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Adaptation Study of Improved Elephant Grasses (Pennisetum purpureum) and Oats (Avena sativa L) at Haro Sabu, Kelem Wollega zone, Ethiopia

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Abstract
Elephant grass (Pennisetum purpureum), is a warm-season perennial grass, which is widely planted in tropical and subtropical regions of the world .Oats (Avena sativa L) is one of the most important cereal fodder crop grown under irrigated and rain fed conditions. A study was conducted to describe forage yield and adaptability of sixteen accessions of elephant grasses (Pennisetum purpureum) at Haro Sabu Agricultural Research centre and seven oats varieties were conducted at one sub site additionally. These two grasses types (oat and elephants) varieties (Jasary, CI-8251, CI-8235, CI-8237, Bonsa, Bonabas and lampton) andILRI 14984, ILRI 16840 ,ILRI 16784 ILRI 16788, ILRI 16789, ILRI 15743, ILRI 16801, ILRI 14389, ILRI 16898, ILRI 16785were planted by Randomized Complete Block Design with three replication. Important biological and morphological traits data were examined using statistical analysis. The dry matter yield, total fresh weight, percent of soil coverage was significantly differences ($p<0.05$) and Sample dry weight was not significantly different ($p>0.05$).The highest biomass and herbage dry matter yield was obtained from 16840 accession number. Hence it is concluded that from the accessions of elephant grasses adapted at Haro Sabu Agricultural research centre ILRI16840, ILRI16784, ILRI16801 and ILRI15743 accessions were took highest dry matter and biomass yields. Regarding to oat varieties it was observed that analyses of data from Hawa Galan sites revealed very highly significant varietal differences ($P < 0.05$) that were four weeks germination, eight weeks germination, and 50% flowering stage. Whereas there were significantdifferences at 5% probability level among oat varieties for four weeks soil cover and total fresh weight under Hawa Galan site (table.1). With regard to eight weeks soil cover, there was no difference ($p>0.05$) in percent between oat variety treatment. It is concluded that Bonabas, Bonsa, Ci-8237 and Jasary showed better performance and adapted varieties as well as beside to dry matter and biomass yields.
Keywords: -Adaptation, Elephant Grass (Pennisetum purpureum) accession, herbage yield, Oat grasses (Avena sativa)

INTRODUCTION

Livestock production plays an important role in Ethiopian farming systems providing milk, meat, draught power, manure, hides and skins. The contribution oflivestock to the national economy is estimated to be30 per cent of the agricultural GDP and 19 per cent ofthe export earnings (Azage and Alemu, 1998).

Livestock derive most of their feed from natural pasture and crop residues. Natural pastures constitute the major feed source providing more than 90 per cent of the livestock feed either in the form of grazing or forages conserved in the form of hay for dry season use (Lulseged, 1985).

The major constraint to cattle production in Ethiopia is nutrition. Cattle are predominantly fed on natural pastures and crop residues. However, due to rising human population, traditional grazing lands are widely being converted to croplands, forcing cattle to graze on marginal and overgrazed lands with poor quality forge (Kitaba and Tamir, 2007). The total grazing and browsing lands of Ethiopia was estimated to be 61 - 65 million hectares (Alemayehu, 1998a), but this is shrinking due to increasing human population and cropping from time to time. On the other hand, the productivity of natural pasture is extremely low, as different studies in different times indicated. For instance, Alemayehu (1998a) estimated that the productivity of natural pasture for lowland was 1 ton DM/ha and for that of highland and mid altitude on freely drained soil was 3 ton DM/ha. The same author sited that seasonally water logged fertile areas of the country yield was about 4 - 6 ton DM/ha. Anyhow, MoA (1984) estimate was relatively lower than that of Alemayehu, 1998a, i-e, 1.5 ton DM/ha and 0.56 ton DM/ha for highlands and lowlands respectively. On good and heavily fertilized soil and in warm humid climate, elephant grass can produce DM yield of 9.16-19.04 t/ha (Bogdan, 1977) and more than 25 t/ha from well managed and fertilized red soil (Tessema and Halima, 1998)for high production elephant grass requires fertile soil but can grow on almost any soil with reduced vigor and production(Bogdan, 1977).

Nevertheless, in Ethiopia great proportion of the livestock feed (80% - 85%), according to Alemayehu, 1998a, comes from this unproductive natural pasture. This occasion or happening could contribute to under production of the livestock products. Another point that was indicated by Alemayehu (1998b) that the grazing

lands (except protected areas) of the country are from poor to very poor condition and will deteriorate farther unless there is immediate action.

Production of improved forage materials is the best option in the form of over sowing on unproductive gazing lands or grazing lands as sole production. There are different improved forage materials, which can be developed using different forage development strategies after identifying the existing animal feed resources and knowing which forage material can adapt to an area. These improved forage materials could include herbaceous annual and perennial legumes and grasses and legume trees. Among the improved forages recommended for the mid latitudes of western Oromia, the following are some.

