



International Journal of Agricultural Sciences and Technology

Publisher's Home Page: <https://www.svedbergopen.com/>



Research Paper

Open Access

Influence of Variety and Cutting Interval on Nutritive Values of Desho Grass Under Supplementary Irrigation in Western Oromia, Ethiopia

Fikre Dereba^{1*}, Zemene Worku² and Diriba Geleti³

¹Oromia Agricultural Research Institute, Ethiopia; Adami Tulu Agricultural Research center, Ethiopia. E-mail: fikrediriba2023@gmail.com

²College of Agricultural and Veterinary Medicine, Jimma University, Ethiopia. E-mail: workuzemene@yahoo.com

³Ethiopia Institute Agricultural Research, Ethiopia.. E-mail: dgeleti2005@yahoo.com

Article Info

Volume 5, Issue 2, November 2025

Received : 10 April 2025

Accepted : 13 August 2025

Published : 25 November 2025

doi: [10.51483/IJAGST.5.2.2025.23-37](https://doi.org/10.51483/IJAGST.5.2.2025.23-37)

Abstract

The study was conducted to evaluate the influence of varieties and cutting intervals on the nutritive values of Desho grass under irrigation at Dambi Dollo University experimental site, Western Ethiopia. The experiment was laid out in RCBD using 3x4 factorial arrangement and three replicates. The factors studied were three Desho grass varieties (Areka /DZF #590, Kindu kosha-1 /DZF #591, Kulumsa /DZF #592) and four cutting intervals (4, 6, 8, and 10 weeks) after standardization cut (105 days). The CROPWAT 8.0 model, local climate data, forage data, and soil data were used to determine Desho grass water requirements and irrigation schedules. The chemical composition, and in vitro digestibility of the feed samples at the subsequent harvests were determined following the standard procedures. The chemical composition of Desho grass affected by the interaction of varieties with cutting intervals, except the DM, ADF, and cellulose. The ash and CP contents decreased, while NDF, ADF, and ADL of all Desho grass varieties were increased with increasing cutting intervals. Only the main effect (varieties and cutting interval) had a significant effect on IVDMD, while IVOMD and ME were affected by the interaction effects. In conclusion, both varieties and cutting intervals had significant effects on nutritive value of Desho grass. The Desho grass varieties Areka /DZF #590 and Kulumsa /DZF #592 harvested at 6 weeks intervals after the standardization cut could be better choices for high forage quality in the study area.

Keywords: Cutting interval, Desho grass, Nutritive values, Supplementary irrigation

© 2025 Fikre Dereba et al. This is an open access article under the CC BY license (<https://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made.

1. Introduction

Ethiopian agriculture faces challenges in forage cultivation, such as lack of funds for improved seeds, limited planting materials, high costs, low knowledge, crop-focused practices, and weak extension services (Zereu and Lijalem, 2016; Fikre, 2018). Additional issues include free grazing, poor coordination among stakeholders, and insufficient support from government and NGOs for forage technologies (Gebreselassie, 2019). Addressing the forage shortage in Ethiopia necessitates adopting improved forage crops (Bezabih et al., 2021). Initiatives focus on selecting nutritious and adaptable forage crops (Diribi, 2022). Moreover, the extended dry season and lack of irrigation exacerbate forage management challenges (Mengistu et al., 2017).

To improve forage production in Ethiopia, it is crucial to focus on irrigation and management practices, especially by choosing drought-tolerant, high-yielding perennial grass varieties. Jayasinghe et al. (2022) emphasize that cultivar

* Corresponding author: Fikre Dereba, Oromia Agricultural Research Institute, Ethiopia; Adami Tulu Agricultural Research center, Ethiopia. E-mail: fikrediriba2023@gmail.com

selection and effective cutting management significantly affect the nutritional quality of tropical pastures. Studies indicate that more frequent cutting can decrease productivity, while longer intervals may increase fiber content, reducing the quality of Napier grass (Tessema et al., 2010). Hare et al. (2013a) reported that cutting every 30 days can result in 3"4% higher crude protein levels compared to cutting every 45 or 60 days, although this approach decreased herbage accumulation by 20% for Brachiaria cultivars. The primary goal in forage production is to achieve high dry matter yields of quality forage. However, as there is often an inverse relationship between dry matter yield and quality in most forage types, developing an effective cutting system is essential to optimize both yield and quality.

Understanding and selecting the right varieties for specific nutritional needs is essential for optimizing livestock production and health. Forage quality is influenced by environmental and genetic factors (Van Soest, 1982). The nutrient composition of forage crops is affected by genotypic traits, environmental conditions, and plant harvesting ages (Lamb et al., 2006). Additionally, forage quality and nutrient content tables may not accurately reflect the actual nutritional value of specific forages (FAO, 2018). Factors such as plant variety, growth stage (maturity), season, management practices, and the presence of anti-quality components can all impact forage quality. Furthermore, regrowth after cutting is a crucial physiological process that affects herbage quality (Geren et al., 2020).

Previous studies on Desho grass (*Pennisetum glaucifolium*) varieties in Ethiopia have primarily focused on their adaptability and yield potential at optimal harvesting stages. However, there is a lack of data on how variety and cutting intervals impact the nutritive value of Desho grass after optimal harvesting under supplementary irrigation. This study aims to evaluate the chemical composition and in vitro digestibility of Desho grass influenced by variety and cutting intervals under supplementary irrigated conditions.

2. Materials and Methods

2.1. Description of the Study Area

The experiment was carried out under irrigation from October 24, 2022, to May 2, 2023, at the Dambi Dollo University in Efa Galano kebele, Sayo district of Kellam Wollega in Oromia Regional State, Western Ethiopia located 652 km away from Addis Ababa, Ethiopia’s capital city (Figure 1). The area lies at a latitude of 8°50'N and a longitude of 34°76'2E with an altitude between 1500-1740 meters above sea level. It has a sub-humid climate with average minimum and maximum annual temperatures of 15 to 28°C, respectively. The area receives an annual rainfall of 850-1200 mm.

