American Journal of Biological and Environmental Statistics
2023; 9(2): 19-26
http://www.sciencepublishinggroup.com/j/ajbes
doi: 10.11648/j.ajbes.20230902.12
ISSN: 2471-9765 (Print); ISSN: 2471-979X (Online)

Collection and Nursery Evaluation of Native Perennial Grass Species for Forage Production in Mid Rift Valley of Oromia, Ethiopia

Nebi Husein, Dawit Abate, Meseret Tilahun, Lalisa Diriba, Usman Seman, Fikedu Nemera

Adami Tulu Agricultural Research Center, Ziway, Ethiopia

Email address:
nabihusein2008gmail.com (Nebi Husein)

To cite this article:
Nebi Husein, Dawit Abate, Meseret Tilahun, Lalisa Diriba, Usman Seman, Fikedu Nemera. Collection and Nursery Evaluation of Native Perennial Grass Species for Forage Production in Mid Rift Valley of Oromia, Ethiopia. *American Journal of Biological and Environmental Statistics*. Vol. 9, No. 2, 2023, pp. 19-26. doi: 10.11648/j.ajbes.20230902.12

Received: August 9, 2023; **Accepted**: August 23, 2023; **Published**: September 6, 2023

Abstract: The study was conducted with the intention to collect and evaluate locally available perennial grasses for their performances. Thus, seeds of 30 perennial grass collections representing 6 species were collected from different areas. Before conducting the actual trial, seeds of collected grass were sown at on-station for seed increase. Among the collected grasses, the species that produced adequate seeds were used for their performance evaluation. Accordingly, 15 grasses from *Cenchrus celiaris*, 5 grasses from *Chloris gayana* and 3 grasses from *Panicum coloratum* collections were tested for agronomic, yield and quality parameters for two consecutive years. Improved varieties from each species were included as a check for making comparisons. The experiment was arranged in randomized block design with three replications. The overall mean value indicated that *Chloris gayana* grass with collection *CGAB02* produced significantly ($p<0.05$) the highest (214.5kg/ha) seed yield value as compared to the others while dry matter yield performance of *Chloris gayana* were not significantly differ among the tested grass species. Other parameters including plot cover, days to 50% of flowering, leaf to stem ratio and survival rates of *Chloris gayana*grass were significantly ($p<0.05$) varied. The combined two years mean result showed that native *Panicum coloratum* with collection *PCHB024* produced the highest seed yield (192.1kg/ha). Whereas the dry matter recorded have no significant difference among the tested *Panicum coloratum* grass collections. Among *Panicum coloratum* grasses, *PCHB024* also performs best in other agronomic and survival rate while improved *Panicum coloratum* variety (check) recorded the highest (14.9%) in crude protein content as compared to the other collections. The two years combined analysis indicated the highest mean seed yield (393.2kg/ha) were recorded for *CCMk019* followed by *CCWB010* and *CCUM012* species. The two years mean showed that the highest dry matter yield (2.58t/ha) was recorded from *CCUM012*. The tested *Cenchrus celiaris* grass collections were also significantly different in all evaluated agronomic and quality parameters. Generally, the performances of local and improved grasses of the same species are comparable in most parameters. However, the survival rates of local grass after the establishment were found to be better than that of improved varieties. Among the tested perennial grasses, CGAB02, *PCHB024*and *CCUM012*and*CCWB010* from *Chloris gayana*, *Panicum coloratum* and *Cenchrus celiaris* grass species respectively were performed best in most important parameters. These best performed local grasses should be further evaluated at on farm condition on degraded grazing lands.

Keywords: Dry Matter Yield, Native Grass Species, Nursery Evaluation, Perennial Grasses

1. Introduction

The livelihood of the smallholder farmers in the mid rift valley of Oromia is mainly dependent on the production of livestock as source of food, income and security in times of hardship. However, livestock production and productivity is very low because of inadequate feed in quantity and quality. Expansion of crop lands, high grazing pressure and recurrent drought reduced the overall feed availability and quality of natural pasture. The degradation of grazing lands is becoming serious in the mid rift valley areas due to climatic, human and other factors which are decreasing valuable plant

species. Now a days, the important grass species mainly perennials have replaced by annuals, more productivities by less productive and more palatable type by undesirable once. Efforts have been made to tackle feed resource constraints through introduction and evaluation of improved forage species for different agro-ecologies of the country.

The highly degraded grazing land could be improved by reseeding with palatable local /native grass species. However, the emphasis given in the natural pasture improvement especially the degraded grazing lands by locally available native forage grass species is minimal. Forage and pasture crops evaluation activities for degraded grazing land improvement were mainly dealt in the past with the introduction of exotic species that are mainly commercial types by neglecting the native genotypes [2]. The added advantage of considering the native perennial grasses species over the exotic once includes their better ability to survive grazing pressure, adaptability to environmental stress like climatic (low and erratic rain fall and recurrent drought) and edaphic constraints. Ecotype variation is also expected between the different collections of native perennial grass species germplasm due to variation in the extent of biotic, climatic and edaphic factors and their interaction that made possible a development of a certain ecotype in a specific locality and/or agro-ecologies [1]. It has also paramount importance that high yielding and palatable grass species should be established in their suitable eco-sites [8].

