International Journal of Scientific Engineering and Science
Volume 4, Issue 6, pp. 20-23, 2020. ISSN (Online): 2456-7361

Screening of Different Bracharia Accessions Tolerant to Acid Soils in Awi Zone, Ethiopia

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***Abstract*—** *The experiment was conducted to screen acidic soil tolerant bracharia accessions. It was conducted in Awi Zone Banja research station with soil PH of 4.69. Seven bracharia grass accessions (BD14720, BD14721, BR13332, BR14743, BR14771, BR14777 and BR14813 were used as treatment materials. Randomized complete block design was used for the experiment. The collected data were analyzed using ANOVA procedure of SAS version 9.4. Dry matter yield was found higher in accessions BD14720 and BR14813. No difference was recorded on CP yield per hectare between bracharia accessions. DM, Ash, OM, CP, NDF, ADF, ADL and IVDMD were showed high difference between treatments. The organic matter content was higher for BD14720 bracharia variety/accession. The CP percentage was higher for BR14771, BR14743 and BR13332, 9.82, 9.72 and 7.57, respectively. In case of areas where feed availability is major problem, forage varieties which give higher dry biomass yield could be more preferable. The crude protein requirement could be fulfilled through supplementation of protein source feeds. Therefore, BD14720, BR14813, BR14777 and BD14721 accessions in ascending order would be appropriate alternative feed resources for acidic soils of Awi Zone.*

***Keywords*—** *Acid soil, Dry matter yield, crude protein yield and Banja district.*

I. INTRODUCTION

A chronic feed deficit represents a major constraint to animal production in many developing countries. The situation manifests itself in poor animal performance, low growth rates, reduced reproductive efficiency, high mortality rates, etc. The genetic potential of many farm animals is inadequately exploited and the outputs of animal production such as meat, milk, eggs, fiber and skins, often fall far short of national requirements.

In the highlands, because of expansion of cultivation, the area of land allocated to grazing progressively declined through time (Alemayehu, 2002; Zerihun, 2002), which affected the availability of feed resources which in turn affect livestock production in the highlands of Ethiopia, where natural pasture and crop residues are the major sources of feed supply to livestock (Seyoum and Zinash, 1995; Zinash et al., 1995; Zerihun, 2002).

In Awi Zone, at Banja district, almost all small-scale farmers' livestock are highly dependent on grazing lands and crop residues for few months. However, most of the areas have no communal grazing lands or very little in size or over-grazed or there is no forage conservation management practice (informal survey and personal communication). Besides, due to low fertility acidic soil the existing pasture productivity is decreasing and degrading. Unless the feed supplies are increased, it is impossible to maximize productivity from the indigenous animals with the existing traditional rearing system even to fulfill the maintenance requirement.

Introducing different types of improved forage species with different mode of use like over sowing, under sowing, mixed or pure stand is essential. Besides evaluating and characterizing the existing indigenous forage resources, research efforts have to be made to define the physiological basis of plants to increase ability of adaptation to acid soils, that could in turn, will lead to improved selection and breeding; the identification of plant-soil, plant-plant, and soil-plant-animal nutrient interactions in forage-based production systems; and improved identification of ecological niches for forage germplasm (CIAT).

The factors that contribute to the low fertility of acid soils and the consequent effects on pasture growth is complex (Rao et al., 1993). Factors that limit pasture productivity and which have been associated with the acid-soil stress complex include Al and manganese (Mn) toxicities and deficiencies of P, nitrogen (N), potassium (K), calcium (Ca), magnesium (Mg), sulfur (S), zinc (Zn), and molybdenum (Mo).

