leaf proportion. The proportion of leaves in forage crops has important influences on the nutritional quality of any forage crop as leaves contain higher levels of nutrients and less fiber than stems. As indicated by Tessema Zewdu [5] the leaf and stem fractions were affected by tillering performance, plant height and age of harvesting. The leaf fraction has significant implications on the nutritive quality of the grass as leaves contain higher levels of nutrients and less fiber than stems. The leaf proportion is associated with the high nutritive value of the forage because the leaf is generally of higher nutritive value described by [6] the performance of animals is closely related to the amount of leaf in the diet.

Generally, local check gave the highest mean DM yield followed by 16791, 14984 and 15743. On the other hand, accession 16783 provided the lowest DM yield. Furthermore, DM yield differences occurred due to variations among the tested accessions, testing years, location and cut effects. The earlier studies described by [26, 27] proved that the wider range of dry matter yield variance among accessions could be attributed to differences in the genetic potential of varieties. The dry matter yield obtained from this study for all tested *Pennisetum purpureum* grass accessions was higher than previously reported values by [19] reported 1.4-7 t/ha for ten elephant grass accessions in rain-fed conditions. However, it is lower than the value by [28] indicated 6.95-17.9 t/ha for ten Napier accessions at Areka, the southern part of Ethiopia.

4.5. Combined Effects of the Nutritional Characteristic of Napier Accessions

Mineral concentrations in the feed can be inferred from the amount of ash in the forage. The ash proportion was lowest in accession 16783, 16791, and 16815, while it was highest in accession 14983 and 15743. McDowell [29] supposed that some of the possible causes of variation in mineral concentration in forage plants are soil properties, morphological components, meteorological conditions, and plant developmental stage.

The highest CP yield was recorded for the Napier genotype 14983 followed by 16794, 16792, and local. On the other hand, Napier accessions 16815, 16783 and 16791 gave the lowest CP yield while the remaining accessions produced an intermediate CP yield. The crude protein content among Napier accessions was varied might be due to genetic variation, stage of harvesting and differences in soil fertility. The overall mean in CP harvested at 60 to planting and 40 days harvest from the first cut in the present study (13.36%) is higher than the value (5.42%) reported by [28].

Among the accessions that were examined, the greatest IVDMD values were recorded by 14894 and local, followed by 15743 and 16813. The lowest values were reported from16873 and 16817 accessions. In tropical grasses, the decrease in OMD with maturity has typically been attributed to a rise in the structural components of the cell wall and digestibility content, which is ranked as the decline in the leaf-to-stem ratio that did the best [30]. The percentage of leaves to stems decreased as the plants grew older, lowering the levels of CP and IVDMD [31]. The highest digestible yield was likewise obtained by Napier accessions that produced the highest CP yield.

The contents of NDF, ADF, and ADL varied significantly ($P<0.001$) among the Napier grass accessions. In Napier accessions, variations in NDF and ADF content are mostly caused by variations in genetic components, harvesting stage, climate, and soil variables. All of the Napier accessions in the current investigation had NDF and ADF contents between 65.28 and 68.86 and 33.29 and 35.64 percent, respectively, which were lower than the values between 61.05 and 70 and 49.59 and 50.82 reported by [32].

Napier accessions may be more digestible than the other grasses, as evidenced by their lower levels of NDF, ADF, and ADL content. The average NDF level of the Napier accessions in this study, however, was greater than the 45–65 NDF concentration of medium-quality roughage feeds that are recommended [33]. Forage feeds' digestibility is negatively impacted by the current study's lower ADL value. According to [10], the digestibility of the feed may suffer if the ADL value is higher than 60 g/kg DM. In general, insoluble fiber, especially lignin, reduces the feed's total digestibility by reducing the availability of nutrients [34].

5. Conclusions

The Napier accession ILRI-14983 was best performed in terms of the number of tillers, ash, and crude protein. Accession ILRI-15743 was better-performed leaf-to-stem ratio and ash content. The local check was given the high amount of dry matter yield per ton per hectare. Accession ILRI-14984, 15743, 16791, 16792, and 16819 were intermediate values in terms of the number of tillers, leaf-to-stem ratio, dry matter yield t/ha, ash, crude protein content, and invitro dry matter digestibility. Based on the overall performance accession 14984, 15743, 16791, and 16819 were recommended for better growth characteristics and nutritional quality parameters. So we recommended the demonstration of selected accessions for Metekel and Awi mid and low land areas and other compa-rable agro-ecologies in the country at farmer level was essintal.

Abbreviations

ADF	Acidic Detergent Fiber
ADL	Acidic Detergent Liginin
CP	Crude Protien
DM	Dry Matter
ILRI	International livestock Research Institute
IVDMD	In-vitro Dry Matter Digestibility
NDF	Neutral Detergent Fiber
OMD	Organic Matter Digestibility
TPP	Tiller Per Plant

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Data Availability Statement

Data is available with the corresponding author upon request.

Conflicts of Interest

The authors declare no conflicts of interest.

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