Chloris gayana, panicum coloratum, Panicum maximum, Pennisetum purpureum, Zea mais, Melinis minutiflora , Sorgum vulgare, Sorghum alum, Desmodium unicenatum, Stylosantus guanensis, Leucena leucocephala, Lablab purporius, Macroptalium atrupurpuruem and Vicia atrupurpuria (Lulseged Gebre-Hiwot and Alemu, 1984).

Elephant grass is also called merker grass, Napier grass, Uganda grass and by several other names in different parts of the world. It carries the name Napier grass to recognize the contribution of Colonel Napier of Rhodesia who first wrote to the Rhodesian Agricultural Department to make them aware of the value of this plant. Napier grass is a tall, stout, deep rooted and high-yielding perennial grass used as forage for Livestock. Also known as elephant grass; it is widespread in East Africa. It grows from sea Level to 2000 m where the rainfall exceeds 1000 mm (Bayer, 1990). It can also provide a continual supply of green forage throughout the year and it fits intensive small scale farming (Alemayehu Mengistu 1997). 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. It is also sometimes cut for hay and to ferment into silage for dry season feeding.

According to survey of HSARC, (2011) the size of the pasture grass land/ PGL/ has declined after the 1996/97 land redistribution because of the decrease in the size of land holdings. Accordingly, the feed obtained from grazing lands is inadequate both in terms of quantity and quality throughout the year.

Oats are grown for use as grain as well as forage and fodder, straw for bedding, hay, , silage and chaff. Oat is an important winter fodder, mostly fed as green but surplus is converted into silage or hay to use during fodder deficit periods (Suttie and Reynolds, 2004).

Oat grass (*Avena sativa*) is one of the most important cereal fodder crop grown in winter under rain fed conditions. It is a quick growing, palatable, succulent and nutritious fodder crop. The oats varieties have already been developed possessing characteristic i.e. early to late duration, high yielding, more nutritious, palatable, multicut and disease free varieties for various agro-ecological zones. Crop outcome is a product of the genotype and the environment in which crop has been grown. Ideal variety is always one, which possesses general adaptation with higher yield potential (Finlay & Wilkinson, 1963).

The oats can provide green fodder after 60-70 days in emergency to tide over the scarcity period but after 90-100 days to get large quantity of fodder. Oats is mostly fed as green and surplus is converted into silage or hay for use during the fodder deficit periods. It is favourite feed of all animals and its straw is soft and superior to wheat and barley. It is high in TDN, protein, fat, vitamin B1 and minerals as phosphorus and iron. The oats grain is particularly valuable feed for horses, dairy cows, poultry and young breeding animals of all kinds (Hussain *et al.*, 2002).

1.1 Growth habit of elephant grasses

Elephant grass (*Pennisetumpurpureum*), also known as Napier grass, is a warm-season perennial grass, which is widely planted in tropical and subtropical regions of the world (Wang *et. al*., 2005).

Elephant grass grows well in all tropical and subtropical regions. It is adaptable to a wide range of annual rainfall between 750 and 2500 mm and altitudes from sea level to 2100 m, but is susceptible to frost damage (Skerman and Riveros, 1990). According to Solomon, (2008) elephant grass grows from Sea level up to 2000 m.a.s.l., annual rainfall between 1480–1620 mm; temperature 25–40^{o}C In the tropical climate, elephant grass grows throughout the year. Elephant grass has a perennial life cycle and is propagated vegetative. It has a profuse root system, penetrating deep into the soil, and an abundance of fibrous roots spreading into the top soil horizons. The rhizomes (underground stem) are short and creeping and nodes develop fine roots and culms. It is known throughout much of the wet tropics for its prolific growth and usage as forage for ruminants (Ruslan*et. al*., 1993).

It is a tall, stout and deep rooted perennial bunched grass well known for its high yielding capacity and usage as forage for livestock (Woodard and prine, 1991).It is a robust perennial with a vigorous root system, sometimes stoloniferous with a creeping rhizome, culms 180–360 cm high (Solomon, 2008).

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

MATERIALS AND METHOD

Description of the study area

The study was conducted at Haro Sabu Agricultural Research Centre (HSARC) during the main cropping season. The centre is located in western Ethiopia in Oromia region at 550 km from Addis Ababa. It lies at latitude of 8° 52'51" N and longitude 35°13'18'' E and altitude of 1515 m above sea level. It has a warm humid climate with average minimum and maximum temperature of 14 and 30°C, respectively. The area receives average annual rain fall of 1000 mm and its distribution pattern is uni-modal. The rain season covers from April to October. The soil type of the experimental site is reddish brown with sandy loam in texture, high organic matter content(7.4%), medium carbon content (5%), medium total nitrogen content (0.43%), low available phosphorus content (6.28ppm), and exchangeable potassium content (0.65%) and pH of 5.3. The area is characterized by coffee based farming system and crop-livestock mixed farming system (HSARC, 2012).

Experimental design, treatments and layout

Randomized complete block design with three replication was used. Ten elephant grasses were planted at Haro sabu ARC on station under rain fed condition for two consequentive years. The Varieties were obtained from Bako agricultural research centre. A plot size of 3mx4m with 1m between row and 50cm between plants were used. The Napier grass were root splinted and each material for planted need to contain three shoots and the materials were planted 15cm deep inclined at a 45^{O} angle (ILRI, 2010). Diammonium phosphate (DAP) fertilizer was applied at planting at a rate of 100 kg/ha as recommended by Bogdan (1977).