Thus, tackling feed problems by screening of most adaptable and promising forage species should be given priority to develop superior genotypes that combine several desirable traits (like acidic soil tolerance as well as suitability to agro ecology of the zone) to improve pasture productivity and combat pasture degradation. Therefore, the objective of this study was to select adaptable and promising grass lines/accessions that can tolerate acidic soil within Injibara agro ecological zone and to analyze the nutrient content of well performed forage grass and legume lines /accessions

II. MATERIAL AND METHODS

Description of the Study Site

The study was conducted at Banja sub-station in Banja District of Awi Administrative Zone, Amhara Regional State, Ethiopia. The District is located at latitude of 10°57′17′′ to 11° 03′05′′ north and longitude of 36°39′09′′ to 36°48′25′′ east and 122 km far from the regional city Bahir Dar to south and 447 km north west of Addis Ababa. It has an elevation ranges between 1870 and 2570 m a.s.l. The sub-station is located at latitude of 10° 56’ 27-53’’ and longitude of 36° 52’ 27-55’’, an altitude of 2489 masl and 130 km South of the regional city Bahir Dar and 460 km North West of Addis Ababa. According

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to National Meteorology Agency weather data from 1984 to 2017, the mean minimum and maximum temperatures of the study area were 10.3 and 22.5 °C, respectively. The mean annual rainfall is 1344 mm with main wet season from June to September usually continued with a less pronounced wet period up to November

The parent material is made up of the volcanic rock and quaternary basalts. The major soil types include Andisols, Nitosols, and Cambisols. Generally, the soil types of the study area are characterized with shallow, moderate to deep and very deep in depth and sandy clay to clay texture types (Alemayehu,2015). The experimental site has average PH value of 4.69 and total nitrogen of 0.23%.

