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Brachiaria Grass Herbage Yield Potential and Nutritional Quality at Midland Agro Ecology of East Hararghe Zone, Ethiopia

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Abstract: Livestock production in the Eastern Oromia of Ethiopia depends mainly on natural pastures and crop residues which are poor in quality and quantity particularly during dry season. Therefore, it need introduction of alternative improved forages of high quality and quantity which are adapted to the areas. Thus, the activity was conducted at three districts of East Hararghe Zone located in midland agro ecology to identify and select the best Brachiaria grass accession/s for dry matter (DM) yield and nutritive quality for these areas. Four brachiaria Urochloa decumbens accessions (ILRI-10871, ILRI-13205, ILRI-14721 and ILRI-14720) and five brachiaria Urochloa ruziziensis accessions (ILRI-13332, ILRI-14743, ILRI-10871, ILRI-14774, LRI-14813) and one local check were evaluated. The accessions were laid out in a randomized complete block design with three replications. Tiller numbers, plant height, forage dry matter yield and plot covers were recorded at their respective recommended stages. The brachiaria accessions had significant ($p<0.05$) effect on plot cover, plant height, tiller number, dry matter yield and in nutritional contents. Based on the current result, higher herbage DM yield (17.83 t/ha) was recorded from Brachiaria Urochloa ruziziensis ILRI-14813 followed by Urochloa decumbens ILRI-14721 **(**16.57 t/ha**),** while lower herbage dry matter yield (7.27 t/ha) was received from Urochloa decumbens ILRI-1087. The chemical composition of the grass was also varied significantly among the tested brachiaria grass accessions. Accordingly, the highest neutral detergent fiber (NDF %) content was recorded by the local check while the highest acid detergent fiber (ADF %) content was obtained by Urochloa ruziziensis ILRI-14743 and Urochloa ruziziensis ILRI-14774. The concentration of crude protein (CP %) also varied significantly among the brachiaria grass accessions ranging from 10.49%-14.45%. The highest crude protein yield was recorded by U. decumbens ILRI-14721, U. decumbens ILRI-10871, U. ruziziensis ILRI-14743 and U. ruziziensis ILRI-14813 while the lowest was obtained by U. decumbens ILRI-13205. Generally, the grass accessions Urochloa ruziziensis ILRI-14813 and Urochloa decumbens ILRI-14721 were well adapted and productive in regarding to herbage yield and nutritional quality. Therefore, these grass accessions were hopeful to fill the gap of low quantity and quality of animal feed supply of the study area. Thus, these two grasses are recommended for the midland agro ecology of East Hararghe zone of Oromia and other areas with similar agro ecologies.

Keywords: Dry Matter Yield, Plant Height, Plot Cover, Tiller Numbers, Nutritional Quality

1. Introduction

Forages play an important role in agricultural economy of developing countries by providing the cheapest source of feed for the livestock. In lowlands of East Hararghe zone, one of the most important challenges to livestock production is scarcity of feeds during the dry season. Smallholder farmers face the challenge that grazing land is gradually becoming scarcer, and their current cattle productivity is too low for effective commercialization. Farmers depend on natural pasture and crop residue for livestock and more often give low priority to pasture establishment. These available feed resources in the smallholder mixed farms are inadequate in quantity and low in quality.

Past attempts to improve livestock production in this area focused mainly on crop residues and farmers usually harvest fodder from thinned crop plants, weeds, and defoliated leaves. Despite these efforts, cultivated forages account very low contribution mainly due to lack of suitable grasses adapted to environmental conditions of the area. In addition, land sub-division has also contributed to feed shortage through limited available land for pasture establishment. Planting nutritious forages on small parcels of land and cut-and-carry these to feed their penned cattle can considerably increase animal production and associated income here. Particularly as beef demand of the area is increasing in the country, this presents cattle-keeping smallholders in East Hararghe zone is with an opportunity to enhance their livelihoods. To address the challenges of feed shortage in the study area, there is need to select high quality forages that are adapted to East Hararghe zone.

The genus Brachiaria consists of about 100 species distributed across tropical and sub-tropical region [14]. Brachiaria have advantage over those in other genera including adaptation to drought and low fertility soils, sequesters carbon through its large roots system, enhance nitrogen use efficiency and subsequently minimize eutrophication and greenhouse gas emissions [1, 9, 12]. Brachiaria plays important roles in soil erosion control and ecological restoration. Brachiaria species have been important component of sown pastures in humid low lands and savannas of tropical America with current estimated acreage of 99 million hectare in Brazil alone [6]. Africa is the center of origin of Brachiaria grasses. Brachiaria species are native to eastern and central Africa and are extensively grown as livestock forage in South America and East Asia [2]. Important species include B. ruziziensis, B. decumbens, B. brizantha and B. humidicola.