A total of 7 treatments of oat varieties (Jasary, CI-8251, CI-8235, CI-8237, Bonsa, Bonabas and lampton) were used. Experimental unit comprised ten rows of 2 meters length with row to row distance of 20 cm and distance of 2m between replication. Weeding was done as early as possible to eliminate re-growth of undesirable plants and in order to promote fodder re-growth by increasing soil aeration will also be done. The plots will be kept weed free throughout growth periods (Orodho, 2006).

Yield determination

For the purpose of yield determination, the entire herbage from the net plot area (1m x 1m) was cut close to the ground. The harvested green forage was weighed plot wise using hanging scale of 50 kg capacity and the total sample fresh yield (TSFW) in q ha-1 was estimated. Sub Samples of about 100 gm was taken from each plot and dried in oven at 60 °C to constant weight from which dry matter yield (DMY) was determined by dividing the oven-dried weight to its fresh weight expressed as percentage. The dry matter yield (DMY) in qha-1 was estimated by multiplying the green forage yield (qha-1) with that of the sample dry matter content divided by 100.

1-Fresh fodder yield (t ha-1): At 50 % flowering stage, all treatments of each replications were harvested and weighed to get fresh fodder yield (FFY). The yields obtained were converted into t ha-1.

2-Dry matter (%): For dry matter determination, 100 gm of plant sample was weighed in each container and placed in an oven at 60 °C for 72 hrs till constant weight was attained. Dry matter percentage was calculated by the following formula.

$$\text{Dry Matter (\%)} = \frac{\text{Wt. of oven dry sample}}{\text{Wt. of sample before drying}} \times 100$$

3-Dry matter yield (t ha-1): Dry fodder yield (DMY) was calculated by applying this formula.

$$\text{DMY (t ha-1)} = \frac{\text{FFY} \times \text{DM (\%)}}{100}$$

Data collected

Detailed observations regarding agronomic characteristics (survival, plant vigour, disease and pest resistance and yield parameters) were recorded at different physiological stages of the plant. During the first four and eight weeks after establishment data was recorded on No of plant germinated, total soil cover and disease incidence. Elephant forage biomass was harvested at height of 1.5cm approximately 90 days and oats harvested at blooming stage post establishment using (1x1) m^2 quadrant. The 100gm sample was weighed and oven dried at 65ºC to constant weight (72 hrs). The dry weight of the whole plant was obtained and used to calculate dry matter (DM) yield. Latter on at the commencement of the dry season, data was recorded on % disease incidence during this period.

Data Analysis

All the data obtained in both years for 10 accessions of elephant grasses and oats varieties used by randomised complete block design (RCBD) were analyzed using SAS 9.1 computer software. Treatment means were

compared using Least Significant Difference (LSD) test at 5% level of probability (Steel &Torrie, 1980).

RESULTS AND DISCUSSION

Growth performance elephant varieties/accessions:-

Differences in mean performance of elephant grasses varieties for the adaptation studied

Under HSARC are presented in Tables 1. They also observed existence of significant variation for these traits among the ten accessions tested.The results indicated that the differences among the means of the ten elephant grasses accessions for the studied traits were significant ($p<0.05$) for four &eight weeks germination and for four and eight weeks soil coverage present, statistically there was no difference ($p>0.05$) in total fresh weight and sample dry weight t between ten of elephant grasses accessions treatment at Haro Sabu Agriculture Research (HSARC) (table.1).

The overall mean population of plant germinated at four weeks counted from the net plot area (1mx1m) were 40.6 for ILRI 14984 and 39.3 for ILRI 16840 under HSARC condition in 2011/12. Although at eight weeks plant germinated counted were 44.7 for ILRI 14984 and 46.3 for ILRI 16840 elephant grasses varieties.

Mean of soil cover percentage at eight weeks were significant differences ($p<0.05$) among elephant grass varieties from 83 for ILRI 16840, 66.7 for ILRI 14984 and ILRI 16784 for 66.7 consequently.

Growth performance oats varieties

Differences in mean performance of the oat varieties for the characters studied

Under HSARC and H/Galan sub-site are presented in Tables 2 and 3 respectively and the combined mean is presented in Table 4.

The results indicated that the differences among the means of the Oat varieties for the studied traits were significant ($p<0.05$) for four &eight weeks germination and 50% flowering for all experimental conditions and again there were significant differences at 5% probability level among oat varieties for four weeks soil coverage (FSWC) and total fresh weight (TFW) under Hawa Galan site With regard to eight weeks soil cover, there was no difference ($p>0.05$) in percent between oat variety treatment at Hawa Galan site(table.2).

The mean population of plant germinated at four weeks counted from the net plot area(1mx1m) were 87 for CI-8235 to73.667 for CI-8251 under HSARC whereas, under H/Galan condition 230.333 for Bonabas to114.333 Jasary although at eight weeks plant germinated counted were87 for CI-8235to 73.333 for CI-8251 under HSARC and under H/Galan condition 230.333 for Bonabas to114.333 Jasary.

