

On-farm Performance Evaluation of Selected Perennial Grass under Rain-Fed Conditions at Deghabour District, Cherer Zone, Ethiopian Somali Region

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Abstract

The study was conducted to evaluate the adaptability and performance of some improved perennial forage species. Completely randomized block design were employed with three treatments and the treatments were replicated three times. The seeds of the forage species were row planted on finely prepared seed bed on nine plots. At the end of the experiment sample from forage species were taken analyzed for nutritional value. Crude protein, dry matter, ash, NDF and ADL were analyzed in Haramaya university nutrition laboratory. Data on plant height, numbers of branch per plant, fresh and dry biomass yield, germination and maturity date of the experimental treatments were collected and analyzed by using general linear model procedure of SAS. The germination and maturity date of the experimental treatments are presented. Analysis of variance shows that there no significant different among the treatments in both parameter. However the germination date of panicum maximum slightly earlier than the other two treatments and also late maturity compared to buffalo grass and Rhodes grass. The biomass yield both in terms of fresh and dry biomass of the experimental treatments in this study are significantly different ($P < 0.0001$). The fresh biomass yield of panicum maximum is significantly greater than both Rhodes grass and buffalo grass. Similarly the dry mass yield of panicum maximum is significantly larger than the other two treatments ($P < 0.0001$). According to the finding of the current study, the mean plant height and branches per plant of the experimental treatments are presented. The analysis of variance shows that there are significant different in the number of branches, but the plant height for Rhodes grass is significantly larger than the other experimental treatments (buffalo grass and panicum maximum). The results of the laboratory analysis and estimation of nutritive values of the different experimental treatments are shown. The study revealed that the dry matter percentage of the three treatments, buffalo grass, Rhodes grass and panicum maximum are 92.96, 92.57 and 92.81 respectively, which indicate there is no significant different in dry matter percentage among the treatments. The crude protein content of Rhodes grass (15.49) is numerically larger than buffalo grass (13.37) and panicum maximum (14.17). As a conclusion, introduction of improved perennial forage species such as buffalo grass, Rhodes grass and panicum maximum in the study area revealed better performance. Therefore, based the finding of the current study the following future work can be recommended. The main challenge in the present study was lack of intensive agronomic practice that has negative impact on the overall performance of the forage species. Hence, it is will be better to undertake further study in large scale with appropriate agronomic package under irrigated condition rather than rain fed.

Keywords: Adaptability; Agronomic; Buffalo Grass; Feed scarcity; Livestock losses

Introduction

Tropical pastures, in addition to their scarce availability, are low in quality, which among other factors, can be due to deficiency in soil nitrogen content, [1-4]. Serious dry season feed shortage is a common phenomenon in marginal and semi-arid area of Ethiopia. The recurrent drought also affects seasonal mobility of pastoral households due to livestock losses and leaves many with few heads of livestock. Feed scarcity in both quantitative and qualitative dimensions is one of the major impediments for the promotion of the livestock sub-sector in Ethiopia [5,6]. Animals are kept on poor quality natural pasture that commonly occur on permanent grasslands, roadsides, pathways and spaces between cropped plots. Much of these feed resources are utilized to support maintenance requirement of the animals with little surplus left for production and there are marked seasonality in quantity and quality of the available feed resources due to various environmental determinants (drought, frost, human interference such as deforestation etc.) [7].

Therefore, an alternative solution to overcome feed shortage and improve livestock productivity would be to introduce improved forage technologies in to the farming systems. Shortage of green forages can

be alleviated by introduction of high yielding new multi cut forages which can supply green herbage in adequate quantities during periods of scarcity. Perennial grasses, palatable and nutritive, mostly serve as a significant source of fodder in arid environments [8,9]. Rhodes grass (*Chloris gayana* Kunth) is a perennial grass of tropical and subtropical Africa where it remained one of the main C_4 forage grasses. Rhodes grass can be used as pasture, hay and ley crop. It is also can be used to stabilize disturbed sites. It is found in open grassland, or in grassland with scattered bush and trees, lake margins or seasonally waterlogged plains up to 2000 m altitude, rarely higher [10,11]. Therefore, this

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study has been designed to test adaptability and demonstrate improved forage technologies; to test adaptability and create awareness on Buffalo Grass (*Cenchrus ciliaris*), Rhodes Grass (*Chloris gayana*), and Panicum maximum in farmers' fields and to evaluate the yield performance of these technologies by farmers' evaluation criteria in the selected kebele of Deghabour districts of Ethiopia Somali region with the following objective:

- On-farm performance evaluation of selected perennial grass under rain-fed conditions of Deghabour District.

