Vol. 11(3), pp. 26-32, April 2019
DOI: 10.5897/JENE2019.0742
Article Number: 094DF3D60775
ISSN 2006-9847

http://www.academicjournals.org/JENE

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Journal of Ecology and The Natural Environment

Full Length Research Paper

Evaluation of Desho Grass (*Pennisetum pedicellatum* Trin) lines for their adaptability at Mechara Research Station, Eastern Oromia, Ethiopia

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Received 23 January, 2019; Accepted 28 February, 2019

This experiment was under taken at Mechara Agricultural Research center of on- station site for two consecutive years of 2016 and 2017 cropping season. The aim of the research was to identify the best adaptable and high biomass and dry matter yielders from four ecotype of Desho grass (*Pennisetum pedicellatum*) to demonstrate promising ecotypes for livestock producer's community in the study area. Randomized complete block design (RCBD) with three replications was employed to evaluate the ecotypes. The result revealed that the agronomic performance of regeneration percentage, plot cover, plant vigor and leaf to stem ratio were not shown significant difference (P>0.05) between Desho grass lines. However, significantly difference (P<0.05) were observed in plant height and dry matter yield between four Desho grass lines. The highest dry matter yield were produced from Areka-DZF # 590 (28.74 t/ha), Kulumsa-DZF#592 (26.14 t/ha) and KK1-DZF # 591(23.59 t/ha) lines and produced 0.71, 0.66 and 0.59 leaf to stem ratio, respectively. The mean value of dry matter yield, biomass (herbage) yield and leaf to stem ratio was increased from first to second harvesting year. The dry matter yield had strongly positive correlation with morphological parameters of leaf to stem ratio (r=0.8; P<0.01), plant height (r=0.62; P<0.05), plot cover (r=75; P<0.05), and low correlation with biomass yield (r=0.2). Based on the result, Areka-DZF#590, Kulumsa-DZF-#592, and KK1-DZF#591 lines were well adapted and performed from Desho grass lines evaluated in this experiment. Therefore, these selected Desho grass lines should be further demonstrated and scaled-up at around Mechara Agricultural Research station and similar agro-ecologies of Hararghe areas.

Key words: Desho grass, dry matter yield, leaf to stem ratio, lines.

INTRODUCTION

Despite Ethiopia having a large livestock population (Central Statistical Agency, 2016), the productivity of livestock is low. The major setback is shortage in quantity and quality of feed resource (Tegegne and Assefa, 2010; Yayneshet, 2010). To combat existing livestock nutritional constraints, the use of locally available forage plants as feed resources is highly recommended as they are familiar to smallholder farmers, grow with low inputs and are adaptable to local agro-ecological conditions (Anele et al., 2009).

Desho grass *(Pennisetum pedicellatum)* is among the indigenous grass in Ethiopia belonging to the Poaceae family of monocot angiosperm plants. Desho grass is perennial grass collected from Chencha district in

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Southern Ethiopia (Welle et al., 2006). It grows in naturally spreading across the escarpment of the Ethiopian highlands and used for multiple purposes (Smith, 2010). Desho grass is used as a year-round livestock fodder. It is a very palatable species to cattle and sheep (Ecocrop, 2010) mainly grown on small home plots used for livestock fodder, soil conservation practices, and sold for income generation as small business opportunity mostly for high land Ethiopian farmers (IPMS 2005; Shiferaw et al., 2011; Leta et al., 2013). To maintain the sustainability of the intervention, the plot is permanently made inaccessible to free grazing livestock; instead, a cut-and-carry system is encouraged (Danano, 2007). Due to its rapid growth rate, Desho grass provides regular harvests, even reaching monthly cuts during the rainy reason. Once a year, just before the dry season, sufficient grass is harvested and stored as hay and can prepared as silage to feed the livestock until the rains return (Danano, 2007).

Ethiopian Minister of Agriculture and Rural Development was documented planting of Desho grass technology as an example of a locally tried and tested land management technique as a success to mitigate land degradation (Bimrew et al., 2017). On the other hand, very little work has been done in collection and conservation of indigenous forage species, which have invaluable importance in the livelihood of the farmers. Livestock have a multifunction in West Hararghe farmers serve as source of milk, meat production, draft power and income generation, especially milk production and fattening practice are indigenous (Abdi et al., 2013).