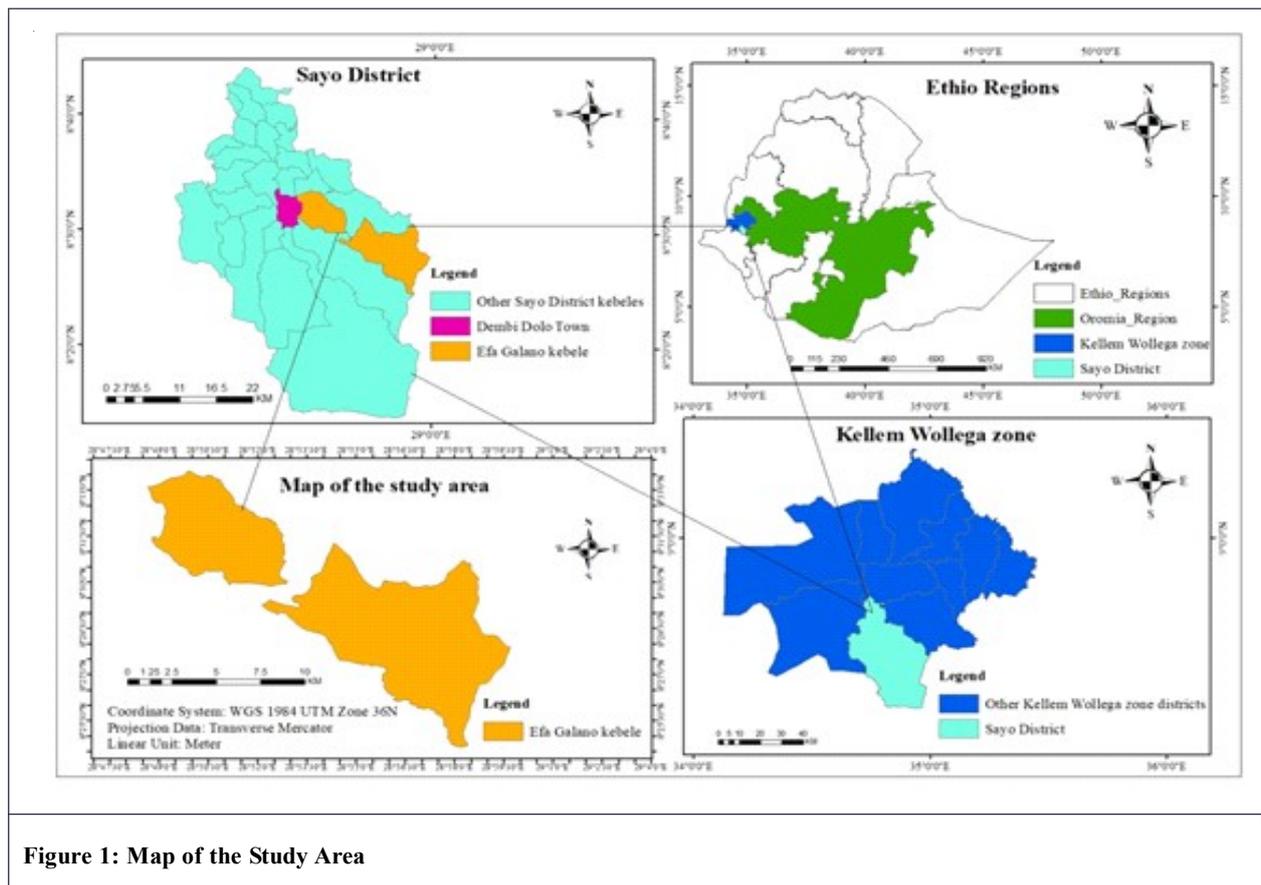
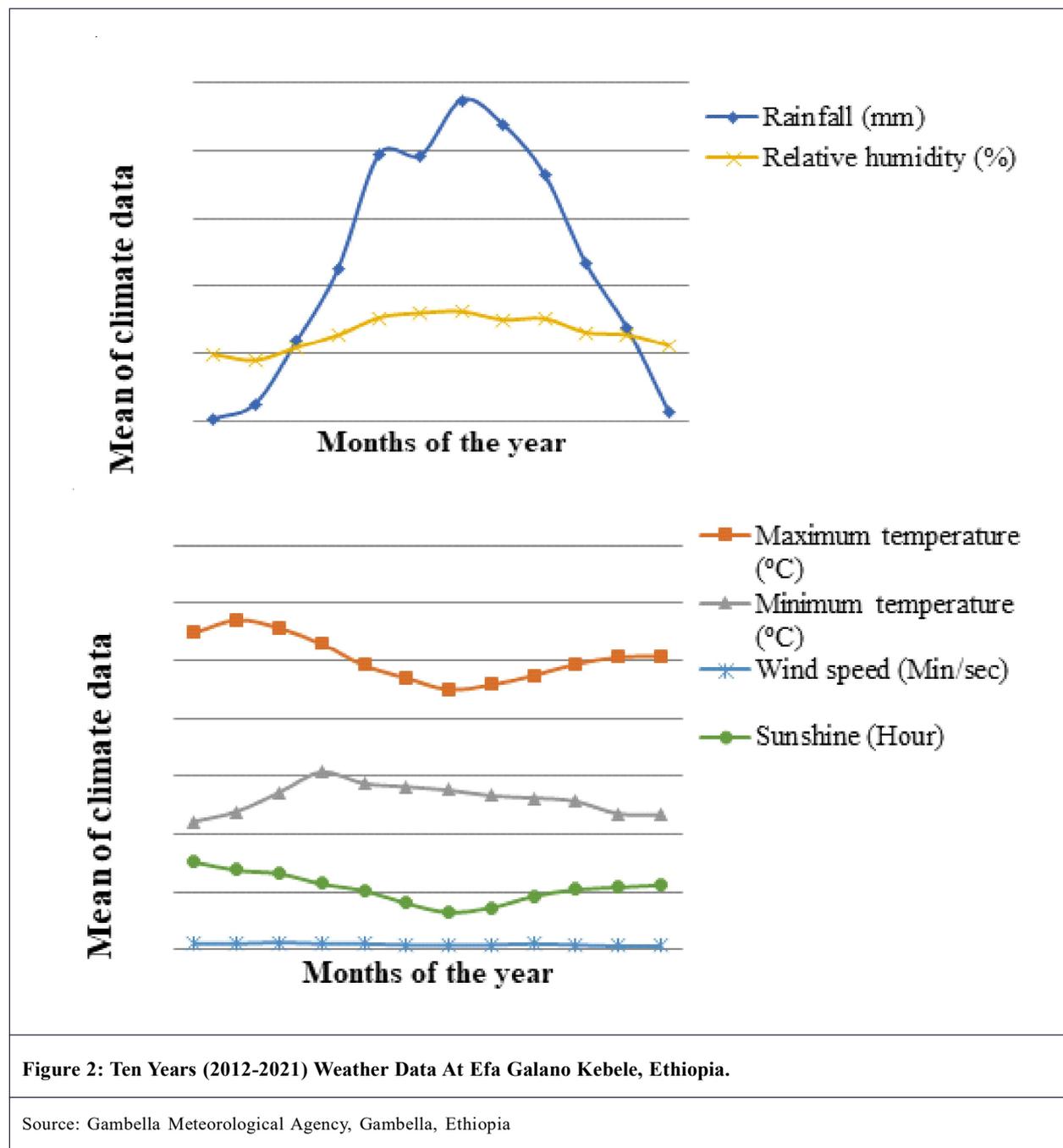


Figure 1: Map of the Study Area

2.2. Weather Data

Ten years (2012-2021) of average weather data (rainfall, minimum temperature, maximum temperature, relative humidity, wind speed, and sunshine) of the area were obtained from the Gambella meteorological agency. Accordingly, information on ten years of weather data of the area was provided in Figure 2 below.



2.3. Soil Chemical and Physical Properties of the Study Site

Laboratory analysis for soil physical and nutrient characteristics of composite soil samples (0–30 cm) collected from the experimental site before planting are shown in Table 1. The collected soil sample was air-dried, then subsampled, ground, and sieved through a 2 mm mesh after removing plant debris. It was further milled to pass through a 0.2 mm sieve for analyses of nitrogen, pH, organic carbon, available phosphorus, organic matter, cation exchange capacity (CEC), and soil texture (Van Reeuwijk, 2002). Soil pH was measured with a digital pH meter in a 1:2.5 soil-to-distilled water suspension. Organic carbon was determined using the wet combustion method, (Walkley and Black, 1934), and organic matter was calculated by multiplying % OC by 1.724. CEC was analyzed with ammonium acetate, and available phosphorus was measured by shaking soil with 0.03 mole ammonium fluoride in 0.1 mole hydrochloric acid, per the Olsen II method (Olsen, 1954). The soil sample analysis was conducted at the Nekemte soil laboratory (Nekemte, Oromia, Ethiopia).

S. No.	Parameters	Value
1	pH	5.79
2	OC (g/kg)	26.1
3	OM (g/kg)	44.9
4	P (mg/kg)	7.82
5	TN (g/kg)	2.2
6	CEC (cmolc/kg)	32.06
7	Clay	400
8	Silt	290
9	Sand	310
10	Clay loam	

Note: OC=Organic carbon, P=phosphorus, TN=Total Nitrogen, OM=organic matter, CEC=cation exchange capacity.

2.4. Experimental Layout, Design and Treatments

The experimental design was a factorial arrangement in a randomized complete block design consisting of three varieties (Areka /DZF #590, Kulumsa /DZF #592, and Kindu kosha-1 /DZF #591) of Desho grass and four the subsequent harvests (4, 6, 8, and 10 weeks) and totally twelve treatments were used (Table 2). Total area of land with 564 m² (47 m × 12 m) was prepared for sowing. In order to refine the soil, the land was ploughed and harrowed with oxen, then hoed. The

Treatments	Varieties	Cutting intervals
T 1	Areka /DZF #590	4 weeks
T 2	Areka /DZF #590	6 weeks
T 3	Areka /DZF #590	8 weeks
T 4	Areka /DZF #590	10 weeks
T 5	Kindu kosha-1 /DZF #591	4 weeks
T 6	Kindu kosha-1 /DZF #591	6 weeks
T 7	Kindu kosha-1 /DZF #591	8 weeks
T 8	Kindu kosha-1 /DZF #591	10 weeks
T 9	Kulumsa /DZF #592	4 weeks
T 10	Kulumsa /DZF #592	6 weeks
T 11	Kulumsa /DZF #592	8 weeks
T 12	Kulumsa /DZF #592	10 weeks

Note: DZF= Debrezeit forage

land was divided into three blocks and each of them has contained twelve treatments. The plot size was (3 m × 3 m) and the spacing between the plot and between blocks was 1 m and 1.5 m respectively. The SAS software (SAS, version 9.3, Cary, NC USA) was used for the randomization of the treatments.

The fine root bed plots were prepared before laying out the experimental plots. Vegetative root splits were used for planting Desho grass, with row and plant spacing of 0.5 m and 0.25 m, respectively, as per the recommendation (Bedeke et al., 2017) to form six rows per plot. Fertilizer was applied at a rate of 100 kg/ha NPS (N= 19%, P₂O₅=38%, S=7%, K=0,) and 50 kg/ha (23% N) urea for all experimental units during establishment (Danano, 2007). At various times throughout the experimental period, Desho grass plots were manually weeded and forage grass growth was promoted through increased soil aeration (Orodho, 2006).