Recently, the mounting demand for livestock products in Africa has renewed interest of farmers, researchers, and development and government agencies on forages particularly to climate resilient forages like Brachiaria grass. Therefore, there have been multiple repatriations of Brachiaria grass to Africa as hybrids and improved landraces [10]. These materials have shown positive performance in terms of improved forage availability and livestock productivity. Despite the immense benefits demonstrated of these grasses in other countries, the potential of improved Brachiaria grass in East Oromia to address the challenge of livestock feed scarcity remain unexploited and there is no information on the production and uses of these grasses in the Eastern parts of the region. Therefore, there is a need for identifying Brachiaria grass accessions that are more productive and adaptable to the lowlands and midlands production systems of East Hararghe, Oromia, since accessions within a species differ in yield potential and quality of forage produced.

2. Materials and Methods

2.1. Description of the Study Area

The study was conducted during 2018, 2019 and 2020 of main cropping season at midland of East Hararghe zone. The study was conducted in Meta, Kersa and Kombolcha districts of the Eastern Hararge Zone, Oromia Regional State. Meta District is located at 445 km from the capital Addis Ababa and 80 km west of Harar town. Meta District is located between 9°0′09″ to 9°0′31″ N latitude and 41°0′29″ to 41°0′44″ E longitude. Altitude of Meta District is 2830 meters above sea level. The annual rainfall amount ranges from 600-900 mm and the temperature ranges between 15°C-37°C. Gara Muleta Mountain, one of the highest mountains in Oromia Regional State, is found in this District. Kersa district is bordering Haromaya district in the East, Kurfa Calle woreda in the south, Dire Dawa City administration in the north and Meta Woreda in the West. The capital city of the woreda is located at 478 km south of Addis Ababa and 42km to the West of Harar town which is the capital city of East Hararghe zone. The woreda contains 35 rural kebeles and the altitude ranges from 1,550 to 2,800 meters above sea level. Kombolcha district is one of the eighteen districts of East Hararghe Zone of Oromia Regional State. It is located at about 17 km north of Harar town and 542 km east of Addis Ababa, the nation's capital city. The altitude of the district ranges from 1200-2460 meters above sea level. Agro climatically, the district ranges from *Woina-dega (mid-altitude)* to Kola (low lands). The annual rainfall ranges from 600mm to 900mm with a bimodal and erratic pattern. The mean annual temperature of the area ranges between 16-25°C.

2.2. Experimental Design and Treatments

The Brachiaria grass accessions used for the experiment were four Brachiaria Urochloa decumbens accessions (ILRI-10871, ILRI-13205, ILRI-14721 and ILRI-14720) and five Brachiaria Urochloa ruziziensis accessions (U. ruziziensis ILRI-13332, U. ruziziensis ILRI-14743, U. decumbens ILRI-10871, U. ruziziensis ILRI-14774, and ruziziensis ILRI-14813) and one local check as control. All the experimental materials were obtained from Holeta Agricultural Research Center except the local check. The accessions were arranged in a randomized complete block design with three replications. The plot sizes were 4 m x 3 m with a 1 m path between plots and 1.5 m between blocks. The grass roots were planted at about 0.5 m and 0.25 m between rows and plants, respectively on a well prepared seed bed.

2.3. Data Collection

Plot cover, plant height and tiller number were recorded at 16 weeks after planting in both agro-ecologies. At 16 weeks after planting, the plants were harvested for dry matter (DM) yield determination. Plant height was determined by measuring the primary shoots from the base of the plant to the topmost flag leaf of four tagged plants as described by

Rayburn and Lozier [13]. The percentage of plot cover was determined from a 1 m x 1 m quadrat sub-divided into 25 squares as described by Njarui and Wandera [11]. Tillers were counted for tagged plants. During the DM yield determination, the plants were cut to a stubble height of 5 cm in an area of 1 m^2. Fresh herbage was harvested, weighed and a sub-sample taken, oven dried at of 65°C for 72 hours to a constant weight.