Among oat varieties in respect to days to 50 % flowering ranged from 94 days for CI-8251 to 82 days for CI-8235 under HSARC and 94 days for CI-8251 to 81.333days for Bonsa under H/Galan sub-site. Mean of soil cover percentage at four weeks were significant differences among oat varieties from 32.333 for CI-8235 to 23.333 for CI-8237 at HSARC and under Hawa Galan site, 35.333 for Bonabas to 23 for Jasary, even though they are not statistically

Herbage and dry fodder yields of elephant varieties/accessions

From ten varieties of elephant grasses conducted at HSARC ILRI 16840 variety was take highest dry matter yield (**10.7** tone/ ha), followed by ILRI 16789 (8.8 tone/ ha), ILRI 16784 (7.5 tone/ ha) and ILRI 16898 (6.9tone/ha) varieties in first year (2011/12 G.C) and its strengthen the findings of (Bogdan, 1977) which was reported that, On good and heavily fertilized soil and in warm humid climate, elephant grass can produce DM yield of 9.16-19.04 tone/ha. On the other hand ILRI 16785 accession of elephant grass was produced the lowest dry matter yield (3.6tone/ha) see table.1.

Fresh fodder yield (t ha^{-1}):

Least squares means of Napier grass herbage fresh fodder yield (t/ha), sample total fresh weight, disease incidences, and sample dry weight over two years were presented in table 1 and 2. The data indicated that there is no significant effect on green fodder yield at two locations. The maximum green fodder yield (44.72 tone/ha**)** was obtained from ILRI 16840 variety Under HSARC in 2011/12 year. During 2012/13 year, from ten treatments studied ILRI 15743 was produced the highest green fodder (37.46 tone/ha) followed by ILRI 16840 (8.5tone/ha) and ILRI 16801 (8.2) table .6

Herbage and dry fodder yields of oats varieties

Fresh fodder yield (t ha^{-1}):

The data indicated that there is no significant effect on green fodder yield at two locations. The maximum green fodder yield (**4.68t ha^{-1}**) was obtained from Bonabas varieties Under HSARC and Bonsa which is get (**8.41 ha^{-1}**) at Hawa Galan site.

Dry fodder Yield (t ha^{-1}):

Under HSARC, Bonabas varieties produced highest dry matter yield (**9.86** t ha^{-1}), followed by Jasary, CI-8237, and Bonsa. On the other hand, Ci-8251 verity was produced the lowest dry matter yield (**4.84** t ha$^{-1)}$

Under Hawa Galan site, where most of the tested varieties produced highest dry matter yield, even though, Bonabas variety produced the highest dry matter yield (**14.051** t ha^{-1}) followed by CI-8237, CI-8235 and Jasary. On the other hand, lampton verity was produced the lowest dry matter yield (**7.863** t ha^{-1})

Grain Yield

The highest grain/seed yield was obtained from Bonsa under HSARC condition and as well as under Hawa Galan site which was (96.71Qt/ha) and (93.62 Qt/ha) followed by Jasary 49.62Qt/ha and 88.33Qt/ha respectively (see table 1&2). The mean value of grain /seed for two sited combination was revealed that, there were statistical difference ($p<0.05$) among sevens oat varieties Table .3. On the other hand, **Ci-8251** (13.22Qt/ha) and Lampton (43.25 Qt/ha) were produced the lowest grain yield under HSARC condition and Hawa Galan site respectively

Disease Resistance

From table 1, Indicates that from ten elephant grasses adapted at Haro Sabu Agricultural research, two varieties (ILRI 16898 & ILRI 16785 were very attacked by disease. On the other hand (ILRI 16840, ILRI 14984 and ILRI 16784) were no more disease observed in 2011/2012 year.

Table.1 Mean value separation of different variables of Adapted elephant grasses accession at HSARC, 2011 /12

Accession	FWPN	EWPN	EWPC	DIS IN In %	TSFW t/ha	**SFWT** In gm	SDWT in gm	DMY t/ha
ILRI 14984	40.6a	44.7a	66.7b	20.2c	21.28b	100^{a}	22.7a	4.9cd
ILRI 16840	39.3a	46.3a	83.3a	17.3c	44.72a	100^{a}	24.3a	10.7a
ILRI 16784	35.3ab	44.7a	66.7b	20.2c	34.58ab	100^{a}	22.2a	7.5abc
ILRI 16788	34.3ab	40.0ab	61.7bc	28.6bc	27.70b	100^{a}	23.1a	6.3bcd
ILRI 16789	30.7bc	39.7ab	60.0bc	29.2bc	35.78ab	100^{a}	25.0a	8.8ab
ILRI 15743	24.3cd	43.0ab	60.3bc	23.2bc	24.01b	100^{a}	23.5a	5.6bcd
ILRI 16801	23.7cd	36.0b	53.3cd	35.7b	23.18b	100^{a}	24.5a	5.7bcd
ILRI 14389	20.3de	42.7ab	51.7cd	23.8bc	22.96b	100^{a}	21.9a	5.1cd
ILRI 16898	15.0e	26.7c	43.3de	52.4a	30.91ab	100^{a}	22.5a	6.9bcd
ILRI 16785	13.7e	22.7c	31.7e	59.5a	31.83 ab	100^{a}	22.6a	3.6d