2.5. Irrigation System

The scheduling for irrigation using the CROPWAT model was carried out based on historical weather data obtained from the Gambella Meteorological Agency for a period of ten years (2012-2021). The weather data included variables such as rainfall, minimum temperature, maximum temperature, relative humidity, wind speed, and sunshine. In addition to the weather data, other important factors considered in the scheduling process were the soil characteristics of the study area, forage characteristics (such as crop coefficient and root depth), and dates of planting and harvest for the forage crops. The crop coefficient (0.40 initial, 0.71 developmental, 0.89 middle, and 0.72 end phases) and root depth values (0.5 m) for Desho grass were used as recommended in the literature (Mengistu, 2015).

The furrow irrigation method was used, and the irrigation schedule varied during different phases of the forage growth. During the initial and developmental phase, irrigation water was applied at intervals of 3 days. After the developmental phase, irrigation water was applied through furrows at about 5 days intervals until the end of the experimental phase. To measure the amount of water applied, a 3-inch Parshall flume was used to measure discharges according to CROPWAT based on the crop water requirement schedule. During the experimental period, the gross and net irrigation amounts of water applied were 577.6 mm and 404.1 mm, respectively. During each irrigation water application, the set time and application time were monitored over time. The application time (min) required to irrigate the predetermined amount into each plot was calculated by using the below formula (Kandiah, 1981).

$$\text{Time required} = \frac{10 \times a \times d}{q \times 60} \text{ Minutes}$$

where: a = area of the plot that was irrigated (in square meters) d = depth of water that was irrigated (in centimeters), q = flow rate of the irrigation system (liters per second)

2.6. Nutritive Value Determination

The uniform cut was made for each plot above 8cm ground level before subsequent harvest according to recommendation (Asmare et al., 2018). Then, at each cutting frequency, harvest and sampling procedures were made from the center of two rows of each plot at 8 cm above the ground level for nutritive value determination. Desho grass samples from cutting intervals of 4, 6, 8, and 10 weeks were collected from each plot, dried in a forced air oven at 65°C for 72 hours, and then milled with a Wiley mill through a 1 mm sieve for chemical analysis. The AOAC method (1990) was used to determine DM, ash, and N. The crude protein was calculated as N × 6.25 (Magomya et al., 2014). Crude protein yield is calculated as the product DM yield with CP content divided by 100. The method of Van Soest et al. (1991) was used to analyze neutral detergent fiber, acid detergent fiber, and acid detergent lignin. Hemicelluloses were calculated by subtracting ADF from NDF content, while cellulose was determined by subtracting ADL from ADF content. Determination of in vitro dry matter digestibility (IVDMD) was made using all of the samples that were used for chemical analysis using the Tilley and Terry (1963) two-stage method. Final stage samples were then ashed to estimate IVOMD. All laboratory analyses were undertaken at Holeta Agricultural Research Center, Holeta, Oromia, Ethiopia.

2.7. Statistical Analysis

Data were subjected to the ANOVA procedure by using the General Linear Model of SAS software (SAS, version 9.3). Significance of differences in treatment means were determined using the least significant difference (LSD) test at 5% significant level or 95 % confidence interval. The model used for data analysis was:

$$Y_{ijk} = \mu + VAR_i + CI_j + (VAR*CI)_{ij} + \beta_k + e_{ijk}$$

where, Y_{ijk} = the response variable

μ = grand mean,

VAR_i = effect of varieties (i = Areka /DZF #590, Kulumsa /DZF #592, Kindu kosha-1 /DZF #591),

CI_j = effect of cutting intervals (j = cutting after 4, 6, 8, and 10 weeks after the standardization (105 days),

$(VAR*CI)_{ij}$ = the interaction effect of varieties*cutting interval

k = the block effect (k = 1, 2, 3),

e_{ijk} = the random error

3. Results and Discussion

3.1. Influence of Varieties, Cutting Interval, and their Interactions on the Chemical Composition of Desho Grass

The influence of varieties, cutting intervals, and their interactions on dry matter, ash, crude protein, neutral detergent fiber, acid detergent fiber, acid detergent lignin, hemicelluloses, and celluloses of Desho grass, are presented in Table 3.

3.1.1. Dry Matter and Ash Contents

The dry matter content of Desho grass did not differ ($p > 0.05$) among varieties, cutting intervals, and their interactions (Table 3). The lack of variation in dry matter content may be due to soil, climate, and probably the physiological stage of the plant at harvest. The present result agreed with Jothirathna *et al.* (2022) who reported that the interaction effect of varieties with cutting interval had no significant effect on dry matter content of Napier hybrid and sorghum evaluated at various cutting intervals. The overall mean value DM content (92.38%) in the present result was comparable to the result of Ajema (2022), who found that the DM content of Desho grass was 92.84%.

The varieties, cutting intervals, and their interactions had a significant effect ($p < 0.05$) on the ash content (Table 3). The ash content currently varies between 6.4% and 11.92%. In line with the current result, Tiruneh *et al.* (2022) also found interaction effect of variety with cutting intervals had a significant effect on the ash composition of Alfalfa, (between 8 to 12.01%). The highest ash content was obtained from Kulumsa /DZF #592 at 4 weeks (11.92%) which was at par with Areka /DZF #590 at 4 weeks (11.73%), followed by Kindu kosha-1 /DZF #591 at 4 weeks (11.16%), of cutting intervals, whereas the lowest was obtained from Kulumsa /DZF #592 at 10 weeks cutting interval (6.4%). The current result was lower than the report by Wamatu (2021), who found that the ash content of Desho grass was 16.89%.

For all varieties, the ash content decreased, as the cutting interval increased. This might be attributed to the natural dilution and movement of nutrients to the roots during the growth and development of plant tissue. This trend is similar to the findings of Lounglawan *et al.* (2014) who reported that ash contents decreased as the cutting interval increased for King Napier grass. Similarly, Weerathunga *et al.* (2023) reported that the overall mean ash content of two Napier hybrids decreased progressively from the 4 to 12 weeks harvesting interval (between 14.1 to 6.4%). EI Mouttaqi *et al.* (2023) found that delaying biomass cutting leads to reduced ash levels, compared to biomass collected during the flowering period. In addition, Tobiyaw (2021) also found that ash content decreased as the harvesting age increased from 60 days to 120 days in Desho grass (13.92% to 12.16%) and higher values were recorded than the current result. The variability in ash content could be due to harvesting age, soil fertility, and agroecological variations.

3.1.2. Crude Protein

Main effect varieties had no significant difference ($p > 0.05$) on CP content, while the cutting interval had a significant effect ($p < 0.05$) on CP content, which decreased dramatically as the cutting interval increased from the 4 to 10 weeks (between 13.91% - 9.74%), (Table 3). In contrast to the current result, Wangchuk *et al.* (2015) reported that cultivars of the Napier hybrid had a significant effect on the CP content tested at different cutting intervals. For instance, a similar trend to the present finding with the result of Wangchuk *et al.* (2015) who noted that the CP content of the Napier hybrid decreased from 28.2% to 8.8% with an increased cutting interval. The more frequent cutting resulted in younger and leafier plants being correlated with the higher crude protein content of the plant, compared with the less frequent cutting (Lounglawan *et al.*, 2014). The trend of the decline in the crude protein content as cutting intervals increase was noted by several authors (Ullah *et al.*, 2010; Hare *et al.*, 2013a; Timpong-Jones *et al.*, 2015; Sumamal and Lowilai, 2020).