However, the emphasis given in the natural pasture, especially the degraded grazing lands improvement by locally available native forage grass species is insignificant. The effort made in the past to collect, characterize and evaluate the locally available perennial grass species to improve their yield potential and quality is also negligible. Hence, this trial was conducted with the intention to identify native grass species with higher DM yield and quality for reclamation and rehabilitation of degraded grazing/ pasture lands and to conserve different species as a breeder line for future breeding and improvement programs.

2. Materials and Methods

2.1. Description of Study Area

Native perennial grass species collection was carried out in West Arsi (Negele Arsi district) and East Showa (Adami Tulu Jidu-Kombolcha, Dugda, Boset and Fentale districts) zones of Oromia Regional State; after the main rainy season. A total of 21 sites were visited across the five districts (Table 1). The altitude of collection areas ranged from 955 to 1760 meter above sea level (masl). During the growing seasons of 2017 and 2020, the annual mean rainfall value of ATARC was 981 and 664 mm, respectively. The mean value of the temperature recorded was 21.8°C with a range of 13 to 29°C (ATARC meteorological station). All collections were carried out in natural habitats, grazing lands, parks, marginal lands, margins of roads and the like. During collection the necessary passport data were recorded.

Table 1. *Native perennial grass collected from different areas of the Rift Valley of Oromia.*

Collected grasses	Identification code	Zones	Districts	Collection sites	Altitude
Chloris gayana					
Chloris gayana–Urgomechara *CGUM01*		East Showa	Adami Tulu	Urgo-mechafara	1592
Chloris gayana– Adanshoborenota	*CGAB02*	East Showa	Adami Tulu	Adansho-borenota	1604
Chloris gayana- Costic Soda	*CGCS03*	East Showa	Adami Tulu	Costic Soda	1648
Chloris gayana- Meki	*CGMk04*	East Showa	Dugda	Meki	1640
Chloris gayana- Odaanshura	*CGOS05*	East Showa	Adami Tulu	Oda-anshura	1570
Chloris gayana-dole	*CGDl06*	West Arsi	Arsi Negele	Dole	1593
Chloris gayana- Abijata Shala Park	*CGAP07*	West Arsi	Arsi Negele	Abijata Shala Park	1635
Chloris gayana (ATARC-improved)	*Chloris gayana*-improved	East Showa	Adami Tulu	Adami Tulu On-station Research site	
Cenchrus celiaris					
Cenchrusceliaris -Dole	*CCDl08*	West Arsi	Arsi Negele	Dole	1593
Cenchrusceliaris- Adama	*CCAD09*	East Showa	Adama	Adama	1560
Cenchrusceliaris- Wiluchu boromo	*CCWB010*	East Showa	Adami Tulu	Wilichu-boromo	1650
Cenchrusceliaris- Denbia-dansho	*CCDA011*	East Showa	Adami Tulu	Denbe-adansho	1596
Cenchrusceliaris- Urgomechara	*CCUM012*	East Showa	Adami Tulu	Urgo-mechafara	1592
Cenchruscetigrus - Dole	*CCDl013*	West Arsi	Arsi Negele	Dole	1593
Cenchrusceliaris- AbijataShala Park	*CCAS014*	West Arsi	Arsi Negele	AbijataShala Park	1650
Cenchrusceliaris- Oyitu-basuma	*CCHB015*	East Showa	Adami Tulu	Oitu-basuma	1667
Cenchrusceliaris- Gerbwidena bororomo	*CCGWB016*	East Showa	Adami Tulu	Gerbi-widena	1629
Cenchrusceliaris- Gerbweshgula	*CCGW017*	East Showa	Adami Tulu	Gerbi-weshgula	1760
Cenchrusceliaris - Tower Indanshe	*CCTI018*	East Showa	Adami Tulu	Tower Indanshe	1654
Cenchrusceliaris- Meki	*CCMk019*	East Showa	Dugda	Meki	1664
Cenchrusceliaris- Boset	*CCBo020*	East Showa	Boset	Boset	1520
Cenchrusceliaris- Dire sedan	*CCDS021*	East Showa	Fentale	Dire sedan	1043
Cenchrusceliaris- Turo	*CCTr022*	East Showa	Fentale	Turo	970
Cenchrusceliaris- Awash park	*CCAP023*	East Showa	Fentale	Awash park	955
Cenchrus celiaris (ATARC-Improved)	*Cenchrus celiaris* - Improved	East Showa	Adami Tulu	Adami Tulu On-station Research site	

Collected grasses	Identification code	Zones	Districts	Collection sites	Altitude
Panicumcoloratum					
Panicum coloratum - Hoyitubasuma	*PCHB024*	East Showa	Adami Tulu	Oitu-basuma	1667
Panicum coloratum - Wiluchuboromo	*PCWB025*	East Showa	Adami Tulu	Wilichu-boromo	1650
Panicum coloratum - Awash park	*PCAP026*	East Showa	Fentale	Awash park	1035
Panicum coloratum (ATARC-Improved)	*Panicum coloratum* - improved	East Showa	Adami Tulu	Adami Tulu On-station Research site	
Other grasses					
Tetrapogontenellus- Hoyitubasuma	*TTHB027*	East Showa	Adami Tulu	Oitu-basuma	1667
Tetrapogontenellus- Awash park	*TTAP028*	East Showa	Fentale	Awash park	955
Enteropogonmacrostachyus- Awash park	*EMAP029*	East Showa	Fentale	Awash park	1035
Lintonianutans- Awash park	*LNAP030*	East Showa	Fentale	Awash park	1035