The Hararghe beef cattle (locally called Harar Sanga) is very famous in domestic markets of larger cities like Addis Ababa (Tadesse et al., 2014). However, there was only seasonal based access for terminal market due to feed scarce and less market-oriented production system (Birmaduma, 2018). Milk marketing is the daily income for livelihood in Hararghe farmer next to *chat (*Abdi et al., 2013*).* Due to the production system is based on natural pasture and linked with crop production related milk availed form market is seasonal and the price of the milk is highly fluctuated in West Hararghe (personal observation). Therefore, adequate quantity and quality of feed resource is crucial for animal production in mostly dairy and beef cattle. Hence, introduction of high yielding and nutritious indigenous forage species like Desho grass is the notable issue to minimize feed shortage in both quality and quantity especially during dry season. Therefore, the study was intended to identify the best adaptable, performance and good quality of Desho grass lines for fodder production in study area.

MATERIALS AND METHODS

Description of study area

The study was conducted at Mechara Agricultural Research Center (McARC) during 2016 and 2017 cropping season for two years. McRAC were found at 40° 19' latitude and 08° 35' E longitude with an altitude of 1,700 m above sea level. It has located at 434 km East of Addis Ababa capital of country, Ethiopia, Oromia National Regional State, West Hararghe in Daro Labu district. The major soil type of the center is sandy loam with reddish color. The ambient temperature the district (center) ranges from 14 to 26°C with the average of 16°C and average annual rainfall of 96 mm/year (McARC, 2017) Figure 1.

Experimental material and design

Four Desho grass lines of DZF#590, Kulumsa-DZF#592, KK2-DZF-589 and KK1-DZF#591 were planted in roots as brought from Dabrazite Agricultural Research Center. The experimental material was design in randomized complete block design (RCBD) with three replication. The plot size used for the experiment was 10.5 m^2 area, which was 3.5 m length with 3.5 m width within space between rows; plots and replication were used 40, 50 and 75 cm, respectively. Inorganic fertilizer of 100 kg/ha of NPS and 50 kg/ha of urea were applied during the establishment.

Experimental management

A total area of 209.25 m^2 was prepared for this experiment. The land was ploughed in February and harrowed in June 2016. The prepared experimental land was divided into three blocks each of which consisted 12 plots with each plots size was 10.5m^2. Desho grass was planted using vegetative root splits in 8 rows on a well-prepared soil. The spacing between rows and plants were 40 and 15 cm, respectively. Land preparation, plant splitting, weeding and harvesting were done according to recommended made by Leta et al. (2013). DAP and urea were applied at planting and after establishment, respectively at the rate of 100 and 50 kg per ha for establishment and 25kg of urea was applied after each harvesting cycle for maintenance (Danano, 2007). Weeding and related management practices were applied according to the grass's requirements.

Data collection

The collected data for the trail was including regeneration percentage, plot cover, plant vigor, leaf to stem ratio, herbage yield, and dry matter yield through oven dry was collected.

Statistical analysis

All data was analyzed with General Linear Model (GLM) procedure of SAS version 9.0 for least Square analysis of variance. The mean separation was carried out using least significance difference (LSD) test at 5% probability level. The statistical model for the analysis data was:

$$Y_{ijk} = \mu + A_j + B_i + e_{ijk}$$

Where; Yijk= response of variable under examination, μ = overall mean, Aj = the jth factor effect of treatment/ lines, Bi = the ith factor effect of block/ replication, eijk = the random error.

