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Research Article

Evaluation of Brachiaria Grass Varieties for their Agronomic Performance in Midland Areas of East Guji Zone, Southern Oromia, Ethiopia

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Abstract

It is referred that the evaluation of Brachiaria grass may be adaptable in drought areas, with good animal feed. The study was conducted with the objective of identifying adaptability, high survival rate, and dry matter yield of Brachiaria grass. The experimental design was Randomized Complete Block Design (RCBD) with three replications. Four Brachiaria Brachiaria mutica Dzf No 18659 (Dzf 483), Brachiaria Decumbens Dzf No 194, Brachiaria mutica 6964 (Dzf No 484), and Brachiaria mulato were evaluated. The result revealed that plot cover, fresh biomass, dry matter yield, and plant height were highly significantly (P<0.001) different among the treatments. The highest value of plant height (170 cm) was measured from the Brachiaria mutica 6964 Dzf No 484 cultivar, followed by the Brachiaria mutica Dzf No 18659 (Dzf 483) cultivar (160 cm), while the shortest (90 cm) plant height was recorded from the Decumbens Dzf No 194 cultivar. The highest dry matter yield (11.95 t/ha) was obtained from the Brachiaria mutica 6964 Dzf No. 484 cultivar, followed by the Brachiaria mutica Dzf No. 18659 (Dzf 483 cultivar) with 11.82 t/ha. The highest survival rate (95.5%) was measured from the Brachiaria mutica Dzf No. 18659 (Dzf 483) cultivar, followed by the Brachiaria mutica 6964 Dzf No. 484 cultivar (87%). The result implies that Brachiaria mutica Dzf No 18659 (Dzf 483) and Brachiaria mutica 6964 (Dzf No 484) were well performed in agronomic parameters. Thus, it could be possible to conclude that the Brachiaria grass should be recommended for improving the constraint of feed shortage in midland agro-ecologies of the Guji zone and similar areas.

Keyswords: Brachiaria; Midland; Cultivars; Agronomic performance

Introduction

Livestock sector is expected to contribute around 19% to Ethiopia's total Gross Domestic Product (GDP) and 45% to the agricultural GDP [1]. It contributes to the livelihoods of 60-70% of the Ethiopian population. Moreover, it ensures the availability of food, creates jobs, transportation and income to the farming community, serve as a source of agricultural inputs such as draft power and organic fertilizer as a direct contribution for crop production [2]. One of the reasons for low productivity of the livestock sector in Ethiopia is shortage of feed and low quality of available feeds, particularly in the dry seasons. Ethiopia experiences chronic shortages of both the quantity and quality of animal feed [3]. Traditional reliance on natural pastures is unsustainable due to land degradation, overgrazing, and conversion of grazing lands to cropland [4]. The quality of available feed (crop residues, poor-quality forages) is often low in nutrients, affecting animal health and productivity. Adoption of improved, high-yielding forage species is limited, hindering the potential to increase feed availability and quality [5]. Inefficient harvesting, storage, and utilization of feed resources lead to significant losses and reduced feed quality. Lack of awareness on proper feeding practices further limits productivity. In the Guji Zone, livestock constraints regarding forage include limited grazing land due to competition with crop production, insufficient forage availability, and a lack of improved forage varieties [6]. Additionally, traditional management practices and inadequate adoption of improved livestock technologies contribute to the problem. Brachiaria grass is one of the tropical and sub-tropical region suitable forage in Africa [7]. Evaluation and adaptation of Brachiaria grass for pasture improvement as early in Africa. But, its use for improvement is very recent. Brachiaria grass, tropical forage, has a history in Ethiopia that includes its role as a native grass and a recognized forage crop for livestock [8]. It's been reported that Brachiaria lata is a palatable grass in Ethiopia's rangelands. They were evaluated in multiple locations involving farmers and four superior cultivars were identified for ruminant feeding. The cultivars have been integrated into mixed crop-livestock farming system; and the significant benefits of Brachiaria grass on livestock productivity (milk and meat production) documented. Livestock production in the midland areas of East Guji, Southern Oromia, Ethiopia, is significantly constrained by feed shortages [9]. Brachiaria grasses offer considerable potential for improving livestock feed resources. To improve availability of livestock feed in terms of quantity and quality, it is better to cultivate bracharia grass forage that have better dry matter yield and nutritional quality. Therefore, this

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study was aimed to evaluate performance of Bracharia grass cultivars and select best adaptable, higher dry matter yield among four cultivars under midland areas of Guji zone.

