



Performance Evaluation of Vetch Varieties/Genotypes for Their Agronomic Performance and Nutritive Value in Selected Midland of East Guji Zone, Adola, Southern Oromia and Ethiopia

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Authors' contributions

This work was carried out in collaboration among all authors. Author TJ designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors ZA and GD managed the analyses of the study and managed the literature searches. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJARR/2020/v9i230218

Editor(s):

(1) Dr. Abhinandan Surgonda Patil, Plant Genomics and Breeding Institute, College of Agriculture and Life Sciences, Seoul National University, Republic of Korea.

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Complete Peer review History: <http://www.sdiarticle4.com/review-history/51848>

Original Research Article

Received 20 August 2019

Accepted 25 October 2019

Published 16 April 2020

ABSTRACT

A study was conducted to identify adaptability, high biomass and dry matter and grain yield of vetch varieties/genotypes at Bore Agricultural Research Center Adola sub-site. The three vetch varieties/genotypes tested were *Vicia dasycarpa*, Lalisa and 5187. Randomized complete block design (RCBD) with three replications was employed to evaluate the variety. The result revealed that date of 50% flowering, date of maturity, pod length per plant and plant height was significantly different (at $p < 0.05$) between treatments. The early flowered genotype was 5187 (62 days) and late

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flowered variety was recorded from *Vicia dasycarpa* (79.9 days). The highest value of plant height was measured from Lalisa variety, while the shortest plant height was recorded from 5187 genotypes (67.7 cm). Date of 50% emergency, pod per plant, fresh biomass yield and grain yield and chemical composition dry matter (DM), crude protein (CP), neutral detergent (NDF), acid detergent lignin (ADL), acid detergent fiber (ADF), total ash content (TASH) and organic matter (OM) did not show significant difference between treatments at ($P>0.05$). Numerically had different values. Both the highest fresh biomass yield and grain yield was obtained from Lalisa variety (2.9 t/ha) and 22.7 qt/ha respectively. The lowest value of biomass and grain yield was produced from 5187 accessions (1.9 t/ha) and *Vicia dasycarpa* 11.3 qt/ha. Lalisa variety was highest in organic matter (OM), total ash content (TASH), crude protein (CP) and less in neutral detergent (NDF) and acid detergent fibre (ADF) content while, *Vicia dasycarpa* was highest in crude protein (CP) and neutral detergent (NDF) and less in organic matter (OM), content total ash content (TASH) and crude protein (CP) content, 5187 genotype had the highest in dry matter (DM) and acid detergent fiber (ADF) and less in crude protein (CP) and acid detergent lignin (ADL) content than the rest accessions. The result of this study implied that Lalisa variety was well adapted and being productive regarding the plant height, biomass yield and seed yield. Lalisa variety, which is hopeful to fill the gap of low quantity ruminant feed supply of the community in the study area. Based on its adaptable, high biomass, high plant height, high grain yield, good CP and OM Lalisa is recommended for further promotion in the midland of East Guji zone.

Keywords: Genotypes; vetch; quality; nutritive value; lalisa; varieties.

1. INTRODUCTION

Vetch has a higher crude protein content compared to many other tropical herbaceous legumes [1]. Contribution of vetch in crop livestock production systems in different parts of the world is well recognized. Its high value, as a protein supplement for ruminants on low-quality diets, has been recorded. Currently, with the rapid increase in human population and demand for food, grazing lands are steadily shrinking in favor of their conversion to arable lands. As a result availability of adequate feeds has become a major setback for increased livestock production. [2,3] improved nutrition through the adoption of sown forage could substantially increase livestock productivity. [4] reported that food-forage crops integration with different methods (nonconventional forage production systems) are important and appropriate in areas where the land shortage is a problem and the agricultural production system is subsistence. Cereal based cropping system through different methods is one of the strategic interventions for optimizing the productivity of a given land use system [5,6].

Among the annual forage legumes, vetches are well adapted and more promising as short term fodder crops. One attraction of vetch is its versatility, which permits diverse utilization as either ruminant feed or green manure. It grows well in the reddish-brown clay soils and the black soils of the highland areas. It has been grown

successfully in areas with acid soil with a pH of 5.5-6. Forage legumes including vetches are rich sources of protein for livestock with cheaper prices compared to concentrates especially in developing countries [7,3] Information on plant height, days to maturity, growth habit and other growth characteristics of the forage legumes are important to integrate with food crops in mixed stands [6]. Previous evaluations of vetches have been limited to adaptation and biomass yield but there is no adequate assessment of different vetch species and accessions concerning growth features forage and seed productivity, forage quality, and digestibility in Guji Zone. Therefore, the study has undertaken the objective to identify and evaluate better adaptable, herbage and grain yield performance of some vetch genotypes/varieties.