The interaction of varieties with cutting intervals has shown a significant difference ($p < 0.05$) in the CP content of Desho grass. The current CP content varied between 8.43 to 14.47% of DM. The highest CP content was obtained from Kindu kosha-1 /DZF #591 at 4 weeks (14.47%), followed by Kulumsa /DZF #592 at 4 weeks (13.66%), and Areka /DZF #590 at 4 weeks (13.58%) of cutting intervals, whereas the lowest was obtained from Kindu kosha -1 /DZF #591 at 10 cutting interval (8.43%). The results indicate that all three varieties showed the highest crude protein at 4 weeks cutting interval and were statistically insignificant to each other. However, as the cutting interval increased, the CP content

Factors	Chemical Composition (% for DM Basis and %DM For Others)							
	DM	Ash	CP	NDF	ADF	ADL	Hem	Cell
Varieties								
Areka /DZF #590	92.30	10.75 ^a	12.15	58.30 ^b	35.27 ^b	5.15 ^b	23.03	30.12 ^b
KK-1 /DZF #591	92.75	9.36 ^b	11.34	60.18 ^a	37.18 ^a	5.67 ^a	22.99	31.51 ^a
Kulumsa /DZF #592	92.09	9.23 ^b	12.06	60.28 ^a	36.69 ^a	5.59 ^a	23.58	31.10 ^a
<i>p</i> -value	0.1590	<.0001	0.054	0.0028	0.0008	0.0037	0.7009	0.0153
Cutting interval								
4 weeks	92.16	11.60 ^a	13.91 ^a	55.61 ^d	33.10 ^d	4.75 ^c	22.51	28.35 ^c
6 weeks	92.48	10.26 ^b	12.54 ^b	58.69 ^c	34.68 ^c	5.28 ^b	24.01	29.40 ^c
8 weeks	92.68	9.29 ^c	11.19 ^c	60.79 ^b	37.88 ^b	5.56 ^b	22.91	32.33 ^b
10 weeks	92.21	7.96 ^d	9.74 ^d	63.24 ^a	39.86 ^a	6.29 ^a	23.38	33.56 ^a
<i>p</i> -value	0.5188	<.0001	<.0001	<.0001	<.0001	<.0001	0.403	<.0001
Interaction effect								
Areka * 4 Weeks	92.51	11.73 ^a	13.58 ^{abc}	57.75 ^{de}	31.56	4.15 ^f	26.19 ^{ab}	27.41
Areka * 6 Weeks	92.38	11.54 ^{ab}	13.56 ^{abc}	58.10 ^{cde}	34.04	5.06 ^{de}	24.06 ^{abcd}	28.98
Areka * 8 Weeks	92.13	9.94 ^c	10.8 ^{def}	58.52 ^{cde}	36.10	5.61 ^{bcd}	22.42 ^{cdef}	30.49
Areka * 10 Weeks	92.19	9.79 ^{cd}	10.64 ^{ef}	58.83 ^{cd}	39.39	5.79 ^{bc}	19.44 ^f	33.60
KK-1 * 4 weeks	92.43	11.16 ^b	14.47 ^a	55.21 ^{ef}	33.83	5.31 ^{cde}	21.38 ^{def}	28.52
KK-1 * 6 weeks	92.67	9.42 ^{de}	11.67 ^{def}	58.81 ^{cd}	35.6	5.56 ^{bcd}	23.21 ^{bcd}	30.04
KK-1 * 8 weeks	93.57	9.16 ^{ef}	10.77 ^{def}	62.56 ^b	39.24	5.69 ^{bc}	23.32 ^{bcd}	33.55
KK-1 * 10 weeks	92.35	7.69 ^e	8.43 ^e	64.14 ^{ab}	40.07	6.13 ^b	24.07 ^{abcd}	33.93
Kulumsa * 4 weeks	91.55	11.92 ^a	13.66 ^{ab}	53.87 ^f	33.92	4.80 ^e	19.95 ^{ef}	29.12
Kulumsa * 6 weeks	92.40	9.82 ^{cd}	12.39 ^{bcd}	59.17 ^{cd}	34.41	5.22 ^{cde}	24.76 ^{abc}	29.19
Kulumsa * 8 weeks	92.34	8.77 ^f	12.01 ^{cde}	61.31 ^{bc}	38.31	5.37 ^{cde}	23.0 ^{bcd}	32.94
Kulumsa * 10 weeks	92.08	6.4 ^h	10.16 ^f	66.76 ^a	40.12	6.97 ^a	26.64 ^a	33.16
Overall mean	92.38	9.78	11.85	59.58	36.38	5.47	23.20	30.91
<i>p</i> -value	0.6564	<.0001	0.022	<.0001	0.3984	0.0093	0.0004	0.2262
CV (%)	0.89	2.86	7.11	2.32	2.98	6.52	8.27	3.55
SE	0.53	0.18	0.56	1.14	1.27	0.21	1.09	1.24
Note: ^{a-h} Means with different letters in a column are significantly different (<i>p</i> <0.05). DM = dry matter; CP= crude protein; NDF= neutral detergent fiber; ADF= acid detergent fiber; ADL= acid detergent lignin; Hem = hemicellulose; Cell= cellulose; CV =coefficient of variation; SE= standard error; Areka /DZF#590;Kulumsa /DZF#592;KK-1=Kindukosha-1/DZF#591. Fiber contents.								

gradually decreased, and cutting variation could more influence on CP content than the varieties of Desho grass. The current result concurred with previous findings that for different grasses, the CP contents decreased as the cutting interval increased (Njarui *et al.*, 2016; Jothirathna *et al.*, 2022; El Mouttaqi *et al.*, 2023).

The overall mean of crude protein content (11.85%) recorded in the present result was lower than the report of Wamatu (2021), who noted that the crude protein content of Desho grass was 12.69% and higher than the result of Ajema (2022) who stated that the crude protein content of Desho grass was 10.47%. The soil fertility, season, and maturity of fodder harvesting are important influencing factors for variation in crude protein contents (Lemus, 2020). The current CP content was higher than most Ethiopian dry forages and roughages which have a CP content of less than 9% (Seyoum and Zinash, 1989), except for Kindu kosha-1 /DZF #591 at 10 weeks cutting intervals.

In general, the present result showed all CP content across varieties at any given cutting interval above 7% CP is needed for microbial protein synthesis in the rumen that can support at least the maintenance requirement of ruminants (Van Soest, 1994). The current result meets the minimum CP of 10% which is adequate for fattening cattle (Aminah and Chen, 1998), and a CP of 10–12% DM which is adequate for rumen function and DMI for dairy cattle (Lean *et al.*, 2014), except for Kindu kosha-1 /DZF #591 at 10 weeks cutting interval. Rivera and Parish (2010) reported that grasses containing below 8%, 8-9%, 10-11%, and over 12% of crude protein are categorized as poor, fair, good, and excellent protein sources, respectively. The present result for the crude protein can be categorized as good to excellent protein sources in the study area, except Kindu kosha-1 /DZF #591 at 10 weeks cutting interval.

In this section, the results for NDF, ADF, ADL, hemicellulose, and cellulose are discussed. As indicated in Table 3, there were significant ($p < 0.05$) interactions between varieties and cutting intervals on neutral detergent fiber (NDF), acid detergent lignin (ADL), and hemicellulose of Desho grass. For the ADF and celluloses, only the main effect (varieties and cutting interval) had a significant effect ($p < 0.05$).

The varieties, cutting interval, and their interactions had a significant effect ($p < 0.05$) on the NDF content of Desho grass. For all varieties, NDF content increased as the cutting interval increased from 4 to 10 weeks. Areka /DZF #590, Kulumsa /DZF #592, and Kindu kosha-1 /DZF #591 the NDF content gradually increased and peaked at 10 weeks of age at nearly 58.83%, 66.76%, and 64.14%, respectively. In line with the present result, Zailan *et al.* (2016) also showed that the NDF content in Napier cultivars increased as the harvesting age increased from 4 to 8 weeks. In the present result, the NDF ranged from 53.87% to 66.76% with an overall mean of 59.58%. This result was consistent with previous studies by Njarui *et al.* (2016) who reported that the NDF content of Brachiaria cultivars increased from 6 weeks (56.1%) to 12 weeks (66.4%). The current result concurred with earlier reports the NDF content of Napier hybrid cultivars increased from 4 weeks (63.70%) to 12 weeks (75.70%) (Weerathunga *et al.*, 2023).

The overall mean of NDF content (59.58%) recorded in the present result was comparable with the report of Asmare *et al.* (2018), who noted that the NDF content of Desho grass was 60.34%. However, the present result was lower than the report of Ajema (2022), who observed NDF content of Desho grass was 73.50%, and higher than the results of Tilahun *et al.* (2017), who noted the NDF content of Desho grass was 47.7%. The soil fertility, harvesting age, and season of forage harvesting are important influencing factors for variation in NDF content (Hameed *et al.*, 2008). Feeds with NDF values below 45% could be considered high quality, those with values between 45% and 65% as medium quality, and feeds with values above 65% as poor quality (Singh and Oosting, 1992). Accordingly, the %NDF level of the current result was found to be classified as a medium quality based on this threshold, except for the Kulumsa /DZF #592 variety at 10 weeks cutting interval. However, Meissner *et al.* (1991) found that NDF content above 60% in tropical grass affects the DM intake. As such, the %NDF observed in this study, which was below 60%, is considered acceptable and had minimal impact on intake, except for Kindu kosha-1 /DZF #591 and Kulumsa /DZF #592 cut at 8 weeks and 10 weeks. Similarly, Tolera and Said (1994) found that when the concentration of total cell wall (NDF) exceeded 60%, it was linked to reduced voluntary feed intake, longer rumination periods, and decreased efficiency in converting ME to net energy.

