Evaluation of Elephant Grass (*Pennisetum purpureum* L) Accessions for Their Agronomic Performances in Lowland Areas of Guji Zone, Southern Oromia, Ethiopia

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Abstract: The study was conducted with the objectives to identify and select better adaptable, higher herbage yielding forage variety. Six elephant grass accessions (ILRI#16791, ILRI#16798, ILRI#16840, ILRI#16800, ILRI#16819 and ILRI#15743) were arranged in randomized complete block design (RCBD) with three replications. All agronomic parameters and biomass yield of forage samples were determined and collected data were examined using statistical analysis. The result revealed that the agronomic performance of plot cover, plant vigor, leaf to stem ratio, leaf length and plant height were not show significant difference (P>0.05) between elephant accession. The result revealed that survive rate, number of leaf per plants, number of tiller per plants and number of node per plants were highly significantly (P<0.001) differ among the treatments. The result revealed that dry matter yield and number of plant regenerate were shown that significant (P<0.05) among the treatments. The highest value of dry matter yield was measured from ILRI#16791 (12.11 t/ha) accession. The highest survive rate (88.8%) was measured from ILRI#16791 accession, followed by (75.5%) ILRI#16819 accession. The result implies that ILRI#16819 and ILRI#16791 were well performed in agronomic parameters. Thus it could be possible to conclude that the elephant grass should be recommended for improving the constraint of feed shortage in lowland agro-ecologies of Guji zone and similar areas.

Keywords: Lowland, Evaluation, Agronomic Performance, *Pennisetum purpureum*

1. Introduction

Napier grass (*Pennisetum purpureum* (L.) Schumach*)*, also known as elephant grass, originated from sub-Saharan tropical Africa [3].

Elephant grass is a tall and deep-rooted perennial bunch grass well known for its high yielding capability and mainly used for cut-and-carry feeding systems [6] and fed in stalls, or it is made into silage or hay. It performs well in low, mid and highland areas of Ethiopia [15, 18].

It grows best at high temperatures but can tolerate low air temperatures under which the yield can be reduced and ceases to grow at a temperature below 10°C [8].

The herbage can be killed by light frosts but the underground parts remain alive unless the soil is frozen and growth resumes rapidly when conditions become ideal [8]. It is propagated vegetative by using stem cuttings, root splits or shoot tips which usually vary across agro-ecologies [10].

Elephant grass can provide a continual supply of green forage throughout the year and best fits in all intensive small scale farming systems [1]. It is a fast growing and has a high annual productivity that depends on the climatic conditions, especially of temperature and rainfall and it can produce biomass yield of 20-30 t DM/ha/year with good agronomic and management practices [7].

Elephant grass can adapt to a wide range of soil types from sandy to clayey. It can also grow in soils in the pH range of

highly acidic to alkaline (Centre for New Crops and Plant Products, 2002).

Elephant grasses are principally used for cut-and carry fodder for animals and used as forage for Livestock to provide a continual supply of green forage throughout the year and it fits intensive small scale farming (Alemayehu Mengistu 1997).

It is also sometimes cut for hay and to ferment into silage for dry season feeding, good nutritive value and mostly used for cut and carry system over the tropical and sub-tropical area of the world [4, 5, 19].

The plant is tall with multiple nodes providing sites for bearing long leaves. Long intermodal intervals permit efficient light distribution through the canopy. Leaves are long and narrow, thus providing the leaf area without hampering canopy wide light distribution.

To improve availability of livestock feed in terms of quantity and quality, it is better to cultivate elephant grass forage that have better biomass yield and nutritional quality. Therefore, the objective of the present study was to evaluate the adaptability potential good biomass yield, herbage dry matter yield of elephant grass accession grown under lowland areas of Guji zone.

2. Materials and Methods

2.1. Description of the Study Area

The experiment was carried out at Bore Agricultural Research Center, which is one of the recently established Research Centers of the Oromia Agricultural Research Institute (OARI) in Bore district, Guji Zone, Southern Oromia. Bore district is located at 385 km to the south Oromia from Finfinne and 220 km from the Guji Zone capital city (Negele) with geographical location of 557'23" to 626'52" N latitudes and 3825'51" to 3856'21" E longitudes, South-eastern Oromia. The annual rain fall is about 1400-1800mm and the annual temperatures of the district ranged from 10.1 to 20°C. The major soil types of the site is mostly black soil.