RESULTS AND DISCUSSION

Performance of Desho grass lines

Performance of Desho grass lines in study site are

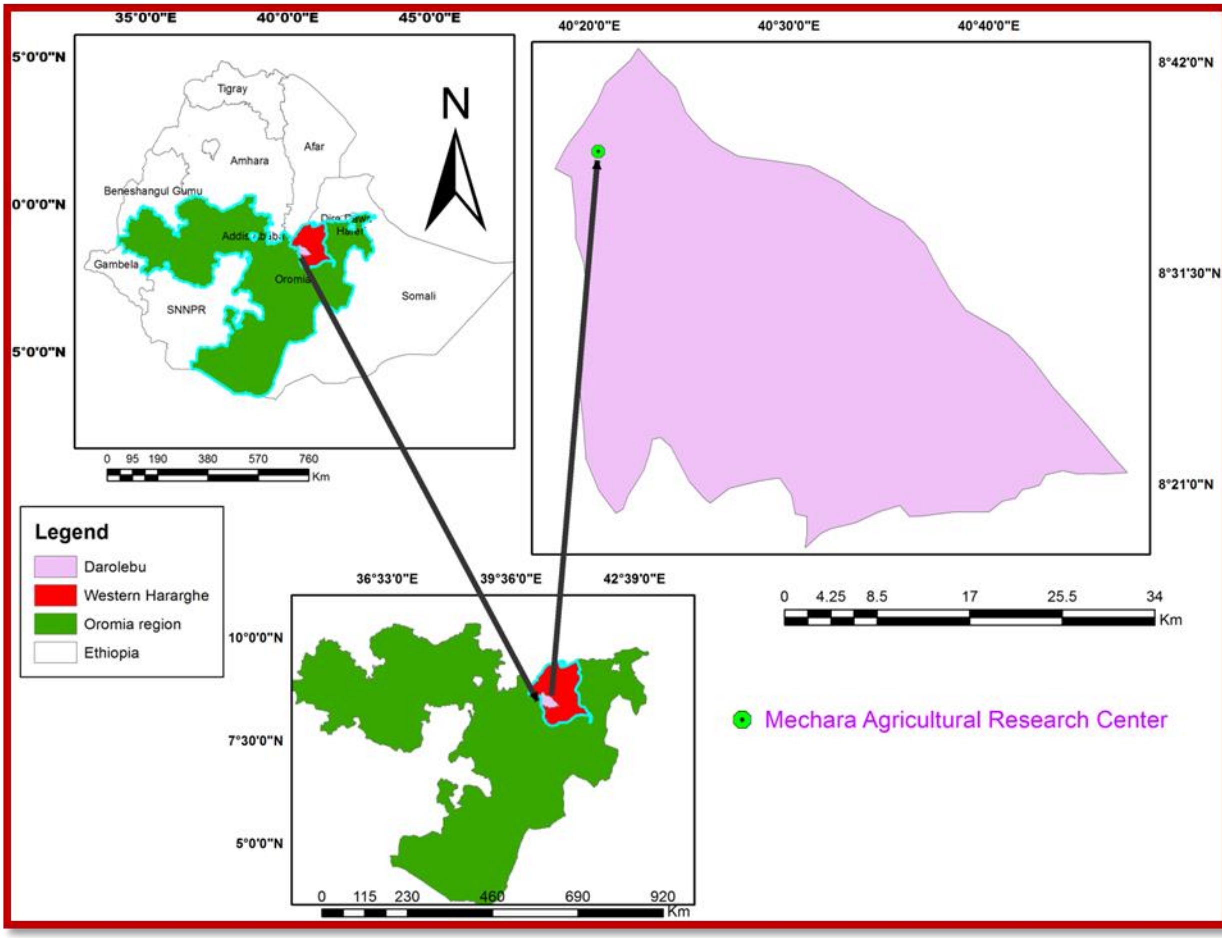

Figure 1. Map of study area.
Source: Own computational GIS data.

presented in Table 1. The result revealed that the agronomic performance of regeneration percentage, plot cover, stand vigor, leaf to stem ratio were not shown significance difference (P>0.05) between Desho grass lines considered in this experiment. However, the analysis variance for plant height (cm) and dry matter yield (t/ha) were shown significance difference (P<0.05) between Desho grass lines. After Desho grass lines was established by splitting method and after each harvesting cycle all Desho grass lines were regenerated well performance greater than 97% of population. This result good performance was indicated that the climate condition and soil type was suitable for crop to provided further investigation.

The mean value of plot cover performance of Desho grass lines considered in this experiment were promised for future works (95.4%). Even though the mean value between grasses line was not indicated significance difference (P>0.05) on plot cover, numerically had different values. The higher plot cover were produced from Areka-DZF # 590 (96.3%) and Kulumsa-DZF #592 (96.2%) lines. This finding was comparable with Tekalegn et al. (2017) who report that Areka-DZF # 590 (95.8%) and Kulumsa-DZF #592(99.2%) lines at Wondogenet Agricultural Research Center, Southern Ethiopia. The similarity of finding indicated that the ability of Desho grass adaptability at different environments and soil types. This might be due to Desho grass is indigenous ecotype for Ethiopia (Smith, 2010).