2.2. Exploration and Seed Collection

At each visited site, seeds of major available native perennial grass species were collected by walking on a transect stops/sites at about 10 km interval across the sward. Farmers were participated in the exploration and collection of the seeds of perennial grasses. More emphasis was given in a collection of the most common distributed sites to acquire variation through collecting at more sites and environments in the dry land agro-ecologies.

2.3. On-Station Evaluation

Accordingly, seeds of 34 perennial grass collections representing 6 species were collected from different areas in the mid rift valley. Before the start of the actual yield and other agronomic performance evaluation, the seeds of collections grass samples were sown at on-station site for initial observation and seed availability increase. Among the collected local grass samples, grasses that germinated and produced adequate seeds were used for their performance evaluation. Accordingly, the selected grass collections from *Cenchrus celiaris*, *Chloris gayana* and *Panicum coloratum* were tested for agronomic, yield and quality parameters for two consecutive years. Improved varieties from each species/ cultivars were included as a check for making comparisons. The experiment was arranged in randomized block design with three replications. A plot size of 3m × 2m, with a spacing of 0.5m between plots and 1m between replication were used [12]. Seed rate at 10kg/ha was used. The seeds were drilled uniformly within the rows. Weeding was undertaken to enable the plants to express their genetic potential.

2.4. Data Collection and Analysis

Data on plot cover, vigor, plant height, date of first flowering, survival rate, herbage yield, seed yield and quality parameters were recorded. Herbage samples from two rows of each plot were harvested when the grass species reached the boot stage. A subsample from each plot was collected within each replication. All samples were dried in a forced air oven at 55°C for 48hrs until they reached a constant weight and were then weighed. Dry matter was determined, and yield was reported on a DM basis. The subsamples were then combined within the same species across replications and one representative sample collected from the combined replications was used for crude protein determination. Total nitrogen was determined following Kjeldahl procedure [13]. Agronomic and yield data were analyzed using analysis of variance by the PROC GLM procedure of SAS (SAS Institute Inc., Cary, NC, USA). Treatment means were compared using least significant difference (LSD) test at the 5% level of probability [11].

3. Result and Discussions

Based on the germinations and seed setting performances of the collected grasses, about 15 collections from *Cenchrus calories*, 5 collections of *Chloris Guyana* and 3 collections from *Panicum coloratum* grasses were selected for further evaluation. The other grass collections which showed poor germination and failed to produce seed were rejected at the initial screening stage as indicated in table 2.

Table 2. *Selected native perennial grass for evaluation based on their germination and seed setting performances.*

Collected grasses	Germination and seed setting performance	Decision made
Chloris gayana		
CGUM01	Germinated but failed to set seed	Not passed to the next evaluation
CGAB02	Germinated and produced seed	Passed to the next evaluation
CGCS03	Germinated and produced seed	Passed to the next evaluation
CGMk04	Germinated and produced seed	Passed to the next evaluation
CGOS05	Germinated but produced inadequate seed	Not passed to the next evaluation
CGDl06	Germinated but produced inadequate seed	Not passed to the next evaluation
CGAP07	Germinated and produced seed	Passed to the next evaluation
Chloris gayana (ATARC-improved)	Germinated and produced seed	Passed to the next evaluation

Collected grasses	Germination and seed setting performance	Decision made
Cenchrus celiaris		
CCtDl08	Germinated and produced seed	Passed to the next evaluation
CCAD09	Germinated and produced seed	Passed to the next evaluation
CCWB010	Germinated and produced seed	Passed to the next evaluation
CCDA011	Germinated and produced seed	Passed to the next evaluation
CCUM012	Germinated and produced seed	Passed to the next evaluation
CCDl013	Germinated and produced seed	Passed to the next evaluation
CCAS014	Germinated and produced seed	Passed to the next evaluation
CCHB015	Germinated and produced seed	Passed to the next evaluation
CCGWB016	Germinated and produced seed	Passed to the next evaluation
CCGW017	Germinated and produced seed	Passed to the next evaluation
CCTl018	Germinated and produced seed	Passed to the next evaluation
CCMk019	Germinated and produced seed	Passed to the next evaluation
CCBo020	Germinated and produced some seed	Passed to the next evaluation
CCDS021	Germinated but produced inadequate seed	Not passed to the next evaluation
CCTr022	Poorly germinated	Not passed to the next evaluation
CCAP023	Germinated and produced some seed	Passed to the next evaluation
Cenchrus celiaris (ATARC-Improved)	Germinated and produced seed	Passed to the next evaluation
Panicum coloratum		
PCHB024	Germinated and produced seed	Passed to the next evaluation
PCWB025	Germinated and produced seed	Passed to the next evaluation
PCAP026	Poorly germinated and failed to set seed	Not passed to the next evaluation
Panicum coloratum (ATARC-Improved)	Germinated and produced seed	Passed to the next evaluation
Other grasses		
TTHB027	Poorly germinated	Not passed to the next evaluation
TTAP028	Poorly germinated	Not passed to the next evaluation
EMAP029	Poorly germinated	Not passed to the next evaluation
LNAP030	Poorly germinated	Not passed to the next evaluation

