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Pre-Extension Demonstration of Brachiaria Grass Technologies in Midlands of Guji Zone, Oromia, Ethiopia

Basha Kebede[1*], Tekle Bobo[2], Dembi Korji[3]
Bore Agricultural Research Center, Oromia Agricultural Research Institute, Ethiopia
Corresponding Author: Basha Kebede bsshkbd@gmail.com

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A B S T R A C T

Improved Brachiaria mutica 6964 (Dzf No 484) and mutica Dzf No 18659 (Dzf No 483) grasses were demonstrated to evaluate their biomass production and assess farmers' feedback on the farmers' field. The grass was planted on 100m2 of 14 farmers during 2022/23 and 2023/2024 seasons. Fresh biomass yield, survival rate regeneration and plot cover and plant height were collected by measurement and interview methods. Training and mini-field day were used to promote Brachiaria grass in midlands of Guji zone. The result of demonstration showed that Dzf No 483 has more survival rate 87.29% than Dzf No 484 (81.21%). Dzf No 483 was also generated more fresh biomass (37.29t/ha) than 484 (32.59t/ha). In addition, Dzf No 483 grass has more regeneration, plant height and plot cover than Dzf No 484. However, the result of independent t test showed that there was only mean difference between regeneration and fresh biomass yield of both varieties at 10% and 5% significance level. Farmers mentioned that Brachiaria grass is used for different livestock feeding. In addition, the grass is used for land conservation through mulching and erosion control.

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INTRODUCTION

Ethiopia is the country with the highest livestock population in Africa (CSA, 2020) and the tenth largest worldwide (Teweldemedhn, 2018). According to Adnew and Asmare (2023), animals serve a variety of purposes in the country, including supporting smallholder farmers and contributing to the GDP. However, due to a number of obstacles, including a shortage of sufficient and high-quality feed (Hunegnaw *et al.,* 2022; FAO, 2019) and seasonally variable feed supply (Adnew *et al.,* 2018), livestock productivity and production per head of animal are extremely low.

The country has a massive food shortage (40% on a dry matter basis) that is becoming worse when it comes to vital nutrients for animals, such as protein and energy. According to FAO (2019), there are deficiencies of 40, 50, and 55% in dry matter, crude protein, and metabolizable energy at the national level. In addition to decreasing ruminant energy use, this mismatch of dry matter and nutrients has increased enteric methane emissions, which contribute to global warming, and decreased livestock output (Zewdu, 2020). Sustainable animal production in the agricultural sector requires a methodical approach to these issues.

Natural pasture and agricultural leftovers are Ethiopia's main feed sources, but they are both deficient in nutrients and unable to meet animal needs; as a result, animals fed only these feedstuffs lost weight. The government has dedicated full efforts to increase forage cropping in recognition of the feed crisis (CSA, 2021). Therefore, it is crucial to search for additional adaptable, productive, and scalable better fodder grasses in the production system (Hunegnaw *et al.,* 2022). Methane emissions from cattle can be decreased and their nutritional requirements can be increased by producing and using higher-quality fodder species via careful selection. An important solution to this issue in tropical regions is the use of higher-quality and climate-smart fodder species (Ongadi *et al.,* 2020).

According to Adnew *et al. (*2021b) and Momesso *et al.* (2022), improved forages could increase the productivity of natural pastures, improve soil fertility through atmospheric nitrogen fixation, stabilize soil and soil microbes, sequester carbon to slow down climate change, improve natural resources and system reliance, and biologically inhibit nitrification, particularly by Brachiaria grasses. Brachiaria grass species are therefore a good choice for the current production system on the tropical ecology and adaptive to climate change. It is also known for climate-smart grass, a highly prolific and high-quality grass that can thrive on acidic soil and with little rainfall. Because of this productive characteristic, Brachiaria is a more promising enhanced fodder grass that can boost animal output and productivity and cover Ethiopia's forage deficiency in standing hay, hay, or silage forms (Hunegnaw *et al.,* 2022).

Furthermore, Brachiaria grass is being employed as a climate-smart push-pull technology (Kumela *et al.,* 2019) since the extensively grown Napier grass, particularly in the highlands, is threatened by stunt and smut diseases, which in severe situations result in a complete loss of the grass (100%) (Khan *et al.,* 2020). Using push-pull technology, Brachiaria grass is revolutionizing integrated agriculture and improving crop and livestock output around the globe (Adnew *et al.,* 2021b; Cheruiyot *et al.,* 2020).

