International Journal of Scientific Engineering and Science
Volume 4, Issue 8, pp. 1-3, 2020. ISSN (Online): 2456-7361

Determination of Appropriate Cutting Date of Perennial Elite Lowland Adaptive Forage Grass Species: Chifir Bequa *(Pennisetum Polystachion)*

Mezgebu Getnet[1], Habtie Arega[2], Esubalew Shitaneh[2], Bainesagn Worku[1]
[1]Ethiopian Institute of Agricultural Research, Debremarkos Agricultural Research Center, P.O. Box 357, Debremarkos, Ethiopia
[2]Ethiopian Institute of Agricultural Research, Pawe Agricultural Research Center, P.O. Box 25, Pawe, Ethiopia
Corresponding author: Mezgebu Getnet E -mail: meget1212 @ gmail.com
Phone: +251913718138

Abstract— *The experiment was conducted to determine the appropriate harvesting date for Chifir Bequa (Pennisetum Polystachion). It was conducted for three years using randomized complete block design with three replications. The treatments used were cutting before heading (T1), cutting at 10% heading (T2), cutting at 25% heading (T3), cutting at 50% heading (T4), cutting at 75% heading (T5) and cutting at 100% heading (T6). Plant height was significantly different (P<0.01) among different stages of forage harvesting. As the grass maturity increases plant height become increased. Leaf constituent of grass harvested before heading shows higher yield than rest of cutting stages. Fresh forage biomass yield was higher at the stage 10% heading (61.75 t/ha) followed by full heading (61.42 t/ha). Dry forage yield was higher in grass harvested at full heading (11.49 t/ha) followed by 9.73 t/ha, 9.59 t/ha, 9.04 t/ha, at 50%, 10% and 75% heading, respectively. Numerically the higher crude protein yield (815 kg/ha) was obtained from forage harvested at 10% heading. Similarly, the numerical value of CP content was found higher in forage grass harvested at 10% heading. The fiber (NDF, ADF and ADL) content of Chifir Bequa (Pennisetum Polystachion) was increasing as the forage maturity increases. The final recommendation revealed from this experiment was the appropriate cutting date for Chifir Bequa (Pennisetum Polystachion) would be at 10% heading stage to avail reasonable dry matter yield and forage quality.*

Keywords— *Chifir Bequa, Pawe, quality and yield.*

I. INTRODUCTION

Timely cutting and removal of forages from the field as hay, green-chop, or silage is vital to optimize yield and quality of the product. The major available feed resources in Ethiopia are natural pasture, crop residues, aftermath grazing, and agro-industrial by-products (Alemayehu, 2006; Adugna, 2007; Firew and Getnet, 2010; Yaynshet, 2010). As CSA (2018) revealed that 54.59%, 31.61%, 6.81% and 1.53% of the total livestock feed supply of the country is derived from grazing on natural pasture, crop residues, hay and agro industrial byproducts respectively. The role of poor-quality crop residues increasing due to expansion of cropping lands and degradation of grazing lands in livestock feeding (Zewdie and Yosef, 2014), which in turn is explanatory for exploring alternative feed resources and improve quality of available feed resources.

Chifir Bequa (*Pennisetum Polystachion)* is the fast-growing tropical grass forage variety, which was release by Ethiopian institute of agricultural research Pawe research center by selecting from locally available potential collections. It yields 7-12 tone of dry matter and 500-1000kg seed yield per hectare. It contains 94.0, 7.7, 6.6, 92.3, 50.5, 80.1 and 59.2 DM %, ASH %, CP %, OM %, IVOMD%, NDF% and ADF%, respectively.

At early stage of growth plants put most of their energy into vegetative growth and contain high concentrations of starches, proteins and minerals, the biomass yield is lower. On the other hand, as plants mature, their fiber component increases and traps the nutrients within indigestible cell walls. Thus, compromising biomass yield and nutritive value is an important issue when we decide the appropriate cutting age of the grass for quality hay. It is known that the quality of given forage as animal feeds is a function of its nutrient concentration, palatability and digestibility by animals (Julier et al., 2001). The high temperature in tropical countries changes the nutritive values of the grass component rapidly during the late growth stages of the grassland (McDonald et al., 2002) and harvesting management is predominantly responsible for these changes (Cop et al., 2009). As quality and quantity of hay is highly dependent on growth stage of the grass, considerable attention should be given to cutting time. Therefore, the objective of this study was to determine the appropriate cutting date of Chifir Bequa (*Pennisetum Polystachion)* for optimum and quality yield.