3.1. Performance of Chloris gayana Grass

Mean seed and dry matter yield performances of *Chloris gayana*grass collected from different sites and evaluated for two years are presented in Table 3. The analysis result indicated that seed yield was significant ($p<0.05$) differ among the evaluated *Chloris gayana* grasses for both years. The highest seed yield value of 70.3 kg/ha and 119.5 kg/ha were recorded for collection*CGAB02*in the year of 2017/18 and 2019/20 respectively. Seed yield recorded from the other collections in the year of 2017/18 were not significantly differ while in the second year, significantly the lowest value was obtained from collection *CGCS03*. The overall mean value also indicated that *CGAB02*collectionproduced significantly the highest (94.9 kg/ha) value as compared to the other collections. Dry matter yield performances of the tested Chloris gayana were not significantly differ among the collections. However, numerically the highest (2.99t/ha) mean dry matter yield from the two year data was recorded for improved *Chloris gayana* grass variety. The overall performances of the tested collections for seed and dry matter were better in the second year, probably due to the presence of better rainfall moisture in the second year as compared to the first year.

Mean agronomic parameters and quality performance of *Chloris gayana* grass collected and tested are presented in the table 4. Plot cover, days to 50% flowering, leaf to stem ratio and survival rates of the tested *Chloris gayana* collections were significantly ($p<0.05$) varies among the themselves. The highest plot cover value (78.6%) was recorded for collection *CGMk04* while the least was obtained from *CGCS03*. The longest days (93.6) to 50% flowering was recorded for improved *Chloris gayana* followed by collections*CGAP07* while the shortest days to reach 50%flowering were recorded for*CGAB02* (68.8 days). Leaf to stem ratio is an important quality parameters indicators for forage grasses and observed the highest (3.5) for collection *CGAB02* while the least (1.4) for *CGMk04*. The difference in leaf to stem ratio could be due to variation in leaf size, area and number of leaf and stem fraction of the grasses. Moreover, the grasses characteristic their adoptability with climatic condition, growth and canopy structures under the growing condition could contributes for the differences in LSR [10]. The higher the stem fraction of a grass might have higher dry matter but poor fodder quality due to high fiber contribution. Grasses that have higher leaf than stem are good quality fodder [5]. Even though it is not significantly differ, numerically higher plant height and crude protein value were recorded for collection *CGCS03*. On the other hand, survival rate of native grass were found to be higher as compared to the improved *Chloris gayana*-improved variety (check). Most of the improved grass was died due to the long dry period in the area.

Table 3. *Mean seed (kg/ha) and dry matter yild (t/ha) performances of native Chloris gayana grasses collected from different sites and evaluated for two years (2017/18 and 2019/20).*

Collected grasses	Year 1 (2017/18)		Year 2 (2019/20)		Mean	
	SY	DMY	SY	DMY	SY	DMY
Chloris gayana -improved	45.3[b]	2.22	110.2[b]	3.77	77.6[c]	2.99
CGAB02	70.3[a]	2.92	119.5[a]	2.39	94.9[a]	2.66
CGMk04	46.0[b]	2.44	118.6[a]	3.06	82.3[b]	2.75
CGAP07	49.6[b]	2.61	117.7[a]	2.62	83.6[b]	2.6
CGCS03	50.6[b]	2.91	102.2[c]	3.05	76.4[c]	2.98
Mean	52.4	2.6	113.6	2.98	83.0	2.8
CV	14.8	28.8	3.4	26.8	5.0	32.2
LSD (0.05)	14.1	NS	7.1	NS	8.3	NS

SY= Seed yield, DMY= dry matter yield, LSD=Least significant difference, CV=Coefficient of variation; [2]Figure having the same letters with in column are not significantly (P>0.05) differ, while values followed by different letter (s) are significantly (p<0.05) differ

Table 4. *Mean agronomic and quality performance of native Chloris gayana grasses collected from different areas.*

Collected grasses	PC (%)	PH (cm)	D50%Fl	LSR	CP (%)	SR (%)
Chloris gayana -improved	77.3[a]	71.8	93.6[a]	2.6[ab]	11.3	47.3
CGAB02	76.3[a]	72.3	68.8[b]	3.5[a]	11.7	50.0
CGMk04	78.6[a]	69.1	89.5[a]	1.4[b]	9.4	51.6
CGAP07	72.0[ab]	70.1	92.2[a]	1.6[b]	10.1	55.0
CGCS03	67.8[b]	77.4	88.6[a]	2.9[a]	12.7	53.3
Mean	74.4	72.2	86.5	2.4	10.9	51.4
CV	9.1	12.4	6.1	26.2	15.4	18.9
LSD (0.05)	8.2	NS	6.3	1.2	NS	NS