In Guji zone there is shortage of feed production due to lack of improved feed varieties and low understanding of farmers on production and usage of improved feed varieties such Brachiaria grass. Different Brachiaria grass varieties were adapted at midlands of Guji Zone and the recommended Brachiaria grasses were not demonstrated under farmers' circumstance for larger promotion. Therefore, it is necessary to conduct promotion and demonstration on farmers land. The objectives of this activity were to evaluate performance of improved Brachiaria technologies at midland areas, to improve farmers' knowledge and skills on Brachiaria production and to assess farmers' feedbacks for further development of Brachiaria grass production at midland areas.

LITERATURE REVIEW

Adoption of Brachiaria cultivars has the potential to increase milk yield from 3 to 5 liters per cow per day at farmers' conditions in Kenya by 15–40% (Ghimire *et al.,* 2015), up to 100% (an average of 36%) (Schiek *et al.,* 2018), and 20% meat output in Rwanda (CSB, 2016). This is in line with the effects of Brachiaria grass on animal productivity. In comparison to Napier grass, Brachiaria grass feeding increased the average body weight growth of 205 g per day over a 12-week period in a controlled nourishment research conducted in Rwanda (Mutimura *et al.,* 2015). Ethiopia additionally experienced a rise in meat output by using Brachiaria grass (Adnew *et al.,* 2021a). According to Adnew *et al.* (2021a) and Tarekegn *et al.* (2023), Brachiaria grass is the most favored grass among farmers in East Africa due to its high levels of resistance to drought and disease, as well as its high palatability, nutritional value, and significant biomass yield that boosted animal productivity.

According to Marchand *et al.* (2019), demonstrations can be imagined in real-world situations that farmers can identify with. In order to participate in active bottom-up learning activities and transmit farmers' traditional knowledge and abilities to the modern era, on-farm demonstrations might be organized (Cooreman *et al.,* 2021). A demonstration event provides farmers and other stakeholders the chance to talk about technology or variety, work together to solve issues, compare methods that are comparable to their own, and become familiar with the actual actions (Ingram *et al.,* 2018). Adamsone-Fiskovica *et al.* (2021), demonstration is defined as practical interactions that participants and organizers believe produce a variety of beneficial outcomes for farmers, with a primary focus on verifying real learning opportunities and farmer empowerment. Agricultural research institutes visibly show an imperative role in on-farm demonstration to transfer their research output to be more successful on farmers land than advisory services (Kebede and Bobo, 2023).

Pre-extension demonstration, pre-scaling up, large-scale technology promotions, and participatory variety selection are used in Ethiopia to convey agricultural technology from research to farmers (Korji *et al.,* 2023). Farmers will be presented many kinds in participatory variety or technology selection, and they will determine which variety best suits their contest. In order to confirm the significance of the suggested new or improved variety or technology in their farming situation, farmers themselves took part in the pre-extension demonstration research at their land from land preparation to post management. At this point, the variety's acceptance can be determined by farmers' choices and preferences. Pre-scaling up and large-scale production can further popularize the best variety chosen during the pre-extension demonstration stage in order to boost output and optimize farmers' benefits (Kebede *et al.,* 2023). The circular link, or "research-extension-farmer linkage pillar," is the focus of Ethiopia's agricultural research system in general and Oromia in particular. Demonstration connects the research, extension, and farmer in agricultural research technology (Kebede, 2024).

METHODOLOGY

Selection Of Experimental Farmers

Improved Brachiaria grass demonstration was conducted in Adola Rede district one of the midlands of Guji zone. Based on farmers interest and number of livestock ownership two kebeles were selected from the district. Kiltu Mura and Kiltu Sorsa kebeles were selected based on their livestock population. Farmers were selected based on their interest to grow Brachiaria grass on their land. Accordingly, 14 farmers were planted brachiaria grass during 2022/23 and 2023/24 production years.

Demonstrated Brachiaria Grass Technologies

Brachiaria mutica 6964 (Dzf No 484) and Bracharia mutica Dzf No 18659 (Dzf No 483) were demonstrated on 5mx10m area. The recommended packages of 50cm between rows, 20cm between tillers, seed rate of 1000tillers/ha and 100 kg/ha NPS at planting and 50kg/ha of UREA fertilizer after tillers establishment were used for the experiment. Brachiaria grasses can be planted either by stem cutting or root splitting. In this demonstration, Brachiaria grasses were planted by root splitting method. The root was planted on prepared hole of 45^0 directions as to quickly emerge.

Agricultural Extension Methods Used

Farmers, Development Agents and experts were trained on Brachiaria production and utilization. At green stage field day was organized to make larger demand and further advertising of Brachiaria in the midlands of Guji Zone.

