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Research Article

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Adaptation trial of *Bracharia ruziziensis* and *Bracharia decumbens* grass ecotypes in midland and lowland areas of Bale Zone, South East Oromia, Ethiopia

Aliyi Kedu*, Wubishet Tesfaye, Gemechis Lencho

Oromia Agricultural Research Institute, Sinana Agricultural Research Center, P.O. Box. 208, Robe Bale, Ethiopia

ABSTRACT

Four ecotypes of *Bracharia ruziziensis* and five *Bracharia decumbens* were separately evaluated across two locations with their respective local check under rain fed condition during 2022 to 2024. The basic Agronomic and yield data were collected. Both grass species basic Agronomic parameters such as plant height and biomass yield had shown statistically significant difference ($P<0.05$) within ecotypes. The leaf to stem ratio of dry biomass is not significantly influenced ($P>0.05$) between *B. ruziziensis* ecotypes but, within *B. decumbens* ecotypes. From the *B. ruziziensis* ecotypes the combined mean of dry Biomass yield obtained were 5.92 t ha^{-1} and the tope yielders were ILRI-14774 (7.46 t ha^{-1}) followed by the ILRI-14813, (6.66 t ha^{-1}). From *B. decumbens* ecotypes ILRI-14721 had yielded the highest average dry biomass (8.61 t ha^{-1}) followed by Local Check, (7.63 t ha^{-1}). *B. ruziziensis* ecotypes had generally shown more fitness in low land and *B. decumbense* performed similarly in both tested agroecologes. Therefore, the ecotype ILRI-14774 from *B. ruziziensis* and *B. decumbens* ecotype ILRI-14721 can be recommended for further popularization.

KEYWORDS: Grass, Ecotypes, Biomass yield, Bale zone, Midland, *Brachiaria* grass

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***Corresponding author:**
Aliyi Kedu
E-mail: lenchoabdibor041@gmail.com

INTRODUCTION

Livestock feed shortage is now a widespread problem in Ethiopia. The most common fodder crops such as fodder Oat, Napier grass and Desho grass are currently in use. A new fodder crop, *Brachiaria*, is currently getting attention of the researchers and farmers. *Brachiaria* grass is a tropical forage grass that is native to Africa. It is climate-smart forage that can help increase livestock productivity and reduce the effects of climate change. *Brachiaria* (Urochloa) grass is an excellent multi-purpose and productive pasture that can withstand high stocking rates with good persistence under continuous or rotational grazing. It adapts best to mid to high-rainfall areas and has highest dry matter yield compared to other grasses.

It can grow at 1500-2800 masl and it best performs at an altitude of 1700-2800 masl (https://kalrogaps.info/index.php/fodder/bracharia-gras).This grass is very fast growing, easy to establish and naturally palatable, good for stabilizing bund, harvested once a month during rainy season and grows at right position. It has superior yields and high-quality feed with 7% more protein than Napier. It does well in poor soils and it also improves soil health (www.simlesa.cimmyt.org/bracharia).This grasses perform excellently in field soils of average fertility, have high re-growth rates, and stand out for their high forage production and nutritive value.

Bale Zone is located between 5.36°N to 8.12°N, Altitude of 300 to 4377 masl, temperature range 10-25 °C and obtains rainfall ranging 550-1200 mm. Based on this 78.5% of the Bale zone area falls in a suitable zone to grow Brachiaria. However the adaptability of these varieties were not checked here in Bale.

The objective of the study is to evaluate adaptability of *B. ruziziensis* and *B. decumbens* grass ecotypes in mid and lowland altitude areas of Bale.

MATERIALS AND METHODS

Description of the Study Area

The activities were carried out at Delo mena subsite and Sinana on station for the three consecutive years, 2022-2024 (Table 1).

Experimental Design and Layout

Brachiaria ruziziensis and *Brachiaria decumbans* grass ecotypes originally from ILRI were brought from Fadis Agricultural Research Center to Sinana Agricultural Research Center (Table 2). The appropriate sites for the trial were selected in two locations and the lands were well prepared for the experiment. The planting were carried out during the end of June, 2022. The planting and weed control were done by hand and the experiments were managed under rain feed condition.

