Global Journal of Science Frontier Research: D
Agriculture and Veterinary
Volume 21 Issue 2 Version 1.0 Year 2021
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Participatory Evaluation of Oat and Vetch Varieties under Farmers Management in Bulle District Highland, Southern Ethiopia

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Abstract- Five oat and three vetch varieties were demonstrated and evaluated under farmers' management conditions at Seka kebele of Bulle Woreda, southern Ethiopia, with the objective of introduction and evaluation of different Oat Vetch species. The oat varieties were Lampton (standard check), CI-2291, CI-8251, CI-8237, and CI-2806, whereas the vetch varieties evaluated were Vicia dasycarpa (V.D), Vicia Sativa (V.S), and Vicia villosa. The varieties were planted in a 3 m x 4 m plots arranged in an RCBD design with four replications. The results indicated that the germination date was influenced by the effect of the year. Accessions like CI-2291 and CI-2806 had higher ($p \leq 0.05$) dry matter yield than other accessions regardless of year effect, while accession CI-8251 and CI-8237 had higher seed yield than other accessions. Regarding vetch varieties, Vicia sativa had a significantly ($P < 0.05$) higher dry matter yield. It is noted that both oat and vetch varieties were well adapted to the study area during both years. From the oat varieties, CI-2291 and CI-2806 could be recommended for herbage production, while CI-8237and CI-8251 for seed production.

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GJSFR-D Classification: *FOR Code: 070199*

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Keywords: dry matter yield, oat, vetch, adaptability, varieties, seed yield.

I. Introduction

One of the bottlenecks of livestock production in Ethiopia is feed shortage both in quantity and quality. In recent years, climate change is an additional threat playing valuable role in challenging the development of feed resources (Dinesh *et al*., 2014). Crop residues and natural pasture are the major feed resource in developing countries. However, crop residues are low in protein, energy, and other important micronutrients essential for animal production (Ramana *et al*., 2015). Animals fed on these feed sources could hardly meet their nutritional requirements and livestock productivity in terms of meat and milk.

The feed and feeding problem of livestock production is more profound in most high land areas of the southern region of the country. The shortage of feed is usually the worst during the late dry season across the region as well as the country level. Efforts were made to fill the gaps since Fourth Livestock Development Project (Mengistu *et al*., 2017), with the significant steps in forage seed production to improve feed supply in quantity (Getnet, 2003). Moreover, a baseline survey conducted in the study area indicated that shortage of feed is one of the factors limiting the productivity of livestock in the area (unpublished report of HARC, 2016) demanding introduction and evaluation of improved forage species to fill the gap.

Oat and vetch are proven for their adaptability and yield potential in highland areas. Farmers usually practice oat planting oat either as a sole crop or in mixed stands with vetch for ruminant feeding (Kebede *et al.,* 2016). These varieties were tested for their high yielding potential at the Bulle sub-station. Therefore, these varieties were proposed for demonstration at farmers' fields to introduce variety, management, and utilization practices. Hence, this study was conducted to demonstrate and evaluate various oat accessions and vetch varieties at farmers' fields.

II. Materials and Methods

a) Description of the study site

Bulle woreda is located at 395 km from Addis Ababa or 86 km from the regional capital Hawassa with an altitude of 2676 *m.a.s.l* and latitude N07'21.469 and longitude E037'47.945. The area is known with two (heavy and light rainy) seasons with clearly demarcated features. It is mainly crop-livestock mixed farming system predominately Enset based coffee-agroforestry and crop-livestock farming system.

b) Site selection and land preparation

Seka kebele of Bulle woreda is characterized by highland agro-ecology with undulating topography, the steepness of the slope varying between 0-45%. As a result, appropriate and plain site selection was one of the pre-conditions before planting. Five oat accessions and three vetch varieities were planted in well-prepared seedbed at Seka Kebele at four farmers' field, considering farmers as a replication.