Methods of Data Collection and Analysis

Plot cover, plant height, regeneration, fresh biomass yield, survival rate and farmers perception on improved Brachiaria grasses were collected through interview and measurement. Land covering of the grass was evaluated on the basis of 1-5 scale where the large value given by farmers indicate plot covering of the grass and the least value indicate for least covering ability of the grass. Plant height was taken randomly from five plants in the plot. Fresh biomass yield was taken from $1m^2$ area through quadrant. Farmers were interviewed the regeneration of Brachiaria grass after harvest. Farmers were also asked the survival rate of Brachiaria grass on their land in the year. Descriptive statistics were used to analysis the quantitative data, and narration was employed to analysis of farmers' perception regarding Brachiaria grasses.

RESEARCH RESULT AND DISCUSSION

Promotion of Brachiaria Grasses

There many extension methods used for promotion of agricultural technologies. The type of promotional methods can determine applicability and usage of technology in farming condition. In this, demonstration training was intensively used to promote Brachiaria grasses. Theoretical training followed by practical training was given for selected farmers. Different types of farmers (male, female and youth) were trained on production and utilization of Brachiaria grasses during 2022/23 and 2023/24 years. Totally, 51 male adult farmers, 18 adult female farmers, 6 youth boys and 4 youth girls were trained to facilitate and promote Brachiaria grass in study areas. In addition, 12 development agents (DAs) and 12 subject matter specialists (SMSs) were trained on demonstration and production of Brachiaria grasses (Table 1).

Table 1. Training Given on Brachiaria Grasses Production

Years	Duration (days)	SMSs			DAs			Farmers				
		M	F	T	M	F	T	Male adult	Female adult	Youth boys	Youth girls	Total
2022/23	2.5	5	1	6	6	-	6	23	8	4	1	36
2023/24	2	6	-	6	6	-	6	28	10	2	3	43
Total	4.5	11	1	12	1 2	-	12	51	18	6	4	79

Training is needed to implement the demonstration of technology and usually focused on enhancing the skills and knowledge while field day is used to promote the best technology to many peoples and agroecologies (Kebede *et al.* (2024). During demonstration of Brachiaria grasses, 116 farmers, 17 extension workers and others were visited the performance of Brachiaria grasses (Table 2).

Table 2. Number of participants on mini-field day on Brachiaria grasses

Years	**Locations**	**Number of participants**											
		Farmers					Extension workers			Other stakeholders (GOs and NGOs)			Grand Total
		Young women	Adult women	Young men	Adult men	T	M	F	T	M	F	T	
2022/23	Kiltu Mura	3	10	2	26	41	9	3	12	10	2	12	65
2023/24	Kiltu Sorsa	2	10	3	60	75	4	1	5	14	-	14	94
Total		5	20	5	86	116	13	4	17	24	2	26	159

Figure 1. Mini filed day on Bracharia grass at Kiltu Mura site, Adola Rede, 2024

Performance of Brachiaria Grasses on Farmers Land

The current plant height of Dzf No 483 (131.29cm) and Dzf No 484 (123.07cm) were greater than the result of Adnew *et al.* (2019) and Wassie *et al.* (2018) on different altitudes (lowland, midland and highland) and (Getiso *et al.*, 2022) found that 63.33cm of Brachiaria Mutica was obtained by irrigation system. Based on Getiso *et al.* (2022) the result of this demonstration revealed that there is a potential in midland of Guji zone for Brachiaria production with rainfall. Such height is important in increasing fresh biomass for livestock feed through chopping methods. In this demonstration, Brachiaria mutica Dzf No 18659 (Dzf No 483) covered the plot more than Brachiaria mutica 6964 (Dzf No 484). Out of five values experimental farmers rated 3.79 and 3.55 mean Dzf No 483 and Dzf No 484 3.79, respectively.

Brachiaria grass is a perennial grass used for livestock feed. In each harvest it gives feed throughout the year with minimum moisture conditions. In this demonstration, the regeneration of Brachiaria varieties was evaluated by farmers. Farmers responded that Brachiaria mutica Dzf No 18659 (Dzf No 483) has more regeneration capacity (81.83%) than Brachiaria mutica 6964 (Dzf No 484) which was 75.71%. This result was similar to Gadisa *et al.* (2020) where Dzf No 483 has more regeneration than Dzf No 484 in Eastern Oromia.

More fresh biomaas yield (37.29t/ha) was harvested from Brachiaria mutica Dzf No 18659 (Dzf No 483) followed by Brachiaria mutica 6964 (Dzf No 484) (32.57t/ha). For livestock feed biomass yield is the most traits expected from forage production. The result of fresh biomass yield in this demonstration was greater than 30.5-33.6 t/ha from the current demonstrated Brachiaria grasses (Gadisa *et al.*, 2020; Ketema *et al.*, 2022). This indicated that similar to Ketema *et al.* (2022) the result of Dzf No 483 and Dzf No 484 grasses were important for livestock feed in midland of Guji zone. The fresh biomass yield obtained from this demonstration was lower than the Tarekegn *et al.* (2023) who obtained 36-88 t/ha on different Brachiaria grass species.