A randomize completed block design with three replications were used at all locations. The plot size of 6 rows; with 2 m length, at 40 cm interspacing with recommended fertilizer rate of 100 kg/ha NPS and 50 kg/ha Urea was used. Spacing between row 40 cm, b/n plot 1 m and b/n block 1.5 m were used.

Data Collected

The collected data were plot cover, stand vigor, herbage yield (using quadrant), plant height, number of tiller per plant and stem thickness. Incidence of disease, insect and weed infestation were observed and recorded.

Table 1: Basic Description of the study area

Districts	Altitude (masl)	Rainfall mm (mean)	Temp.
Dalo mena	300-1508	986.2	22.5°C
Sinana	1650-2950	1060-1130	19.5°C

Table 2: List of *B. ruziziensis* and *B. decumbance eco* types with their source for the experiment

S. No.	Acc. Number	Ecotypes	Source
1	14774	*B. ruziziensis*	ILRI
2	Local Check	*B. ruziziensis*	ILRI
3	14813	*B. ruziziensis*	ILRI
4	14743	*B. ruziziensis*	ILRI
5	13332	*B. ruziziensis*	ILRI
1	(Local Check)	*B. decumbens*	ILRI
2	13205	*B. decumbens*	ILRI
3	14771	*B. decumbens*	ILRI
4	14721	*B. decumbens*	ILRI
5	14720	*B. decumbens*	ILRI
1	10871	*B. decumbens*	ILRI

Table 3: ANOVA of Dry biomass yield of *B. ruziziensis* grass ecotypes

Sources of variation	Df	Sum Sq	Mean Sq	F value	Pr (>F)
Year	2	325.7	162.84	19.512	5.45e-07***
Location	1	25.0	25.01	2.996	0.0896 ns
Ecotypes	4	277.9	69.49	8.326	3.15e-05***
Ecotypes x Replication	8	69.0	8.62	1.033	0.4244 ns
Year x Location x Ecotypes	18	587.6	32.65	3.912	6.89e-05***
Residuals	50	417.3	8.35		

ns = non-significant. Signif. codes: '***'=0.001; '**'=0.01; '*'=0.05; '.'=0.1; ' '=1

Plant Height

The height of harvested plant was taken the ground to the tip of the plant. The average of six plant heights was taken randomly from each plot at the 90 days after establishment or 90 days after urea top dressing for re-growth data.

Estimation of Biomass Yield

The biomass yield of different Brachiaria grass ecotypes was harvested at 10 cm above the ground. Weight of the total fresh biomass yield was measured from each plot in the field using a portable balance with a sensitivity of 0.01 g and a subsample was taken from each plot to the laboratory, upon arrival at laboratory it was oven dried for 72 hours at temperature of 65 °C. The oven dried samples were weighed to determine the total dry matter yield. Then the result was converted in to dry matter ton per hectare for comparison. Sampled leaf was separated from stem to determine leaf to stem ratio. Since the area is located in bimodal rainfall area the required data was collected twice a year for three consecutive years (2022-2024). The total of six harvesting season's data were used for this paper writing.

Statistical Analysis

Prior to inferential statistics the normality, homogeneity and sorting of the data were done. During data analysis consideration were given to location as random variable and genotypes as fixed variable. The soft were program R 4.3.3 metan analysis package was used for data analysis. The data were analyzed with the model:

$$Yijk = \mu + Gi + Ej + (GE)ij + B(k) + eijk$$

Where, Yijk=Measured response of accessions (i) in Block (k), of environment (j), μ=grand mean Gi=effect of the genotype (i), Ej=Effect of the environment (j), GEij=genotype and environment interaction; Bk,(j)=effect of block k in environment j; eijk=random error of genotype i in block k of environment j.

RESULTS AND DISCUSSION

Dry Biomass Yield (DMY)

The combined analysis of Biomass yield of *B. ruziziensis* ecotypes were tested over two locations for three successive years as presented in Table 3. The result of ANOVA showed that

Table 4: ANOVA of dry biomass yield of B. decumbans grass ecotypes

Sources of variation	Df	Sum Sq.	Mean Sq.	F value	Pr(>F)	sig.
Year	2	100.41	50.21	22.452	5.26E-08	***
Location	1	1.76	1.76	0.789	0.378	
Ecotype	5	101.41	20.28	9.07	1.83E-06	***
Location X Ecotype	5	256.98	51.4	22.984	8.23E-13	***
Year X Location X Ecotype	22	242.25	11.01	4.924	4.54E-07	***
Residuals	60	134.17	2.24			

