



# Performance Evaluation of Improved Oat Varieties/Accessions at East Guji Zone, Oromia, Ethiopia

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**Abstract:** The study was conducted with the objectives to introduce adaptive, high grain and forage yielder of improved Oat accessions/varieties for mid land of Guji zone, Oromia, Ethiopia. The experiment was conducted in Randomized Complete Block Design (RCBD) with three replications under Bore Agricultural Research Center, Adola sub site for two consecutive (2013/14 to 2014/15) in the mean season. Data of 50% date flowering, date of mature, biomass yield, plant height and diseases incidence were collected. Significant ( $P < 0.001$ ) differences were observed for all measured agronomic traits except for lodging and green fodder yield. The result indicates that Jasari was the shortest and Grayaleris was the longest in terms of date of 50% flowering. Grayaleris Variety is late mature whereas Bona Bas variety is early mature. The maximum and minimum plant height was recorded from Lampton and Grayaleris variety respectively that showed significant ( $P < 0.001$ ) variation. Jasari variety (90%) followed by 6710 (83.33%) accession and lampton (78.33%) variety was the most susceptible and has low resistance to disease reaction (leaf and stem rust) and the lowest diseases severity was recorded from Bona Bas (1.67%) followed by Bonsa (6.6%) and 79Ab382 (TX) 80SA95 (10%) varieties. The maximum grain yield (28.85 quant/ha) was produced by accession 79Ab382 (TX) 80SA95 followed by accessions CI-8235 and CI-8237 which where (26.48 and 26.43 quant/ha) respectively and Lampton variety produced minimum grain yield (15.36 quant/ha). From this study, it is concluded that the oat varieties/ accessions 79Ab382 (TX) 80SA95, CI-8235 and Bonsa were found a promising in terms of grain yield, green fodder yield, absence of lodge and diseases resistance than others that could be demonstrated and popularized as an alternative feed resources under smallholder conditions in the study areas and other places of Guji zones of Oromia region with similar climatic and edaphic conditions.

**Keywords:** Accessions, Biomass Yield, Disease Reaction, Grain Yield and Variety

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## 1. Introduction

Oat (*Avena sativa* L.) is an important multi-purpose cereal crops cultivated for grain, feed and straw over more than 9 million hectares globally [3]. Traditionally oats have been cultivated in cropping areas not appropriate for wheat, barley or maize and the cultivated area maintained stable over the years and it is adapted to wide range of soil types and because on marginal soils oats can perform better than other small-grain cereals [1]. It is also the most important winter cereal fodder crops [6] and liked by animals due to high

palatability, quick growing succulent, softness and nutritious fodder crop. The improved varieties of oats produce three-fold green fodder i.e. 60-80 tons per hectare and can feed double number of animals per unit area as against the traditional fodder crops [4]. The oats varieties have already been developed possessing characteristic i.e. early to late duration, high yielding, more nutritious, palatable, multi cut and disease free varieties for various agro-ecological zones. Oat is a cold and drought tolerant crop and it provide green fodder during the lean period when green fodder is scarce and animals are fed with dry fodder [5].

Selection of the promising oat varieties is one of the most

important decisions of a plant breeder. This decision has an impact on the potential yield (forage and grain), seed quality (test weight and protein), disease and insect management and maturity of the crop. Introduction of the new oat cultivars along with the expansion of dairy has given impetus to commercial forage growing areas [13]. There is no any animal feed technology which is tested mid land agro ecology of Guji zone and no information on improved forage production due to the remoteness of the area and after established, Bore Agricultural Research Center is try to introduce improved forage production technologies. Therefore, the experiment was conducted with the objectives of introduce adaptive, high grain and forage yielder of improved Oat accessions/varieties to the area so as to address farmers in quality and quantity of forages for sustainable livestock production and productivity of their by contributing to the food security through increasing livestock production

## 2. Materials and Methods

### 2.1. Description of the Study Area

Adola Rede district is located 470 km away from Addis Ababa, the capital city of Ethiopia, to the South and 120 Km from the zonal capital city, Negele Borena. The district is bordered by Ana Sora district in the North, Wadera district in the South and Odo Shakiso in the West and Girja district in the East directions. The district has altitude range of 1350-2340 m.a.s.l., total land coverage of 1254.56km<sup>2</sup>, annual mean of 1000 mm rainfall and annual average of 28°C of temperature.

Adola district is practiced mixed farming, mining, forest product production and semi-nomadic economic were the major livelihood of farmers. The district is characterized by three agro- climatic zones, namely Dega 11% humid, Weina Dega 29%, sub humid and Kola 60% dry arid respectively which are suitable for production of different crops. The rainfall pattern of the study area is bimodal for lowland and midland areas and uni-modal for highland parts. The major soils of the district are Nitosols (red basaltic soils) and Orthic Acrosols. They are red brown and black brown in colors and they are found on sloping terrain. Therefore, their agricultural utilization is good under natural vegetation. The major crop produced in the area includes maize, sorghum, teff, haricot bean, chat, coffee and the others.