2. MATERIALS AND METHODS

2.1 Description of the Study Area

The experiment was carried out at Adola sub-site of Bore Agricultural Research Center, which is one of the recently established Research Centers of the Oromia Agricultural Research Institute (OARI). Adola Rede district located around Adola town which is situated at a distance of 470 km from Addis Ababa and 120 km from the zonal capital city, Negele Borena. It is an area of where mixed farming and Sami nomadic economic activity takes place, which is

the major livelihood of the local people. The total area of the district is 1254.56 km². Astronomically, Adola Rede district is located between 5°44'10" - 6°12'38" northing latitudes and 38°45'10" 39°12'37" easting longitudes. The district is characterized by three agro-climatic zones, namely Dega 11% humid, Weina Dega 29% subhumid and Kola 60% dry arid respectively [8]. Most of the earth surface of the district is slopes or hills of the land surface with an elevation ranging from 1500 meters up to 2000 meter in the larger southern portion of North-Western part. Plains, dissected hill plateau and mountain as well as valleys and gorges characterized the relief of the district. The major soil of the district is red-brown and black-brown in colors and they are found on sloping terrain. Therefore, their agricultural utilization is good under natural vegetation. The percentage coverage of each soil is red soils 80% brown soil 15% and black clack 5% respectively [9].

2.2 Experimental Treatments and Design

The study was executed using three variety/genotypes of vetch (Lalisa variety, *Vicia dasycarpa* and 5187 accessions). The experiment was conducted in a randomized complete block design with three replications. Seeds were sown in rows spaced 30 cm on a plot size of 1.8 m x 3 m = 5.4 m². The treatments were sown according to their recommended seeding rates: 30 kg ha⁻¹ for Lalisa variety, *Vicia dasycarpa* and 5187 accessions at sowing, 100 kg ha⁻¹ NPS fertilizer was uniformly applied for all treatments at sowing time.

2.3 Data Collection

Data were collected on days to 50% emergency, days to 50% flowering, days to forage harvest (maturity), plant height, and fresh biomass yield, logging %, forage dry matter (DM) yield, seed yield and nutritive value. Seed yield weight was calculated at 10% moisture content. At days to 50% flowering stage the middle rows of each plot were harvested for dry matter herbage determination and chemical analysis. Plants were harvested at ground level and fresh biomass weighed immediately using a 0.1 g scale. Then, a sub-sample of 15-20% of the total weight was separated and put into a paper bag for dry matter herbage determination. The samples were oven-dried at 105°C for 24 hours. To determine grain yield, the pods were harvested from the rest rows at optimum physiological maturity by handpicking.

2.4 Statistical Analysis

Analysis of variance (ANOVA) procedures of SAS general linear model (GLM) was used to compare treatment means [10] Bartlett's test for homogeneity of variance was carried out to determine the validity of the individual experiment. Duncan Multiple Range Test (DMRT) at 5% significance was used for comparison of means. The statistical model for the analysis data was:

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

Where;

Y_{ijk} = response of variable under examination,
 μ = overall mean,
A_j = the jth factor effect of treatment/ cultivar,
B_i = the ith factor effect of block/ replication,
e_{ijk} = the random error.

3. RESULTS AND DISCUSSION

3.1 Yield and Yield Components

Mean value of agronomic and yield parameter of Vetch varieties are shown in (Table 1) below. The analyzed result shows that days to 50% flowering, date of maturity, pod length per plant and plant height was significantly different between treatments at (P<0.05). The early flowered variety was 5187 accession (62 days) followed Lalisa variety (76 days) and late flowered varieties were recorded from *Vicia dasycarpa* (79.9 days). The highest value of plant height was measured from Lalisa variety (112.2 cm), followed by *Vicia dasycarpa* (102.3 cm). The result of the current study was lower compared to the result of [11] that *Vicia dasycarpa* was (151.6 cm). The shortest plant height was obtained from 5187 accessions (67.7 cm). Date of 50% emergency, pod per plant, fresh biomass yield and grain yield did not show significant differences between treatments at (P>0.05) numerically had different values. Both the highest fresh biomass yield and seed yield was obtained from Lalisa variety (2.9 t/ha) and (22.7 qt/ha) respectively. The result of this study did not agree with the result of [12] Lalisa variety didn't give seed yield. The difference might be attributed to the variation in soil fertility and agro ecology in the different site where the studies conducted. The lowest value of biomass and seed yield was produced from 5187 accessions (1.9 t/ha) and *Vicia dasycarpa* (11.3 qt/ha).