Plant vigor percent was not shown significant difference (P> 0.05) however, numerically it had different values. The highest plant vigor percent was recorded from Kulumsa-DZF #592 (93.67%) and Areka-DZF # 590 (91.7%) of Desho grass lines. This finding was comparable with Tekalegn et al. (2017) who reported that 98.3% for Kulumsa-DZF #592 and 96.3 % for Areka-DZF # 590 Desho grass lines plot covar percent in Southern, Ethiopia.

Plant height is an important parameter contributing to yield in forage crops. The mean value of plant height were shown significance difference (P <0.05) among Desho grass lines considered in this experiment. The

Table 1. Performance of Desho grass lines at Mechara on station.

Treatment	R (%)	PC (%)	VI (%)	PH(cm)	LSR	Bmt/ha	DMY (t/ha)
Areka-DZF # 590	98	96.3	91.67	92.73[a]	0.71	44.8	28.74[a]
KK1-DZF # 591	97.83	95	90.33	92.6[a]	0.59	32.1	23.59[b]
Kulumsa-DZF #592	98.67	96.23	93.6	93.67[a]	0.66	59.87	26.14[ab]
KK2-DZF # 589	97.17	93.9	90.67	71.27b	0.51	46.13	20.31[c]
Mean	97.92	95.38	91.6	87.6	0.62	45.5	24.69
CV	0.62	1.0	1.76	9.0	14.8	34.2	5.2
LSD (5%)	1.21	1.85	3.22	15.76	0.18	2.45	2.557
Sig.	Ns	Ns	Ns	*	Ns	Ns	**

KK= Kindo Kosha, R (%) = Regeneration percentage, PC (%) = plot cover, VI (%) = Plant Vigor, PH (cm) = Plant Height in cent meter, LSR= Leaf to stem ratio, DMY= Dry matter yield in ton per hectare.

highest plant height was produced from Areka-DZF # 590 (92.67 cm) followed by KK1-DZF # 591 (92.6 cm) whereas the lowest was produced from KK2-DZF # 589 (71.27 cm). This finding was comparable with Bimrew et al. (2017) who reported that plant height for Desho grass was (94 cm) at mid and (87 cm) high land altitude of Northern, Ethiopia.

The analysis of variance was not shown significance difference (P>0.05) on leaf to steam ratio, however, numerically it had different values. Numerically, the higher value of leaf to stem ratio was produced by Areka-DZF # 590 (0.71) and Kulumsa-DZF #592 (0.66) Desho grass lines. The lowest leaf to steam ratio was produced by KK2-DZF # 589 (0.51) Desho grass lines. The result recorded from Areka-DZF # 590 was comparable with Tekalegn et al. (2017) who reported that leaf to stem ratio (0.72). However, as plant maturity increased, the value of leaf to stem ratio was decreased. In contrast the current finding was below the finding of Bimrew (2016) who reported that leaf to stem ratio 1.25, 1.18 and 0.8 at 90, 120 and 150 consecutive harvesting dates for Desho grass. This large difference might be due to difference made in stage of maturity to harvest.

The analysis variance of herbage yield was not shown statistically significance difference (P>0.05) between Desho grass lines, however, numerically the value had difference. The highest herbage yield were produced from Kulumsa-DZF #592 (59.87 t/ha), KK2-DZF # 589 (46.13 t/ha) and Areka-DZF # 590 (44.8), respectively. The analysis variance for dry matter yield was indicated strongly significance difference (P<0.01) between considered Desho grass lines in this experiment. The highest least square mean values of 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 Desho grass lines. Whereas, the lowest DMY was produced by KK2-DZF # 589 (20.31 t/ha) lines. The current finding was better than Bimrew et al. (2017) who reported that mean value of dry matter yield (16.84 t/ha) at Midland and (14.62 t/ha) at high land of Northern Ethiopia. This difference might be due to soil type, stage of harvesting and management system.

Performance of four Desho grass lines during first and second year

Plant height (cm) of four Desho lines

Plant height (cm) during first and second harvesting cycle of four Desho grass was shown on Figure 2. According to the figure indicated that first harvesting had had higher plant height than second harvesting cycle. This happened might be due to the behavior of crop were grown in lie than erect at medium growing lifetime. During the first (47.33, 48.00 and 48.67 cm) and second (45.4, 44.6 and 45 cm) plant height were produced from the Areka-DZF # 590,KK1-DZF # 591and Kulumsa-DZF #592 Desho grass lines, respectively. This result higher than finding of Bimrew et al. (2017b) who reported that the mean value of Desho grass plant height (39.4 cm) under irrigation at Northern Ethiopia. This difference might be due to soil type and harvesting at difference dates.