### 2.2. Experimental Materials, Treatments and Experimental Design

The experiment was carried out from 2013/14 to 2014/15 for two years at Bore Agricultural Research Center (BOARC), Adola Rede research sub site of Guji, Oromia National State, Ethiopia. The study was conducted with randomized complete block design (RCBD) in three replications of plot size 3×4 m<sup>2</sup> of a total area of 12m<sup>2</sup>. The space between block, plot and row were 1.5m, 1m and 0.25m respectively. Land preparation was done from end May to the mid of September for three times with a tractor for the first,

then the second and third by oxen and manually harrowed and leveled before planting. After land preparation was done, twelve Oat varieties/Accessions (Jasari, 6710, 712, CI-8237, CI-8235, 6207, Bonsa, 80SA95, 5453, Lampton, Bona Bas, Grayalegris) were sown under rain fed conditions. The seed rate of 80 kg ha<sup>-1</sup> was sown through hand drilling with 5 -10 cm deeps when the soil has enough moisture for seed germination. Fertilizer application was uniformly applied to all plots in the form of DAP and Urea at the rate of 50 and 100kg/ha respectively at the time of sowing. All other crop management practices were done uniformly to all plots as required.

### 2.3. Data Collection and Measurement

Data was collected for date of 50% flowering, date of maturity, lodging percentage, disease resistance, green forage yield, plant height and seed yield data were carefully collected for all accessions/varieties for two consecutive years.

### 2.4. Statistical Analysis

All agronomic data was analyzed by using the Fisher's analysis of variance (ANOVA) techniques and treatment's means were compared using Least Significance Difference (LSD) test at 5% probability level [9].

## 3. Result and Discussion

### 3.1. Agronomic Traits of Napier Grass Cultivars

#### 3.1.1. Date of 50% Flowering and Date of Maturity

The data recorded for 50% flowering date showed that there was statistically significance ( $P<0.001$ ) difference among the varieties/accessions. The shortest and longest date of 50% flowering was recorded from Jasari (58 days) and Grayaleris (74.67 days) respectively. This result is showed shorter days to 50% flowering as Nawaz et al [7] reported from 150.33 to 133.33 days of 50% flowering and [10] from 113.25 to 127.0 days. Days taken to 50% flowering in the varieties are different probably due to their varietal characteristics and adaptability.

The maximum and minimum date of maturity was recorded from Grayaleris (160 days) and Bona Bas (118.33 days) respectively. [7] reported that the maximum and minimum 210 and 179 days to mature respectively were longer than the present result. Significant differences in days taken to maturity among different varieties may be due the genetic makeup or adaptability.

#### 3.1.2. Plant Height and Green Fodder Yield

Plant height is a major factor contributing towards forage yield of different crops. The data showed that there was significance ( $p<0.001$ ) variation among varieties/ accessions (table 1). From present study, the minimum height of 93.33 cm was recorded from Grayaleris variety while the maximum height of 156 cm was recorded from Lampton variety which is in line with [6, 7] who reported variation in plant height

among the varieties. ([11, 10] reported that Lampton variety produce the tallest plant height (179.25 and 184.5 cm) respectively which is a similar result with the present findings that stand first. The main cause of those differences in plant height is due to differences in genetic makeup of the varieties/accessions of oats. [12] Explained that plant height may differ in varieties due to environmental conditions which in turn cause variation in hormonal balance and cell division rate. The significant effect of variety on plant height in present study is in agreement with previous findings [11, 6, 5].

### 3.1.3. Green Fodder Yield

Data regarding mean green forage yield (GFY) of oat varieties is presented in (Table 1). There was no statistically significance ( $P>0.05$ ) difference among the varieties/accessions. Numerically the maximum green fodder yield 66.67 ton/h was obtained from bonsa followed by bonabas (65.33 ton/h) and accession 712 (64.93 ton/h). Minimum fodder yield 36.93 ton/h was recorded from Grayaleris. The result of present study is in contrast with [5] and [6] who reported that significance difference among the genotypes of oat. [6] Reported from 33.33 to 47.6t/ha and [5] from 45.8 to 53.9 t/ha which is lower than the present results. Usman Semman et al [11] reported from 105.60 to 54.40 t/ha of green fodder yield which was higher than the present.

### 3.1.4. Grain Yield

There were significant ( $P>0.001$ ) differences in the grain yield of oat varieties/accessions. It is evident from the data that maximum grain yield (28.85 quant/ha) was produced by

accession 79Ab382 (TX) 80SA95 followed by accessions CI-8235 and CI-8237 which produced grain yields (26.48 and 26.43 quant/ha) respectively. Lampton oat variety produced minimum grain yield (15.36 quant/ha) followed by variety Grayalegris (15.6 quant/ha) similar findings with [10] Lampton produce lower grain yield. This is might be due to lodging nature of Lampton variety. The grain yield obtained from the present finding was higher than yield reported by Nawaz et al [7] which was 8.10 to 24.03 quant/ha and almost similar with Dawit Abate and Mulusew Fikere [2] who reported from 21.70 to 29.80 quant/ha and Sanchez-Martin et al [8] reported oat could be produced 21.70 to 17.20 quant/ha that grain yield was strongly affected by agro-climatic conditions.

