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Evaluation of Desho (*Pennisetum pedicellatum* Trin) grasses for dry matter yield and nutritive quality for the mid Rift Valley of Oromia at Adami Tulu Agricultural Research Center

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Abstract

Study was conducted at Adami Tulu Agricultural Research Center for two years of 2018 and 2019 cropping season to identify adaptable, high quality and high biomass yielder Desho grass varieties. Four desho grass varieties and Randomized complete block design (RCBD) with three replications was used. Current result indicated the agronomic performance of leaf length, number of tiller per plant, leaf to stem ratio, plant cover and vigor were not shown significance difference (P>0.05). While plant height (cm) and total dry matter yield (t/ha) were shown significance difference (P<0.05). The highest dry matter yield were produced from KK1-DZF # 591 (15.12 tha-1) and KK2-DZF # 589 (14.04 tha-1) varieties and 0.79 and 0.78 leaf to stem ratio, respectively. DM% content had strong positively correlation with leaf to stem ratio(r= 0.85; P <0.01), plant height(r=0.61; p<0.05). TDMY strongly correlated with PH(r=0.88; p<0.01) and LSR strongly correlated with number of tiller per plant(r=0.89; p<0.01). Based on the result, KK1-DZF # 591 (15.12tha-1) and KK2-DZF # 589 (14.04 tha-1) were well adapted from the varieties evaluated. Therefore, selected varieties should be further evaluated under irrigation condition and demonstrated at around Adami Tulu Agricultural Research Center and similar agro-ecologies.

Keywords: Biomass, Desho, Nutritive quality, Variety.

INTRODUCTION

Livestock are considered as a mobile bank that can be hired, shared, inherited and contracted by rural households [1]. According to [2] report, the major feed resources in the country are green fodder (54.59%), crop residue (31.6%), hay (6.81%) and agricultural by product (1.53%). One of the means of climate smart agriculture which can help to reduce greenhouse gas emissions and increase livestock productivity of the country is through improved livestock feed and feeding practices [3]. However, the contribution of this subsector to date has been suboptimal [4]. One of the important constraints causing low productivity of livestock is low quality and insufficient supply of forage [5].

In Ethiopia, Desho grass is a perennial plant which was first identified in the Southern region of the country at Chencha in 1991 and was utilized for soil conservation and animal feed [6]. It is an indigenous grass of Ethiopia belonging to the family of Poaceae [6, 7] with different names in different countries of Africa: As annual kyasuwa grass in Nigeria, Barrein in Mauritius and Desho in Ethiopia [8]. The grass is drought tolerant and is used as feed for ruminant animals [5, 8]. It has potential to address some of the challenges of feed scarcity, since it produces high dry matter yields of forage per unit area and ensures a sustained forage supply due to its multi-cut nature [7]. Desho (*Pennisetum pedicellatum*) is one of adaptable multipurpose perennial grass which has an extensive root system that anchors well in the soil. It grows in mid and high altitudes (1500-2800 masl) with a wide adaptation range of well-drained soils and topographies, with optimum elevation over 1700 masl on medium to low soil fertility [6, 10]. It has vigorous vegetative growth and a high biomass production capacity 30-109 of green herbage/ha/year and crude protein of 5.4% [7]. The grass is convenient for small holder farmers as a backyard enterprise for cut and carry feeding systems. It can be preserved as hay and silage for use as dry season feed. It also provides good soil cover and used as erosion control and grazing land improvement [6, 7, 9] suggests that desho grass is both potential feed source and a means of soil conservation in the mixed crop-livestock production systems of Ethiopia.

Morphologically it is closer to the genus Brachiaria with which it shares the acidic wetter areas of southern Ethiopia.

Moreover, the grass has a potential to control water loss effectively and recovers rapidly after watering even under severe drought conditions [6, 10].

One approach for alleviating the problem is identification and development of forage species suitable for the existing climatic condition. Hence, production of adaptable forage species with high herbage yield and quality are very important for tackling feed shortage and rehabilitating degraded natural pasture/grazing lands.

Objective

To evaluate the adaptability and yield performance of Desho grass varieties for forage production and recommend to the end users.