Materials and Methods

Description of the Study Area

The experiment was carried out at Adola sub-site of Bore Agricultural Research Center (BoARC), Adola Dostrict, Guji Zone of Oromia. Adola dstrict islocated around at a distance of 470 km from Addis Ababa and 120 km from the zonal capital city, Negele Borena. It is an area where a mixed farming and sami-nomadic economic activity takes places, which has the major livelihood of the local people. The total area of district is 1254.56 km^2. The district is situated at 5°44'10"- 6°12'38"N latitudes and38°34'10"- 39°12'37"E longitudes. The district is characterized by three agro-climatic zones, namely highland 11%, midland 29% and lowland 60% respectively. The major soil type of the dstricts is nitosol (red basaltic soil) and orthic Acrosols [10].

Experimental Treatments and Design

The experiment was conducted at Bore Agricultural Research center during 2019 and 2020 cropping season. Four Brachiaria grass cultivars (Brachiaria mutica Dzf No 18659 (Dzf 483)), Brachiaria decumbence Dzf No 194, Brachiaria mutica 6964 Dzf No 484, and Brachiaria mulato) roots were brought from Ethiopian Institute of Agricultural Research, Debrezeite Agricultural Research Center (DZAC) and Oromia Agricultural Research, Mechara Agricultural Research Center (McARC) in randomized complete block design (RCBD) with three replications. The prepared experimental land was divided into three blocks which totally contain about 12 plots with each plot size area 7.5 m^2. The Brachiaria cultivars were spitted on plot size 2.5m length m x 3m width within space between rows and plants were 50 cm, 20cm and 1m between plots and replication respectively. Inorganic fertilizer of 100kg/ha of NPS and 50Kg/ha of urea were applied during the establishment.

Data Collection

All data on morphological parameters and dry matter yield of forage were like plants height, fresh biomass, dry matter yield, leaf to steam ratio, survive rate, plot cover and vigor were recorded.

Plant survival rate was calculated as the ratio of the number of alive plants per plot to the total number of plants planted per plot and then multiplied by 100 [11].

Plant height: Plant height was measured on the primary bud from the soil surface to the base of the top-most leaf using a meter designated by [12]. It was based on five plants was randomly selected in each plot, measured using a steel tape from the ground level to the highest leaf. For determination of biomass yield, genotypes were cutting at 5-10cm from the ground level from two central rows [13].

Vigor and plot cover: These were measured on plot basis using (1-9) rate scale and converted into percentages. The 1-9 scales are described is a common type of visual assessment scale. The values are subjective and rely on an observer's interpretation.

Dry matter yield (DMY): After harvesting the middle four rows, the total biomass yield was determined using sensetive balance from each plot at each harvesting date. The dry matter yield (DMY) was determined at the end of every harvesting day. Based on 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 [14]. The harvested fresh sample was measured right in field by sensitive weight balance and 300g subsample per plot was brought to Bore Agricultural Research Center and sampled sample was placed to oven dried for 72 hours at a temperature of 65co for dry matter determination.

Then dry matter yield (t/ha) was calculated by [15] formula:

The dry matter yield (t/ha) = TFW × (DWss /HA × FWss) ×10

Where TFW = total fresh weight kg/plot,

DWss = dry weight of subsample in grams,

FWss = fresh weight of subsample in grams,

HA = Harvest plot area in square meters and 10 is a constant for conversion of yields in kg/m2 to t/ha.

Leaf to stem ratio (LSR) - leaf to stem ratio of crops was determined at the optimum harvesting stage by taking 200g samples from each plot, partitioning into leaves and stems by manually. Each sample of leaf and stem was dried in the oven dry at 105C^0 for 24 hours, and then, the leaf: stem ratio was estimated by dividing leaf dry weight by stem dry weight. The leaf-to-stem ratio was calculated by applying the following formula [16]:

$$LSR = \frac{\text{Dry weight of leaves (g)}}{\text{Dry weight of stem (g)}}$$

Statistical Analysis

All collected data were analyzed using the general linear model procedure of SAS (SAS 2002) version 9.1. Mean were separated using least significant difference (LSD) at 5% significant level. The statistical model for the analysis data was: Yijk= μ + Aj + Bi + eijk

Where; Yijk= response of variable under examination, μ = overall mean,

Aj = the jth factor effect of treatment/cultivar,

Bi = the ith factor effect of block/ replication and

eijk = the random error.