II. MATERIALS AND METHODS

Description of the Study Area

The experiment was conducted in Pawe Agricultural Research Center Metekel Zone of Benishangul Gumuz Regional State. Is located 543 k.m north west of Addis Ababa. The topography of the zone presents undulating hills slightly down to low land plateaus having varying altitudes from 600-2800 m.a.s.l and the annual rain fall of 900-1450mm. About 80% of the area characterized by sub humid and humid tropical climate with annual minimum and maximum temperature of 20^0c and 35^0c respectively (Metekel Zone Department of Agriculture and Pawe Agricultural Research Center).

International Journal of Scientific Engineering and Science
Volume 4, Issue 8, pp. 1-3, 2020. ISSN (Online): 2456-7361

Treatments and Data Management

The experimental design used was Randomized complete block with four replications. The grass was sown on 3 x 4m well prepared experimental plot in late June. The blanket recommendation 100kg per hectare phosphorus fertilizer was applied during planting. Weeding and other management activities were exercised accordingly. The treatments applied were cutting before heading (T1), cutting at 10% heading (T2), cutting at 25% heading (T3), cutting at 50% heading (T4), cutting at 75% heading (T5) and cutting at 100% heading (T6).

Cutting of four plots per treatment was made in each harvesting time and data were taken for plant height, biomass yield and leaf to stem ratio.

Plant height: Plant height was taken from ten plants randomly per each plot at harvesting time and the average height was recorded as plant height.

Biomass yield: The forage biomass yield was taken measuring the whole sward harvested per plot and calculated to convert in to yield per hectare.

Leaf to stem ratio: After measuring the total fresh biomass yield immediately after cutting representative sample was taken, weighed and separated carefully into leaf and stem the calculated to determine the ratio of leaf to stem.

Crude protein yield: crude protein yield per hectare was calculated by multiplying the total dry matter yield per hectare by the CP percentage of sward from plot with the same unit.

Day to day close follow up was made to accurately estimate the stage of grass growth or percentage of heading. This was made by more than three experienced individuals at a time the make the estimation close to real.

Chemical Analysis

The representative samples were taken from each plot, measured and oven dried in 65°C for 72 hours. After partial dry matter was determined the samples were ground to pass 1mm sieve size and properly packed, labeled and sent to Holleta Agricultural Research Centre Nutrition Laboratory to determine DM, ASH, CP, NDF, ADF, ADL and IVDMD.

Dry matter and ash were determined using (AOAC, 1990) procedure. Crude Protein (CP) was determined using Kjeldahl method. Goering and Van Soest (1970) procedures were used to determine Neutral Detergent Fiber (NDF) and Acid Detergent Fiber (ADF). The in vitro Dry Matter Digestibility (IVDMD) was determined according to the two stages method out lined by Tilley and Terry (1963). All chemical analyses were carried out at Holleta Agricultural Research Center, Nutrition laboratory.

Statistical Analysis

Data were collected, arranged in Microsoft excel and analyzed using ANOVA procedure of SAS version 9.4. Means were separated using Tukey's (HSD) honestly significance difference.

III. Result and Discussion

Effect of Cutting Date on Forage Yield and Growth Performance of Chifir Bequa (Pennisetum Polystachion)

Forage yield and growth performance of Chifir Bequa (*Pennisetum Polystachion)* in different stages of cutting is presented in Table 1. Plant height was significantly different ($P<0.01$) among different stages of forage harvesting. As the grass maturity increases plant height become increased. Leaf is important component for forage quality and palatability. The cut before heading was leafier than rest of cutting stages. Fresh forage biomass yield per hectare was higher at the stage of 10% heading (61.75 t/ha) followed by full heading (61.42 t/ha). Dry forage yield was higher in grass harvested at full heading (11.49 t/ha) followed by 9.73 t/ha, 9.59 t/ha, 9.04 t/ha, at 50%, 10% and 75% heading, respectively. Protein yield is the most important parameter to determine the quality forages. Numerically the higher crude protein yield (815 kg/ha) was obtained from forage harvested at 10% heading. At early stage of growth plants put most of their energy into vegetative growth and contain high concentrations of starches, proteins and minerals, the biomass yield is lower. On the other hand, as plants mature, their fiber component increases and traps the nutrients within indigestible cell walls. Thus compromising biomass yield and nutritive value is an important issue when we decide the appropriate cutting age of the grass for quality forage. Therefore, optimum stage of cutting for Chifir Bequa based on this study is at 10% heading.