Table 1. Agronomic and yield parameters of vetch varieties/genotypes

Genotypes	Date of 50% emergency	Date of 50% flowering	Date of maturity	Pod per plant	Pod length [cm]	Plant height [cm]	Fresh biomass yield [t/ha]	Seed yield [qt/ha]
Vicia dasycarpa	8	79.9 ^a	122 ^b	2.9	0.9 ^b	102.3a	2.1	11.3
Lalisa	8	76 ^a	129.6 ^a	5.2	1.5 ^{ab}	112.2 ^a	2.9	22.7
5187	8	62 ^b	108 ^c	6.2	2.3 ^a	67.7 ^b	1.9	22.2
Mean	8	72	119.9	4.8	1.5	94	2.4	18.7
CV	0	14	2.9	74.6	69.9	15.2	58.7	80.7
LSD (5%)	*	*	*	ns	*	*	ns	ns

^{a, b} Mean in a column within the same category having different superscripts differ ($p < 0.05$) cm; centimeter, t/ha; tone per hectare, qt/ha; quintal per hectare, CV=Coefficient of variation, LSD= Least significant difference

Table 2. Mean chemical composition of vetch varieties /genotypes

Varieties	DM%	CP%	NDF%	ADL%	ADF%	TASH%	OM%
Lalisa	88.9	20.8	66.3	18.1	42.5	73.9	76.6
Vicia dayscarpa	89.2	26.2	87.5	10.6	36.8	35.8	73.1
5187	91.5	2.6	66.4	10.5	42.6	42.6	75.3
Overall average	89.86	16.5	73.4	13.06	40.6	50.76	75

ADF= Acid detergent fiber; ADL= Acid detergent lignin; CP = Crude protein; NDF = Neutral detergent fiber and OM = Organic matter; TASH=Total ash; DM=Dry matter

3.2 Chemical Composition

From vetch accessions tested (Table 2), Lalisa variety was highest in OM, TASH, CP and less in NDF and ADF content, *Vicia dayscarpa* was highest in CP and NDF and less in OM, TASH and CP content, 5187 genotype had the highest in DM and ADF and less in CP and ADL content than the rest accessions at ($P<0.05$). The CP content of Lalisa variety and *Vicia dasycarpa* were above the average CP content of a feed which is 10.6, but less than the CP content of protein supplement feed which is 32.6. The result is in line with the suggestion of [13] who noted the CP content of young herbage to be as high as 14 to 16%. This level of CP is above the recommended minimum level of CP in the diet of ruminants for optimum rumen function [14] However, genotype 5187 was a significant difference in CP comparing with Lalisa variety and *Vicia dasycarpa*. The decrease in NDF content has been associated with increasing digestibility and hence feed intake [15,16]. The NDF content of all accessions was less than the average NDF content of feed which is 56.2. Roughage diets with NDF content of 45-65 and below 45% were generally considered as medium and high-quality feeds, respectively [16]. The NDF percentage of Vetch recorded in this experiment ranged below 55% value which can be categorized as a high-quality feed category. The lowest ADF value 42.5 in Lalisa variety was reported by [17].

4. CONCLUSION AND RECOMMENDATION

The result of this study implied that the Lalisa variety was well adapted and being productive regarding the plant height (112.2 cm), biomass yield (2.9 t/ha) and seed yield (22q t/ha). Lalisa variety, which is hopeful to fill the gap of low quantity ruminant feed supply of the community in the study area. Also, the nutritional values (chemical composition) were promising particularly the crude protein content in *Vicia dasycarpa*. Thus it could be possible to conclude that the vetch variety/genotype used as a protein supplement for tropical ruminants which are suffering from poor quality tropical grasses and low protein and digestible crop residues which are the major ruminant feed sources, particularly in Guji. Based on its adaptability, high biomass, high plant height, high grain yield, good CP and OM Lalisa is recommended for further promotion in the midland of East Guji zone.

ACKNOWLEDGEMENTS

The authors are grateful to the Oromia Agricultural Research Institute (IQQO) for financial support to implement the study. The animal nutrition laboratory workers of Haramaya University were also acknowledged for their support in the chemical analysis of the feed samples.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
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