Effect of Plant Spacing and Harvesting Age on Plant Characteristics, Yield and Chemical composition of Para grass (*Brachiaria mutica)* at Bahir Dar, Ethiopia

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Abstract
Natural pasture in Ethiopia is typically low in forage botanical composition, biomass yield nutritive value because of overgrazing and lack of alternative improved forage plants. The field experiment was conducted to determine the effects of plant spacing and harvesting age on agronomic performance and chemical composition of Para grass (*Brachiaria mutica*) at Bahir Dar, Ethiopia. The experiment was a 3×3 factorial layout in a RCBD with three replications giving a total of 27 plots. The between plant spacing were 15, 30 and 45 cm and the harvesting ages were 60, 90 and 120 days. The data collected were morphological characteristics such as plant height(PH), number of tillers per plant (NTPP), leaf length per plant (LLPP), number of roots per plant (NRPP), root length per plant (RLPP), leaf to stem ratio (LSR), number of leaves per plant (NLPP), dry matter yield (DMY) and chemical composition of the forage. Forage samples were taken for chemical composition analyses. All data were subjected to GLM ANOVA procedures of SAS version 9.0. Results showed that the interaction between plant spacing and harvesting age had a significant ($p<0.05$) effect on plant characteristics, DMY and chemical composition of Para grass except CP yield ($p>0.05$). Plant characteristics were significantly ($p<0.05$) increased as the plant spacing and age of harvesting raised and PH, OM and ADF were increased as maturity of the plant at all plant spacing. DMY and DM content were significantly ($p<0.05$) increased with narrow plant spacing and advanced maturity. Therefore it could be concluded that both harvesting age and between plant spacing are critical in the forage production parameters.

Keywords: chemical composition, forage yield, harvesting age, morphological characteristics, plant spacing

1. Introduction

Ethiopia is endowed with larger livestock population in Africa, but low in terms its productivity. The major and frequently reported reason is inadequate quantity and quality feed for livestock sector [1]. The major livestock feed resources in Ethiopia are natural pasture and crop residue [2], but they are characterized as poor in their nutritional value; they do not provide adequate nutrientsfor animal production [3-4]. A basic shortcoming of natural pasture in Ethiopia is low forage dry matter production, poor in botanical composition, poor nutritive value and degraded. These are outcomes of overgrazing without introducing other improved forage [5]. Moreover, the grazing land is constantly converted to cropping land in response to the alarmingly increasing human population food demand. Then it is time to act on improving the existing grazing land through introduction of improved grasses by studying their agronomic performance and chemical composition [4].

Utilizing improved forage varieties has several advantages like improving animal nutrition resulting in better livestock products; it helps the livestock producers to conserve forage for dry

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season and protect the soil from erosion and improve its fertility. Furthermore, planting improved grass could improve marginal lands, improve carbon sequestration to mitigate climate change, support system substantially and enhance natural assets and system reliance. So far Napier and Rhodes grasses are the dominant improved grasses introduced in the back yard system of the livestock producer in Ethiopia [6]. But still other agro ecologically compatible forage species are demanded to make sure more alternatives to be compatible both for farmers and the ecosystem. Among the emerging improved forage grasses Brachiria grass is the promising and a candidate climate smart grasss and supposed to replace Napier grass in case napier is affected by diseases and insects. In addition Para grass could be an alternative grass to improve the existing natural grasslands in Ethiopia and enhancing the availability of feed to the livestock sector.

Para grass *(Brachiaria mutica)* is being cultivated throughout tropical world due to its ability to grow in low rainfall and acidic soil for sustainable fodder production [7]. A vigorous plant, individual stolons can be up to 5 meters long, but it can be affected by many factors such as plant spacing and harvesting stage. Because of its running nature it could be a promising grass in degraded grazing lands such as available in Ethiopia. Previous study reported that plant spacing and harvesting stage affecting the plant characteristics, biomass yield and nutritive values for Desho grass and Brachiaria Mulato II [8-9]. However, scientific evidence regarding their morphological characteristics, dry matter yield and chemical composition of *Brachiaria mutica* grass because of plant spacing and harvesting stage is limited. Therefore, this field experiment was undertaken to investigate the effects of plant spacing and harvesting age on plant agronomic performance, biomass yield and chemical composition of *Brachiaria mutica* grass at Bahir Dar, northwest Ethiopia. We hypothesized that plant spacing and harvesting stage could contribute for the forage agronomy, yield and chemical composition of the forage grass. The paper is aimed to evaluate the effects of plant spacing and harvesting stage on the plant characteristics, forage yield and chemical composition of Para grass grown in Bahir Dar, Ethiopia.