The main effect varieties and cutting interval had a significant effect ($p < 0.05$) on the ADF content of Desho grass, but was not affected by their interactions (Table 3). The current result aligns with earlier reports showing that the interaction between cultivars and cutting intervals had no significant effect on the ADF content of Brachiaria grass (Kifuko-Koeh *et al.*, 2016; Nyambati *et al.*, 2016). The main effect result showed that higher ADF content was obtained from Kindu kosha-1 /DZF #591 (37.18%), which was at par with Kulumsa /DZF #592 (36.69%), while significantly lower ADF was recorded from Areka /DZF #590 (35.27%) with an overall mean 36.38%. Similarly, Ondiko *et al.* (2016) also noted that cultivars had a significant effect on the ADF content of Brachiaria grass when evaluated under various cutting intervals.

Regarding cutting interval, a significantly higher ADF content was obtained at 10 weeks (39.86%), whereas a significantly lower ADF was recorded at 4 weeks (33.10%) cutting interval. This showed that as the cutting interval

increased the ADF content also increased. The current result agreed with earlier reports, showing that ADF contents increased as the cutting interval increased for different forage grasses (Hare *et al.*, 2013a; Hare *et al.*, 2013b; Sumamal and Lowilai, 2020; El Mouttaqi *et al.*, 2023). The overall mean of ADF content (36.38%) recorded in the present result was higher than the report of Wamatu (2021), who noted that the ADF content of Desho grass was 31.60% and lower than the results of Ajema (2022) who reported the ADF content of Desho grass was 41.38%. The variation in ADF content in current and previous reports might be associated with environment, cutting age, cutting cycle, and management conditions. In general, the feed with ADF below 40% is high quality, while above 40% is low quality, as suggested by Kellems and Church (1998). Hence, the %ADF observed in this study was below this threshold, indicating high quality.

The interactions of varieties with cutting intervals had a significant effect on the ADL content of Desho grass ($p < 0.05$) (Table 3). In the present result, the ADL content ranged from 4.15% to 6.97% with an overall mean of 5.47%. The current result of ADL content increased with increasing cutting intervals for all tested varieties. This result concurs with the result of El Mouttaqi *et al.* (2023), the ADL content of Blue panicgrass increased as the cutting interval increased from 20 to 100 days, ranging from 2.98% to 8.96% and 2.73% to 5.81% during the summer and winter seasons, respectively. Moreover, AkinyiNguku (2015) also noted that the ADL content of Brachiaria cultivars increased with increasing cutting intervals from 6 to 12 weeks (3.9% to 4.9%). In contrast to the current result, the interaction effect of cultivars with cutting interval had no significant difference in the ADL content of Brachiaria grass as reported by various scholars (Kifuko-Koech *et al.*, 2016; Njarui *et al.*, 2016; Nyambati *et al.*, 2016).

The overall mean of ADL content (5.47%) recorded in the present result was comparable with the result of Abera *et al.* (2021), who found that the ADL content of Desho grass was 5.29%. However, it was higher than the report of Wamatu (2021), who noted that the ADL content of Desho grass was 3.62%, and the result of Ajema (2022) who stated that the ADL content of Desho grass was 4.52%. In addition, the current result is lower than the report made by Asmare *et al.* (2018), who noted that the ADL content of Desho grass was 17.50%. The variation in ADL content in current and previous reports might be associated with soil fertility, cutting age, altitude, weather conditions, and management during the experimental period. According to Reed *et al.* (1988), the roughages ADL value was below 10% which classifies under a good range of quality and when becomes above 10% which is in a bad range, that limits DM intake. Based on this, the %ADL observed in this study was below this threshold, and considered as under a good range of quality. However, Van Soest (1982) found that lignin content above 6% has a negative impact on the digestibility of forage. Hence, the %ADL observed in the present result was below this threshold except for Kindu kosha-1 /DZF #591 and Kulumsa /DZF #592 cut at 10 weeks intervals.

The main effect varieties and cutting intervals had no significant effect ($p > 0.05$) on the hemicellulose content of Desho grass (Table 3). However, the interaction effect of varieties with cutting intervals had a significant difference ($p < 0.05$) in the hemicellulose content of Desho grass. In the present result, the interaction effect of hemicellulose content of Desho grass ranged from 19.44% to 26.64% with an overall mean of 23.20%. The hemicellulose content of the Areka /DZF #590 variety decreased with increasing cutting interval (26.19% to 19.44%) and for Kindu kosha-1 /DZF #591 increased with increasing cutting interval (21.38% to 24.07%), while for Kulumsa /DZF #592 an inconsistent trend was observed with increasing cutting interval. The current result is contrary to the findings of Onjai-Uea *et al.* (2022) who found that the interaction effect of cultivars with cutting interval had no significant difference on the hemicellulose content of Purple Napier grass. According to the same source, numerically hemicellulose content of the NP-1 cultivar increased with increasing cutting age, but an inconsistent trend was observed with increasing cutting age for the PN cultivar, which is observed in the current result. Furthermore, the hemicellulose content of Napier grass decreased with decreasing frequency of defoliation as reported by Tessema *et al.* (2010), which is a similar trend to the current result for the Areka /DZF #590.

The main effect varieties and cutting interval had a significant effect ($p < 0.05$) on the cellulose content of Desho grass, but was not affected by their interactions (Table 3). Higher cellulose content was obtained from Kindu kosha-1 / DZF #591 (31.51%), which was at par with Kulumsa /DZF #592 (31.10%), while significantly lower cellulose was recorded from Areka /DZF #590 (30.12%) with an overall mean of 30.91%. The present result agreed with the result of Pereira *et al.* (2021), who noted that forage cultivars had a significant effect on cellulose contents when evaluated at various regrowth intervals. Regarding cutting interval, a significantly higher cellulose content was obtained at 10 weeks (33.56%), whereas a significantly lower cellulose was recorded at 4 weeks (28.35%) cutting interval. In this result, cellulose content increased with increasing cutting interval. This result concurs with the result of Tessema *et al.* (2010) who reported that the cellulose content of Napier grass significantly increased with a decrease in defoliation frequency. However, the present result contradicts a previous report by Pereira *et al.* (2021), who noted that the regrowth interval did not influence the cellulose content of forage cultivars. This difference might be due to different ecological conditions, harvest time, and different varietal materials.

3.2. Effects of Varieties, Cutting Interval and their Interactions on In Vitro Digestibility and Metabolizable Energy Content of Desho Grass

The varieties, cutting interval, and their interactions had a significant effect ($p < 0.05$) on IVOMD and ME, while only the main effect (varieties and cutting interval) had a significant effect ($p < 0.05$) on IVDMD of Desho grass (Table 4).

Table 4: In Vitro Digestibility and Metabolizable Energy Content of Desho Grass as Affected by Varieties, Cutting Interval, and Their Interactions

Factors	Parameters		
	IVDMD (%)	IVOMD (%)	ME (MJ/kg ⁻¹)
Varieties			
Areka /DZF #590	63.99 ^a	61.87 ^a	9.28 ^a
KK-1 /DZF #591	62.36 ^b	57.80 ^c	8.67 ^c
Kulumsa /DZF #592	61.83 ^b	59.72 ^b	8.95 ^b
<i>p</i> -value	0.0077	<.0001	<.0001
Cutting interval			
4 weeks	65.63 ^a	60.64 ^{ab}	9.09 ^{ab}
6 weeks	64.17 ^a	61.35 ^a	9.20 ^a
8 weeks	61.45 ^b	59.87 ^b	8.98 ^b
10 weeks	59.64 ^c	57.32 ^c	8.60 ^c
<i>p</i> -value	<.0001	<.0001	<.0001
Interaction effect			
Areka * 4 Weeks	66.72	60.65 ^{bcd}	9.10 ^{bcd}
Areka * 6 Weeks	66.65	65.01 ^a	9.75 ^a
Areka * 8 Weeks	61.87	62.70 ^{ab}	9.41 ^{ab}
Areka * 10 Weeks	60.72	59.13 ^{de}	8.87 ^{de}
KK-1 * 4 weeks	66.97	62.05 ^{bc}	9.31 ^{bc}
KK-1 * 6 weeks	62.76	58.79 ^{de}	8.82 ^{de}
KK-1 * 8 weeks	61.12	57.07 ^e	8.56 ^e
KK-1 * 10 weeks	58.58	53.29 ^f	7.99 ^f
Kulumsa * 4 weeks	63.22	59.23 ^{de}	8.89 ^{de}
Kulumsa * 6 weeks	63.10	60.24 ^{bcd}	9.04 ^{bcd}
Kulumsa * 8 weeks	61.37	59.85 ^{cd}	8.98 ^{cd}
Kulumsa * 10 weeks	59.63	59.56 ^{ede}	8.94 ^{ede}
Overall mean	62.72	59.79	8.97
<i>p</i> -value	0.0922	<.0001	<.0001
CV (%)	2.51	2.23	2.22
SE	0.88	0.86	0.13

Note: ^{a-f} Means with different letters in a column are significantly different ($p < 0.05$); IVDMD= in vitro dry matter digestibility; IVOMD= in vitro organic matter digestibility; ME= metabolizable energy; MJ = mega joule; kg = kilogram; CV = coefficient of variation; Kindu kosha-1 /DZF #591; Areka /DZF #590; Kulumsa /DZF #592; SE=standard error

The highest IVDMD was obtained from Areka /DZF #590 (63.99%) followed by Kindu kosha-1 /DZF #591 (62.36%), which was at par with Kulumsa /DZF #592 (61.83%) with an overall mean 62.72%. In line with the current result, Zailan *et al.* (2016) reported that cultivars had a significant effect on IVDMD of Napier hybrids harvested at 6 and 8 weeks of age.