Results & Discussion

Agronomic Performance of Brachiaria Grass

Number of Plant Survival: The performances of Bracharia grass cultivar were shown in Table 1. The result indicated that the tested cultivars were varied non-significantly (p>0.05) on survive rate percentages. Numerically the highest survive rate percentages were recorded from Brachiaria mutica Dzf No 18659 (Dzf 483) (95.5%) followed by Bracharia mulato (82.5%) cultivars. The lowest survive rate percentage was recorded from Brachiaria Decumbens Dzf No 194 (70.3%).

Plot Cover (%): The result of plot cover was indicated highly significance difference (P<0.001) among Bracharia grass cultivars.

Table 1: Over all mean agronomic performance of Brachiaria grass cultivars in Midland agro-ecologies of areas.

cultivars	SR%	Pc%	Vg%	FBM (t/ha)	LSR	PH (cm)	DMY t/ha
Brachiaria mutica Dzf No 18659 (Dzf No 483)	95.5	94.4a	92.5	33.52a	0.82	160a	11.82a
Brachiaria Mutica 6964 (Dzf No 484)	74.7	87a	88.8	33.6a	0.4	170a	11.95a
Bracharia mulato	82.5	62.9b	57.1	28.13b	0.53	92b	10a
Brachiaria Decumbence Dzf No 194	70.3	48.1b	70.3	25.85b	0.74	90b	6.33b
Mean	80.8	73.1	77.2	30.28	0.62	128.2	10.02
CV	14.8	12.3	31.9	6.6	43.8	12.7	12.2
PV (5%)	ns	**	ns	**	ns	**	**

a,b,c Mean in a column within the same category having different superscripts differ significantly ($p<0.05$) PH (cm)=plant height in centimeter, Pc%=plot cover percentage, LSR=leaf to steam ratio, Vg%=vigor percentage, SR%=survive rate percentage, FBM t/ha= Fresh biomass tone per hectare, DMY t/ha =dry matter yield tone per hectare, CV=Coefficient of variation, PV= probability value, **= highly significant, ns= None significant different.

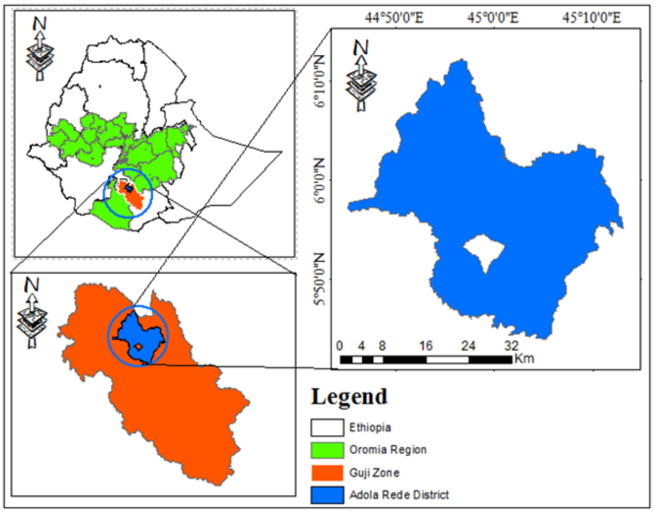

Figure 1: Map of study area.
Source: Own computational GIS data.

The difference in plot cover among the grass accessions might be attributed to differences in growth rate among the grasses accessions. The delay or slow to establish from the planted root may took time build reasonable plot cover and height. The rapidly and highly potential of plot cover were recorded from Brachiaria mutica 18659 Dzf No 483 (94.4%) and Brachiaria mutica 6964 Dzf No 484(87%) cultivars. This result is good indication for adaptability Bracharia grass with soil, water and environment of study area Machogu (2013) [17] reported that ground cover is an important attribute of any vegetation, especially in relation to soil and water conservation support this study. It is also an important parameter in restoration of degraded areas, where moisture is the main limiting factor. This result was lower than [18] who reports the plot cover for Brachiaria grass is (96-98) %. The significant variations were likely caused by various agro-ecologies, agronomic practices like harvesting time, spacing, cutting cycle, fertilizer, different soil types, and climatic factors.