2. Materials and methods

The field study was conducted in Bahir Dar town at Shum Abo elementary school compound. Bahir Dar is the administrative city of Amhara National Regional State; it is situated approximately 580 km northwest of Addis Ababa, the capital of Ethiopia. The experimental area is located at 11° 37. 44'N latitude and 37° 27 65'E longitude. The elevation for the experimental site is about 1788 m.a.s.l. The area receives an average annual rainfall ranging between 850 mm to 1250 mm with the minimum and maximum average daily temperatures of 15°C and 30°C, respectively [10]. The soil fertility in the area according to different land use was cultivated land has 1.49% SOC, forest land (3.32%) and grass land (2.88%) [11].

Experimental layout, design and treatments

The experimental design used was a factorial arrangement of treatments in randomized complete block design (RCBD) consisting of 2 factors (plant spacing and harvesting age) with 3 replications. There were three blocks, each containing nine plots resulting in twenty-seven plots in total with each plot measuring 2 m x 2 m. The experiment had a total of 9 treatments with a factorial combination of three levels of intra-row spacing/plant spacing in the row (15 cm, 30 cm and 45 cm) and was compared at 3 harvesting dates (60, 90 and 120 days). The inter-row spacing was the same for all treatment (0.5 m). The spacing between block and plots was 1 meter and 0.5 meters respectively. Total area of the experiment was 176 m^2 (22 m x 8 m). Plot size of each treatment was 4 m^2 (2 m x 2 m) and net plot area (harvestable area) was 2 m^2 (1m x 2 m) used by excluding one outer row on both sides of each plot and 0.07 m for 0.15 m, 0.15 m for 0.30 m and 0.22 m for 0.45 m row length and 0.25 m for 0.5 m row width were subtracted during planting on both ends of the rows to avoid possible border effects.

The *Brachiaria mutica* grass as planting material was collected from the Andassa Livestock Research Center. Before planting, the experimental land was first cleared of weeds and then back-hoe, two times before subdividing it into blocks and plots. Before digging out the *Brachiaria mutica* grass from the established area, the biomass was trimmed almost at equal height to facilitate regrowth after transplant. The *Brachiaria mutica* grass was planted in June 2017 by root split propagation mechanism in the rain season; planted and fertilized with DAP and Urea based on the recommendation of Cameron and Lemcke (2008) [12], two thirds of the root splits were buried in the depth of 10-15 cm on a well-prepared seedbed, and the apical third was left on the ground. Weeds were controlled by hand weeding to avoid interference by interspecific competition. Weeding was done early and then two times per month until the final harvesting was accomplished, to eliminate regrowth of undesirable plants and removal of the dry root in order to promote fodder re-growth by increasing soil aeration.

Data collection

Data on the plant morphology and yield parameters were recorded throughout the experimental period (120 days). In each plot six plants were randomly selected to record number of tiller per plant (NTPP), total number of leaves per plant (TLPP), leaf length per plant (LLPP), length and number of root per plant and leaf: stem ratio (LSR). Mean plant height from each treatment was determined by measuring the height of six randomly selected plants from ground level to the tip of the apical meristem. Sample tillers from each randomly-taken plant were used to determine the number of leaves per tiller (NLPT) [13].

Morphological parameters

Plant height

A measurement of plant height was undertaken immediately before the time of biomass harvest, at the end of each of the three harvesting days. From the total of four rows within each plot an entire of two rows were selected by excluding the two border rows and then six tillers were randomly selected for the measurement of plant height at an interval of 30 days from 60th day after transplanting up to 120 days of final harvesting days and averaged from net plot area of each harvesting age. It was measured from base of the plant to tip of the upper leaves of the main stem.

Number of tillers per plant

The number tillers per plants were counted from the randomly selected sample of six plant of each plot from two rows at 60, 90 and 120 days after transplanting from net plot area and mean was calculated. Main stem was also included to calculate the total tillers per plant

Number of leaves per plant

The number of leaves per tiller was counted from the sample of six tillers at 60, 90 and 120 days of harvesting and from 15, 30 and 45 cm plant spacing of the experimental plot area. Mean was calculated and then the total number of leaves per plant was estimated from the tiller number per plant and leaf number per tiller.