Means with the same letter in a column are not significantly different (p>0.05)

KEY; **FWPN**=four weeks plant number/m^2, EWPN=eight weeks plant number/m^2, EWPC= eight weeks plot cover, DIS IN=disease incidence in%, TSFWT t/ha =total sample fresh weight in tone per hector, SFWT=sample fresh weight, SDWT gm=sample dry weight in gram, DMYE t/ha =dry matter yield in tone per hector ha

Table2. **The mean value of different oat varieties under the agro-climatic condition of HSARC, 2013/14**

Varieties	**FWPN**	**EWPN**	**FWSC**	**EWSC**	**DISR**	**DYFWL**	**TFWT in Qt**	**SFWT in gm**	**SDWT in gm**	**DMYt/ha**	**SDY in gm**	**SDY Qt/ha**
Jasary	79.33^{bc}	78b^{cd}	29.33^{ab}	82.66^{d}	2.66^{ab}	85.66^{ab}	3.78^{bc}	100^{a}	20.18^{ab}	7.65^{b}	297.77^{b}	49.62^{b}
Ci-8251	73.66^{d}	73.33^{d}	26^{ab}	90.33^{bc}	3.0^{a}	94^{a}	3.37^{c}	100^{a}	14.50^{cd}	4.8^{c}	79.30^{c}	13.22^{c}
Ci-8235	87^{a}	87^{a}	32.33^{a}	92.66^{b}	2.33^{b}	81.66^{b}	3.82^{bc}	100^{a}	17.36^{bc}	6.67^{bc}	262.27^{b}	43.71^{b}
Ci-8237	82.33^{ab}	82^{ab}	23.33^{b}	88^{c}	2.90^{ab}	88^{ab}	3.84^{bc}	100^{a}	16.36^{cd}	6.28^{bc}	184.47^{bc}	30.74^{bc}
Bonsa	75.67^{cd}	75.33^{cd}	27.33^{ab}	93.66^{ab}	0.00^{c}	85^{ab}	4.68^{a}	100^{a}	13.43^{d}	6.28^{bc}	561.73^{a}	93.62^{a}
Bonabas	80^{bc}	83.33^{ab}	30.66^{a}	98^{a}	0.00^{c}	82^{b}	4.46^{ab}	100^{a}	22.03^{a}	9.86^{a}	283.53^{b}	47.25^{b}
Lampton	81^{b}	81a^{bc}	28.66^{ab}	92^{bc}	2.50^{ab}	83.66^{b}	3.80^{bc}	100^{a}	15.73^{cd}	5.98^{bc}	90.07^{c}	15.01^{c}
LSD	4.95	6.54	6.72	4.59	0.59	9.8516	.83	0	2.98	1.90	126.12	21.02
SE(M)	7.74	13.54	14.27	6.66	0.11	30.66	221.9	0	2.81	11.43	5.026	8.37
CV (%)	3.48	4.6	13.38	2.83	17.41	6.46	11.86	0	9.81	15.72	28.21	28.21

Means with the same letter in a column are not significantly different (p>0.05)

FWPN =four weeks Plant number, **EWPN** =Eight weeks plant number**, FWSC**=Four weeks soil cover, **EWSC**=eight weeks soil cover, **DISR**=disease record, **DYFWL**= days to 50% flower, **TFWT in quntal** =Total fresh weight in quntal per plot, **SFWT in gm**=Sample fresh weight from each plots in gram, **SDWT** =Sample dry weight, **DMY t/ha**=dry matter yield in tone per hector, **SDY in gm**=Seed yield in gram per plot, **SDY Qt/ha**=Seed yield in quntal per hector

Table 3. The mean value of different oat varieties under the rain feed condition Hawa Galan sub site, 2013/14