2.4. Chemical Composition

Partially dried feed samples were ground to pass through a 1 mm sieve screens using Wiley mill and stored in airtight plastic bags for chemical analysis. The DM content was determined by oven drying at 105°C for 24 hours. The ash component was determined by igniting the dried sample in a muffle furnace at 550 to 600°C for 4 hours. The nitrogen was determined using the micro-Kjeldahl technique. The CP was calculated as 6.25 x Nitrogen. The method of Van Soest and Robertson [15] was used to determine neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL). Hemicelluloses were calculated by subtracting the ADF from the NDF content while cellulose was determined by subtracting the ADL from the ADF content. Chemical composition was analyzed at Haramaya University animal nutrition laboratory.

2.5. Data Analysis

The values on agronomic parameters and dry matter yields were statistically evaluated by analysis of variance (ANOVA) using general linear model (GLM) procedure of Statistical Analysis Software to perform ANOVA (SAS 9.1). Means were separated using Tukey's test at $p < 0.05$ [4].

3. Results and Discussion

3.1. Morphological and Yield Data of Bracharia Grass Accessions

The result of combined analysis of variance showed that ground cover, plant height, tiller number and dry matter yield at harvesting was significantly difference ($p<0.05$) among the tested Brachiaria accessions (Table 1). Since the interaction among the treatment and location is non-significant combined analysis was used. The ground cover and plant height of the grass ranges from 20% to 100% and 58.67 cm to 101.7 cm, respectively. The highest (87.23%) mean ground cover was recorded for Brachiaria grass accessions U. ruziziensis ILRI-14813, while the lowest (62.00%) mean ground cover was obtained from U. ruziziensis ILRI-14743 The Brachiaria grass U. decumbens ILRI-14721 and U. ruziziensis ILRI-14813 accessions were significantly ($p<0.001$) taller than U. decumbens ILRI-10871 and U. ruziziensis ILRI-14774 accessions. However, no significant differences observed in plant height between U. decumbens ILRI-14721 and U. ruziziensis ILRI-14813 accessions. There was statistically significant variation ($p<0.004$) was observed in numbers of tillers among the brachiaria grass accessions evaluated. The higher (69.95%) tiller number was recorded from Brachiaria grass accession U. ruziziensis ILRI-14813, while U. decumbens ILRI-10871 had the lower tiller number.

There were also significant ($p<0.001$) differences among the Brachiaria accessions on DM yields in t/ha. The mean value of herbage DM yield was ranged between 7.27 – 17.83 t/ha. The highest mean value was obtained from U. ruziziensis ILRI-14813 (17.83 t/ha) followed by U. decumbens ILRI-14721 (16.57 ton/ha) accessions. The higher dry matter production of these two accessions might be related to their higher plant height and ground cover. This result was supported by Mganga [8] and Nguku *et al*., [10], who observed that, pasture species which grow fast and tall are more efficient, competitive and higher biomass production. The higher mean value of DM yields in the current study was comparable with that of Hare *et al*., [5], who reported 16.3 t/ha annual DM yield for brachiaria grass in Thailand.

Table 1. *Composite mean Agronomic and yield of Brachiaria grass accessions at midland agro ecology.*

Treatments	GC (%)	PH (cm)	TN	DMY (t/ha)
U. decumbens ILRI-10871	65.31^{b}	58.67^{bc}	37.60^{c}	7.27^{d}
U. decumbens ILRI-13205	67.0^{b}	74.33^{abc}	46.34^{abc}	9.98^{cd}
U. ruziziensis ILRI-13332	70.34^{ab}	76.33^{abc}	53.35^{abc}	11.37^{cd}
U. decumbens ILRI-14720	80.34^{ab}	80.0^{abc}	54.60^{abc}	10.97^{cd}
U. decumbens ILRI-14721	78.68^{ab}	101.67^{a}	68.32^{ab}	16.57^{ab}
U. ruziziensis ILRI-14743	62.00^{b}	82.33^{abc}	53.40^{abc}	8.77^{cd}
U. decumbens ILRI-10871	66.99^{b}	86.67^{abc}	44.64^{abc}	10.20^{cd}
U. ruziziensis ILRI-14774	62.01^{b}	56.33^{c}	44.00^{abc}	12.18^{bc}
Local check	76.67^{ab}	76.00^{abc}	42.48^{bc}	7.43^{cd}
U. ruziziensis ILRI-14813	87.23^{a}	91.67^{a}	69.95^{a}	17.83^{a}
CV (%)	9.6	21.6	17.2	14.6
LSD (5%)	11.78	14.94	15.09	2.83
P-value	**	**	**	**

GC=Ground cover, PH=Plant height, TN=tiller number; DMY=Dry matter yield; CV= Coefficient of variation.