Leaf length per plant

Leaf length per plant was measured from the base of the collar region of the leaf to the tip of the leaf. It is measured from randomly selected sample plant from the two rows at each plant spacing and harvesting age.

Number and length of root per plant

The number and length of root were counted and measured after the shoot parameters were accomplished. At the end of each harvesting days, six sets of root samples were collected from all plots with an auger at 0.5 m depth. The six sets of samples from each plot were clean up from any residual soil and other debris. The numbers of roots per plant were counted and mean was calculated. Length of root was measured from the crown part to the tip of the root and their mean was calculated.

Leaf to stem ratio (LSR)

Sample taken from each plant spacing and harvesting age was properly measured and fresh stems and leaves of each of the six harvested plants were separated and weighed. After individual plant measurements, stems and leaves were bulked separately and sub sample staken for partial DM analysis. Each sample of leaf and stem were air dried and then leaf: stem ratio (LSR) was estimated by dividing leaf dry weight to stem dry weight. The mean of each parameter were calculated.

Dry matter yields

The dry matter yield (DMY) was determined at the end of every harvesting day and plant spacing. At each harvest, the two rows at the middle of each plot were cut at five cm above the ground. The samples were weighed fresh using a spring balance; then sub-samples of about 400 g fresh plants were taken from the sample and weighed fresh after which they were air dried to give dry weights. Leaf and stem dry weight divided by leaf and stem fresh weight and multiplied by 100 to determine partial DM% for each sample. On the basis of these partial DM % and fresh biomass yield from the sample area of each plot were used to calculate total dry matter yields for each plot, thereafter, converted to metric tons per hectare.

Forage quality measurements
After drying, samples were ground to pass a 1-mm Wiley mill screen and stored in airtight containers for different chemical analyses. Samples of each were subjected to chemical analysis for determination of organic matter following the methods of AOAC (2004) [14]. Forage quality measurements such as determination of crude protein (N*6.25) (Kjeldhal procedure), Acid Detergent Fiber (ADF), Neutral Detergent Fiber (NDF) and Acid Detergent Lignin (ADL) were analyzed using Van Soest's et al. methods (1991) [15]. Ash was determined by igniting at 550°C overnight for 6 hours, total DM by drying at 105°C for 24 hour. Dry matter yield (DMY) was multiplied with CP content of the feed samples to determine Crude Protein Yield (CPY). All the chemical analyses were done Holeta Agricultural Research Center Animal Nutrition Laboratory.

Statistical Analysis
All the collected data were statistically analyzed using General Linear Model (GLM) procedure of SASstatistical computer package version 9.0 [16]. Treatment means were compared by the least significant difference test (LSD) at $p<0.05$. Differences were considered statistically significant at 0.5% significance level.
The statistical model for the analysis of data was:

$Y_{ijk}=\mu+S_i+H_j+ S_i*H_j+e_{ijk}$, where:
yijk=all dependent variables (morphological data, chemical composition, and yield) collected
μ=overall mean
S_i=the effect of i^{th} spacing between plants (15, 30 and 45cm)
H_j=the effect of j^{th} harvesting age (60, 90 and 120 days)
S_i*H_j=the interaction of plant spacing and harvesting age
e_{ijk}=random error

3. Results and discussion

Effect of plant spacing and harvesting age on plant characteristics and dry matter yield of *Brachiaria mutica* grass

Significant ($p<0.01$) interaction effect of plant spacing and harvesting age on plant characteristics and dry matter yield (DMY) of para grass are presented in Table1. An increment in plant height (PH) at later harvest stages could be due to massive root development and efficient nutrient uptake, allowing the plant to continue to increase in height of the grass [17]. The expected increment in PH at maturity is in agreement with the findings of Asmarenet al (2017) [18], who reported for Desho grass. The mean PH (2.55 cm) from our result is significantly higher than Desho grass (91 cm) at the same age of harvesting (120 days). Similarly, the plant height obtained in the present finding was higher (2.55 cm) than the results 58.5 cm plant height for Napier grass after 12 weeks [19]. The difference might be from their genetic makeup, management, soil type and climatic condition at the time of the experiment. Additionally Mustaring et al. (2014) [20] reported that *Brachiaria mutica* had the highest plant height (207.47 cm) than *B. brizantha* and *B. mulato* at 8 week of harvesting.
The maximum number of tiller (67.4) was counted from the wider plant spacing (45 cm) and at the late harvesting age (120 days). The reason behind this might be that plants require wider plant spacing to grow and develop under reduced competition for environmental resources, especially light, space, moisture and nutrients [21-22]. It is supported with Ansah et al. (2010) [23] who reported that as the plants approached maturity; numerous tillers appeared, growing out from the leaf axils of the main stems. The number of tillers increases from 54.6 to 79.9 tillers per plant in Desho grass as reported by Worku et al. (2017) [22] is greater than from our result (35.2 to 67.4). This difference might be due to the variation in plant genetics, different plant spacing, maturity stage, weather condition, soil type and management. Also our result is analogous to the finding of Rambau et al. (2016) [19] who reported for Napier grass shows, the number of tillers increased with increase maturity of the Napier grass.