Leaf to stem ratio (LSR) of four Desho lines

The average of leaf to stem ration in first and second harvesting time were shown in Figure 3. The greater LST was produced at the second harvesting cycle than the first cycle. This was due to the behavior of plant were produced more leaf (prolific tiller) and lie horizontal than erect. The mean value of leaf to stem ratio were produced during the first (0.71, 0.59 and 0.6) and second (0.82, 0.58 and 1.07) from the Desho grass lines of Areka-DZF # 590, KK1-DZF # 591and Kulumsa-DZF #592, respectively. The current result were higher than Tekalegn et al. (2017) who reported that leaf to stem ratio of Desho grass lines were (0.47, 0.44 and 0.55) during first and (0.57, 0.36 and 0.76) second harvesting cycle of Kulumsa-DZF #592, KK1-DZF # 591 and KK2-DZF # 589, respectively at Southern Ethiopia.

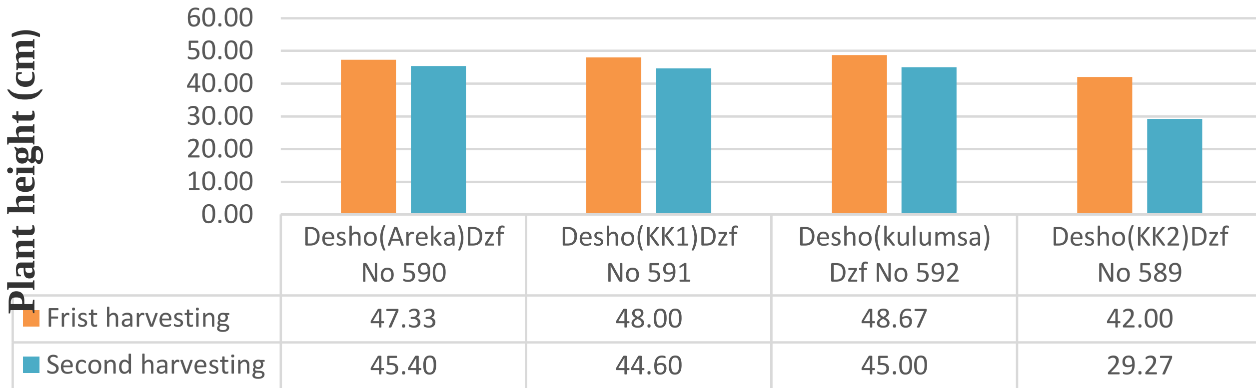

Figure 2. Plant height (cm) of Desho grass lines.