Materials and Methods

Description of research sites

The current study was conducted in the selected kebele of Degehabur District, Cherer Zone. Cherer Zone is one of the nine Zones in the Somali Region of Ethiopia. This zone is named after its largest city, Degehabur. Cherer Zone is bordered on the south by Korahe, on the southwest by Fiq, on the northwest by Jigjiga, on the northeast by Somalia, and on the southeast by Werder. This Zone has a total population of 478,168, of whom 268,006 are men and 210,162 women. While 62,584 or 13.01% are urban inhabitants, a further 223,778 or 46.8% were pastoralists. Livestock, particularly cattle, shoats and camel are important integral components of rural livelihood systems in the zones [12].

Experimental design and treatments

The experiment was conducted by using Completely Randomized Block Design (CRBD) with three treatments and replicated three times. The pure stands of each species were also included for comparison and the base seed rate used for grass species (Table 1). The seeds of the species were row planted on plots of 12 m (4 m × 3 m) area at 40 cm inter-row spacing with three replications in the experiments and there were six rows per plot with a one-metre border between each plot of grass species.

$$Y_{ij} = A + \beta_i + t_j + e_{ij}$$

Where: Y_{ij} = Yield parameters measured, A = General mean of the tested species, β_i = block effects, t_j = treatment effects and e_{ij} = Random error.

Land preparation and experimental materials

In the current study, the experimental site was selected and ploughed before the onset of the rainy season and harrowed when the first rain hit the ground. Fine seed bed on nine plots was prepared and line sowing of experimental seed was done. However, the attempt of the study was failed because of interrupted rain at experimental site (Figures 1 and 2). The second attempt of the study was made with the same procedure at different site in which it was successful (Figure 3).

No	Grass and Legume species	Seeding rate	Inter row spacing
1	Buffalo Grass (<i>Cenchrus ciliaris</i>)	10-12 kg/ha	40 cm
2	Rhodes Grass (<i>Chloris gayana</i>)	10-12 kg/ha	40 cm
3	Panicum maximum	8-10 kg/ha	40 cm

Table 1: Model for the treatment design.



Figure 1: Experimental site selection for study (failed attempt).



Figure 2: Seed bed preparation (failed attempt).



Figure 3: Seed bed preparation and sowing of experimental seeds (attempt successful).

The experimental seed was purified and screening against irregular shape for increased germination percentage. The same amount of fertilizer was applied to all plots at the rate of 100 kg/ha and Dap 50 kg/ha and hand weeding was done once after 15 days for all experimental treatments.

Forage sample and chemical analysis

The DM yield determination of experimental sample of grass species were conducted by harvesting two middle rows when the grass component reached 50 percent flowering stage and the harvested biomass was then separated in to each treatments. The fresh weight of each was recorded just after partitioning and the sub sample of each component species are dried in the forced oven dry at a temperature of 65°C for 72 hours, at Haramaya University Animal Nutrition Laboratory and then calculate the dry matter content of the forages. All samples of plot were analyzed for DM, Ash and CP, according to the procedures of AOAC [13]. The crude protein (CP) content was calculated by multiplying N content with a factor of 6.25. Neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) was analyzed as per the procedure of Van Soest and Robertson (1985) [14]. ADL was determined only for feed samples. In vitro dry matter digestibility (IVDMD) was determined following the procedure of Tilley and Terry [15]. Metabolizable energy ME, Mi/kilogram of dry matter of the forage was estimated by the prediction equation developed by McCormick et al. [16] was ME (Mj)/kg of DM=0.016x organic matter digestibility.

Data collection procedure

Data on Plant height (PH), germination and flowering date, days of maturity, biomass yield of the forage species were collected according to the following procedure.

Plant height was collected by randomly selecting ten plants from each experimental plot and measured with meter stick from ground level to the tip. Germination Date and Flowering date of the treatments were determined by recording the date at which the plant germinate and date of flowering. Days of maturity (DTM) (days) calculated as the number of days from sowing to the date when 75% of reach physiological maturity will be recorded. Biomass yield was recorded by weighing above ground total biomass of all the plants in each plot at harvest after sun dried and attained constant weight.