Table 1. Morphological characteristics and dry matter yield of *Brachiaria mutica* grass as affected by harvesting age and plant spacing

Variables		Parameters							
Harvesting date	Plant spacing	PH (m)	NTPP	LLPP (cm)	NRPP	RLPP (cm)	LSR	NLPP	DMY (t/ha)
60	15	1.14^{c}	35.2^{e}	20.1^{de}	132.7^{bc}	12.2^{d}	1.37^{a}	245.1^{f}	8.59^{cd}
	30	1.11^{c}	37.1^{de}	19.6^{de}	137.3^{bc}	13.7^{cd}	1.14^{abc}	219.3^{f}	5.08^{d}
	45	0.91^{c}	48.5^{c}	17.4^{e}	99.3^{c}	15.6^{abc}	1.31^{ab}	283.6^{ef}	2.83^{d}
90	15	1.92^{b}	38.7^{de}	23.9^{abc}	138.3^{bc}	14.3^{bcd}	0.998^{c}	433.9^{de}	13.18^{bc}
	30	1.71^{b}	47.4^{c}	22.4^{bcd}	135.9^{bc}	16.77^{abc}	1.03^{c}	542.7^{cd}	14.79^{abc}
	45	1.84^{b}	57.9^{b}	21.4^{cd}	121.5^{bc}	16.3^{abc}	1.08^{bc}	872.6^{b}	12.33^{bc}
120	15	2.48^{a}	44.4^{cd}	25.4^{ab}	139.7^{bc}	16.4^{abc}	0.92^{c}	691.5^{c}	20.19^{a}
	30	2.60^{a}	57.8^{b}	26.5^{a}	168.1^{ab}	17.2^{ab}	1.005^{c}	1142.1^{a}	16.17^{ab}
	45	2.57^{a}	67.4^{a}	26.7^{a}	208.5^{a}	17.9^{a}	0.974^{c}	1280.7^{a}	18.74^{ab}
Mean		1.8	48.27	22.6	142.3	15.59	1.09	634.6	12.43
SE		0.17	2.65	1.07	17.01	1.02	0.08	54.05	2.26
Significance level		***	***	***	*	*	**	***	***
R^2		0.87	0.88	0.8	0.79	0.87	0.67	0.95	0.75
CV		15.7	9.49	8.2	12	11	12.7	14.7	15

*=significant at 0.05; **=significant at 0.01; ***=significant at 0.001; means within column followed by the same letters are not significantly different; SE, standard error of the mean. PH=plant height; NTPP=number of tillers per plant; LLPP=leaf length; NRPP=Number of root per plant; RLPP=Root length per plant; LSR=Leaf to Stem Ratio; NLPP=number of leaves per plant and DMY=dry matter yield

Brachiaria mutica grass harvested at 45 and 30 cm plant spacing from the late harvesting (120 days) recorded the longest LLPP (26.7 cm and 26.5 cm). Leaf length was increased progressively with enhanced age of harvesting and this is supported with the finding of Rambau et al. (2016) [19] on Napier grass. This is because leaf length in grasses is greatly influenced by the developmental stage of the plant: reproductive or vegetative. This change in leaf growth rate seems to be due to an increase in cell division which could be related to environmental regulation of the gibberellins pathway [24]. An average leaf length for Marandu grass is 19.22 cm is reported which is less than from our finding [25]. This variation may be due to the difference in their species, soil fertility, maturity stage and weather condition.