varieties	FWPN	EWPN	FWSC	EWSC	DISR	DYFWL	TFWT in Qt	SFWT in gm	SDWT in gm	DMY t/ha	SDY in gm	SDY Qt/ha
Jasary	114.33^{e}	114.33^{e}	23.00^{b}	91.00^{b}	0.00^{a}	86.00^{b}	7.70a^{bc}	100^{a}	14.13^{c}	10.84^{a}	530.03^{ab}	88.33^{ab}
CI-8251	140.33^{d}	140.33^{d}	28.00^{b}	93.67^{ab}	0.00^{a}	94.33^{a}	7.21^{bc}	100^{a}	14.467^{bc}	10.36^{a}	346.23^{bcd}	57.7^{bcd}
CI-8235	148.67^{bc}	148.00^{b}	23.33^{b}	91.67^{ab}	0.00^{a}	92.00^{a}	7.84^{ab}	100^{a}	15.13^{bc}	8.80^{a}	326.10^{cd}	54.35^{cd}
CI-8237	159^{b}	159.00^{b}	28.67^{ab}	96.67^{ab}	0.00^{a}	92.33^{a}	7.08c	100^{a}	17.13^{a}	12.14^{a}	499.57^{abc}	83.26^{abc}
Bonsa	115.67^{e}	115.67^{e}	24.00^{b}	96.33^{ab}	0.00^{a}	81.33^{c}	8.41^{a}	100^{a}	14.80^{bc}	12.33^{a}	580.27^{a}	96.71^{a}
Bonabas	230.33^{a}	230.33^{a}	35.33^{a}	98.67^{a}	0.00^{a}	84.33^{cb}	7.61^{bc}	100^{a}	18.47^{a}	14.05^{a}	363.93^{bcd}	60.65^{bcd}
Lampton	130.67^{d}	130.67^{d}	24.67^{d}	92.00^{ab}	0.00^{a}	92.33^{a}	7.16^{bc}	100^{a}	15.13^{bc}	7.86^{a}	259.50^{d}	43.25^{d}
LSD (5%)	13.52	13.1	6.82	7.41	0.00	3.58	733.17	0	2.78	6.40	202.09	33.68
SE(M)	7.60	7.36	3.83	4.16	0.00	2.01	412.12	0	1.56	3.60	113.59	18.93
CV (%)	5.12	4.96	14.36	4.42	0.00	2.26	5.43	0	10.01	33.00	27.36	27.36

Means with the same letter in a column are not significantly different (p>0.05).
FWPN =four weeks Plant number, **EWPN** =Eight weeks plant number**, FWSC**=Four weeks soil cover, **EWSC**=eight weeks soil cover, **DISR**=disease record, **DYFWL**= days to 50% flower, **TFWT in quntal** =Total fresh weight in quntal per plot, **SFWT in gm**=Sample fresh weight from each plots in gram, **SDWT** =Sample dry weight, **DMY t/ha**=dry matter yield in tone per hector, **SDY in gm**=Seed yield in gram per plot, **SDY Qt/ha**=Seed yield in quntal per hecto

Table4. The mean value of different oat varieties under the rain feed condition combined two location (HSARC and Hawa Galan sub site) 2013/14

varieties	FWPN	EWPN	FWSC	EWSC	DISR	DYFWL	TFWT in Qt	SFWT in gm	SDWT in gm	DMY t/ha	SDY in gm	SDY Qt/ha
Jasary	96.83^{b}	96.17^{c}	26.167^{b}	86.83^{c}	1.33^{a}	85.833^{bc}	5.74^{bc}	100.0^{a}	17.157^{b}	9.25^{ab}	413.9^{b}	68.98^{b}
Ci-8251	107.00^{b}	106.83^{bc}	27^{b}	92^{b}	1.50^{a}	94.167^{a}	5.29^{c}	100.0^{a}	14.483^{cd}	7.60^{b}	212.77^{de}	35.46^{de}
Ci-8235	117.83^{b}	117.50^{bc}	27.83^{ab}	92.17^{b}	1.16^{a}	86.833^{bc}	5.83^{bc}	100.0^{a}	16.250^{cbd}	7.73^{b}	294.18^{cde}	49.03c^{de}
Ci-8237	120.67^{b}	120.50^{b}	26^{b}	92.33^{b}	1.45^{a}	90.167^{ab}	5.46^{c}	100.0^{a}	16.750^{bc}	9.20^{ab}	342.02^{bc}	57.0^{bc}
Bonsa	95.67^{b}	95.50^{c}	25.66^{b}	95^{b}	0.00^{b}	83.167^{c}	6.55^{a}	100.0^{a}	14.117d	9.30^{ab}	571^{a}	95.16a
Bonabas	155.17^{a}	156.83^{a}	33.00^{a}	98.33^{a}	0.00^{b}	83.167^{c}	6.03^{ab}	100.0^{a}	20.250^{a}	11.96^{a}	323.73^{bcd}	53.95^{bcd}
Lampton	105.8^{b}	105.83^{bc}	26.66^{b}	92b	1.25^{a}	88^{bc}	5.48^{c}	100.0^{a}	15.433^{cbd}	6.92^{b}	174.78^{e}	29.13^{e}
LSD	13.36	12.95	3.03	2.31	0.46	2.81	292.46	0	1.30	1.57	63.87	10.64
SE(M)	21.26	20.6	4.8	3.6	0.73	4.47	465.2	0	2.07	2512.6	101.6	16.93
CV (%)	18.63	18.05	17.5	3.9	76.5	5.12	8.05	0	12.6	28.3	30.4	30.4

Means with the same letter in a column are not significantly different (p>0.05).
FWPN =four weeks Plant number, **EWPN** =Eight weeks plant number**, FWSC**=Four weeks soil cover, **EWSC**=eight weeks soil cover, **DISR**=disease record, **DYFWL**= days to 50% flower, **TFWT in Quntal** =Total fresh weight in Quntal per plot, **SFWT in gm**=Sample fresh weight from each plots in gram, **SDWT** =Sample dry weight, **DMY t/ha**=dry matter yield in tone per hector, **SDY in gm**=Seed yield in gram per plot, **SDY Qt/ha**=Seed yield in quntal perhector