MATERIALS AND METHODS

Description of the Study Area

The study was conducted at on-station site of Adami Tulu Agricultural Research Center (ATARC), Shashemene sub site and Kofele FTC under rain fed conditions. Adami Tulu Agricultural Research Center altitude is about 1650 meters above sea level. It has an average annual rainfall of 760 mm. Shashemene sub site represents mid altitude agro-ecology while Kofele is found at highland agro-ecology.

Establishment

About four Desho grass lines were used for the study. The grass varieties were collected from different research centers and from ILRI. The experiment was laid out in RCBD design with three replications. Plot size with 3mx3m and spacing of 50cm, 1m and 1.5m for rows, plots and block was used respectively.

Each treatment groups were assigned randomly and independently to each experimental block. The plant was established by root splitting. NPS fertilizer was applied at the rate of 100 kg/ha to enhance sward consolidation. Management practices (weeding, pest and disease monitoring/ control) were done uniformly.

Data Collection

The collected data were including plot cover, stand vigor, leave length, herbage yield using quadrant sampling and leaf to stem ratio. Incidence of disease, insect and weed infestation were observed and recorded. The height of harvested plant was taken from the ground to the tip of the plant. The average of six plant heights was taken randomly from each plot at the time of 50% flowering.

Estimation of Biomass Yield

The biomass yield of different Desho grass lines were harvested at 50% flowering at 10cm above the ground. Weight of the total fresh biomass yield was measured from each plot in the field 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 [11]. Sampled leaf was separated from stem to determine leaf to stem ratio.

Data Analysis

Quantitative data sets were analyzed using general linear model of statistical analysis system (SAS) [12]. Procedures of 2002 version 9.0. Least significant difference (LSD) test was employed for variables whose F-values declared a significant difference ($P<0.05$). The statistical model for data analysis was: -

$$Y_{ijk} = \mu + t_i + bj + e_{ijk},$$

Where Y_{ijk} is the response variable under examination
μ is the overall mean
t_i is the treatment effect
b_j is the block effect/ random effect of experimental plots and
e_{ijk} is the random error associated with the observation ij.

RESULTS AND DISCUSSIONS

Performance of Desho grass varieties at Adami Tulu Agricultural Research center on-station site

Performance of current Desho grass varieties presented in table 1. The result indicated that leaf length, number of tillers per plant, leaf to stem ratio, plant cover and vigor were not significantly different ($P > 0.05$). While, plant height (cm) and dry matter yield (t/ha) were shown significance difference ($P<0.05$) among the evaluated varieties.

Although mean value among varieties were not statistically different ($P>0.05$) on plot cover, numerically different. The highest plot cover recorded from KK2- DZF #589 (96.38%) and Kulumsa-DZF # 592(96.31%) followed by Areka-DZF # 590(95.97%) and KK1-DZF # 591(95.6%) respectively. In line with this result [13], reported that Areka –DZF #590 (96.3%) and Kulumsa-DZF #592 (96.2%) varieties at Mechara Agricultural Research center, Oromia Agricultural Research Institute. Similarity of finding refers that ability of the grass fitness at different agro ecologies and soil types. Similarly, percent of vigor was not statistically different ($P> 0.05$) but numerically different. Mean value of plant vigor reported in this experiment were (95%) which is comparable with 95.4% vigor that was reported by [14] at Wondogenet Agricultural Research Center. LSR was not statistically different ($P>0.05$) only different in figure. (Table 1). Mean value of leave to stem ratio (0.78) reported from current study was higher than that of [13] (0.62) and [14] (0.57) respectively. This difference might be due to difference in agro ecology and soil effect.

Table 1: Agronomic performance of desho grass varieties at Adami Tulu Agricultural Research Center.