PC= plot cover, PH = plant height, D50%Fl= Days to 50% flowering, LSR= leaf to stem ratio, CP = crude protein, SR= survival rate LSD=Least significant difference. CV=Coefficient of variation; [2]Figure having the same letters with in column are not significantly (P>0.05) differ, while values followed by different letter (s) are significantly (p<0.05) differ

3.2. Performance of Panicum coloratum Grasses

The analysis result showed a significant (P<0.05) variation in seed yield while the dry matter recorded have no significant difference among the tested *Panicum coloratum* (Table 5). The highest seed yield (56.3kg/ha) was obtained from the improved variety of *Panicum coloratum* in the first year while collection *PCHB024* produced the top seed yield (118.8 kg/ha) in the second year. The combined two mean analysis also showed that *PCHB024* produced the highest seed yield (73.2 kg/ha). Numerically higher dry matter yield was produced from *PCHB024* with better mean yield performance recorded in the second year. The seed and dry matter differences observed among the tested *Panicum coloratum* could be due to their ecotype differences in which they collected. Studies also indicated that the physical environment such as soil types and climates can be a major limiting factor in growth, productivity and survival of grass species [3, 4].

The analysis showed a significant (P<0.05) variation in plot cover, plant height, days to 50% flowering leaf to stem ratio and crude protein and survival rate of the tested *Panicum coloratum* (table 6). Native *Panicum coloratum* (*PCHB024)* produced the highest plot cover (88.3%), the longest days (100 days) to reach 50% of flowering and the highest (45.3%) survival rate among the other tested grasses. However, with regards to plant height and leaf to stem ratio, *PCWB025* was showed the top value 75.8cm and 3.67 respectively while improved *Panicum coloratum* variety (check) recorded the highest (14.9%) in crude protein content as compared to the other collections. The significant difference observed in many parameters among the tested *Panicum coloratum* grasses is probably due to the variations of collection sites in climatic conditions (temperature and rainfall) and other edaphic factors. Thus, from the tested *Panicum coloratum* grasses, *Panicum coloratum* of collection *PCHB024* have shown better overall agronomic, yield and quality performance as compared to the other grasses.

Table 5. *Mean seed (kg/ha) and dry matter yield (t/ha) performances of native Panicum coloratum collected from different sites and evaluated for two years (2017/18 and 2019/20).*

Collected grasses	Year 1 (2017/18)		Year 2 (2019/20)		Mean	
	SY	DMY	SY	DMY	SY	DMY
PCWB025	31.3[b]	2.69	90.0[b]	2.41[b]	60.6[b]	2.55
PCHB024	27.5[b]	2.64	118.8[a]	2.82[a]	73.2[a]	2.73
Panicumcoloratum - ATARC improved	56.3[a]	2.14	99.2[b]	2.87[a]	72.5[ab]	2.51
Mean	38.4	2.49	99.2	2.69	68.8	2.59
CV	21.4	32.3	4.2	6.4	6.2	31.4
LSD (0.05)	16.4	NS	8.3	0.34	12.3	NS

SY= Seed yield, DMY= dry matter yield, LSD=Least significant difference. CV=Coefficient of variation; [2]Figure having the same letters with in column are not significantly (P>0.05) differ, while values followed by different letter (s) are significantly (p<0.05) differ

Table 6. *Mean agronomic and quality performance of native Panicum coloratum grasses collected from different areas.*

Collected grasses	PC	PH (cm)	D50%Fl	LSR	CP (%)	SR (%)
PCWB025	78.5[b]	75.8[a]	91.5[b]	3.67[a]	10.06[b]	44.3[a]
PCHB024	88.3[a]	70.4[ab]	100.0[a]	3.06[b]	13.2[ab]	45.3[a]
Panicum coloratum - ATARC improved	76.8[b]	65.2[b]	75.3[c]	2.95[b]	14.9[a]	36.0[b]
Mean	81.2	70.5	88.9	3.23	12.7	41.8
CV	5.0	8.5	5.9	2.5	14.5	9.0
LSD (0.05)	5.2	7.6	6.64	0.16	3.69	7.5

PC= plot cover, PH = plant height, D50%Fl= Days to 50% flowering, LSR= leaf to stem ratio, CP = crude protein, SR= survival rate LSD=Least significant difference. CV=Coefficient of variation; [2]Figure having the same letters with in column are not significantly (P>0.05) differ, while values followed by different letter (s) are significantly (p<0.05) differ