Table.5 Analysis of variance of Adapted forage grass (elephant grass) in at HSARC 2011/12 G.C

Traits	Rep.MS(df=2)	TrtMS(df=3)	MSE(df=6)	Mean	cv(%)
FWPN	48.9ns	284.8*	19.6	27.7	15.9
EWPN	78.5ns	191.8*	18.2	38.6	11.1
EWPC	25.1ns	595.1*	51.3	57.9	12.4
DIS IN	250.4ns	611.7*	58.0	31.0	24.6
T SFWT	1844.13 ns	1624.86 ns	815.43	2.96	30.4
SFWT	0	0	0	0	0
SDWT	0.001ns	3.3ns	4.3	23.2	8.9
DMYE	1312.16ns	13087.89 *	4012.91	6.56	30.6

***KEY**; FWPN=four weeks plant number/m2, EWPN=eight weeks plant number/m2, EWPC= eight weeks plant number/m2, DIS IN=disease incidence in%, T SFWT=total sample fresh weight/m2, SFWT=sample fresh weight, SDWT=sample dry weight, DMYE=dry matter yield/ha*
***Note:** means of sample fresh weight analysis were the same (mean variation was null b/c of equal weight of sample has been used).*
During 2012/13 year from ten varieties of elephant grasses, ILRI 16840. ILRI 14984 and ILRI 16784 were not more attacked by disease. But on the other hand, ILRI 16785 and ILRI 16898 were more disease observed see (table.6).

Table 6. Mean value separation of different variables of Adapted elephant grasses accession at HSARC, 20012/13 cropping season.

Accession	DISIN in %	TSFWT t/ha	**SFWT** in gm	SDWT	DMY t/ha
ILRI 14984	20.2c	16.56d	100a	23.3d	3.8e
ILRI 16840	17.3c	34.80a	100a	24.7c	8.5ab
ILRI 16784	20.2c	33.33abc	100a	23.7c	7.9abcd
ILRI 16788	28.6bc	19.93cd	100a	23.7d	4.9cde
ILRI 16789	29.2bc	20.26cd	100a	23.7d	4.8de
ILRI 15743	23.2bc	37.46a	100a	24.3c	9.1a
ILRI 16801	35.7b	31.00abc	100a	26.5b	8.2ab
ILRI 14389	23.8bc	23.33bcd	100a	23.3d	5.4bcde
ILRI 16898	52.4a	21.33cd	100a	22.7e	4.8de
ILRI 16785	59.5a	28.80abcd	100	28.3a	8.1abc

EY;TSFWT=total sample fresh weigh in g/m^2, SFWT=sample fresh weight, SDWT=sample dry weight, DMYE=dry matter yield/ ha

Table.7. Analysis of variance of introduced forage grass (elephant grass) in 20012/13 at haro Sabu ARC

Traits	**Rep.MS(df=2)**	**TrtMS(df=3)**	**MSE(df=6)**	**Mean**	**Cv(%)**
T SFWT	237656333*	15947500*	61346333	26683.3	29.4
SFWT	0	0	0	0	0
SDWT	0.05ns	8.7*	0.07	24.5	1.1
DMYE	145798115*	116233923*	369605260	65849.03	29.2

KEY;TSFWT=total sample fresh weight/m^2, SFWT=sample fresh weight, SDWT=sample dry weight, DMYE=dry matter yield/

Note: means of sample fresh weight analysis were the same (mean variation was null b/c of equal weight of sample has been used).

CONCLUSIONS AND RECOMMENDATIONS

It could be concluded from this study that the tested elephant grasses varieties and oats varieties adapted well to the agro ecologies of Kelem and west Wollega zones of Oromia Regional State. From ten adapted of elephant grasses varieties and seven oats varieties ILRI 16840, ILRI 16789 and ILRI 16784 and Bonsa, Ci-8237 and Jasary produced well dry matter and fresh fodder yield were and they are suitable for use as animal feeds under the study area respectively. Hence if the above mentioned varieties are demonstrated and popularized to the small scale holder farmers, they can boost the income of pro poor farmer.

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LIST OF ABBREVIATIONS

DAP Diammonium phosphate
DMY Dry Matter yield
G.C Gregorian calendar
HSARC Haro Sabu Agricultre Research Center
IRLI International Livestock Research Institute
LSDLeast Significant Difference
OARI Oromia Agricultural Research Institute
PGL Pasture Grass Land
RCBDRandomized Complete Block Design
TDN Total Digestible Nutrient
TSFW Total sample Fresh Yield

Declarations'

Not applicable

Availability of data and material

Please contact author for data requests(if any)

Ethics approval and consent to participate

Report on ethical or involve the use of any animal or human data or tissue is not applicable.

But the body or institution which approved the study was Oromia Agricultural Research Institute, Haro Sabu Agriculture Research Center where the study was carried out.