Data analysis

The data was analyzed by using the General Linear Model Procedure of the SAS computer software. Treatment means were separated using Least Significant Difference (LSD) tests.

Results and Discussion

Results of field plantations

Germination rate and date of 50% maturity of experimental treatments: The germination and maturity date of the experimental treatments are presented in the Table 2. Analysis of variance shows that there no significant different among the treatments in both parameter. However the germination date of panicum maximum slightly earlier than the other two treatments and also late maturity compared to buffalo grass and Rhodes grass. The finding from the current study is in agreement with Yenesew et al. [17] who reported that the maturity date of Rhodes grass ranges from three to five months. Amarjit et al. [18] also reported that the germination date of panicum maximum when treated with potassium cyanide is six days which is in complementary with this study.

Fresh and dry biomass yield: The biomass yield both in terms of fresh and dry biomass of the experimental treatments in this study are significantly different ($P < 0.0001$) (Table 3). The fresh biomass yield of panicum maximum is significantly greater than both Rhodes grass and buffalo grass. Similarly the dry mass yield of panicum maximum is significantly larger than the other two treatments ($P < 0.0001$). The current result is supported by Ifran et al. [19] who reported that average dry mass yield of oat grass 9.7 g in the study conducted in Pakistan. The same author also reported 39.25 g green fodder yield at 50% maturity level, which is not in disagreement with this result. Similarly, Ullah et al. [20] reported that the fresh biomass yield panicum maximum and Rhodes grass are 34.45 g and 23.96 g respectively, which are slightly different from the present findings. The same author has reported that the dry biomass yield of panicum maximum and Rhodes grass are 14.22 g and 8.17 g respectively, which is numerically small than the current result in case of Rhodes grass and significantly larger than this finding in case of panicum maximum. The dry biomass yield of buffalo grass in the present finding is in agreement with the result reported by Kizima [21] which state that 10.7 g dry biomasses yield of buffalo grass in the study conducted in Tanzania.

Parameters	Forage Grass Species				
	Buffalo Grass	Rhodes Grass	Panicum Maximum	SEM	Sign.
Germination Date	13.00	10.66	9.00	0.67	NS
Maturity Date	88.33	87.33	92.00	0.81	NS

NS: not significant.

Table 2: Germination and maturity date of experimental treatments.

Parameters	Forage Grass Species				
	Buffalo Grass	Rhodes Grass	Panicum Maximum	SEM	Sign.
FBY	31.34 ^c	48.40 ^a	46.67 ^b	2.62	-
DMY	12.25 ^b	10.62 ^c	27.55 ^a	2.71	-

FBY: Fresh Biomass Yield; DMY: Dry Matter Yield; SEM: Standard Error of Mean; ^{a,b,c}Level of significance.

Table 3: Fresh and dry biomass yield of experimental treatments.

Parameters	Forage Grass Species				
	Buffalo Grass	Rhodes Grass	Panicum Maximum	SEM	Sign.
NBR/PI	8.03	8.13	8.20	0.12	NS
PH	122.81 ^a	139.10 ^b	131.36 ^c	2.39	-

NB/pl: Number of Branches/Plant; PH: Plant Height; NS: Not Significant; ^{a,b,c}Level of significance.

Table 4: Plant height (cm) and number of branch per plant.

Treatments	Chemical composition (% DM)					
	DM	Ash	CP	NDF	ADF	ADL
Buffalo Grass (<i>Cenchrus ciliaris</i>)	92.96	14.39	13.37	74.55	42.0648	15.88
Rhodes Grass (<i>Chloris gayana</i>)	92.57	16.85	15.49	74.32	28.93	8.50
Panicum maximum	92.81	11.23	14.17	73.55	42.89	11.89

DM: Dry Matter; CP: Crude Protein; NDF: Neutral Detergent Fiber; ADF: Acid Detergent Fiber; ADL: Acid Detergent Lignin

Table 5: Nutritional value of experimental treatments (Chemical composition of forage grass species).

Plant height and number of branch per plant: According to the finding of the current study, the mean plant height and branches per plant of the experimental treatments are presented in Table 4. The analysis of variance shows that there are significant different in the number of branches, but the plant height for Rhodes grass is significantly larger than the other experimental treatments (buffalo grass and panicum maximum). This finding is comparable with that of Irfan et al. [19] who reported the average plant height at 50% heading of oat grass is 102 cm. Ullah et al. [20] has also reported the plant height for panicum maximum, buffalo grass and Rhodes grass are 3.5 m, 1.5 m and 1.5 m respectively. This is comparable with the result of the current study particularly the latter two treatments are highly related and the plant height of panicum maximum reported by Ullah et al. [20] is significantly larger than that of panicum maximum (131.6 m) reported under this study.