3.2. Nutritional Quality of Brachiaria Grass Accessions

Nutritional qualities of the tested Brachiaria grass accessions are presented in Table 2. The result of analysis of variance for DM, Ash, CP, NDF, ADF and ADL content were indicated significantly different ($P<0.001$) among the Brachiaria accessions. Local check had higher NDF content (72.73%), while U. ruziziensis ILRI-14813 was produced lower NDF (60.34%). The overall mean value of ADF obtained from Bracharia grass accessions were ranged from 28.68-35.21%. Accession U. ruziziensis ILRI-14774 and U. ruziziensis ILRI-14743 were recorded the highest (34.83 and 35.21) % ADF values, respectively among the tested grass accessions. This is specified that these accessions considerably enhanced less digestible than the other Brachiaria accessions. The least square mean value of all the Brachiaria accessions excluding U. decumbens ILRI-13205, U. decumbens ILRI-10871 and U. decumbens ILRI-14720 accessions had recorded higher CP content (13.29-14.45%) than the local check (11.76%). Brachiaria grass accession U. decumbens ILRI-14721 accumulated the higher CP content than the other evaluated brachiaria grass accessions. All the

Brachiaria accessions considered in the trial were recorded lower NDF than local check and consequently they were more digestible than the local check. The CP content of the whole accessions except U. decumbens ILRI-13205, U. decumbens ILRI-10871, U. decumbens ILRI-14720 and local check were higher when compared with the findings of Nguku [10], who reported CP content of 7-12.8% in a semi-arid region of Kenya.

Table 2. *Chemical composition of Brachiaria grass accessions at midland agro ecology.*

Treatment	DM%	Ash%	CP%	NDF%	ADF%	ADL%
U. decumbens ILRI-10871	91.39^{b}	11.59^{b}	12.49^{ef}	68.07^{c}	32.21^{b}	8.24^{ab}
U. decumbens ILRI-13205	91.13^{bc}	11.7^{b}	10.49^{g}	62.45^{ef}	32.2^{b}	7.72^{ab}
U. ruziziensis ILRI-13332	90.8^{de}	12.36^{a}	13.42^{bcd}	64.93^{d}	30.52^{c}	8.24^{ab}
U. decumbens ILRI-14720	90.45^{f}	11.16^{c}	12.6^{def}	61.78^{fg}	28.53^{d}	7.32^{bc}
U. decumbens ILRI-14721	90.73^{def}	11.73^{b}	14.45^{a}	64.01^{de}	32.38^{b}	5.54^{d}
U. ruziziensis ILRI-14743	90.92^{cd}	12.42^{a}	13.96^{abc}	70.64^{b}	35.21^{a}	8.71^{a}
U. decumbens ILRI-10871	91.12^{bc}	11.48^{b}	14.18^{ab}	69.25^{bc}	28.56^{d}	6.04^{d}
U. ruziziensis ILRI-14774	90.55^{ef}	10.6^{d}	13.29^{cde}	63.39^{def}	34.83^{a}	6.24^{d}
U. ruziziensis ILRI-14813	92.09^{a}	11.46^{b}	13.71^{abc}	60.34^{g}	28.68^{d}	6.51^{cd}
Local check	90.0^{g}	11.6^{b}	11.76^{f}	72.73^{a}	29.68^{cd}	7.41^{bc}
CV	1.4	1.8	2.7	1.6	1.3	4.9
LSD	0.17	0.16	0,52	1.22	0.72	0.60
p-value	***	***	***	***	***	***

DM: Dry matter, CP: Crude protein, NDF: Neutral Detergent Fiber, ADF: Acid Detergent Fiber, ADL: Acid Detergent Lignin, LSD: least significant difference, CV: coefficient of variation.

4. Conclusions and Recommendations

The current study was revealed that the brachiaria accessions had more tillers, ground cover, plant height and dry matter yield during the production seasons in midland agro ecology. Brachiaria grass accession of U. ruziziensis ILRI-14813 was recorded higher herbage dry matter yield followed by U. decumbens ILRI-14721. They were the most productive grasses yielded 17.83 and 16.57 t/ha, respectively. Also Brachiaria grass U. ruziziensis ILRI-14813 and U. decumbens ILRI-14721 had produced better nutritive value among the tested brachiaria accessions. In conclusion, the two Brachiaria accessions were produced optimum herbage yield and nutrient quality at midland areas and should be recommended for promising forage biomass production at the study areas and other areas with similar agro ecologies.