3.3. Performance of Cenchrus celiaris Grasses

Mean seed and dry matter yield performances of *Cenchrus celiar is* grasses collected from different sites tested for two years are also indicated in table 7. The analysis indicated that the tested *Cenchrus celiar is* grasses collected from different sites were significantly (P<0.05) differ in seed and dry matter yield. The highest seed yield were obtained from native *Cenchrus celiaris* of collection *CCMk019*in the 2017/18 and 2019/20 trial periods. Similarly the two years combined analys is also showed the highest mean seed yield (393.2kg/ha) was recorded for collection*CCMk019* followed by *CCGWB016*and *CCUM012*, with a value of 383.6 and 383.3kg/ha respectively. The minimum seed yield (144.6kg/ha) was recorded from collection*CCDl013* in 2015/16 while *CCGW017*gives the least seed yield in 2019/20 experimental year. The two years combined mean also indicated that collection*CCGW017* was the least seed yielder among the tested *Cenchrus celiaris* grasses. Most of the native *Cenchrus celiaris* grasses performed better in seed yield as compared to the improved *Cenchrus celiaris* (check) variety. The dry matter yield recorded from the tested *Cenchrus celiaris* grasses varies from 1.5 t/ha to 2.5t/ha in the first year and from 2.12 to 3.02t/ha in the second year. During the first year, the highest dry matter yield (2.6t/ha) was obtained from the collection*CCAP023* while in the second year improved *Cenchrus celiaris* variety produced the highest dry matter yield (3.02 t/ha). The two years mean indicated that the highest dry matter yield (2.58t/ha) was recorded for *CCUM012*while the least value (1.86t/ha) obtained from collction*CCGW017*.

The analysis result of agronomic and quality parameters of *Cenchrus calories* grass collections is also presented in table 8. The tested *Cenchrus celiaris* grasses were significantly differ in all evaluated agronomic and quality parameters. The highest plot cover and plant height were recorded for collection*CCtDl08* with a value of 92.6% and 65.7 cm respectively whereas the least plot cover value (63.3%) and plant height (50.3cm) were recorded from collections*CCAD09* and *CCMk019* respectively. *Cenchrus celiaris* with collection number*CCDl013*was attained 50% flowering at longer days (71.2dys) followed by *Cenchrus celiaris* of improved variety (69.8days) as compared to the other grasses while the fastest grass to attain 50% of flowering werecollections*CCUM012* and *CCDA011*. The highest leaf to stem ratio value (5.6) was recorded by collection*CCtDl08* followed by *Cenchrus celiaris*-Improved variety while the least value (1.8) was recorded by *CCDl013*. Crude protein contents were also differ among the tested grasses with the highest value (10.5) recorded for *Cenchrus celiaris* -improved variety followed by collections*CCGWB016* and *CCAP023*. The survival rate is one of the important parameters taken for screening the best grasses that tolerate mainly moisture shortage occurred in the long dry periods in the area. Accordingly, the highest values of survival rate were recorded for *Cenchrus celiaris* grasses collection with*CCUM012*while the least value of survival rate was obtained from collection *CCGW017* (58. 2).

Generally, among the tested *Cenchrus celiaris* grass collections, *CCUM012* and *CCWB010* were found to be the best performed with respect to the major important parameters required for identifying the best perennial grasses for rehabilitation of degraded grazing lands in the moisture stressed areas of rift valley conditions.

Table 7. *Mean seed (kg/ha) and dry matter yield (t/ha) performances of native Cenchrus celiaris grasses collected from different sites and evaluated for two years (2017/18 and 2019/20).*

Collected grasses	Year 1 (2017/18)		Year 2 (2019/20)		Mean	
	SY	DMY	SY	DMY	SY	DMY
Cenchrus celiaris -improved	175.0[de]	1.9[ab]	203.6[d]	3.02[a]	189.3[d]	2.46[ab]
CCAD09	204.2[cde]	2.4[a]	283.0[bc]	2.12[b]	243.5[c]	2.25[abc]
CCUM012	373.3[a]	2.5[a]	393.3[a]	2.71[ab]	383.3[a]	2.58[a]
CCMk019	386.2[a]	1.9[ab]	400.3[a]	2.34[ab]	393.2[a]	2.09[abc]
CCtDl08	251.1[bc]	2.2[ab]	276.6[bc]	2.56[ab]	263.8[bc]	2.38[abc]
CCGWB016	238.0[bcd]	1.8[ab]	296.0[b]	2.25[b]	267.0[bc]	2.04[abc]
CCDA011	276.0[b]	1.9[ab]	276.6[b]	2.39[ab]	276.3[bc]	2.15[abc]
CCBo020	166.8[e]	2.5[a]	221.7[cd]	2.52[ab]	194.3[d]	2.51[a]
CCAS014	284.6[b]	2.6[a]	286.7[b]	2.17[b]	285.7[bc]	2.39[abc]
CCWB010	375.6[a]	1.9[ab]	391.6[a]	2.71[ab]	383.6[a]	2.28[abc]

Collected grasses	Year 1 (2017/18)		Year 2 (2019/20)		Mean	
	SY	DMY	SY	DMY	SY	DMY
CCHB015	275.3^{b}	2.5^{a}	314.6^{b}	2.13^{b}	295.0^{b}	2.31^{abc}
CCTI018	262.5^{bc}	2.4^{a}	306.0^{b}	2.35^{ab}	284.2^{bc}	2.38^{abc}
CCAP023	242.6^{bc}	1.5^{b}	309.5^{b}	2.27^{b}	276.1^{bc}	1.89^{c}
CCGW017	156.3^{e}	1.5^{b}	190.0^{d}	2.21^{b}	173.2^{d}	1.86^{c}
CCDl013	144.6^{e}	2.3^{ab}	223.3^{cd}	2.73^{ab}	184.0^{d}	2.49^{a}
Mean	254.2	2.1	291.5	2.43	272.8	2.27
CV	15.7	24.1	12.7	17.9	15.5	22.8
LSD (0.05)	66.6	0.85	62.1	0.73	48.7	0.59

