

ADAPTATION AND FORAGE YIELD OF VETCHES (*VICIA* SPP.) IN THE SOUTHERN HIGHLANDS OF ETHIOPIA

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Aim. To study the adaptation of vetch species and the level of their forage yield in the highlands of the region. **Methods.** Field and laboratory methods, statistical analysis. **Results.** The study was conducted in Bulle and Chenchu districts of Southern region of Ethiopia with the objective to identify adaptable and high forage yielding vetch species for the high lands of the region. Five vetch species (*Vicia sativa* L., *V. dasycarpa* Ten., *V. atropurpurea* Desf., *V. villosa* Roth. and *V. benghalensis* L.) were tested at both locations for two years. The result showed that there was significant variation in dry matter yield of the tested species in the two locations. Vetches planted at Bulle performed well when compared with Chenchu area with mean DM yield of 5.3 and 1.2 t/ha, respectively. Among the vetch species, *Vicia sativa*, *Vicia villosa*, *Vicia dasycarpa*, and *Vicia benghalensis* adapted well at Bulle and produced on average 4 to 7 t/ha forage DM. In Chenchu area, *V. dasycarpa* and *V. villosa* were the best performing species with forage DM yield of 1.6–1.8 t/ha. **Conclusions.** The vetch species tested in the current study could be used for conventional pasture and forage production, in livestock exclusion areas, in forage strips, as an under-sowing with food crops, or as a backyard forage crop in the southern highlands of Ethiopia.

Keywords: adaptation, forage yield, Vetches, *Vicia* species, Southern Ethiopia

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INTRODUCTION

The Southern Nations and Nationalities and Peoples region (SNNPR) of Ethiopia has diversified animal feed resources, livestock species and suitable agro ecology for crop livestock production. In the region there are different kinds of feed resources for use as animal feed. The feeds that are mainly used as animal feeds are crop residues, natural/green pastures and feeds from grazing lands. However, the fodder from grazing lands is poor in quantity and quality due to overgrazing and overstocking. Crop residues are also of poor quality unless otherwise supplemented with other feeds which are rich in protein such as legumes [1].

Vetches are the most important and widely cultivated annual forage legumes in the highlands farming system of Ethiopia [2]. One attraction of vetch is its versatility, which permits diverse utilization as ei-

ther ruminant feed or green manure[3]. As a legume crop, it provides nitrogen to the soil and reduces the incidence of diseases in succeeding non-leguminous crop. Vetches grow well on the reddish brown clay soils and the black soils of the highland areas. It has been grown successfully in areas with an acid pH of 5.5–6. Leaves of vetch species are very palatable and nutritious and it can be grown alone or in mixture with oats to improve the quality of the forage [2]. Integrating vetches (*Vicia* spp.) into the intensive production system of mid and high altitudinal areas of the southern region of Ethiopia could alleviate the problem of feed scarcity without affecting the yield and productivity of other crops since the forage legumes can boost crop yield and soil fertility by fixing atmospheric nitrogen into the soil. However, there is a need to identify better adapting and high yielding vetch (*Vicia* species) for the highlands of southern region of Ethiopia.

MATERIAL AND METHODS

Description of the experimental sites

The experiment was conducted in 2007 and 2008 at Bulle and Chenchu districts of Southern Nations and Nationalities and Peoples region (SNNPR) of Ethiopia. Bulle is one of the six districts in the Gedeo zone. It is located in the southern part of Hawassa, 117 km from the region's capital and 27 km from the zone's capital Dilla. The altitude is 2008 meters above sea level (masl). Mean annual rainfall in the district is 1,401–1,800 mm, with temperature ranging from 12.6 to 20 °C [4]. Soils of Bulle district belong to clay loam textural class. The pH of the soils of Bulle area ranges from 5.19 to 5.51 and was categorized as very strongly acidic [5].

Chenchu district is found about 325 km west of Hawassa the way to Arbaminch, the altitude is 2800 masl. The annual rainfall distribution in Chenchu varies between 900 mm to 1200 mm. The minimum temperature in the district ranges from 11 to 13 °C, while the maximum temperature is in the range from 18 to 23 °C. The soils of Chenchu are too acidic, so crop productions in the areas are seriously affected [6]. Chenchu soils are also characterized by very low available phosphorus and exchangeable potassium [7].