Demonstrated Brachiaria grasses were adapted to the weather condition of midlands of Guji zone. The survival of Dzf No 483 and Dzf No 484 were 87.29% and 81.21%, respectively. This showed that the grasses were tolerant to drought during dry season and frost during wet season. Recently, feed for livestock and crop production in midland of Guji zone is frequently affected by drought. However, currently demonstrated Brachiaria grasses were tolerant to drought and the best grass used for livestock feed.

Table 3. Performance of Brachiaria grasses on farmers land

Parameters	Variety demonstrated	N	Mean	Std. Dev.
Plot cover scale (1-5)	Brachiaria mutica 6964 (Dzf No 484)	14	3.55	1.010
	Brachiaria mutica Dzf No 18659 (Dzf No 483)	14	3.79	0.914
Plant height (cm)	Brachiaria mutica 6964 (Dzf No 484)	14	123.07	20.262
	Brachiaria mutica Dzf No 18659 (Dzf No 483)	14	131.29	23.828
Regeneration (%)	Brachiaria mutica 6964 (Dzf No 484)	14	75.71	7.559
	Brachiaria mutica Dzf No 18659 (Dzf No 483)	14	81.93	10.111
Fresh biomass (t/ha)	Brachiaria mutica 6964 (Dzf No 484)	14	32.57	5.199
	Brachiaria mutica Dzf No 18659 (Dzf No 483)	14	37.29	6.082
Survival rate (%)	Brachiaria mutica 6964 (Dzf No 484)	14	81.21	11.801
	Brachiaria mutica Dzf No 18659 (Dzf No 483)	14	87.29	8.175

The result of independent t test showed that Dzf No 483 and Dzf No 484 Brachiaria grasses were differ in terms of regeneration and fresh biomass parameters. There was a mean difference in regeneration trait of improved Dzf No 483 and Dzf No 484 Brachiaria grasses at 10% significance level and 5% significance level for fresh biomass yield (Table 4).

Table 4. The result of Independent Samples Test

Parameters		t test for equality of means			
		t	Df	Sig. (2-tailed)	Mean Difference
Plot cover scale (1-5)	Equal variances assumed	0.638	26	0.529	0.232
	Equal variances not assumed	0.638	25.742	0.529	0.232
Plant height (cm)	Equal variances assumed	0.983	26	0.335	8.214
	Equal variances not assumed	0.983	25.345	0.335	8.214
Regeneration (%)	Equal variances assumed	1.842	26	0.077	6.214
	Equal variances not assumed	1.842	24.074	0.078	6.214
Fresh biomass (t/ha)	Equal variances assumed	2.205	26	0.037	4.714
	Equal variances not assumed	2.205	25.386	0.037	4.714
Survival rate (%)	Equal variances assumed	1.582	26	0.126	6.071
	Equal variances not assumed	1.582	23.142	0.127	6.071

Farmers' Perception on Demonstrated Brachiaria Grass

Farmers mentioned that Brachiaria grass is used for different livestock feeding. In addition, the grass is used for land conservation through mulching and erosion control. There many areas not suitable for ploughing due to hill topography. Such land is suitable for Brachiaria production as intensification of land is important because Brachiaria is used as both soil conservation and in another way it is used for livestock feeding. Through its deep root and long root splits helps soil conservation. Farmers mentioned that in additional to livestock feeding the demonstrated Brachiaria grasses were used as home decoration during holidays.

CONCLUSIONS AND RECOMMENDATIONS

Brachiaria mutica Dzf No 18659 (Dzf No 483) and Brachiaria mutica 6964 (Dzf No 484) were demonstrated on farmers. The result demonstration showed that except regeneration and fresh biomass parameters both brachiaria grasses showed similar characteristic regarding plot cover, plant height and survival rate. In addition to livestock feeding, the grasses were also used as soil conservation, mulching and home decoration during holidays. Since both grasses were good on covering the land, survival rate and fresh biomass yield farmers should either Brachiaria mutica Dzf No 483 or Dzf No 484 for feed production.

Therefore, both Brachiaria mutica Dzf No 483 and Dzf No 484 grasses can be popularized through pre-scaling up in midlands of Guji zone.

ADVANCED RESEARCH

This demonstration was conducted only on one district. Therefore, it is necessary to promote improved Brachiaria grasses in many midlands of Guji zone.

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