Signif. codes: '***'=0.001; '**'=0.01; '*'=0.05; '.'=0.1; ' '=1

Table 5: Major Agronomic and yield parameters performances of B. ruziziensis by year and Environment

Years	2022		2023		2024		Sinana	Dalomena	Total
Location	Sinana	Dalomena	Sinana	Dalomena	Sinana	Dalomena			
PH	62.3	105	77.8	83.8	77.8	81.8	72.63	90.20	81.42
FBM	16.6	24.7	14.6	20.5	13.2	12.2	14.80	19.13	16.97
DBMY	5.8	8.64	5.1	7.17	4.62	4.27	5.17	6.69	5.93
LS	0.869	0.844	0.89	0.857	0.88	0.743	0.88	0.81	0.85

PH = Plant height in cm; FBM = Fresh Forage Biomass yield in t ha^{-1}; DBMY = Dry Forage Biomass yield in t ha^{-1}; LS = Leaf to stem ratio

Table 6: Major Agronomic and yield parameters Performances of B. decumbens by year and Environment

Years	2022		2023		2024		Sinana	Dalomena	Total
Location	Sinana	Dalomena	Sinana	Dalomena	Sinana	Dalomena			
PH	83.3	95.2	83.4	105	83.4	81.6	83.37	93.93	88.65
FBM	21	22.6	21.2	25.8	21.3	13.8	21.17	20.73	20.95
DBMY	7.36	7.93	7.44	9.04	7.47	4.83	7.42	7.27	7.35
LS	0.94	0.72	0.66	0.79	0.70	0.78	0.77	0.76	0.77

PH=Plant height in cm; FBM=Fresh Forage Biomass yield in t ha^{-1}; DBMY=Dry Forage Biomass yield in t ha^{-1}; LS=Leaf to stem ratio

genotype, environment and their interaction were significantly ($P<0.05$) influenced the dry biomass yield.

The combined analysis of Biomass yield of *B. decumbance* ecotypes are tested over two locations and for three successive years as presented in Table 4. The result of ANOVA showed that genotype, environment and their interaction were significantly ($P<0.05$) influenced the dry biomass yield.

The combined mean of dry biomass yield over location and over three years of *B. ruziziensis* ecotypes had shown 5.92 t ha^{-1}. The result agrees with other studies reports by, Meseret *et al.* (2022), 5.47-9.27 t ha^{-1}, study conducted on *B. Molato* and other land races and below the result reported by Ketema *et al.* (2022) 6.3-11.5 t ha^{-1} and Tolera *et al.* (2021), 8.77-17.83 t ha^{-1} and Wassie *et al.* (2018).

From *B. ruziziensis* ecotypes ILRI-14774 had yielded the highest average dry biomass 7.46 t ha^{-1} followed by ILRI-14813, 6.66 t ha^{-1} (Table 5). For this type grasses related to the environment Dalomena has shown better suitability than Sinana on station.

The combined mean of dry biomass yield over location and over three years of *B. decumbens* ecotypes had shown 7.35 t ha^{-1} (Table 6). The result agrees with other findings reports by, Meseret *et al.* (2022), 5.47-9.27 t ha^{-1}, study conducted on *B. Molato* and *B. decumbances*, Ketema *et al.* (2022) 6.3-11.5 t ha^{-1} and below the result reported by Tolera *et al.* (2021), 8.77-17.83 t ha^{-1}. From *B. decumbens* ecotypes ILRI-14721 had yielded the highest average dry biomass 8.61 t ha^{-1} followed by Local Check, 7.63 t ha^{-1}.