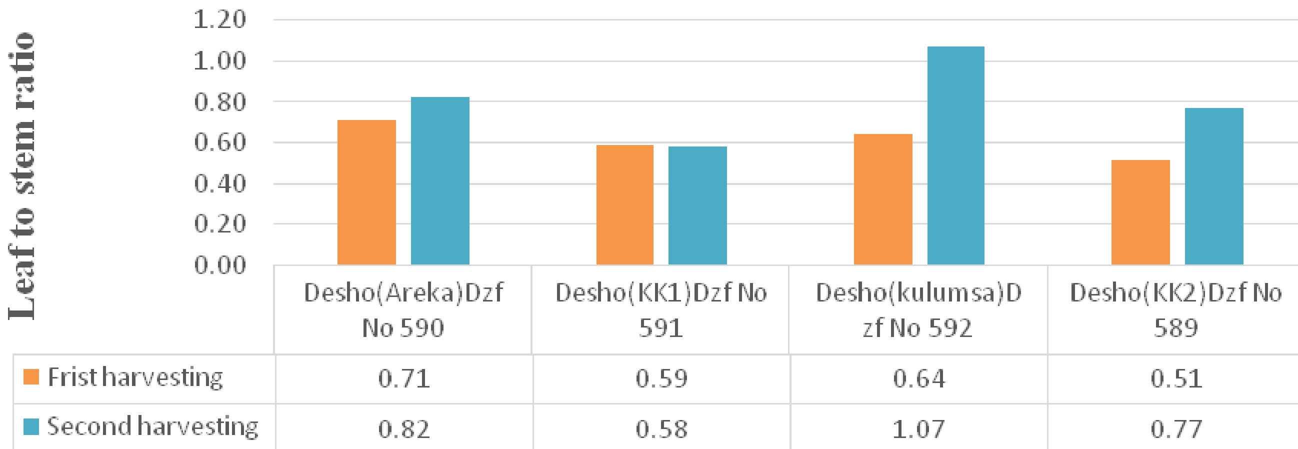

Figure 3. Leaf to stem ratio of Desho grass lines.

Biomass yield (t/ha)

The average biomass (herbage) yield in first and second harvesting were shown in Figure 4. The greater biomass yield (t/ha) was produced at the second harvesting cycle than first cycle. This result produced might be due to tiller number is increased up to optimum growth of plant tissue. However, gradually the morphological performance is decreased. The current finding was supported by Tilahun et al. (2017) who reported, that the mean value of tiller number per plant of Desho grass was increased from 36.4 t/ha at 75 days growth to 106.4 t/ha at 135 days.

Dry matter yield (t/ha) of four Desho lines

The average dry matter yield of four Desho grass lines are presented in Figure 5. More dry matter yield of ton per hectare were produced during the second than first harvesting cycle from all Desho grass lines. The mean average of dry matter yield was obtained during the first (28.74, 23.59 and 26.98 t/ha) and second (30.52, 28.62 and 30.98) from Areka-DZF # 590, KK1-DZF # 591 and Kulumsa-DZF #592 lines, respectively. The current finding was in lined with Tekalegn et al. (2017) who reported for similar Desho grass lines dry matter yield were produced 30.3, 28.43 and 30.9 t/ha, respectively at Wondogenet Agricultural Research Center, Southern, Ethiopia. However, the report of Tilahun et al. (2017) at different days of harvesting (7.1 t/ha at 90 days, 15.7 t/ha at 120 days and 25.5 t/ha at 150 at days) were produced lower dry matter yield than current finding. This difference might be due to line difference, agro ecology, and stage harvesting.

Correlation of morphological parameter and dry matter yield for Desho grass lines

Pearson correlation of Desho grass lines morphological parametric are presented in Table 2. The dry matter yield

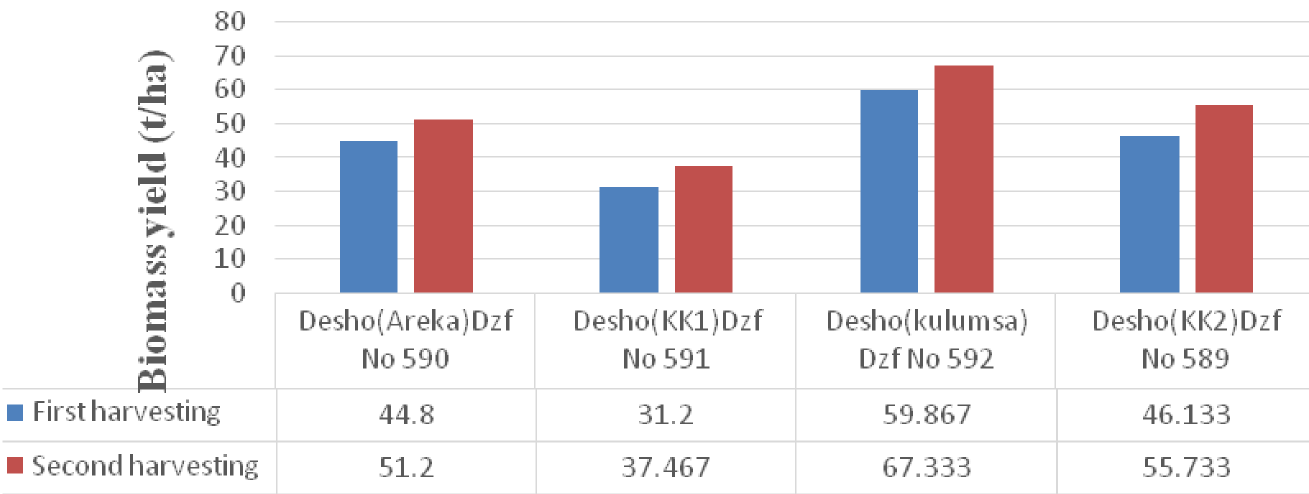

Figure 4. Biomass yield of Desho grass (t/ha) lines.