Cutting interval had a significant effect ($p < 0.05$) on IVDMD. The highest IVDMD was recorded at 4 weeks cutting interval, which was at par with 6 weeks, whereas the lowest was obtained at 10 weeks cutting interval. The current result IVDMD ranged from 59.64% to 65.63% with an overall mean of 62.72%. The IVDMD decreased as the cutting interval increased. As plants mature, their fiber content tends to increase, while their digestibility decreases (Mahyuddin, 2008). Similarly, the IVDMD of Brachiaria cultivars tested at various cutting intervals decreased as the cutting intervals increased (between 61.1 to 46%) (Njarui *et al.*, 2016). The current IVDMD agreed with the results of Tessema *et al.* (2010), who noted that a decrease in the IVDMD of Napier grass at defoliation frequencies of 60 days (63.9%), 90 days (62.9%), and 120 days (56.9%). Furthermore, the current findings are consistent with a previous report that the IVDMD of Purple guinea grass decreased as the cutting interval increased (between 80.48 to 74.70%) (Sumamal and Lowilai, 2020).

The overall mean of IVDMD content (62.72%) recorded in the present result was comparable to the report of Terefe *et al.* (2022), who reported an IVDMD of Desho grass was 63.08%. However, it was higher than the report of Mekonnen *et al.* (2021), who noted that the IVDMD of Desho grass was 58% and lower than the results of Ajema (2022) who reported an IVDMD of Desho grass was 66.75%. This difference may be related to cutting age and agroecological variations. The present %IVDMD lies within the range reported by De Geus (1977) for the dry matter digestibility of cultivated tropical grasses ranging from 50% to 65%, while lower than the digestibility of temperate grasses which ranges between 65% and 80%. Rivera and Parish (2010) stated that digestibility higher than 65% indicates good nutritive value and values below this level limit intake. IVDMD values observed in this study for all varieties and cutting intervals were below this threshold which may implicate lower voluntary intake and digestibility except for Desho grass cut at 4 weeks intervals.

IVOMD a significantly ($p < 0.05$) affected by the interaction of varieties and cutting interval. The highest organic matter digestibility was recorded from Areka /DZF #590 (65.01%) at 6 weeks, whereas the lowest recorded from Kindu kosha-1 /DZF #591 (53.29%) at 10 weeks cutting interval with an overall mean of 59.79%. The overall mean of the current finding is lower than Ajema (2022), who reported that the IVOMD of the Desho grass was 62.58%. However, it was higher than the report of Abera *et al.* (2021), who noted that an IVOMD of Desho grass was 52.19%. This difference could be due to season, climate, soil fertility, cutting age, and manage mental conditions.

In this result, the IVOMD of Areka /DZF #590 and Kulumsa /DZF #592 was highest at 6 to 8 weeks cutting intervals, and then gradually decreased. This trend was observed in other studies by Weerathunga *et al.* (2023) who stated that the Napier cultivars had the highest IVOMD at 6 and 8 weeks, which then progressively declined. In the case of Kindu Kosha-1 /DZF #591, a higher IVOMD was observed at 4 weeks then gradually decreased as the cutting interval increased. This result is consistent with the result of Abera *et al.* (2021), who found that the IVOMD of Desho grass was higher at the early harvesting date compared to the intermediate and late harvesting dates. Meissner *et al.* (2000) found that high-quality forage may contain greater than 70% in vitro organic matter digestibility. However, González-Hernández and Silva-Pando (1999) stated that 50% IVOMD is sufficient for animal maintenance. Thus, the current IVOMD result was above the minimum recommended level, but below the threshold for high quality digestibility of organic matter.

ME a significantly ($p < 0.05$) affected by the interaction of varieties and cutting interval. The ME values in the present study followed a similar pattern of IVOMD content, hence ME is a derivative of IVOMD. The highest ME was recorded from Areka /DZF #590 (9.75 MJ/kg⁻¹) at 6 weeks intervals, while the lowest was recorded from Kindu kosha-1 /DZF #591 (7.99 MJ/kg⁻¹) at 10 weeks cutting interval with an overall mean of 8.97 MJ/kg⁻¹. The overall mean of the present result was lower than the finding of Ajema (2022), which stated that the metabolizable energy of Desho grass was 10.01 MJ/kg⁻¹. However, it is higher than the result of Asmare *et al.* (2017), which indicated that the ME (MJ/kg) of Desho grass was 6.18 MJ/kg. This variation could be attributed to harvesting age, weather conditions, season, soil type, and fertility. The metabolizable energy for all varieties, cutting interval, and their interactions were higher than the critical threshold of 7.5 MJ/kg for roughage and forage as determined by Owen and Jayasuriya (1989). However, Lonsdale (1989) found that feeds containing more than 12.0 MJ/kg of DM of metabolizable energy and feeds containing less than 9.0 MJ/kg of DM of ME are categorized as high and low energy feeds, respectively. On this basis, the present result for the ME of Areka/DZF #590 cut at 4 weeks, 6 weeks, and 8 weeks, Kulumsa /DZF #592 cut at 6 weeks, and Kindu kosha-1 /DZF #591 cut at 4 weeks can be categorized as a medium energy feed in the study area. However, the current ME results does not meet the NRC (2001) recommendation of a minimum metabolizable energy (10 MJ/kg) requirement for dairy cattle.

4. Conclusion

This study optimized Desho grass production by identifying suitable varieties and the ideal cutting intervals for maximum quality. While all varieties performed well at the experimental site, they varied in chemical composition and in vitro digestibility. The interaction between variety and cutting interval significantly affected ash, crude protein (CP), neutral detergent fiber (NDF), acid detergent lignin (ADL), and hemicellulose, whereas acid detergent fiber (ADF) and cellulose were influenced only by the main factors. Crude protein and ash contents declined with longer cutting intervals, while fiber content increased. Both variety and cutting intervals significantly influenced in vitro organic matter digestibility (IVOMD) and metabolizable energy (ME), with in vitro dry matter digestibility (IVDMD) being affected only by main factors. A 6-week cutting interval was optimal for nutritional composition and in vitro digestibility. This information can assist livestock producers and smallholder farmers in selecting the best cutting intervals for Desho grass varieties with higher nutrient content. The varieties Areka/DZF #590 and Kulumsa/DZF #592, when cut every 6 weeks, produced superior forage quality and digestibility compared to other treatments under supplementary irrigation. Overall, this study offers valuable insights for enhancing Desho grass production for animal feed, and further research on animal responses to different harvest stages of Desho grass is recommended.

Funding

No special funding was provided for this project.

Ethics Approval and Consent to Participate

Not applicable.

Data Availability Statement

All the data needed to support this study are available upon request

CRedit Authorship Contribution Statement

Fikre Dereba: Writing – review & editing, Writing – original draft, Supervision, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Zemene Worku:** Writing – review & editing, Supervision, Investigation, Data curation, Conceptualization. **Diriba Geleti:** Writing – review & editing, Supervision, Data curation, Conceptualization.

Competing Interest

The authors declare no competing financial interests or personal relationships that could have influenced the work reported in this paper.

Acknowledgment

The authors would like to acknowledge the Oromia Agricultural Research Institute (OARI) for the financial support provided to conduct this experiment.