Brachiaria mutica grass harvested from wider and intermediate plant spacing at late harvesting age scored the highest NLPP (1280.7 and 1142.1 leaves) respectively. With the increase in the stage of maturity, the greater the numbers of leaves which are an important for the photosynthetic and transpiration surface were produced from the newly emerging tillers. In addition to this more leaves per plant were produced at the wider plant spacing. This could be attributed to less competition between plants which resulted in taller plants and better growth of leaf. Therefore, this result is in agreement with finding of Tilahun et al. (2017) [8] indicated that, LNPP, could determines the photosynthetic capacity of the plants, was significantly affected by harvesting age. The current result is in line with [Tilahun et al. (2017); Asmare et al. (2017); Wangchuk et al. (2015] indicated that the number of leaves per plant was significantly affected by harvesting date of grasses.

The highest number of roots (208.5) were counted from wider plant spacing (45 cm) and from the late harvesting age (120 days) followed by intermediate plant spacing (30 cm). The number of roots increases linearly with maturity of the plant. This result confirms the individual advantage for plants with larger area for exploration for resource especially in the drought season. Plant spacing become lesser than the normal spacing then the root biomass decline [27] and Ostonen et al. (2007) [28] obtained that, root density in soil profile is strongly dependent on the total number of roots per hill. Root spring out from node and the total number of nodes per plant determine the total number of roots even if the varietal differences in the average number of roots are observed. The shortest root length (12.2 cm) was measured from the narrow plant spacing (15 cm) and at early harvesting age (60 days). The result indicated that the length of the roots increased with increasing plant spacing and harvesting age which is supported with Akman, and Topal (2013) [29]. An increase in root length increase absorbing surface, thus they may be an important for water and mineral absorption. The explanation was that the uptake of a different nutrient in competing plants was proportional to the root length, as the greater the root length, the shorter the distance the nutrient has to travel to the root. Narrow plant spacing (15 cm) at early harvesting age (60 days) resulted in significantly higher (1.37) leaf to stem ratio compared to intermediate (90 days) and late harvesting (120 days) LSR declined sharp lays the harvesting ages increase. The reason for this might be the accumulation of more cell wall components in plant tissues as a result of stem development with advancing maturity. Beside to this leaves are higher in quality than stems and the proportion of leaves in forage declines as the plant matures [30-31] for different forage grasses. But, it is an important factor affecting diet selection, quality and intake of forage. The total DMY increased progressively with lower plant spacing and increasing harvesting age.

This is due to the fact that, as grass matures, herbage yield is increased due to the rapid increase in the tissues of the plant, development of additional tillers and leaf formation, leaf elongation and stem development with increasing plant age [8, 18]. The possible reason for more biomass yield in narrowed spacing could be more established plants which make use of the available resources without giving chance for the weed [32-33]. But, the result of Tilahun et al. (2017) [8], disagree with our finding, that is plant spacing had no significant effect on dry matter (DM) of Desho grass.

Effect of Plant Spacing and Harvesting Age on chemical composition of para grass

Significant interaction effects were observed on almost all chemical composition of *Brachiaria mutica* grass Table 2; except crude protein yield. The DM content increases linearly with an increase harvesting age; it may be due to an increase in DMY with maturity and supported by Asmare, et al. (2017) [18] and Rambau et al. (2016) [19].

Table 2. The interaction effect between harvesting age and plant spacing on the chemical composition of *Brachiariamutica* grass

Variables		Parameters						
Harvesting date	Plant spacing	DM	Ash	OM	CP	NDF	ADF	ADL
60	15	94.36[bcd]	14.65[a]	85.35[c]	13.44[a]	68.22[dc]	34.56[b]	4.15[bcd]
	30	94.21[cd]	14.67[a]	85.32[c]	13.69[a]	69.43[bc]	34.41[b]	4.42[ab]
	45	94.14[d]	14.60[a]	85.40[c]	13.41[a]	68.24[cd]	33.58[b]	3.95[d]
90	15	94.42[bcd]	12.75[b]	87.25[b]	10.16[b]	66.33[e]	35.97[a]	4.13b[cd]
	30	94.55[ab]	12.59[b]	87.41[b]	9.85[b]	66.91[de]	36.02[a]	4.06[cd]
	45	94.43[bc]	12.05[b]	87.95[b]	8.37[bc]	68.21[cd]	36.40[a]	4.15[abcd]
120	15	94.75[a]	10.69[c]	89.30[a]	6.59[cd]	70.83[ab]	35.91[a]	4.38[abc]
	30	94.72[a]	10.39[c]	89.60[a]	6.20[cd]	71.14[a]	36.26[a]	4.44[ab]
	45	94.62[ab]	10.40[c]	89.59[a]	5.70[d]	70.96[ab]	36.56[a]	4.47[a]
Mean		94.46	12.53	87.46	9.71	68.93	35.51	4.23
SE		0.088	0.42	0.42	0.69	0.69	0.38	0.10
Significance level		**	***	***	***	***	**	*
R^2		0.83	0.94	0.94	0.95	0.92	0.87	0.76
CV		0.1	4.7	0.67	10.08	0.99	1.5	3.36