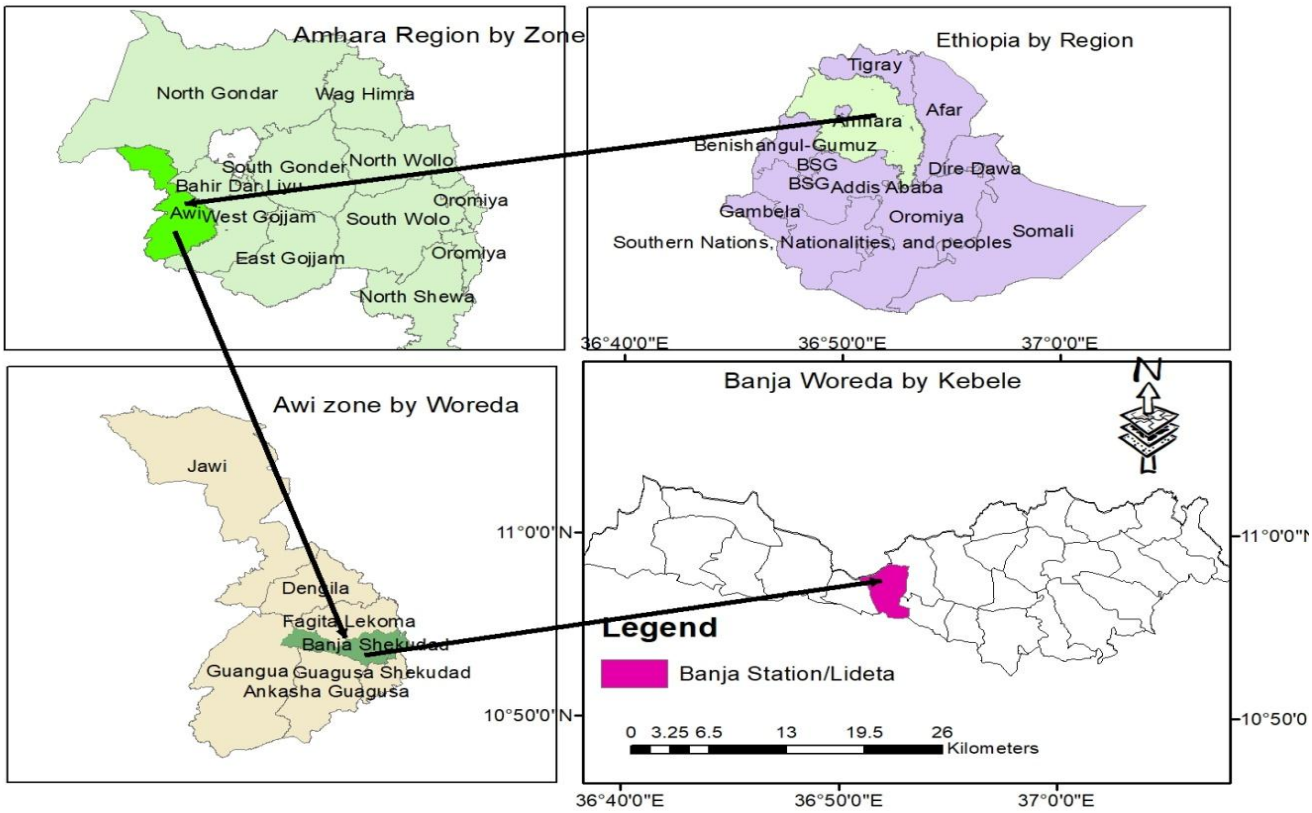

Fig. 1. Location map of the study area, Banja district, north western Ethiopia

Source: Mesfin Kuma, 2019

Experimental Materials and Management

The root splits of seven Bracharia accessions known for their acidic soil tolerance were collected from Holleta Agricultural Research Center and established at Injibara research sub-station. Agronomic and growth data were taken from land preparation to harvesting of the grass. Plant height was taken from ten randomly selected plants from each plot and averaged. Leaf to stem ratio was calculated by dividing the weight of leaf to weight of stem and leaf and stem percentage was calculated from samples weight of grass by carefully separating leaf and stem. Fresh total biomass and dry total biomass were weighed and converted in to yield per hectare. Crude protein yield per hectare was calculated from total dry biomass yield multiplied by the percent crude protein content of bracharia accessions. At the stage of ten percent flowering the grass has harvested, samples taken for determination of leaf and stem and subsamples taken to determine dry matter using 72 hours oven drying in 60^{o}c. The laboratory sample was ground to pass 1mm sieve size properly packed and sent to Holleta Agricultural Research Centre nutrition laboratory to determine ash, organic matter (OM), crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), acid detergent lignin (ADL) and invitro dry matter digestibility (IVDMD).

Statistical Analysis

Data was collected accordingly, cleaned and analyzed using the ANOVA procedure of SAS version 9.4. The means were separated using list significance difference (LSD).

III. Result and Discussion

Yield and Yield Components of Grass Varieties

The yield and yield components of Bracharia grass accessions was presented in Table 1. No significance difference was observed in PH between verities/accessions. Numerically variety/accession BR13332 shows higher plant height than others. The dry biomass yield of bracharia accessions was higher in accessions BD14720 and BR14813. Crude protein yield per hectare was not different between accessions. Higher protein yield was recorded from BR14813

followed by BR14777 and BD14720. In case of areas where feed availability is major problem, forage accessions which give higher dry biomass yield could be more preferable. The crude protein requirement could be fulfilled through supplementation of protein source feeds. Therefore, BD14720 and BR14813 accessions would be appropriate alternative feed resources for acidic soils of Awi Zone.

TABLE 1. Yield and yield components of bracharia accessions

Variety	Parameters						
	PH	LSR	Leaf%	Stem%	FTPH	DTPH	kgCP
BD14720	54.57	1.59	56.58	40.47	91.95^{a}	19.45^{a}	733.96
BD14721	51.73	1.72	57.72	36.89	72.50^{abc}	15.00^{abc}	719.65
BR13332	77.73	1.61	46.56	34.14	31.20^{bcd}	7.54^{bcd}	604.96
BR14743	66.77	1.49	49.11	36.64	21.39^{cd}	4.92^{cd}	481.52
BR14771	68.70	2.29	57.83	37.28	14.63^{d}	3.39^{d}	331.87
BR14777	42.40	1.71	61.00	38.36	81.30^{ab}	15.41^{ab}	848.76
BR14813	42.87	1.94	63.36	35.03	86.39^{ab}	19.05^{a}	881.04
CV%	60.81	54.60	23.84	36.45	83.30	72.76	86.04
SL	0.51	0.82	0.31	0.99	0.02	0.01	0.62

*** = Significant at alpha 0.001; ** = Significant at alpha 0.01; * = Significant at alpha 0.05; PH = Plant height; LSR = Leaf to Stem ratio; FTPH = Fresh biomass yield ton per hectare; DTPH = dry biomass yield ton per hectare; kgCP = Crude protein yield kilograms per hectare; CV = Coefficient of Variation; SL = Significance level.