### 3.1.5. Diseases Occurrence and Lodging Percentage

The diseases severity was the most important criteria during the data collection. Statistical variation ( $P<0.001$ ) was observed among the varieties/accessions tested. Jasari variety (90%) followed by 6710 (83.33%) accession and lampton (78.33%) variety was the most susceptible and has low resistance to disease reaction (leaf and stem rust). The lowest diseases severity was recorded from Bona Bas (1.67%) variety followed by Bonsa (6.6%) and 79Ab382 (TX) 80SA95 (10%). Even though, Bona Bas variety is a diseases tolerant, Bonsa and 79Ab382 (TX) 80SA95 genotypes are superior to Bona Bas in terms of grain yield. Disease is the most factor reduce grain yield [8] reported that the most affected by diseases (rust), the lowest in yield.

**Table 1.** Average performance of different oat varieties/accession under the agro-climatic conditions of Adola Rede district.

Treatments	D50%F	MD	Dis%	Lodg %	Plh	GFYt/h	GYldqtha
6710	64 <sup>cde</sup>	120 <sup>ef</sup>	83.33 <sup>ab</sup>	8.33	154.67 <sup>ab</sup>	53.6	20.5 <sup>c</sup>
712	64.67 <sup>cde</sup>	119 <sup>ef</sup>	13.33 <sup>efg</sup>	0	136 <sup>d</sup>	64.93	21.89 <sup>c</sup>
5453	66 <sup>cd</sup>	121 <sup>de</sup>	11.67 <sup>efgh</sup>	0	138.33 <sup>cd</sup>	55.73	20.74 <sup>c</sup>
6207	65 <sup>cde</sup>	120.67 <sup>de</sup>	20 <sup>def</sup>	0	136 <sup>d</sup>	52.4	21.34 <sup>c</sup>
CI-8237	63.67 <sup>de</sup>	122 <sup>d</sup>	21.67 <sup>de</sup>	0	150 <sup>abc</sup>	48.27	26.43 <sup>ab</sup>
CI-8235	64 <sup>cde</sup>	124 <sup>c</sup>	25 <sup>d</sup>	0	148 <sup>abcd</sup>	58	26.48 <sup>ab</sup>
79Ab382 (TX) 80SA95	63 <sup>c</sup>	124 <sup>c</sup>	10 <sup>fgh</sup>	0	141.67 <sup>bcd</sup>	59.07	28.85 <sup>a</sup>
Bonsa	66.67 <sup>c</sup>	120 <sup>ef</sup>	6.6 <sup>gh</sup>	0	138 <sup>cd</sup>	66.67	25.4 <sup>b</sup>
Lampton	70 <sup>b</sup>	128 <sup>b</sup>	78.33 <sup>b</sup>	10	156 <sup>a</sup>	46.93	15.39 <sup>d</sup>
BonaBas	59.67 <sup>f</sup>	118.33 <sup>g</sup>	1.67 <sup>h</sup>	0	154.33 <sup>ab</sup>	65.33	17.01 <sup>d</sup>
Grayalegris	74.67 <sup>a</sup>	160 <sup>a</sup>	38.33 <sup>c</sup>	0	93.33 <sup>c</sup>	36.93	15.6 <sup>d</sup>
Jasari	58 <sup>f</sup>	121 <sup>d</sup>	90 <sup>a</sup>	0	145.33 <sup>abcd</sup>	38.8	17.58 <sup>d</sup>
Mean	64.94	128.83	33.33	1.52	140.97	53.89	21.44
CV	2.69	0.67	17.85	386.05	5.62	21.53	7.6
LSD (0.05%)	2.96	1.41	10.08	9.99	13.42	19.65	2.76
P-Value	***	***	***	NS	***	NS	***

a, b, c.. Means in a column within the same category having different superscripts differ (from  $P<0.05$  to  $P<0.001$ ); \* = significant, \*\* = very significant, \*\*\* = highly significant, D50%F = date of 50% flower, MD = maturity date, DS, = disease severity, Lodg = lodging, Plh (cm) = plant height in centi meter, GFYt/h = Green fodder yield tone per hectare, GYldqtha = grain yield quintal per hectare.

## 4. Conclusion and Recommendation

On the basis of two years field investigations, clearly indicate that oat varieties/ accessions 79Ab382 (TX) 80SA95, CI-8235 and Bonsa were performed more efficient

with respect to grain yield, Green fodder yield, absence of lodge and resistance to diseases than other tested oat varieties/accessions. It is possible to conclude these varieties/accessions could be demonstrated and popularized as an alternative feed resources under smallholder conditions

in the study areas and other places of Guji zones of Oromia region with similar climatic and edaphic conditions.

## Conflict of Interests

The authors declare that they have no competing interests.

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