Table 1. Effect of cutting date on forage yield and growth performance of Chifir Bequa (*Pennisetum Polystachion)*

Stage of cutting	Parameters						
	PH	**LSR**	**Leaf%**	**Stem%**	**FTPH**	**DTPH**	**kgcp**
BH	137.72^{b}	1.46^{a}	54.24	44.00^{b}	56.42	6.64^{b}	547.86
H10	178.39^{a}	1.29^{ab}	54.11	44.24^{b}	61.75	9.59^{ab}	815.31
H25	198.25^{a}	1.04^{ab}	48.87	49.19^{a}	55.75	8.07^{ab}	541.70
H50	202.53^{a}	0.96^{b}	47.33	50.92^{a}	59.92	9.73^{ab}	630.50
H75	203.21^{a}	1.02^{ab}	48.84	49.61^{a}	54.75	9.04^{ab}	555.55
H100	204.93^{a}	0.99^{ab}	47.44	49.88^{a}	61.42	11.49^{a}	676.34
CV%	11.87	34.63	11.49	12.35	21.17	49.53	68.30
SL	***	**	NS	**	NS	*	NS

*** = Significant at alpha 0.001; ** = Significant at alpha 0.01; * = Significant at alpha 0.05; $\overline{NS}$ = None Significant; PH = Plant height; LSR = Leaf to Stem ratio; FTPH = Fresh biomass yield ton per hectare; DTPH = dry biomass yield ton per hectare; kgCP = Crude protein yield kilograms per hectare; BH = Before heading; H10 = At 10% heading; H25 = At 25% heading; H50 = At 50% heading; H75 = At 75% heading; H100 = At 100% heading; CV = Coefficient of Variation; SL = Significance level.

Effect of Cutting Date on Chemical Composition of Chifir Bequa (Pennisetum Polystachion)

The nutritional composition of Chifir Bequa (*Pennisetum Polystachion)* is presented in Table 2. Dry matter and organic matter content of the grass forage was higher in grass harvested at full heading. This is understandable that as grass maturity increases the dry matter content increases in most of grass forages. Crude protein content of grass harvested at different stage differ among treatments. Numerically the higher CP content was found in forage grass harvested at 10% heading. The CP content of grass decreases as the grass become mature. As would be expected, the highest CP concentration was obtained at the earliest stage of harvesting, with values declining as harvesting was delayed. This result is in agreement to the findings by (Njarui et al. 2016) and (Mutimura et al. 2017) in Brachiaria grasses. Similarly, (Bayble et al. 2016) and (Ansah et al. 2010) reported a decreasing trend of CP with increase in harvesting age for Napier grass. This is a growth dilution effect with increase in structural carbohydrate content of forage materials harvested at late maturity reducing the percentage of protein in the forage.

The fiber (NDF, ADF and ADL) content of Chifir Bequa (*Pennisetum Polystachion)* was increasing as the forage maturity increases. As would be expected, NDF, ADF and ADL concentrations increased as harvesting date was delayed though there was no significant difference for NDF and ADF in the current study.

Table 2. Effect of cutting date on chemical composition of Chifir Bequa (*Pennisetum Polystachion)*

Stage of cutting	Parameters							
	DM	**Ash**	**OM**	**CP**	**NDF**	**ADF**	**ADL**	**IVDMD**
BH	90.68	11.18	88.82	7.74	74.69	45.41	6.77[b]	43.82
H10	90.72	10.86	89.15	7.79	74.87	45.77	6.92[b]	44.13
H25	90.56	11.24	88.76	6.90	75.92	48.32	7.61[a]	39.21
H50	90.62	10.98	89.02	6.83	76.37	49.27	7.81[a]	38.24
H75	90.77	10.93	89.07	6.48	76.66	49.56	8.03[a]	38.34
H100	90.95	10.29	89.71	6.56	76.43	49.83	8.13[a]	38.94
CV%	0.36	9.54	1.17	36.58	3.03	9.74	10.96	21.02
SL	NS	NS	NS	NS	NS	NS	***	NS

*** = Significant at alpha 0.001; ** = Significant at alpha 0.01; * = Significant at alpha 0.05; NS = None Significant; DM = Dry matter; OM = Organic matter; CP = Crude protein; NDF = Neutral detergent fiber; ADF = Acid detergent fiber; ADL = Acid detergent lignin; IVDMD = Invitro dry matter digestibility; BH = Before heading; H10 = At 10% heading; H25 = At 25% heading; H50 = At 50% heading; H75 = At 75% heading; H100 = At 100% heading; CV = Coefficient of Variation; SL = Significance level.