Experimental design and treatments

Five vetch species (*Vicia sativa* L. (common vetch), *V. dasycarpa* Ten. (smooth vetch), *V. atropurpurea* Desf. (purple vetch), *V. villosa* Roth. (hairy vetch) and *V. bengalensis* L.) were evaluated for their forage yield potential at Bulle and Chenchu research stations of the Southern Agricultural Research Institute, in southern region of Ethiopia. The planting materials were collected from the Holeta Agricultural Research Center in central Ethiopia. The forage species were planted in the plot area of 2 m × 3 m = 6 m² with 30 cm row spacing in randomized completed block design (RCBD) with four replications. A spacing of one meter was used between plots and between blocks. Based on experimental design, each treatment was assigned randomly to the experimental units within a block. The experimental plots were uniformly fertilized with diammonium phosphate (DAP) fertilizer, planting at a rate of 100 kg/ha. The vetch species were sown according to recommended seed rates (30 kg/ha). Twice hand weeding was practiced, the first hand weeding was made thirty days after crop emergence and the second weeding was done thirty days after the first weeding to minimize

yield reduction due to weed competitions for soil nutrients, water and solar radiation.

Data collection and statistical analysis

Plant height was measured from ground to the tip of the plant at the time of forage harvesting. The biomass yield of vetch species was harvested at 50 % flowering above the ground level. The weight of the total fresh biomass yield was recorded from each plot in the field and from each plot 500 g forage samples were taken, then oven dried for 72 hours at the temperature of 65 °C to determine the dry matter content of the forages. Plot-cover score data of the treatments was collected as a visual estimation of the amount of groundcover that is given at crop emergence. The plot cover was estimated on a scale from 0 to 5, with 5 considered a perfect cover. This score is valuable as an indicator of vigor in growth and establishment of the crop. For statistical analyses, the data were subjected to analysis of variance using the General Linear Model (GLM) Procedure of SAS [8]. Plant height, plot cover and dry matter yield data were used as fixed effects (dependent variables) and tested species were considered as independent variable in the model. The differences between the means were separated by the multiple range test of LSD.

RESULTS AND DISCUSSION

Dry matter yield and agronomic parameters of the tested vetch species were presented in Table 1 and 2. There was significant variation ($P < 0.05$) in dry matter yield of the tested species in the two locations. The vetches, planted at Bulle, performed well when compared with Chenchu area with mean DM yield of 5.3 and 1.2 t/ha, at Bulle and Chenchu, respectively. Moreover, there was a significant ($P < 0.05$) variation in plant height at harvest and plot coverage of the vetch varieties tested at both locations (Table 2). On average the tested species grown up to a height of 1.6 and 0.5 m with mean plot coverage score (0–5 scale) at crop emergence were 3.4 and 2.3 at Bulle and Chenchu, respectively. This was due to the early germination and vigorous growth of the vetch species at Bulle owing to the favorable environmental (rainfall and soil) condition, compared to Chenchu. The variation in plant height and plot coverage score at crop emergence (crop germination and establishment) contributed as well for the variation in DM yield of the tested vetch species at both locations.

The higher dry matter yield of vetches in Bulle, compared to Chenchu, is due to the higher rainfall and better soil conditions at Bulle. The authors of [9] reported that

in addition to genetic variability, soil fertility and environmental conditions will have substantial effect on forage yield and yield attributes. According to [6] the soils of Chencha are too acidic, so crop productions in the areas are seriously affected. Chencha soils are also characterized by very low available phosphorus and exchangeable potassium [7]. Among the vetch species tested *V. sativa*, *V. villosa*, *V. dasycarpa*, and *V. bengalensis* adapted well at Bulle and produced on average 4 to 7 t/ha forage DM. In Chencha area, *V. dasycarpa* and *V. villosa* are the best performing species with forage DM yield of 1.6–1.8 t/ha. Other studies in the highlands of southern region of Ethiopia (at Angecha) reported a forage yield of 4.2, 4.5 and 4.4 t/h DM for *V. sativa*, *V. dasycarpa* and *V. villosa*, respectively [10]. A forage DM yield of 5.2 and 7.1 t/ha was also reported for *V. dasycarpa* and *V. atropurpurea* species, respectively, in the central highlands of Ethiopia [11]. Similarly, a DM yield of 3.0–8.5 t/ha was reported for vicia species in the northern highlands of Ethiopia [12].