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APPENDICES

Appendex1. Analysis variance value of different oat varietiesunder the rain feed condition of HSARC, 2013/14

Parameters	Rep.MS(df=2)	Var. MS(df=9)	MSE(df=12)	Mean	CV (%)
FWPN	10.86ns	57.32*	7.75	79.86	3.5
EWPN	2.71ns	67.66*	13.55	80.00	4.6
FWSC	41.33ns	26.96ns	14.27	28.24	13.38
EWSC	5.33ns	69.38*	6.66	91.05	2.83
DISR	0.00ns	5.28**	0.11	1.91	17.41
DYFWL	0.00ns	54.38ns	30.66	85.71	6.46
TFWT	109.27	606.24	221.91	3.97	11.86
SFWT	0.00	0.00	.00	.00	.00
SDWT	1.198	28.25	2.81	17.09	9.81
DMYT/HA	345.95	757.64	1142.65	6.79	15.72
SDY in gm	1169.71	79867.07	5025.88	251.30	28.21
SDY Qt/ha	6.49	190.15	1.25	0.59	0.67

FWPN =four weeks Plant number, **EWPN** =Eight weeks plant number**, FWSC**=Four weeks soil cover, **EWSC**=eight weeks soil cover, **DISR**=disease record, **DYFWL**= days to 50% flower, **TFWT in quntal** =Total fresh weight in quntal per plot, **SFWT in gm**=Sample fresh weight from each plots in gram, **SDWT** =Sample dry weight, **DMY t/ha**=dry matter yield in tone per hector, **SDY in gm**=Seed yield in gram per plot, **SDY Qt/ha**=Seed yield in Quntal per hecto

Note**:** means of sample fresh weight analysis were the same (mean variation was null b/c of equal weight of sample has been used).

Appendex2.

Analysis variance value of different oat varietiesunder the rain feed condition of Hawa Galan sub site, 2013/14

Parameters	Rep.MS(df=2)	Var. MS(df=9)	MSE(df=12)	Mean	CV (%)
FWPN	78.42	4718.5	78.42	148.43	5.12
EWPN	86.33	4718.55	54.22	148.33	4.9
FWSC	31.00	58.23	14.72	26.71	14.36
EWSC	0.43	26.16	17.37	94.28	4.42
DISR	0.00	0.00	0.00	0.00	0.00
DYFWL	4.33	74.60	4.05	88.95	2.26
TSFWT	1531.66	661.98	169.84	7.57	5.44
SFWT	0.00	0.00	.00	.00	.00
SDWT	5.33	7.53	2.44	15.60	10.01
DMYt/ha	7655.56	13706.28	12969.60	10.91	33.00
SDY in gm	3475.10	43558.66	12903.89	415.09	27.36
SDY Qt/ha	19.31	103.71	30.72	0.9	0.06

FWPN =four weeks Plant number, **EWPN** =Eight weeks plant number**, FWSC**=Four weeks soil cover, **EWSC**=eight weeks soil cover, **DISR**=disease record, **DYFWL**= days to 50% flower, **TSFWT in quntal** =Total fresh weight in quntal per plot, **SFWT in gm**=Sample fresh weight from each plots in gram, **SDWT** =Sample dry weight, **DMY t/ha**=dry matter yield in tone per hector, **SDY in gm**=Seed yield in gram per plot, **SDY Qt/ha**=Seed yield in quntal per hector

Note**:** means of sample fresh weight analysis were the same (mean variation was null b/c of equal weight of sample has been used).

Appendex3.

Analysis variance value of different oat varietiesunder the rain feed condition of combined two location (HSARC and Hawa Galan sub site) 2013/14.

Parameters	Rep.MS(df=2)	Loc. Ms (df=1)	Var. MS(df=9)	MSE(df=32)	Mean	CV (%)
FWPN	73.78ns	49371.42	2500.19	452.21	114.14	18.63
EWPN	59.80	49029.16	2667.33	424.53	114.16	18.04
FWSC	13.30	24.38	38.69	23.29	27.47	17.56
EWSC	1.45	110.09*	72.83	13.54	92.66	3.97
DISR	0.00	38.47	2.64	0.53	0.96	76.55
DYFWL	2.16	110.09	92.38	20.01	87.33	5.12
TFWT	1075.54	136528.20	1085.78	216.45	5.77	8.05
SFWT	0.00	.00	0.00	.00	.00	.00
SDWT	0.73	22.94	25.34	4.29	16.34	12.67
DMYT/ha	1690.1	177673.78	16663.29	6313.47	8.85	28.37
SDY	4260.45	281670.48	104351.00	10324.20	333.19	30.49
SDY Qt/ha	23.67	335.32	248.45	24.58	0.79	0.07

FWPN =four weeks Plant number, **EWPN** =Eight weeks plant number**, FWSC**=Four weeks soil cover, **EWSC**=eight weeks soil cover, **DISR**=disease record, **DYFWL**= days to 50% flower, **TFWT in quntal** =Total fresh weight in quntal per plot, **SFWT in gm**=Sample fresh weight from each plots in gram, **SDWT** =Sample dry weight, **DMY t/ha**=dry matter yield in tone per hector, **SDY in gm**=Seed yield in gram per plot, **SDY Qt/ha**=Seed yield in quntal per hector

Note**:** means of sample fresh weight analysis were the same (mean variation was null b/c of equal weight of sample has been used).