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c) Sources of varieties and experimental design

Five oat varieties namely, Lampton (local), *CI-2291, CI-8251, CI-8237, and CI-2806* sourced from Holetta Agricultural Research Center, were planted in the second week of July 2016 and 2017 in a plot size of 3 m x 4 m arranged in RCBD design with three replications. The seed rate was 100 kg/ha for oats and 25 kg/ha for vetch with a fertilizer rate of 100 kg NPS/ha. The varieties were planted by drilling 30 cm between rows, 2 m between blocks and 1 m between plots. Similarly, three vetch varieties namely *Vicia dasycarpa* (V.D), *Vicia Sativa* (V.S), and *Vicia villosa* (V.V) were planted in RCBD with four replications. The plot size was 3 mx4 m (12 m^2); 2 m between blocks and 1 m between plots.

d) Data collection and management

In this experiment, date of germination, date of 50% flowering, plant height, number of branches per plant, dry matter yield and seed yield were recorded. During sampling each plot was divided into two half crosswise with an effective plot size of 2 m * 3 m. half of the plots were used for forage sampling, and the other half for seed yield determination. Forage and dry matter yield were determined by harvesting half of the plot. Plants were harvested by hand. The dry matter yield was calculated after drying a sample of 500 g green forage in an oven at 105^0c for 24 hours in the soil laboratory of Hawassa Agricultural Research Center. The plant height was measured by averaging the natural standing height of ten plants per plot. At 50% flowering, forages were harvested for herbage and dry matter yield. The number of tillers per plant was taken from ten plants per plot.

e) Data management

The data collected were subjected to analysis of variance using the general linear model (GLM) procedure in SPSS (version 20) and mean separation was done using Tukey's test at 5% probability level. The model employed was:

f) Statistical model

$Yij = \mu + bj + Vi + eij$, Where; Yij = response variables (DM, plant height, number of tillers)

μ = Overall mean

Bj = Block effect

Vi = the effect of oat varieties (i=1, 2,3,4,5) and vetch varieties (i=1,2,3)

eij = Random error

III. Results and Discussion

a) Yield and yield components of oat (Avena sativa)

Effect of accession and year on yield attributes and yield of oat are given in Tables 1-3. This study indicated that the yield and yield components of oat and vetch were influenced by varietal differences. Yield and yield components of oat (*Avena sativa*) are indicated in Table 1. Germination date was significantly ($P<0.05$) affected by varietal (accession) differences. CI-2806 variety emerged late compared to others. Year effect also has shown a bit variation on number of date taken to germinate, in 2016 cropping season all varieties were germinated at least one day lesser than the second cropping year, which might be due to lack of sufficient moisture in the soil in year two cropping season.

Table 1: Effect of accession and year on germination date of Oats

Treatment	Year	Mean	Std. Error
Standard check	2016	8.0a	.11
	2017	10.0b	.11
CI-2291	2016	8.0a	.11
	2017	9.0a	.11
CI-8251	2016	9.0a	.11
	2017	8.3a	.11
CI-8237	2016	9.0a	.11
	2017	10.3a	.11
CI-2806	2016	10.0a	.11
	2017	11.0a	.11

b) Dry matter yield

The dry matter yield varied between 5.5-8.4 tons per hectare. In this study year had no significant role on dry matter yield variation at ($p<0.05$). On the other hand, varieties had a statistically a significant effect on dry matter yield. CI-2806, had significantly ($p<0.05$) higher yield followed by CI-2291.

Table 2: Effect of accession and year on Dry matter yield of Oat

Accession	Year	Mean	Std. Error
Standard check	2016	6.350	.247
	2017	7.250	.247
CI-2291	2016	8.375	.247
	2017	7.100	.247
CI-8251	2016	5.500	.247
	2017	6.925	.247
CI-8237	2016	6.275	.247
	2017	5.675	.247
CI-2806	2016	8.375	.247
	2017	8.275	.247

Table 3: Effect of year and accession on seed yield of oat string

Accession	Year	Mean t/ha	Std. Error
Standard check	2016	2.98^a	.130
	2017	2.93^a	.130
CI-2291,	2016	2.30^b	.130
	2017	2.55^b	.130
CI-8251,	2016	3.30^a	.130
	2017	3.35^a	.130
CI-8237,	2016	3.20^a	.130
	2017	3.03^a	.130
CI-2806	2016	2.88^{ab}	.130
	2017	2.48^b	.130

c) Vetch species

Yield and yield components of vetch (*Vicia* varieties) are presented in Table 4 and Table 5. Vicia accessions had significant effect on the date of germination, the number of tillers, and plant height. *Vicia sativa* had significantly ($p<0.05$) higher date of germination, while the differences between *V. dasycarpa* and *V. villosa* was not significant. *V. sativa* and *V. villosa* took longer days to reach 50% flowering compared to *V. dasycarpa.* The difference between relatively early maturing and late-maturing varieties was about 13 days. The findings of this study were similar to reports of (Kebede *et al*., 2016), who noted 25 days difference between Vicia varieties. *Vicia sativa* and *V. vilosa* had a significantly higher number of tiller than *V. dayscarpa*. There was no year effect on yield components of the accessions.