The research site represents lowland of Guji Zone at Gorodola district located at distance of 565 km from Addis Ababa and 30 km from the Zonal capital city, Negele Borena. The District is situated at which is located between located between 4°56'15" - 5°48'00" northing latitudes and 39°43'00" - 39°6'30" easting longitudes, with an altitude of 1100 m.a.s.l. receiving high rainfall characterized by bimodal distribution. The annually temperature of the district range from 25°C and 27°C and annual rainfall depth varies in the range from 500 mm to 700 mm with mean value of 600 mm by two type of rainy season, namely season summer (locally name "Gana") which starts in early march up to June, and autumn (locally name" hageya"), which starts late September up to reaches beginning of November. The total area of the district is 2491.570 km^2. The Gorodola peasants association under study area where mixed farming economic activities take place, which is the major livelihood of the people and communities of the district depend up on pastoralist and some of them are agro pastoralist. The major soils of the district are Nitosols (red basaltic soils) and Orthc Acrosols. The two soils are found on the highland areas, and they are red brown and black brown in colors and on sloping terrain and their utilization are good under natural vegetation respectively. And also the major soil types of district sand, clay most of the times these soils expose for erosion; therefore it has little agricultural potentials (SAC profile of Goro dola District office, 2003).

2.2. Experimental Treatments and Design

The six elephant grass genotypes included for this experiment were ILRI#16840, ILRI#16819, ILRI#16800, ILRI#16791, ILRI#15743, and ILRI#16798. The planting material of the accessions were brought from Bako agricultural research center. The propagation of elephant grass is by root splits and stem cutting with three nodes planting upright by burying two basal nodes into soil. Accessions were planted at the beginning of the main rainy season in 5 × 2.5 m plot using a randomized complete block design (RCBD) with three replications.

Elephant grass is propagated vegetative by using stem cuttings, root splits or shoot tips [17]. The root splits were planted in rows with five rows per plot. A total of 25 root splits were planted per plot with the intra and inter row spacing of 0.5 m and 1 m respectively, giving a density of 20,000 tillers/ha. There were 1.5 m width between blocks and 1m width between plots. Stem cuttings with three nodes were planted to a depth of 15 to 20 cm at an angle of 45° [9, 14]. Fertilize rate was uniformly applied to all plots in the form of nitrogen phosphate sulfate (NPS) at the rate of 100 kg/ha. After every harvest, the plots were top dressed with 50 kg Urea/ha of which one-third applied at the first shower of rain and the remaining two third applied during the active growth stage of the plant. All other crop management practices were used uniformly to all genotypes as recommended.

2.3. Data Collection

All agronomic data like plant survival rate, number of tillers per plant, number of leaf per plant, leaf length per plant, plant height, Number of node per plant, forage DM yield and leaf to stem fractions were collected.

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.

Plant height 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.

In order to measure dry matter yield, the harvested fresh sample was measured right in field by sensetive 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 65°C for dry matter determination. Then dry matter yield (t/ha) was calculated by [12] 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/m to t/ha.

In order to measure leaf to stem ration, the morphological parts were separately weighed to know their sample fresh weight, oven dried for 24 h at a temperature of 105C and separately weighed to estimate the proportions of these morphological parts. Accordingly, leaves were separated from stems and the fractions were estimated based on the dry weight of each component.

2.4. 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:

$$Yijk = \mu + Aj + Bi + eijk$$

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, eijk = the random error.

3. Result and Discussion

3.1. Performance of Elephant Grass Accessions

The performances of elephant grass accessions were shown in Table 1. The result indicated that the tested accessions were highly significantly (p<0.01) on survive rate percentages. The highest survive rate percentages were recorded from ILRI#19791 (88.8%) followed by ILRI#16819 (75.5%) accessions. The lowest survive rate percentage was recorded from ILRI#16798 (62.8%). This varied is due to different accessions, soil types and moisture with environmental factors. This value was lower than [2] that reports from 79.8 to 100%. The higher survival rate of accessions might be due different soil types, with the environment than the newly introduced genotypes.

The result of regenerate percentage was indicated significance difference (P<0.05) among elephant grass accessions. This result indicated that the potential adaptability and productivity of accessions were different. The rapidly and highly potential of regenerate were recorded from ILRI#16791 (88.8%) followed by ILRI#16819 and ILRI#16840 (73.3%) accessions. This result is good indication for adaptability elephant grass with soil, water and environment of study area.

3.2. Plant Height (cm)

The mean average of plants height at study area were non-significant (P>0.05) different between treatments.

The highest plant height was recorded from ILRI#16819 (233.5 cm) accession whereas, the lowest plant height was recorded from ILRI#16800 (126.2cm) accessions. This result is numerically different. This result was almost agree with result reported by [11] 216.6 cm harvesting on time of elephant grass important for good nutritive value and reduction of defoliation of appropriate management. This idea is the same as major agronomic practices required, harvesting of elephant grass at appropriate cutting height and defoliation frequencies are very important to improve DM yield and nutritive values of this plant [17].