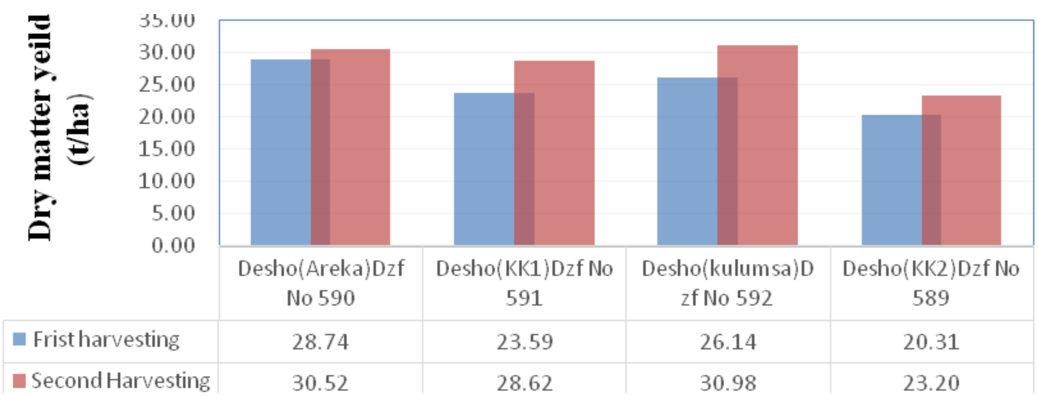

Figure 5. Dry matter yield of Desho grass (t/ha) lines.

Table 2. Pearson correlation of Desho grass lines morphological parameters.

	R	PC	V	PH	BM	LST	DMY
R	1						
PC	0.4	1					
V	0.94*	0.35	1				
PH	0.54	0.52	0.25	1			
BM	0.35	0.41	0.30	0.99**	1		
LST	0.56	0.52	0.53	0.48	0.09	1	
DMY	0.44	0.75*	0.47	0.62*	0.20	0.81**	1

DMY = dry matter yield, LSR = leaf to stem ratio, BM= biomass yield, pH = plant height plant, V= vigor, PC=plot cover, R =regeneration percent,* =P < 0.05, ** =P <0.01.

(DMY) content had strongly positively correlation with plot cover (r= 0.75; P <0.05), plant height (r= 0.62; P<0.01), leaf to stem ratio (r=0.81; P <0.01). The moderate correlation was recorded on dry matter yield with plant vigor (r=0.47), regeneration percent (r= 0.44) and lower correlation was recorded on biomass yield (r=0.44) with dry matter yield. The positive association of DMY with morphological parameters might be resulted from harvesting at appropriate maturity stage and better competition for radiant energy with extended days to harvest. Tessema et al. (2002) and Bimrew et al. (2017) were gave the similar report on the positive correlation of morphological parameter with dry matter yield on Napier and Desho grass respectively.

CONCLUSIONS AND RECOMMENDATION

The results revealed that there were not shown significant differences (P>0.05) on regeneration percentage, plot cover, vigor and leaf to stem ratio between Desho grass lines. However, plant height and dry matter yield ton per hectare were shown significance difference (P<0.05) between Desho grass lines. Among the lines, particularly Areka-DZF#590 and Kulumsa-DZF#592 were performed more both in dry matter yield and leaf stem ratio. The dry matter yield was positive association with morphological parameters (leaf to stem ratio, plant height, plot cover and biomass yield. Based on the study result, Areka-DZF#590, Kulumsa-DZF#592 and KK1-DZF#591 lines were well-adapted and performed in forage yield potentials. Hence, these grasses are recommended to Mechara and in similar agro-ecologies for future demonstration and up-scaling as animal feed sources and land rehabilitation purpose. These selected Desho grass lines should be further demonstrated and scaled-up at Mechara on-farm condition and similar agro-ecologies of Hararghe areas.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

ACKNOWLEDGMENT

The authors would like to express their depth gratitude to the Oromia Agricultural Research Institute (OARI) for funding research work and Dabrazite Agricultural Research Center for providing experiment materials.

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