Variety	PHcm	LLcm	TDMYt/ha	TPP (counts)	LSR	Vigor (%)	Cover (%)
KK1-DZF # 591	104.38[a]	49.98	15.12[a]	90.84	0.79	94.78	95.6
KK2-DZF # 589	88.49[b]	45.57	14.04[ab]	89.09	0.78	95.32	96.38
Kulumsa-DZF #592	97.96[ab]	47.01	13.80[ab]	87.04	0.78	95.42	96.31
Areka-DZF # 590	102.92[ab]	48.13	11.66[b]	86.42	0.77	94.49	95.97
Mean	98.44	47.67	13.66	88.35	0.78	95	96.06
CV(%)	15.36	13.29	21.54	28.84	13.60	1.1	1.1
LSD(0.05)	14.51	NS	2.82	NS	NS	NS	NS

PH (cm) = Plant Height in cent meter, LSR= Leaf to stem ratio, DMY= Dry matter yield in ton per hectare, TPP = number of tillers per plant, LL = leave length & KK= Kindo Kosha, ns= non-significant, CV=Coefficient of Variation.

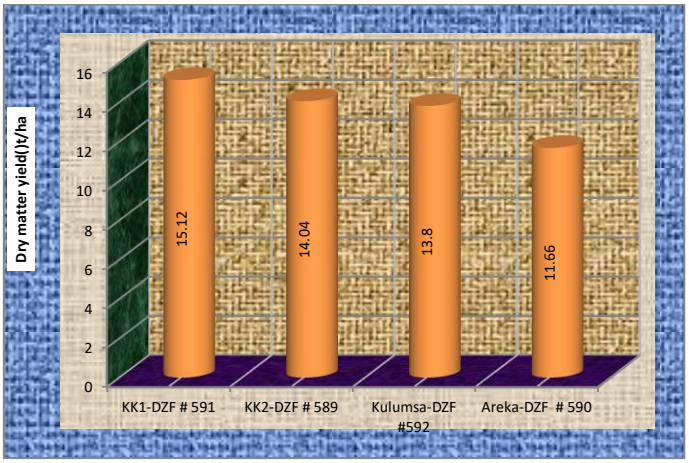

Figure 1: Dry matter yield of desho grass varieties in (ton/ha).

Table 2: Agronomic Performance of varieties during first and second harvest.

Harvest	PHcm	LLcm	TDMY(t/ha)	NTPP (counts)	LSR	Vigor (%)
1st year	105.76[a]	47.58	14.31	75.97[b]	0.73[b]	99.7
2nd year	83.79[b]	47.89	12.34	113.11[a]	0.89[a]	94.9
Mean	98.44	47.69	13.66	88.35	0.78	97.2
CV (%)	12.1	13.3	21.8	19.3	9.2	6.4
LSD (0.05)	8.57	NS	NS	12.23	0.05	NS

PH = plant height, LSR= Leaf to stem ratio, DMY=dry matter yield, NTPP=number of tillers per plant, LL=leave length, ns= non-significant, CV=Coefficient of Variation.

Agronomic performance of desho grass varieties at first and second harvest.

First and second harvest performance of Desho grass varieties presented in Table 2. plant Height significantly deference ($p<0.05$) high at first harvest. Number of tiller per plant and LSR showed significantly ($P<0.05$) high during second harvest than first. Even though, the dry matter yield in ton per hectare was not differ significantly ($P>0.05$) between harvest, large amount of dry matter (14.31 t/ha) was produced during first harvest. This result is in contradicted with the report of [14] that large amount of dry matter in ton per hectare of 28.83±2.66 was produced during second harvest.

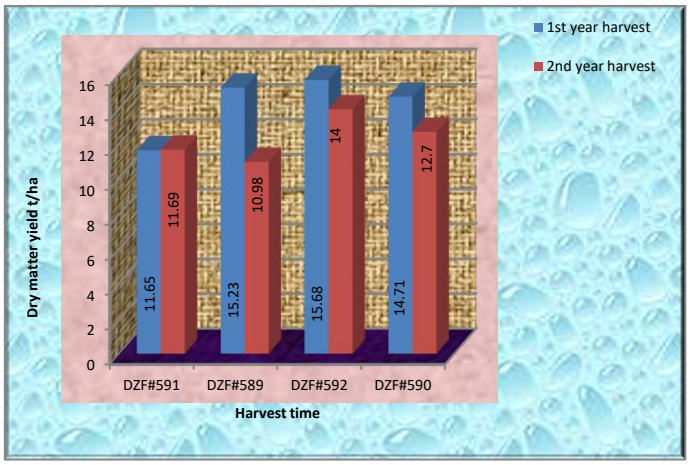

Figure 2: Dry matter yield (t/ha) of Desho grass varieties during first and second harvest