CONCLUSIONS

The vetch species tested in the current study showed variation in forage yield and other measured yield attributes. Among the vetch species tested *V. sativa*, *V. villosa*, *V. dasycarpa*, and *V. bengalensis* adapted well at Bulle and produced on average 4 to 7 t/ha forage DM. In Chencha area, *V. dasycarpa* and *V. villosa* are the best performing species with forage DM yield range of 1.6–1.8 t/ha. The vetch species tested in the current study may necessitate further nutritional investigation, however, in this regard the authors would like to refer the readers to the works of [13] in the central highlands of Ethiopia. The vetch species tested in the current study could be used for conventional pasture and forage production, in livestock exclusion areas, in forage strips, as an under-sowing with food crops, or as a backyard forage crop in the southern highlands of Ethiopia.

Table 1. Dry matter yield of vetch species tested at Bulle and Chencha in 2007 and 2008

Treatments	Dry matter (DM) yield, t/ha				Overall Mean
	Bulle		Chencha		
	2007	2008	2007	2008	
<i>Vicia sativa</i>	4.1	6.9a	0.6d	0.2	3.0a
<i>V. dasycarpa</i>	6.2	4.6a	1.8a	1.5	3.5ab
<i>V. atropurpurea</i>	4.4	0.5b	1.0cd	0.0	1.5c
<i>V. villosa</i>	5.7	6.7a	1.6ab	0.6	3.7ab
<i>V. bengalensis</i>	6.2	7.4a	1.2bc	0.7	3.9a
Mean	5.3	5.2	1.2	0.6	3.1
LSD 5 %	NS	3.014	0.5447	NS	0.910

Means followed by the same letter within a column are not statistically significant (P < 0.05).

Table 2. Mean height at harvest and plot coverage of the vetch species tested at Bulle and Chencha in 2007 and 2008

Treatments	Height at harvest, m			Plot cover at crop emergence (0–5)		
	Bulle	Chencha	Mean	Bulle	Chencha	Mean
<i>Vicia sativa</i>	1.6b	0.2	0.9b	1.4b	1.5b	1.4b
<i>V. dasycarpa</i>	1.9a	0.8	1.3a	4.1a	3.3a	3.7a
<i>V. atropurpurea</i>	0.8c	0.1	0.5c	3.3ab	0.3c	1.7b
<i>V. villosa</i>	1.9a	0.7	1.3a	4.0a	3.1a	3.6a
<i>V. bengalensis</i>	1.8ab	0.8	1.3a	4.3a	3.4a	3.8a
Mean	1.6	0.5	1.1	3.4	2.3	2.8
LSD 5 %	0.1823	NS	0.1345	2.189	0.8297	1.109

Means followed by the same letter within a column are not statistically significant (P < 0.05).

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Адаптація і вихід кормів вики (*Vicia* spp.) у південних високогірних регіонах Ефіопії

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Мета. Вивчити пристосовуваність рослин вики різних видів та рівень їхньої кормозаготівлі для високогірних земель регіону. **Методи.** Польовий, лабораторний, статистичний аналіз. **Результати.** Дослідження проводили у двох районах Південного регіону Ефіопії Бале і Ченчи. П'ять видів вики (*Vicia sativa* L., *V. dasycarpa* Ten., *V. atropurpurea* Desf., *V. villosa* Roth., *V. benghalensis* L.) випробувано в обох районах протягом двох років. Показано, що існує значна різниця в урожайності сухої речовини тестованих видів із двох місцевостей. Насадження вики в Бале добре зарекомендували себе порівняно з областю Ченчи з середнім виходом сухої речовини 5,3 і 1,2 т/га відповідно. Серед досліджених видів вики добре адаптувалися в Бале *V. sativa*, *V. villosa*, *V. dasycarpa* і *V. bengalensis*, середній вихід сухої речовини з кормів яких становить 4–7 т/га. У районі Ченчи *V. dasycarpa* і *V. villosa* є найефективнішими видами, вміст сухої речовини у кормах дорівнює 1,6–1,8 т/га. **Висновки.** Різновиди вики, проаналізовані в представленій роботі, можуть бути використані для звичайних пасовищ і виробництва кормів, а також у виняткових районах тваринництва, в посівних кормових смугах, як посів після продовольчих культур або по краях посівів кормової культури в південних гірських районах Ефіопії.

Ключові слова: адаптація, вихід кормів, вика, види *Vicia*, Південна Ефіопія.

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