SY= Seed yield, DMY= dry matter yield, LSD=Least significant difference. CV=Coefficient of variation; [2]Figure having the same letters with in column are not significantly (P>0.05) differ, while values followed by different letter (s) are significantly (p<0.05) differ

Table 8. *Mean agronomic and quality performance of native Cenchrus celiaris grasses collected from different areas.*

Collected grasses	PC (%)	PH (cm)	D50% Fl	LSR	CP (%)	SR (%)
Cenchrus celiaris -improved	82.3^{abcde}	55.0^{cde}	69.8^{ab}	5.1^{ab}	10.5^{a}	60.0^{ab}
CCAD09	63.3^{f}	54.6^{de}	64.2c	4.0b^{cd}	7.5^{abc}	67.3^{ab}
CCUM012	89.3^{a}	64.9^{a}	61.5c	4.4^{abc}	10.1^{a}	71.3^{a}
CCMk019	82.6^{abcd}	50.3^{e}	62.2c	3.4^{cdef}	7.8^{abc}	63.0^{ab}
CCtDl08	92.6^{a}	65.7^{a}	62.6c	5.6^{a}	6.7^{abc}	68.1^{ab}
CCGWB016	85.6^{abc}	64.0^{ab}	64.2c	3.6^{bcde}	10.4^{a}	58.3^{b}
CCDA011	85.6^{abc}	56.0^{bcde}	61.5c	4.5^{abc}	9.4^{ab}	68.3^{ab}
CCBo020	71.6^{def}	54.2^{e}	65.3bc	2.0^{gf}	8.6^{ab}	68.3^{ab}
CCAS014	88.3^{ab}	60.7^{abcd}	64.2c	4.5^{abc}	8.8^{ab}	66.6^{ab}
CCWB010	86.0^{abc}	58.5^{abcde}	63.3c	3.6b^{cdef}	7.5^{abc}	66.6^{ab}
CCHB015	69.6^{ef}	53.3^{de}	63.2c	2.1^{efg}	8.5^{ab}	64.6^{ab}
CCTI018	81.3^{abcde}	63.0^{abc}	63.5c	4.0^{bcd}	5.6^{bc}	61.0^{ab}
CCAP023	75.0^{cdef}	53.3^{de}	63.5c	2.6^{defg}	10.3^{a}	68.3^{ab}
CCGW017	74.6^{cdef}	59.3^{abcd}	63.8c	2.2^{efg}	6.7^{abc}	58.2^{b}
CCDl013	75.7^{bcdef}	64.9^{a}	71.2a	1.8^{g}	4.1^{c}	69.3^{ab}
Mean	80.2	58.5	64.2	3.59	8.2	65.3
CV	13.9	12.1	6.7	26.0	30.1	11.58
LSD (0.05)	12.9	8.2	5.0	1.56	4.38	12.6

PC= plot cover, PH = plant height, D50%Fl= Days to 50% flowering, LSR= leaf to stem ratio, CP = crude protein, SR= survival rate LSD=Least significant difference. CV=Coefficient of variation; [2]Figure having the same letters with in column are not significantly (P>0.05) differ, while values followed by different letter (s) are significantly (p<0.05) differ

3.4. Performance of Native vs Improved Grass

Mean agronomic parameters, yield and quality performances of perennial forage grasses collected and tested are presented in table 9. The highest mean of plot cover and plant height were recorded for *Chloris gayana* grasses of improved variety. The longest day to attain 50 % flowering was required for *Panicumcoloratum* locally collected grasses while *Cenchrus celiaris* of local grass requires the shortest days to reach 50 % flowering. The highest mean seed yield was recorded for *Cenchrus celiaris* locally collected native grasses. The maximum mean forage dry matter yield was obtained from *Chlorisgayana* of improved variety grass followed by native *Panicumcoloratum* grasses. Likewise, the highest value of leaf to stem ratio was recorded for *Cenchrus celiaris* of improved variety followed by locally collected *Panicum coloratum* and *Cenchrus celiaris* of locally collected grasses. The mean value of crude protein contents of the grasses varies from 7.1% for locally collected *Cenchrus celiaris* to 12.9% for *Panicum coloratum* of improved variety. As the reports [6, 7], there were significant differences among grass species in crude protein contents. Crude protein content of some grasses ranged from high (15-25%) to low (3-5%) [9]. Survival rate of the grasses were also range from 44.1 to 65.4% with the highest mean value for *Cenchrus celiaris* of locally collected grass and smallest value was recorded for native *Panicum coloratum* grass.

Generally, the mean value of the tested perennial grasses indicated that the improved grass varieties performed best in dry matter yield and crude protein however, the locally collected grasses were better in the survival rate. Hence, among the locally collected native grasses *Cenchrus celiaris*, *Panicum coloratum* and *Chloris gayana* grasses were performed well in yield and quality parameters. Moreover, these locally collected perennial grasses have the ability to survive longer dry periods as compared to the other grass species.