Plant Height (PH)

Related to the plant height, a significant difference had been observed ($p<0.05$) on both Brachiaria types. The *B. ruziziensis* ecotype ILRI-14743 and *B. decumbense* ecotype ILRI-14721 had shown the highest value 93.4 cm and 96.6 cm respectively. The

Table 7: Basic Agronomic and yield performance of Brachiaria ruziziensis grass ecotypes

S. No.	Ecotypes	PH	FBM	DBMY	LS
1.	*B. ruziziensis* ILRI-14774	85.4[ab]	21.3[a]	7.46[a]	0.98[a]
2.	*B. ruziziensis* (Local Check)	65.2[c]	15.6[b]	5.45[b]	0.93[a]
3.	*B. ruziziensis* ILRI-14813	84.2[ab]	19.0[ab]	6.66[ab]	0.93[a]
4.	*B. ruziziensis* ILRI-14743	93.4[a]	14.9[b]	5.23[b]	0.99[a]
5.	*B. ruziziensis* ILRI-13332	79.0[b]	13.9[b]	4.87[b]	0.90[a]
	Mean	81.44	16.94	5.92	0.95
	CV%	22.57	20.68	20.68	15.46
	LSD (0.05)	12.3	2.35	0.82	0.08

PH = Plant height in cm; FBM = Fresh Forage Biomass yield in t ha^{-1}; DBMY = Dry Forage Biomass yield in t ha^{-1}; LS = Leaf to stem ratio

Table 8: Basic Agronomic and yield performance of B. decumbens grass ecotypes

S. No.	Ecotypes	PH	FBM	DBMY	LS
1	*B. decumbens* (Local Check)	85.40[ab]	21.80[a]	7.63[a]	0.89[a]
2	*B. decumbens* ILRI-13205	85.20[ab]	17.30[d]	6.06[d]	0.88[a]
3	*B. decumbens* ILRI-14771	79.30[b]	20.00[bc]	7.02[bc]	0.83[ab]
4	*B. decumbens* ILRI-14721	96.60[a]	24.50[a]	8.61[a]	0.84[ab]
5	*B. decumbens* ILRI-14720	90.50[ab]	21.50[ab]	7.56[ab]	0.92[a]
6	*B. decumbens* ILRI-10871	94.40[a]	20.60[cd]	7.22[cd]	0.83[ab]
	Mean	88.57	20.95	7.35	0.77
	CV%	21.82	19.42	19.48	24.24
	LSD (0.05)	12.88	2.83	0.997	0.19

PH = Plant height in cm; FBM = Fresh Forage Biomass yield in t ha^{-1}; DBMY = Dry Forage Biomass yield in t ha^{-1}; LS = Leaf to stem ratio

leaf to stem ratio was higher at Sinana than Dalomena, this indicates more leafiness of the *B. ruziziensis* at mid altitude area than low land. A higher dry biomass yield and plant height by *B. ruzizienesis* was also obtained from Dalomena this could indicate the more association of this grass type to hot environment. Unlike this; *B. decumbense* had shown comparable performance in both mid and lowland areas. This could be related to better adaptability of these grass types relatively to wider agroecology.

The overall dry biomass yield of both grass types had indicated gradual decreasing pattern which is related to advancement in the age of the plant and nutrient depilation of the soil do to nutrient uptake by the grasses for the three successive years without adequate fertilizer supplement.

Leaf to stem ratio

The Combined mean value of the leafiness of the *B. rezizienesis* ecotypes over two locations in three years were not significantly different (P>0.05) which falls in the range of (0.9-0.99) (Table 7). Whereas the significant difference was observed on *B. decumbens* ecotypes with the highest leafiness of 0.92 were obtained from ecotype ILRI-14720 (Table 8). This is comparable with reports of Tolera *et al.* (2021), Ketema *et al.* (2022) and Meseret *et al.* (2022). The leaf-to-stem ratio data has shown a significant difference between the experiment years (P<0.05). More leafiness was observed on year one of the experiment. This is related to the overpopulation of the grass bunch as the age of the grass advances.

CONCLUSION AND RECOMMENDATION

In this study, four *B. ruziziensis* and five *B. decumbens* ecotypes were compared with their respective previously adapted one at two locations for three successive years. The basic agronomic and Yield parameters had shown a better adaptation of these materials than their respective local checks. The result of ANOVA showed that genotype, environment and their interaction were significantly (P<0.05) influenced the basic Agronomic and Yield parameters such as Plant height, Dry Biomass yield, and leaf to stem ratio. *B. ruziziensis* ecotypes had generally shown more fitness in low land and *B. decumbens* performed similarly in both tested agroecology. The ecotype ILRI-14774 from *B. ruziziensis* and *B. decumbens* ecotype ILRI-14721 has yielded the highest biomass. Therefore, these two ecotypes can be recommended for further popularization.

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