References

- Abera, M., Tolera, A., Nurfeta, A. and Geleti, D. (2021). [Production, Utilization and Constraints of Desho Grass. *Pennisetum glaucifolium*](#).
- Ajema Desalegn, H. (2022). [Biomass Yield and Nutritive Value of Desho \(*Pennisetum Glaucifolium*\) Grass as Affected by Forage Stand Height under Central Highland Condition of Ethiopia \(Doctoral dissertation, Addis Ababa University\)](#).
- AkinyiNguku, S. (2015). [An Evaluation of Brachiaria Grass Cultivars Productivity in Semi Arid of Kenya \(Doctoral dissertation, M. Sc thesis, South Eastern Kenya University, Kitui, Kenya\)](#).
- Aminah, A. and Chen, C.P. (1998). [Future prospects for fodder and pasture production. *Feeding Dairy Cows in the Tropics, Rome: Food and Agriculture Organization, Delhi: Daya Publish-ing*, 127-41.](#)
- AOAC (Association of Analytical Chemists). (1990). [Official Methods of Analysis 15th Ed. AOAC Inc. Arlington, Virginia, USA. 1298 p.](#)
- Asmare, B., Demeke, S., Tolemariam, T., Tegegne, F., Haile, A. and Wamatu, J. (2017). [Effects of Altitude and Harvesting Dates on Morphological Characteristics, Yield and Nutritive Value of Desho Grass \(*Pennisetum pedicellatum* Trin.\) in Ethiopia. *Agriculture and Natural Resources*, 51\(3\), 148-153.](#)

- Asmare, B., Mekuriaw, Y. and Tekliye, L. (2018). Evaluation of Desho Grass (*Pennisetum pedicellatum* Trin.) Morphology, Yield and Chemical Composition Under Irrigation in Northwestern Ethiopia. *Journal of Agriculture and Environment for International Development*.
- Bedeke, W., Hidosa, D. and Berhanu, T. (2017). Effect of Planting Space and Fertilizer Rate on Productivity of Desho Grass (*Pennisetum Pedicellatum*) in Jinka Agricultural Research Center, Southern Ethiopia. *Int. J. Res. Agri. Forest.*, 4(11),14-19.
- Bezabih, M., Adie, A. and Mekonnen, K. (2021). *Africa Rising Ethiopian Highlands Feed and Forage Development Training Manual*.
- Danano, D. (2007). Improved Grazing Land Management- Ethiopia. in Liniger H and Critchley W (Eds.), *Where the land is greener* (pp. 313-316). Bern, Switzerland: WOCAT.
- De Geus, J.G. (1977). *Production Potentialities of Pastures in the Tropics and Subtropics. Production Potentialities of Pastures in the Tropics and Subtropics*.
- Diribi Mijena. (2022). Improved Forage Production in Ethiopia: Efforts Done, Success Achieved, Challenges, and Future Opportunities: Review. *International Journal of Food Science and Agriculture*, 6(3), 260-266. DOI: 10.26855/ijfsa.2022.09.004.
- El Mouttaqi, A., Mnaouer, I., Nilahyane, A., Ashilenje, D.S., Amombo, E., Belcaid, M., Ibourki, M., Lazaar, K., Soulaïmani, A., Devkota, K.P. and Kouïsi, L. (2023). Influence of Cutting Time Interval and Season on Productivity, Nutrient Partitioning, and Forage Quality of Blue Panicgrass (*Panicum antidotale* Retz.) Under Saline Irrigation in Southern region of Morocco. *Frontiers in Plant Science*, 14, p. 1186036.
- FAO. (2018). *Report on Feed Inventory and Feed Balance in Ethiopia*.
- Fikre, H. (2018). Efforts Being Made and Success Achieved in Producing Improved Seed of Forage Crops in Ethiopia: Review Article. *Acad. Res. J. Agri. Sci. Res.*, 6(3), 125-133.
- Gebreselassie, L. (2019). Review on Determinants For Adoption of Improved Forages in Ethiopia. *Journal of Scientific and Innovative Research*, 8(4), 112-115.
- Geren, H., KAVUT, Y. and Hayrullah, U.N.L.U. (2020). Effect of Different Cutting Intervals on the Forage Yield and Some Silage Quality Characteristics of Giant King Grass (*Pennisetum hybridum*) Under Mediterranean Climatic Conditions. *Turkish Journal of Field Crops*, 25(1), 1-8.
- González-Hernández, M.P. and Silva-Pando, F.J. (1999). Nutritional Attributes of Understory Plants Known As Components of Deer Diets. *Rangeland Ecology & Management/Journal of Range Management Archives*, 52(2), 132-138.
- Hameed, M., Naz, N., Ahmad, M.S.A. and Islam-ud-Din, R.A. (2008). Morphological Adaptations of Some Grasses From the Salt Range, Pakistan. *Pak. J. Bot*, 40(4), 1571-1578.
- Hare, M.D., Phengphet, S., Songsiri, T., Sutin, N. and Stern, E. (2013a). Effect of Cutting Interval on Yield and Quality of Three *Brachiaria* Hybrids in Thailand. *Tropical Grasslands – Forrajes Tropicales*. 1, 84"86.
- Hare, M.D., Phengphet, S., Songsiri, T., Sutin, N. and Stern, E. (2013b). Effect of Cutting Interval on Yield and Quality of Two *Panicum Maximum* Cultivars in Thailand. *Tropical Grasslands – Forrajes Tropicales*. 1, 87"89.
- Jayasinghe, P., Ramilan, T., Donaghy, D.J., Pembleton, K.G. and Barber, D.G. (2022). Comparison of Nutritive Values of Tropical Pasture Species Grown in Different Environments, and Implications for Livestock Methane Production: A Meta-Analysis. *Animals*, 12(14), 1806.
- Jothirathna, H.H., Seresinhe, T., Manawadu, A., Weerasinghe, P. and Mahipala, K. (2022). Forage Growth, Yield, and Quality Responses of Two Hybrids of Napier and Sorghum At Three Cutting Intervals in the Southern Province of Sri Lanka. *Die Bodenkultur: Journal of Land Management, Food and Environment*, 73(1), 1-11.
- Kandiah, A. (1981). *Guide For Measurement Op Irrigation Hater Usbtg Parshall Flukes and Siphons*.
- Kellems, R.O. and D.C. Church. (1998). *Livestock Feeds & Feeding*. (4th edition.). PrenticeHall, Inc., New Jersey, USA, 573.
- Kifuko-Koech, M.N. and Ndung'u-Magiroyi, M.M.K. (2016). Establishment and Early Growth of *Brachiaria* Grass Cultivars in Acidic Soils of Western Kenya. *Climate Smart Brachiaria Grasses for Improving Livestock Production in East Africa Kenya Experience*, 80.
- Lamb, J.F., Sheaffer, C.C., Rhodes, L.H., Sulc, R.M., Undersander, D.J. and Brummer, E.C. (2006). Five Decades of Alfalfa Cultivar Improvement: Impact on Forage Yield, Persistence, and Nutritive Value. *Crop Science*, 46(2), 902-909.