Table 9. *Mean agronomic, yield and quality performances of perennial grasses tested at Adami Tulu on-station.*

Perennial grasses	PC (%)	PH (cm)	D50%Fl.	SY (kg/ha)	DMY (t/ha)	LSR	CP (%)	SR (%)
Chloris gayana-improved	89.3	76.0	96.0	281.3	3.8	2.3	11.0	45.0
Chloris gayana-native	76.8	75.4	94.3	361.1	2.8	2.4	9.7	53.8
Panicum coloratum-native	85.0	72.2	100.0	326.7	3.4	4.8	11.6	44.1

Perennial grasses	PC (%)	PH (cm)	D50%Fl.	SY (kg/ha)	DMY (t/ha)	LSR	CP (%)	SR (%)
Panicum coloratum-improved	84.3	67.2	75.3	300.0	0.9	2.6	12.9	39.3
Cenchrus celiaris-improved	83.3	56.0	69.3	408.9	2.4	5.1	10.5	60.0
Cenchrus celiaris-native	83.3	59.5	63.0	501.3	1.8	3.7	8.5	65.4
Mean	83.6	67.7	82.9	363.2	2.5	3.4	10.7	51.2

PC= plot cover, PH = plant height, D50%Fl= Days to 50% flowering, SY= Seed yield, DMY= dry matter yield, LSR= leaf to stem ratio, CP = crude protein, SR= survival rate

4. Conclusion and Recommendations

The performance of local and improved grasses of the same species is comparable in most agronomic and yield parameters. However, the survival rates of locally collected native grass after the establishment were found to be better than that of improved varieties. The slight differences observed in the agronomic, yield and quality performances within the grass species is probably due to the variation of the collection area with respect to biotic, climatic and edaphic factors. However, to have very significant ecotype variation, it is important to consider many areas with different agro-ecologies, climate, soil and other factors as much as possible. The best performed collected local grass from each species; *CGAB02* collection, *PCHB024* and *CCUM012* and *CCWB010* from *Chloris gayana*, *Panicum coloratum* and *Cenchrus celiaris* grass species respectively shouldfurther be evaluated at on farm condition on degraded grazing lands. The selected perennial grasses should also maintain at on-station as a breeder line for future improvement programs. Such studies should also focus on native forage legume species so that better performed forage legume variety will be developed.

References

[1] AL-Ghumaiz NS, M. I Motawei. 2011. Productivity, forage quality and presence of dehydrin genes in some introduced pasture grass cultivars growing under heat stress in central region of Saudi Arabia. AJCS 5, (8): 1001-1006.

[2] Chaparro CJ, LE Sollenberger, KH Quesenberry. 1996. Light interception, reserve status and persistence of clipped Mott elephantgrass swards. Crop Sci., 36: 649-655.

[3] Chaparro CJ, LE Sollenberger, LE Jones Jr, 1995. Defoliation effects on Mott elephantgrass productivity and leaf percentage. Agron. J., 87: 981-985.

[4] Dannhauser CS. 1991. The herbage yield and quality of three grass species on two marginal maize soils at Potchefstroom. J. Grassland Soc. Southern Africa, 8: 120-121.

[5] Kammann, C., L. Grünhage, U. Grüters, S. Janze and H. J. Jaeger. 2005. Response of aboveground grassland biomass and soil moisture to moderate long-term CO_2 enrichment. Basic and Applied Ecology, 6: 351-36.

[6] Goldman JJ, TL Springer. 2011. Agronomic performance of eastern gamagrass cultivars and experimental germplasm grown on the southern plains. Native Plants Journal, 12, (2): 100-105.

[7] Hefer GD, NM Tainton. 1990. Effect of nitrogen concentration of urea ammonium nitrate and application level on the dry matter and chemical composition of Pennisetumclandestinum and Cynodon dryland pastures. J. Grassland Soc. Society of Southern Africa, 7: 36-40.

[8] Mohammad, N. and A. H. Naqvi, 1987. Dry matter yield of promising grasses in the arid rangeland of Sindh, Pakistan. Trop. Agric. (Trinidad), 64: 70–1.

[9] Pieterse PA, NFG Rethman, J Van Bosch. 1997. Production, water use efficiency and quality of four cultivars of Panicum maximum at different levels of nitrogen fertilization. Tropical Grasslands, 31: 117- 123.

[10] Sheaffer, C. C., Martin, N. P., Lamb, J. F. S., Cuomo, G. R., Jewett, J. G. and Quering, S. R. 2000. Leaf and stem properties of alfalfa entries. Agronomy Journal, 92 (4): 733-739.

[11] Steel, R. G. D and J. H. Torrie. 1980. Principles and procedures of statistics: A Biometrical Approach. McGrawHillbookCo. Inc. New York.

[12] Wijitphan S, P Lorwilai, C Arkaseang. 2009. Effects of plant spacing on yields and nutritive values of napier grass (Pennisetum purpureum schum.) under intensive management of nitrogen fertilizer and irrigation. Pakistan J. of Nutrition 8, (8) 1240-1243.

[13] Kjeldahl, J. 1883. "Neue Methode zur Bestimmung des Stickstoffs in organischen Körpern" (New method for the determination of nitrogen in organic substances), Zeitschrift für analytische Chemie, 22 (1): 366-383.