Plant height

Plant height has statistical difference ($P<0.05$) among the varieties evaluated. In line with current study [13], who reported that plant height of the desho grass among the four varieties were significant ($P>0.05$) at Mechara Agricultural Research Center, Oromia Agricultural Research Institute. In contrast of the current study [14] reported that plant height of the desho grass among the four varieties not significant ($P>0.05$). This difference might be due to soil effect and rain fall flexibility. The recorded plant height from KK1-DZF# 591 was 104.38cm which higher than that of KK2-DZF# 589 (102.92cm) and the lower record from Areka-DZF# 590 (88.49cm). In contrast of current finding [13] was reported that highest plant height was produced from Areka-DZF # 590 (92.67 cm) followed by KK1-DZF # 591 (92.6 cm). This might be due to edaphic, altitude and weather condition deference.

Dry matter yield (t/ha)

The mean value of desho grass varieties dry matter yield presented in table 1. The current report of the dry matter yield was statistically significant ($p<0.05$) among the varieties. The highest mean was recorded from KK1-DZF # 591(15.12 t/ha) followed by KK2-DZF # 589(14.04 t/ha) and Kulumsa-DZF #592(13.80 t/ha). In line with the current study [14] reported that DMY of Desho grass was strongly showed significance deference ($P<0.01$) in which the highest dry matter yield (DMY) were produced from Areka-DZF # 590 (28.74 t/ha) followed by Kulumsa-DZF #592 (26.14 t/ha) than the other two varieties and The lowest was recorded from KK2-DZF # 589 (20.31 t/ha) var. Current finding similar with [15] who reported that dry matter yield (16.84 t/ha) at Midland and (14.62 t/ha) at high land of Northern Ethiopia.

July,2018 GC at on-station Desho grass trial 1st establishment.

July,2019GC at on-station Desho grass trial 2nd year.

Table 3: Pearson correlation of Desho grass varieties morphological parameters.

	PH	LL	TDMY	TPP	LSR	VIG	COV	DM%
PH	1							
LL	0.16	1						
TDMY	0.88*	-0.05	1					
TPP	-0.45	0.06	0.59	1				
LSR	-0.36	0.12	-0.57	0.89**	1			
VIG	0.05	-0.11	0.28	0.08	0.03	1		
COV	0.09	0.15	0.78*	-0.30	-0.29	-0.40	1	
DM%	0.61*	-0.02	0.1	0.16	0.85**	-0.08	-0.17	1

*TDMY =total dry matter yield, LL=leaf length, LSR = leaf to stem ratio, TPP=tiller per plant, DM%= percentage of dry matter, PH = plant height, VIG= vigor, COV= cover, * = P<0.05, ** = P < 0.01.*

DM% strongly positively correlated with LSR ($r= 0.85$; $P < 0.01$), plant height ($r=0.61$; $P <0.05$) and also TDMY strongly correlated with PH($r=0.88$; $p<0.01$) and LSR strongly correlated with number of tiller per plant ($r= 0.89$; $p<0.01$). The moderate correlation recorded on tiller per plant with TDMY ($r = 0.59$) and lower correlation was recorded on DM% ($r=0.1$) with TDMY.

CONCLUSION

The result revealed non-significant differences ($P>0.05$) in leaf length, number of tiller per plant, leaf to stem ratio, plant cover and vigor between Desho grass varieties considered in the experiment. However, PH (cm) and TDMY(t/ha) were significantly different ($P<0.05$). Even

though, the dry matter yield in ton per hectare was not differ significantly (P>0.05), large amount of dry matter in ton per hectare 14.31 (t/ha) was produced during first harvest. Therefore, all varieties of Desho grasses were well adapted and performed under Adami Tulu Agricultural Research Center at on-station environmental conditions. Among the varieties particularly Kindo Kosha1-DZF # 591, Kindo kosha2-DZF # 589 and Kulumsa-DZF #592 were well performed in DMY and LSR. So further research is needed to exploit its potential under irrigation condition and a range of livestock production performances.

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Conflict of Interest

None declared.

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