Plant Height (cm): The analysis of variance for plant height in this study was indicated highly statistically significance difference ($p<0.001$) among cultivars.

The highest plant height was recorded from Brachiaria Mutica 6964 Dzf No 484 (170cm) cultivars whereas, the lowest plant height was recorded from Brachiaria Decumbence Dzf No 194 (90cm) cultivars. The various phenotypic and genetic characteristics of the species were to blame for the variations in plant height among the examined varieties. This result is agreement with Machogu (2013) [17], who reported that 91 cm height for Bracharia hybrid (Mulat II) in Kenya and higher than 50-70 cm in Northern Ethiopian [8]. The results of the current study showed that the several brachiaria grass accessions tested in the southern midland of Oromia, Ethiopia, ranged in height from 90 to 170 cm. In comparison to Brachiaria hybrid (Mulato II) grass and other cultivars of brachiaria grass assessed in Kenya's dry areas, the present result's plant height is lower than current result [18]. This difference might be due to variations of genotypes, agronomic activities, various soil and environmental adaptability.

Leaf to Stem Ratio: The analysis of variance for leaf to stem ration in this study was not indicated statistically significance difference ($p>0.05$) among cultivars. However, the least mean values of leaf to stem ratio was indicated numerically difference among cultivars. The highest leaf to stem ratio was recorded from Brachiaria mutica 18659 Dzf No 483 (0.82) cultivar and the lowest value was recorded from Brachiaria Mutica 6964 Dzf No 484 (0.4). However, this result agreement with Aldava-Navarro et al. (2017) [19] who reports the leaf to stem ratio for Brachiaria brizantha is 0.4 in Mexico.

Fresh Biomass Yield (t/ha)

The fresh biomass yield (t/ha) result among cultivars were shown statistically highly significance difference ($p<0.01$). The highest fresh biomass yield value were recorded from Brachiaria mutica 18659 Dzf No 483 (33.52t/ha) which is followed by Brachiaria mutica 6964 Dzf No 484 (33.6 t/ha) cultivar. This finding was not comparable with Gadisa et al. (2020) [20] 45.8 t/ha for Bracharia mulato in West Hararghe Zone, Eastern Oromia, Ethiopia. This much yield of fresh biomass production used as a discriminator of drought tolerant and unsusceptible genotypes for disease and adaptability to the area.

Dry Matter Yield (t/ha)

The dry matter yield (t/ha) result among cultivars were shown statistically highly significance difference ($p<0.01$). The highest dry matter yield value was recorded from Brachiaria mutica 6964 Dzf No 484 (11.95t/ha) followed by Brachiaria mutica 18659 Dzf No 483 (11.82t/ha) cultivars. According to this study, the maximum height, large, thick stems, long leaves, and greater leaf numbers of the Brachiaria Mutica species are primarily responsible for their high dry matter yields. This result is lower than Wassie et al. (2018) [8] who report that 37.75 t/ha from Eth. 13809 Bracharia cultivars in Northern Ethiopia and also lower than the result compared with that obtained by Hare et al. (2007) [21] (16.3 t/ha DM yield). Variations in dry matter yield production across the cultivars can be attributed to differences in growth rate and growth habit, which are mediated through the genotypic and phenotypic differences. According to Gadisa et al. (2020) [20] who reported the dry matter yield of brachiaria grass conducted around west Hararghe zone, eastern Oromia, Ethiopia is higher than current result. This was due to agro-ecological factor likes temperature, types of soil and topographically.

Conclusions and Recommendations

In the Guji Zone, performance testing of four brachiaria grass varieties was done in different locations during two cropping years. In this study, significant differences amongst the studied Brachiaria grass varieties were found in terms of data like number of plants that survived, plant height, leaf stem ratio, and forage DM yield. According to the findings, Brachiaria mutica Dzf No 18659 (Dzf 483) and Brachiaria mutica 6964 (Dzf No 484) were well adapted and being productive regarding the plant height, biomass yield and Dry matter yield which, is hopeful to fill the gap of low quality and quantity ruminant feed supply of the community. Therefore, of the evaluated grasses, two varieties have been chosen as enhanced, adapted variety in the study area because they have greater potential as fodder plants used for animal feed. Thus, it was advised that these two varieties be tested further and scaled up in the research locations and other regions with comparable agro-ecologies.

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