Chemical Composition of Bracharia Accessions

Chemical composition of experimental grass verities/accessions was presented in Table 2. All parameters of chemical composition of grasses were different. The dry matter content of bracharia grass accessions were ranging from 92.17 to 93.23%. The crude protein (CP) content was higher in bracharia grass accessions BR14771 and BR14743 followed by BR13332. The CP value ranges from 3.25 to 9.82% among the grass accessions and is comparable to bracharia Mulatto II cultivar harvested at 120 days (9.36%) (Wubet Adinew *et al*, 2019). The CP content of BR14771, BR14743 and BR13332 bracharia accessions can fulfil the maintenance requirement of ruminant animals. The CP content >7% is adequate for proper function of rumen microbes and to meet maintenance requirement of animals (Van Soest 1994), given other factors such as lignification does not limit feed digestibility and nutrient utilization.

TABLE 2. the chemical composition of bracharia accessions

Variety	Parameters							
	DM	Ash	OM	CP	NDF	ADF	ADL	IVDMD
BD14720	93.23^{a}	10.24^{d}	89.76^{a}	3.25^{c}	71.80^{a}	41.18^{a}	5.46^{a}	51.11^{bc}
BD14721	93.22^{a}	11.33^{c}	88.68^{b}	3.99^{c}	68.63^{bc}	41.12^{a}	5.05^{b}	51.17^{bc}
BR13332	92.77^{b}	12.94^{b}	87.07^{c}	7.57^{b}	67.57^{c}	38.39^{b}	4.69^{cd}	54.34^{ab}
BR14743	92.17^{c}	15.03^{a}	84.97^{d}	9.72^{a}	64.60^{d}	37.68^{b}	4.47^{d}	54.83^{a}
BR14771	92.36^{c}	14.62^{a}	85.39^{d}	9.82^{a}	64.87^{d}	37.21^{b}	4.52^{d}	54.83^{a}
BR14777	93.32^{a}	11.59^{c}	88.45^{b}	5.04^{c}	69.48^{b}	40.48^{a}	4.92^{bc}	51.91^{ab}
BR14813	93.38^{a}	11.13^{c}	88.88^{b}	3.79^{c}	69.17^{b}	41.37^{a}	4.82^{bc}	47.69^{c}
CV%	0.24	6.00	0.85	27.07	2.00	3.42	4.48	5.77
SL	***	***	***	***	***	***	***	***

*** = Significant at alpha 0.001; ** = Significant at alpha 0.01; * = Significant at alpha 0.05; DM = Dry matter; OM = Organic matter; CP = Crude protein; NDF = Neutral detergent fiber; ADF = Acid detergent fiber; ADL = Acid detergent lignin; IVDMD = Invitro dry matter digestibility; CV = Coefficient of Variation; SL = Significance level.

IV. Conclusion and Recommendations

The study was conducted to screen best acidic soil tolerant bracharia accessions at highland of Awi Zone with soil PH value of 4.69. Highland areas of Awi Zone were affected by soil acidity thereby livestock feed shortage become the major challenge for livestock production. The experiment was conducted in the area representing most of Awi Zone areas with acidic soil.

Result shows that, BD14720 and BR14813 can have higher dry biomass yield (19.45t/ha) and (19.05t/ha), respectively, followed by BR14777 (15.41t/ha) and BD14721 (15.00t/ha). The CP yield per hectare was recorded higher for BR14813 (881.04 kg/ha) and BR14777 (848.76 kg/ha). These indicates that the higher biomass yield with good quality forage could be produced in acidic soil of Awi Zone and other similar agroecology of the country.

In terms of nutrient composition, the dry matter content of bracharia grass accessions were ranging from 92.17 to 93.23%. The crude protein (CP) content was higher in bracharia grass accessions BR14771 and BR14743 followed by BR13332. The CP value ranges from 3.25 to 9.82% among the grass accessions. In case of areas where feed availability is major problem, forage varieties which give higher dry biomass yield could be more preferable. The crude protein requirement could be fulfilled through supplementation of protein source feeds. Therefore, BD14720, BR14813, BR14777 and BD14721 accessions in ascending order would be recommended alternative feed resources for acidic soils of Awi Zone.

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