Nutritional value of experimental treatments: The results of the laboratory analysis and estimation of nutritive values of the different experimental treatments are shown in Table 5. The study revealed that the dry matter percentage of the three treatments, buffalo grass, Rhodes grass and panicum maximum are 92.96, 92.57 and 92.81 respectively, which indicate there is no significant different in dry matter percentage among the treatments. The crude protein content of Rhodes grass (15.49) is numerically larger than buffalo grass (13.37) and panicum maximum (14.17). Kizma et al. [21] reported 90.7% dry matter for buffalo grass, which similar with the result presented in this study. However, the same author reported 7.1 crude protein percentages for buffalo grass which is significantly larger than that of buffalo grass (13.37) in the current study [22-27]. The difference in environment, soil type and management system might contribute for such big variation in crude protein content of the buffalo grass [28-32]. ADF and NDF contents of buffalo grass in this study are comparable with the result of Kizma et al. [21] (2014) who reported 52.5 and 83.7 percent of ADF and NDF for buffalo grass. Itanna and Coulman [33] reported 55.2 percent NDF and 31.8 percent of ADF in the study conducted to evaluate quality of oat grass treated by different wastes, which is in agreement with the current finding [34-38].

Summary, Conclusion and Recommendation

The experiment was conducted to evaluate biomass yield and adaptability of some selected perennial grass in the study area. Completely randomized block design was used with three treat and replicated three times. The seeds of the species were row planted on plots of 12 m (4 m × 3 m) area at 40 cm inter-row spacing with three replications in the experiments and there were six rows per plot with a one-metre border between each plot of grass species. The experimental site was selected and ploughed before the onset of the rainy season and harrowed when the first rain hit the ground. Fine seed bed on nine plots was prepared and line sowing of experimental seed was done. The fresh weight of each treatment was recorded just after partitioning and the sub sample of each component species are dried in the forced oven dry at a temperature of 65°C for 72 hours, at Haramaya University Animal Nutrition Laboratory and then calculate the dry matter content of the

forages. Data on Plant height (PH), germination and flowering date, days of maturity, biomass yield, drought tolerance and acceptability or palatability of the forage species were collected according to the following procedure. The data was analyzed by using the General Linear Model Procedure of the SAS computer software. Treatment means were separated using Least Significant Difference (LSD) tests.

Analysis of variance shows that there no significant different among the treatments in both parameter. However the germination date of panicum maximum slightly earlier than the other two treatments and also late maturity compared to buffalo grass and Rhodes grass. The biomass yield both in terms of fresh and dry biomass of the experimental treatments in this study are significantly different ($P < 0.0001$). The fresh biomass yield of panicum maximum is significantly greater than both Rhodes grass and buffalo grass. Similarly the dry mass yield of panicum maximum is significantly larger than the other two treatments ($P < 0.0001$). The analysis of variance shows that there are significant different in the number of branches, but the plant height for Rhodes grass is significantly larger than the other experimental treatments (buffalo grass and panicum maximum) The study revealed that the dry matter percentage of the three treatments, buffalo grass, Rhodes grass and panicum maximum are 92.96, 92.57 and 92.81 respectively, which indicate there is no significant different in dry matter percentage among the treatments. The crude protein content of Rhodes grass (15.49) is numerically larger than buffalo grass (13.37) and panicum maximum (14.17).

As a conclusion, introduction of improved perennial forage species such as buffalo grass, Rhodes grass and panicum maximum in the study area revealed better performance. Therefore, based the finding of the current study the following future work can be recommended:

1. The main challenge in the present study was poor agronomic practice and intensive follow-up at the research site that negatively impacted on the overall performance of the forage species. Hence, it is highly recommended to undertake further study in large scale with appropriate agronomic package with intensive follow - up under irrigated condition.
2. The result from this finding revealed that the forage species that are introduced in the study area produced better performance and adapted well to the area. Therefore, it is recommended to test other forage species not evaluated under the current study.
3. Intensive community training how to produce improved forage species particularly during long rainy season could probably result in better performance and policy make can also prepare complete package on how to establish and adapt improved forages species in dry land ecosystem.

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