3.3. Leaf to Stem Ratio

The analysis of variance for number of leaf per plant in this study was indicated statistically significance difference (p<0.05) among accessions. The highest number of leaf per plant was recorded from ILRI#16819 (17.67) accession and the lowest value was recorded from elephant grass ILRI#15743 (13.3).

3.4. Number of Tiller Per Plants

The number of tiller per plant result among accessions were shown statistically highly significance difference (p<0.01). The number of tiller per plant value were recorded from ILRI#16819 (19.6) which is followed by ILRI#16791 (14.5) accessions. The lowest number of tiller per plant was recorded from ILRI#16800 (7.4) accession. The result studied was agree with result reported by values by [11] which ranged from 9-12 tillers per plant from Ethiopia. The variation tiller number due to different genetic variation, soil fertility, soil moisture and environmental factors. This idea is agree with the variation of elephant grass tillers per plant reported under central Kenya by [13].

3.5. Dry Matter Yield (t/ha)

The dry matter yield (t/ha) result among accessions were shown statistically highly significance difference (p<0.01). The highest dry matter yield value were recorded from ILRI#16791 (12.11t/ha) followed by ILRI#16840 (10 t/ha) accessions. The lowest dry matter yield was recorded from ILRI#16798 (7.7 t/ha) followed by ILRI#16800 (8.17 t/ha) which harvested 3 months age interval. This result is lower than the other findings of which was 41.05 t/ha at 4 months age as reported by [2] and also lower than result reported by [9] which ranged from 12-18 t/ha elephant grass varieties under rain fed condition.

Variations in dry matter yield production across the genotypes can be attributed to differences in growth rate and might be due to the proportional increment of dry matter yield with advance in age of cutting [18].

The number of node per plant result were shown that statistically highly significance difference (p<0.01). The highest number of node per plant was recorded from ILRI#16819 (12.3). The lowest number of node per plant was recorded from ILRI#16840 (8.4). Agronomic traits, stem elongation also influenced by variation in soil type,

temperature, amount and distribution of rainfall, genotypes and accession by year interaction effects.

Table 1. *Over all three location mean agronomic performance of Elephant grass genotypes at lowland area.*

Genotypes	Parameters										
	SR %	RG %	Pc%	Vg%	LSR	PH (cm)	NLPP	LL (cm)	NTPP	NNPP	DMY t/ha
ILRI#16840	73.3[ab]	73.3[b]	86.9	87.9	0.67	131.9	15[bc]	80.3	14.4[abc]	8.4[b]	10.0[ab]
ILRI#16791	88.8[a]	88.8[a]	85.1	86.9	0.72	126.6	14[c]	62.6	14.5[ab]	8.9[ab]	12.11[a]
ILRI#16819	75.5[ab]	73.3[b]	87.8	86.05	0.66	133.5	17.67[a]	68.1	19.6[a]	12.3[a]	9.17[ab]
ILRI#16800	71[b]	64.4[b]	77.7	84.6	0.71	126.2	14.6[bc]	72.8	7.4[c]	8.12[b]	8.17[b]
ILRI#16798	62.8[b]	62.2[b]	82.3	83.7	0.74	129	16.3[ab]	80.7	10.4[bc]	9.4[ab]	7.7[b]
ILRI#15743	68.8[b]	66.6[b]	91.6	93.4	0.71	128.2	13.3[c]	82	11b[c]	9.1[ab]	8.39[b]
Mean	73.3	71.5	85.3	87.1	0.705	129.2	15.17	74.5	12.0	9.3	9.24
CV	12.4	14.5	13.6	12.6	32.8	19	11.5	39	29.3	21.3	28.4
LSD (%5)	**	*	Ns	Ns	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, RG%=Regenerate percentage, NTPP=number of tiller per plants, NLPP= number of leaf per plants, LL=leaf length in centimeter, NNPP=Number of node per plants, DMY t/ha =dry matter yield tone per hectare, CV=Coefficient of variation, LSD= Least significant difference, *=significant difference, **= highly significant, Ns= None significant different.

4. Conclusions and Recommendations

The result implies that elephant grass accessions ILRI#*16819 and* ILRI#*16791* were well adapted and being productive regarding the Survive rate, regenerate and Dry matter yield which, is hopeful to fill the gap of low quantity ruminant feed supply of the community.

The current study indicated that elephant grass accessions ILRI#16819 and ILRI#16791 were good agronomic performance at study area.

Therefore, based on its adaptability, Survive rate, regenerate and dry matter yield elephant grass accessions ILRI#16819 and ILRI#16791 is recommended for further promotion in the Lowland agro-ecologies of Guji zone and similar areas.

Acknowledgements

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