IV. Conclusion and Recommendations

Timely cutting and removal of forages from the field as hay, green-chop, or silage is vital to optimize yield and quality of the product. Chifir Bequa (*Pennisetum Polystachion)* is one of fast growing potential tropical grass that yields 7-12 tone of dry matter per hectare. In the current study it yields 6.64 to 11.49 tone dry matter per hectare in different stages of cutting. According to the current study good quality forage yield was obtained from the grass harvested at 10% heading. The CP content and invitro dry matter digestibility was higher at 10% heading stage.

Finally it is recommended to harvest Chifir Bequa (*Pennisetum Polystachion)* at 10% heading stage for good quality forage yield by compromising dry matter yield and CP content.

For future works it is good to confirm this harvesting stage by observing animal response.

Reference

[1] Adugna Tolera, 2007. Feed resources for producing export quality meat and livestock in Ethiopia. Ethiopia Sanitary and Phytosanitary Standards and Livestock and Meat Marketing project (SPS-LMM). 77p

[2] Alemayehu Mengistu, 2006. Country Pasture/Forage Resource Profiles: Ethiopia. Available at http:// www.fao.org/AGp/agpc/doc/counprof Ethiopia.htm. Accessed on 05/01/2015.

[3] Ansah T, Osafo ELK, Hansen HH. 2010. Herbage yield and chemical composition of four varieties of Napier (Pennisetum purpureum) grass harvested at three different days after planting. Agric Biol J N Am. 1(5):923–9. https://doi.org/10.5251/abjna.2010.1.5.923.929.

[4] Bayble T, Melaku S, Prasad NK. 2016. Effects of cutting dates on nutritive value of Napier (Pennisetum purpureum) grass planted sole and in association with Desmodium (Desmodium intortum) or Lablab (Lablab purpureus). Livestock Research for Rural Development 2007-19, article #11. www.lrrd.org/lrrd1 9/1/bayb1 9011.htm.

[5] CSA (Central Statistical Authority), 2015.Agricultural sample survey agricultural sample survey livestock and livestock characteristics (private peasant holdings), Ethiopia

[6] Firew Tegegne and Getnet Assefa, 2010. Feed resource assessments in Amhara National Regional State. Ethiopian Sanitary and phyto-sanitary standards and livestock and meat marketing program (SPS-LMM) Texas A and M University system Addis Ababa, Ethiopia.P2-105.

[7] Julier, B., Guines F., Ecalle, C. and Huyghe, C., 2001. From description to explanation of variations in alfalfa digestibility. Options, Quality in lucerne and medics for animal production. In: Proceedings of the XIV EU Carpia Medicago sp. Group Meetings, Zaragoza, Spain. 45, 19–23.

[8] Mutimura M, Ebong C, Rao IM, Nsahlai IV 2017. Effect of cutting time on agronomic and nutritional characteristics of nine commercial cultivars of Brachiaria grass compared with Napier grass during establishment under semi-arid conditions in Rwanda. Afr J Agric Res.12 (35):2692–703.

[9] Njarui DMG, Gichangi E, Gatheru M, Nyambati EM, Ondiko CN, Njunie MN, Ndungu KW, Kiiya WW, Kute CAO, Ayako W. 2016. A comparative analysis of livestock farming in smallholder mixed crop-livestock systems in Kenya: 1. Livestock inventory and management. Livestock Research for Rural Development, 28, Article #066.

[10] Yaynshet Tesfay, 2010. Feed Resources Available in Tigray Region, North Ethiopia, For Production of Export Quality Meat and Livestock Addis Ababa Ethiopia, pp: 9-16.

[11] Zewdie Wondatir and Yosef Mekasha, 2014. Feed resources availability and livestock production in the central rift valley of Ethiopia. International Journal of Livestock Production. 5(2), pp. 30-35.