Means within a column with different superscripts differ significantly ($p<0.05$). *=significant at 0.05; **=significant at 0.01; ***=significant at 0.001.SE=Standard Error; DM=Dry Matter%; Ash=Ash%; OM=Organic Matter%; NDF=Neutral Detergent Fiber%; ADF=Acid Detergent Fiber%; ADL=Acid Detergent Lignin% and CP=Crude Protein%

The mineral (ash) content of the grass was reduced with increased in the stage of maturity as more in plant spacing and supported by different scholars research report [8, 34-35]. This is due to the fact that, as grasses mature, the mineral content declines due to a natural dilution process and translocation of minerals to the roots [36]. In contrary with our finding, the result of Rambau et al. (2016) [19] shows, plant maturity had no effect on ash content of Napier grass.

As expected, crude protein content of the forage was significantly reduced with advanced in the harvesting age. The decline in CP content with advancing stage of maturity is due accretion of higher proportion of fiber corresponding to plant growth [37] or the decreasing CP contents of grasses with increasing plant harvesting may be because of reduced leaf to stem ratio [39]. In the present finding the CP content at early harvesting is double of the existing natural pasture in Ethiopia as indicated by Kitaba and Berhan (2007) [35]. The fiber content of the grass in the present study increased as becomes more matured and similar with the previous findings [18, 39]. This is due to the fact that, as the plant becomes mature the cellulose, hemicelluloses, lignin and silica which are found in the insoluble portion of the forage become increased. The consequence is that it affects the nutrition of the ruminant animals as it becomes more matured (40-41). Plant Spacing has no significant effect on the fiber contents of the forage [34]. Our finding is disagreeing with the finding of Bayble et al., (2002) [34] that plant spacing has no significant effect on the ADL and Rambau et al. (2016) [19] show that, plant maturity had no effect on ADL content of Napier grass.

Both plant spacing and harvesting age had high significant ($p<0.01$) effect on crude protein yield but their interaction does not have a significant effect (Table 3). Crude protein yield was increased when spacing between plants reduced and with increasing harvesting age. An increase in CPY with the grass maturity implying that, the increase in DM yield faster than the decline in CP with maturity. Similar finding in US indicated that, the crude protein yield often Brachiaria cultivar shows an increase with their age.

Table 3. Crude protein yield of *Brachiariamutica* grass as affected by harvesting age and plant spacing

Parameter	Harvesting age (days)				Plant spacing (cm)						
	60	90	120	Mean	15	30	45	Mean	SE	R^2	CV
CPY	0.76^b	1.17^a	1.273^a	1.07	1.23^a	1.15^b	0.83^c	1.07	0.19	0.68	23.5

Means with different letters within rows are significantly different ($p<0.05$). CPY=crude protein yield

Similar finding by Tilahun et al. (2017) [8] indicated that, Crude protein yields (CPY) of Desho grass increased progressively and significantly as growth period increased (0.76 t/ha at 75 days to 2.36 t/ha at 135 days) in reverse plant spacing had no significant effect on CPY with an overall mean of 1.57 t/ha and similarly Negasu et al. (2020) [9] reported that plant spacing did not affect in CPY for brachiaria Mulato-II grown in lowland area.

4Conclusions

This study showed the importance of considering the two main factors to maximize forage yield and quality of *Brachiaria mutica* grass. In these points of view, all of the morphological characteristics of *Brachiaria mutica* grass were highly affected by the interaction between plant spacing and harvesting days. *Brachiaria mutica* grass should be harvested before maturity stage (120 days) to retain its high nutrient content particularly crude protein (CP) and *Brachiaria mutica* grass harvested from narrow plant spacing (15 cm) at 90 days of harvesting would be more beneficial to get high quality and quantity yields and as an option to solve the scarcity of land. Among the spacing tested, the two closest spacing, 15 and 30 cm, are recommended for the production of high dry matter yield than the wider spacing (45 cm).

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