Table 4: Effect of accession on date germination, date of 50% flowering, plant height, number of tillers of vetch

Accession * year				
Dependent Variable	Accession	Year	Mean	Std. Error
Date of germination	Vicia sativa	2016	14.0	.34
		2017	14.5	.34
	Vicia vilosa	2016	15.78	.34
		2017	16.0	.34
	Vicia dyscarpa	2016	15.7	.34
		2017	17.0	.34
50% flowering date	Vicia sativa	2016	82.2a	.93
		2017	83.7a	.93
	Vicia vilossa	2016	72.5b	.93
		2017	73.3b	.93
	Vicia dyscarpa	2016	72.3b	.93
		2017	69.5b	.93
Plant height	Vicia sativa	2016	89.6b	1.39
		2017	77.3bc	1.39
	Vicia vilosa	2016	119.5a	1.39
		2017	119.0a	1.39
	Vicia dyscarpa	2016	109.0a	1.39
		2017	110.5a	1.39
Number of tiller/plant	Vicia sativa	2016	20.3a	.52
		2017	19.5a	.52
	Vicia vilosa	2016	19.3a	.52
		2017	20.5a	.52
	Vicia dyscarpa	2016	16.0b	.52
		2017	16.0b	.52

d) Dry matter yield and seed yield of vetch species

Vicia sativa had higher ($p<0.05$) seed yield compared to other varieties. The dry matter yield of V.*dyscarpa* was a higher at ($p<0.05$) than other vetch varieties**.** The seed yield of the evaluated vetch varieties ranged between 3.1 t/ha for *V. dasycarpa* in 2017 to 4.4 t/ha for *V. staiva* in the same year. The seed yield obtained in the current study was by far higher than the results reported by (Kebede *et al.,* 2016) at Holeta and Ginchi sites of the central highland Zones of Ethiopia. It was also reported by Mengistu (2017) that the potential of forage seed production has not been exploited across regions and ecological zones due to various barriers.

Table 5: Effect of accession on dry matter, DM yield (ton DM/ha) and seed yield (100 kg/ ha) of vetch

	Variety * year			
	Variety	year	Mean	Std. Error
DM yield	Vicia sativa	2016	5.62[b]	.068
		2017	5.15[b]	.068
	Vicia vilosa	2016	5.02[b]	.068
		2017	5.00[b]	.068
	Vicia dasycarpa	2016	6.32[a]	.068
		2017	6.20[a]	.068
Seed yield	Vicia sativa	2016	4.27[c]	.091
		2017	4.35[c]	.091
	Vicia vilosa	2016	3.17[d]	.091
		2017	3.27[d]	.091
	Vicia dasycarpa	2016	3.30[d]	.091
		2017	3.12[d]	.091

IV. Conclusion

The evaluated oat and vetch varieties were well adapted to the study area at both years. From the oat varieties, CI-2291 and 2806 were superior in most parameters, Dry matter yield, in contrast to this, CI-8237 and CI-8251 had a higher seed yield than other varieties and are recommended, for use in Bulle and similar agro-ecologies. Likewise, from the vetch varieties, *Vicia dasycarpa* had a higher dry matter yield, and thus, it can be recommended for Bulle and similar environments. *Vicia villosa* could be recommended followed by *Vicia dasycarpa* for dry matter yield. In contrast *V. Sativa* is preferably recommended for seed production.

Acknowledgments

The authors would like to acknowledge EIAR and SARI, for funding support from the agricultural growth program (AGP-II) and technical backups. Similarly, we acknowledge SARI and HARC for the timely supervision and support during implementation of research activity. We also thank the staff of livestock research process of Hawassa Agricultural Research Center (HARC) research assistants for their help during the execution of the research, experimental management and data collection.

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