- Lean, I.J., Golder, H.M. and Hall, M.B. (2014). Feeding, Evaluating, and Controlling Rumen Function. *Veterinary Clinics: Food Animal Practice*, 30(3), 539-575.
- Lemus, R. (2020). Forage Nutritive Value on Livestock Production: Why cP and TDN Matter. *Forage News*, 13(10), 1Y3.
- Lonsdale, C. (1989). *Straights: Raw Materials for Animal Feed Compounders and Farmers*. Scholium International.
- Lounglawan, P., Lounglawan, W. and Suksombat, W. (2014). Effect of Cutting Interval and Cutting Height on Yield and Chemical Composition of King Napier grass (*Pennisetum purpureum* x *Pennisetum americanum*). *APCBEE procedia*, 8, 27-31.
- Magomya, A.M., Kubmarawa, D., Ndahi, J.A. and Yebpella, G.G. (2014). Determination of Plant Proteins Via the Kjeldahl Method and Amino Acid Analysis: A Comparative Study. *Int. J. Sci. Technol. Res*, 3(4), 68-72.
- Mahyuddin, P. (2008). Relationship Between Chemical Component and in Vitro Digestibility of Tropical Grasses. *Hayati Journal of Biosciences*, 15(2), pp.85-89.
- Meissner, H.H., Zacharias, P.J.K. and O'Reagain, P.J. (2000). Forage Quality (Feed Value). In: Tainton N.M. (Ed.) *Pasture Management in South Africa*. University of Natal Press, Pietermaritzburg. 66–88.
- Meissner, H.H., Koster, H.H., Nieuwoudt, S.H. and Coetze, R.J. (1991). Effects of Energy Supplementation on Intake and Digestion of Early and Mid-Season Ryegrass and 66 Panicum/Smuts Finger Hay, and on in Sacco Disappearance of Various Forage Species. *South African Journal of Animal Science*, 21, 33–42.
- Mekonnen, K., Gebreyes, M., Abdulkadir, B., Seifu, H. and Thorne, P.J. (2021). Training Module on Livestock Feed and Forage Innovations.
- Mengistu, A., Kebede, G., Feyissa, F. and Assefa, G. (2017). Review on Major Feed Resources in Ethiopia: Conditions, Challenges and Opportunities. *Academic Research Journal of Agricultural Science and Research*, 5(3), 176-185.
- Mengistu, D.T. (2015). Evaluation of Wetting Front Detector to Determine Water Demand, Water and Crop Productivity of Selected Fodder Varieties Under Supplemental Irrigation (Case Studies in Lemo and Angeacha Areas of Snp Region).
- Njarui, D.M.G., Gatheru, M., Ghimire, S.R. and Mureithi, J.G. (2016). November. Effects of Seasons and Cutting Intervals on Productivity and Nutritive Value of Brachiaria Grass Cultivars in Semi-Arid Eastern Kenya. in *Climate Smart Brachiaria Grasses For Improving Livestock Production in East Africa: Kenya Experience*. Proceedings of a workshop (pp. 46-61).
- NRC, I. (2001). *Nutrient Requirements of Dairy Cattle*. National Research Council, 519.
- Nyambati, E.M., Ayako, W., Chelimo, E.J. and Njarui, D.M.G. (2016). Production and Nutritive Quality of Brachiaria Grass Cultivars Subjected to Different Cutting Intervals in the Cool Sub-Humid Highlands of Central Kenya. *Climate Smart Brachiaria Grasses for Improving Livestock Production in East Africa Kenya Experience*, p.62.
- Olsen, S.R. (1954). Estimation of Available Phosphorus in Soils By Extraction With Sodium Bicarbonate (No. 939). US Department of Agriculture.
- Ondiko, C.N., Njarui, M.N.D., Auma, E. and Ngode, L. (2016). Effects of Cutting Frequency on Forage Production and Nutritive Value of Brachiaria Grass Cultivars in Coastal Lowlands of Kenya. *Climate Smart Brachiaria Grasses for Improving Livestock Production in East Africa Kenya Experience*, 70.
- Onjai-Uea, N., Paengkoum, S., Taethaisong, N., Thongpea, S., Sinpru, B., Surakhunthod, J., Meethip, W., Purba, R.A.P. and Paengkoum, P. (2022). Effect of Cultivar, Plant Spacing and Harvesting Age on Yield, Characteristics, Chemical Composition, and Anthocyanin Composition of Purple Napier Grass. *Animals*, 13(1), 10.
- Orodho, A. (2006). The Role and Importance of Napier Grass in the Smallholder Dairy Industry in Kenya. *Food and Agriculture Organization, Rome Retrieved August, 24, 2011*.
- Owen, E. and Jayasuriya, M.C.N. (1989). Use of Crop Residues As Animal Feeds in Developing Countries. *Research and Development in Agriculture*, 6(3), 129-138.
- Pereira, G.F., Emerenciano Neto, J.V., Difante, G.D.S., Assis, L.C.D.S.L.C., Lima, P.D.O. and Santos, R.D.S. (2021). Production and Quality of Tropical Grasses At Different Regrowth Intervals in the Brazilian Semiarid. *Acta Scientiarum. Animal Sciences*, 43.
- Reed, J.D., Kebede, Y. and Fussell, L.K. (1988). Factors Affecting the Nutritive Value of Sorghum and Millet Crop Residues. in *Plant Breeding and the Nutritive Value of Crop Residues: Proceedings of a Workshop Held at ILCA, Addis Ababa, Ethiopia, 7-10 December 1987* (p. 233). ILRI (aka ILCA and ILRAD).

- Rivera, J.D. and Parish, J.A. (2010). *Interpreting Forage and Feed Analysis Reports*.
- Seyoum, B. and Zinash, S. (1989). *The Composition of Ethiopian Feedstuffs*. Institute of Agricultural Research, Addis Ababa, Ethiopia, p.33.
- Singh, G.P. and Oosting, S.J. (1992). *A Model For Describing the Energy Value of Straws*. *Indian Dairyman*, XLI, 322-327.
- Sumamal, W. and Lowilai, P. (2020). *Influence of Cutting Interval on Yield and Quality of Purple Guinea Grass (Panicum maximum TD58) Under Irrigation*.
- Tessema, Z.K., Mihret, J. and Solomon, M. (2010). *Effect of Defoliation Frequency and Cutting Height on Growth, Dry Matter Yield and Nutritive Value of Napier Grass (Pennisetum Purpureum (L.) Schumach)*. *Grass and forage science*, 65(4), 421-430.
- Tilahun, G., Asmare, B. and Mekuriaw, Y. (2017). *Effects of Harvesting Age and Spacing on Plant Characteristics, Chemical Composition and Yield of Desho Grass (Pennisetum pedicellatum Trin.) in the Highlands of Ethiopia*. *Tropical Grasslands-Forrajes Tropicales*, 5(2), 77-84.
- Tilley, J.M.A. and Terry, R.A. (1963). *A Two Stage Technique For in Vitro Digestion of Forage Crops*. *Journal of British Grassland Society*, 18: 104-111.
- Timpong-Jones, E.C., Adjorlolo, L.K. and Ayizanga, R.A. (2015). *The Impact of Harvest Frequency on Herbage Yield and Quality of Cynodon Nlemfuensis*. *West African Journal of Applied Ecology*, 23(2), 7-15.
- Tiruneh, A.T., Amsalu, D.G. and Adane, K.K. (2022). *Effect of Variety and Cutting Interval on Yield and Proximate Composition of Alfalfa (Medicago sativa L.) Under Irrigation in Central Gondar zone, Ethiopia*.
- Tobiyaw, T. (2021). *Effects of Cutting Interval on Morphological Parameters, Biomass Yield and Chemical Composition of Para (Brachairia Muticastapf), Napier (Pennisetum Purpureum) and Desho (Pennisetum Pedicellatum) Grasses Grown Under Irrigation Condition in Mecha Woreda, West Gojjam Zone, Ethiopia*.
- Tolera, A. and Said, A.N. (1994). *Assessment of Feed Resources in Welayta Sodo*. *Ethiopian Journal of Agricultural Sciences*.
- Ullah, M.A., Anwar, M. and Rana, A.S. (2010). *Effect of Nitrogen Fertilization and Harvesting Intervals on the Yield and Forage Quality of Elephant Grass (Pennisetum purpureum) Under Mesic Climate of Pothowar Plateau*. *Pakistan Journal of Agricultural Sciences*, 47(3), 231-234.
- Van Reeuwijk L.P. (2002). *Procedures for Soil Analysis. Technical Paper/International Soil Reference and Information Centre*. Vol. 9, sixth Edition, Netherlands
- Van Soest P.J., Roberston, J.B. and Lewis, B.A. (1991). *Methods For Dietary Fiber, Neutral Detergent Fiber, and Non Starch Polysaccharides in Relation to Animal Nutrition*. *Journal of Dairy Science*, 74, 3583-3597.
- Van Soest, P.J. (1994). *Nutritional Ecology of Ruminants*. 2nd Edition. Cornell university press, London USA pp: 476.
- Van Soest, P.J. (1982). *Analytical Systems For Evaluation of Feeds*. *Nutritional Ecology of the Ruminant*, 75-94.
- Walkley, A. and Black, I.A. (1934). *An Examination of the Degtjareff Method For Determining Soil Organic Matter, and A Proposed Modification of the Chromic Acid Titration Method*. *Soil Science*, 37, 29-38.
- Wamatu, J. (2021). *Farmers' Participatory Evaluation and Performance Testing of Selected Forage Varieties in Selected Districts of Eastern Amhara Region, Ethiopia*
- Wangchuk, K., Rai, K., Nirola, H., Dendup, C. and Mongar, D. (2015). *Forage Growth, Yield and Quality Responses of Napier Hybrid Grass Cultivars to Three Cutting Intervals in the Himalayan Foothills*. *Tropical Grasslands-Forrajes Tropicales*, 3(3), 142-150.
- Weerathunga, D., Udagama, D., Campbell, S., Barber, D. and Weerasinghe, P. (2023). *Performance of Napier Hybrids Cultivars CO5 (Pennisetum glaucum× P. Purpureum schumach) and Sampoorana (Pennisetum pedicillatum× P. americanum) Harvested at Five Intervals*.
- Zailan, M.Z., Yaakub, H. and Jusoh, S. (2016). *Yield and Nutritive Value of Four Napier (Pennisetum Purpureum) Cultivars At Different Harvesting Ages*. *Agriculture and Biology Journal of North America*, 7(5), 213-219.
- Zereu, G. and Lijalem, T. (2016). *Status of Improved Forage Production, Utilization and Constraints For Adoption in Wolaita Zone, Southern Ethiopia*. *Livestock Research for Rural Development*, 28(78).

Cite this article as: Fikre Dereba, Zemene Worku and Diriba Geleti (2025). *Influence of Variety and Cutting Interval on Nutritive Values of Desho Grass Under Supplementary Irrigation in Western Oromia, Ethiopia*. *International Journal of Agricultural Sciences and Technology*, 5(1), 23-37. doi: 10.51483/IJAGST.5.1.2025.23-37.