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References

[1] Arango J., Moreta D., Núñez J., Hartmann K., Domínguez M., Ishitani M., Miles J., Subbarao G., Peters M., Rao I. (2014). Developing methods to evaluate phenotypic variability in biological nitrification inhibition (BNI) capacity of Brachiaria grasses. Tropical Grasslands—Forrajes Tropicales, 2: 6-8.

[2] FAO, (2015). Grassland Index. A searchable catalogue of grass and forage legumes. FAO, Rome, Italy. Htt.

[3] Ghimire S., Njarui D., Mutimura M., Cardoso J., Johnson L., Gichangi E., Teasdale S., Odokonyero K., Caradus J., Rao I., Djikeng A. (2015). Climate-smart Brachiaria for improving livestock production in East Africa: Emerging opportunities. In Sustainable use of grassland resources for forage production, biodiversity and environmental protection.

[4] Gomez, K. A. and Gomez, A. A. (1984). Statistical procedures for agricultural research, 2nd edition. John Viley and Sons Inc., New York.

[5] Hare, M. D., Tatsapong, P. and Phengphet S. (2009). Herbage yield and quality of Brachiariacultivars, Paspalumatratum and Panicum maximum in North East Thailand. Tropical Grassland Journal, 43: 65-72.

[6] Jank L., Barrios S. C., do Valle C. B., Simeão R. M., Alves G. F. (2014). The value of improved pastures to Brazilian beef production. Crop Pasture Sci., 65: 1132-1137.

[7] Maass B. L., Midega A. O., Mutimura M., Rahetlah V. B., Salgado P., Kabirizi J. M., Khan Z. R., Ghimire S., Rao, I. M. (2015). Homecoming of Brachiaria: Improved hybrids prove useful for African animal agriculture. E. Africa Agriculture and Forestry Journal, 81: 71-78.

[8] Mganga, K. (2009). Impact of grass reseeding technology on rehabilitation of degraded rangelands: A case study in Kibwezi, Kenya. MSc Thesis, University of Nairobi, Nairobi, Kenya. 14 p.

[9] Moreta D. E., Arango J., Sotelo M., Vergara D., Rincón A., Ishitani N., Castro A., Miles J., Peters M., Tohme J., Subbarao G. V., Rao I. M. (2014). Biological nitrification inhibition (BNI) in Brachiaria pastures: A novel strategy to improve eco-efficiency of crop-livestock systems and to mitigate climate change. Tropical Grasslands–Forrajes Tropicales, 2: 88–91.

[10] Nguku, S. A. (2015). An evaluation of Brachiaria grass cultivars productivity in semi-arid Kenya. MSc thesis. South Eastern Kenya University. 113 p.

[11] Njarui, D. M. G, and Wandera, F. P. (2004). Effect of cutting interval on productivity of five selected herbaceous legumes and grasses in semi-arid areas in Tropical Kenya. Tropical Grasslands. 38: 158-166.

[12] Rao I., Ishitani M., Miles J., Peters M., Tohme J., Arango J., Moreta D. E., Lopez H., Castro A., Hoek R. V. D., Martens S., Hyman J., Tapasco J., Duitam J., Suárez H., Borrero G., Núñez J., Hartmann K., Domínguez M., Sotelo M., Vergara D., Lavelle P., Subbarao G. V., Rincon A., Plazas C., Cadisch G., Mendoza R., Rathjen, L., Karwat H. (2014). Climate-smart crop-livestock systems for smallholders in the tropics: Integration of new forage hybrids to intensify agriculture and to mitigate climate change through regulation of nitrification in soil. Tropical Grasslands–Forrajes Tropicales, 2: 130–132.

[13] Rayburn, E. B. and Lozier, J. D. (2007). Alternative Methods of estimating forage height and sward capacitance. In E. A. Rayburn, pastures can be cross calibrated. St. Paul Minnesota. USA. Plant Management Network. 59: 50-69.

[14] Renvoize, S. A., Clayton W. D., Kabuye C. H. S. (1996). Morphology, taxonomy and natural distribution of Brachiaria (Trin.) Griseb. In Brachiaria: Biology, Agronomy, and Improvement; Miles, J. W.; Maass, B. L.; do Valle C. B., Eds.; International Centre for Tropical Agriculture: Cali, Colombia, pp. 1-15. Silva P. I., Martins A. M., Gouvea E. G., Pessoa-Filho M., Ferreira M. E. 2013. Development and validation.

[15] Van Soest, P. J. and Robertson, J. B. 1985. A Laboratory Manual for Animal Science, Cornell University, Ithaca, New York, USA.