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Adaptability of vetch (*Vicia spp.*) for potential feed production in Gumara-Maksegnit watershed, North Gondar, Ethiopia

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Abstract

An experiment was conducted to evaluate the adaptability and productivity of different vetch species under the ecological conditions of Gumara- Maksegnit watershed in the year 2012. Five vetch species (*Vicia dasycarpa*, *Vicia villosa*, *Vicia atropurpurea*, *Vicia benghalensis* and *Vicia sativa*) were used as experimental treatments. Seeds were broadcasted at a rate of 25kg ha^{-1}. Field trial was arranged in a randomized complete block design (RCBD) with four replications. Plant height, number of branches per plant, number of pods per plant, dry matter percentage, herbage and dry matter yield were recorded.

The results indicated that vetch species evaluated showed statistical variation in dry matter percentage (DM %), green herbage yield (t ha^{-1}), dry matter yield (t ha^{-1}), and plant height at harvest (cm) while there is no statistical difference in number of branches and pods per plant among the species. From the vetch species evaluated *V. villosa* and *V. sativa* scored the highest and the least herbage and dry matter yield. Based on the biological yield obtained *Vicia dasycarpa*, *Vicia villosa* and *Vicia atropurpurea* are more adaptive and productive than others. Thus according to the results of this study *Vicia dasycarpa*, *Vicia villosa* and *Vicia atropurpurea* are recommended for wider use as livestock feed in the Gumara- Maksegnit watershed area.

Key words: *dry matter yield, herbage yield, vetch species, watershed*

Introduction

The farming system of North Gondar zone is predominantly crop- livestock mixed farming system; livestock plays a vital role for the poor smallholder farmer as a source of power, food, immediate cash income, and fertilizer. North Gondar zone has the largest livestock population of any zone in the Amhara region. Uncontrolled grazing of increasingly scarce common areas has contributed to the degradation of many range and pasture lands.

Most ruminant livestock in the zone rely on the local grasses and crop residues for their roughage and much of their nutrition. Experiences in the study area show that these feed resources alone cannot fulfill the feed requirements for the livestock population in the area due to their lower quality and quantity. This problem is especially severe during the dry season. On the other hand improved grasses and legumes, proved to be adaptive and productive in other parts of Africa are highly palatable and have relatively higher nutrient content that make them desirable for inclusion in improved forage production programs (Alemayehu Mengistu 1997).

Because of the sever feed shortage problem of the area, farmers are efficient in utilizing crop residue to feed their livestock and are completely dependent on the crop residue they produce for the long dry season which is poor in its protein and vitamin content, and digestibility. Thus supplementing this type of feeding system with some improved feeding technologies like legume feed sources has got an advantage in meeting the protein and vitamin needs of the animals and improves the digestibility of the crop residues.

The potential to improve livestock productivity on available feed resources (native pasture, crop residues and agro industrial by- products) is limited due to different reasons like poor nutritive values of native pasture and crop residues and high cost and limited availability of agro industrial by- products. So to alleviate this problem we need to look for other options. Huge opportunity is created to fill the gap of feed shortage with the use of numerous promising improved forage crop species identified for various agro- ecologies, with particular emphasis on cultivated forage crops. But, the adoption rate for improved forage crops has been very low and less sustainable.

The area occupied by improved forage crops is insignificant and little contribution to the annual feed budget (Alemayehu Mengistu 2002).

Some efforts were made by different actors to introduce improved forage species to the farmers of high and mid altitude areas of North Gondar. However, these efforts didn't bring significant change because the already introduced forage crops were not tested for their adaptability and productivity. Thus, this adaptation trial was conducted to introduce the best forage species to strengthen the already started effort.

The objective of the present research study was to identify best adaptive and productive vetch species for fodder production in the model village of Gumara- Maksegnit watershed.

Materials and methods

Area description

The experiment was conducted on the farmers' field of Gumara-Maksegnit watershed in the year 2012. Gumara-Maksegnit watershed is located between latitude 12^0 25' 14.9'' N and longitude 037^0 36' 18.5'' E at an elevation of 2104m above sea level.

The area has a moist tropical climate and the mean monthly maximum temperature ranges from 25.3 °C to 32 °C with a mean value of 28.5°C, while the mean monthly minimum temperature ranges from 10.6 °C to 16.1 °C with a mean of 13.6 °C. Based on 20 years (1987-2007) data, the total annual rainfall ranges between 641 mm and 1678 mm with a mean value of 1052 mm. Farmers reported that the rainfall is small in amount, unpredictable in onset and cessation and poorly distributed. This nature of the rainfall is heavily influencing crop production and livestock husbandry and thus farmers' livelihood. The topography of the area ranges from gentle slope to sharp steep slope. The watershed is inhabited by 1148 households and 4246 individuals with an average family size of four persons. Settlement in the watershed is scattered and the landholding is characterized as small and fragmented. About 55% of the total land is cultivable, 23% of the area is covered by forest and grazing land, 7% is west land and 15% of the land is used for settlement. Livelihood of households in the watershed is dependent on forests, livestock and crop production (Yonas et al 2010).

Experimental design and plant material

In this study experimental materials were five species of vetch (*Vicia dasycarpa, Vicia villosa, Vicia atropurpurea, Vicia benghalensis and Vicia sativa*). Field trials were arranged in a randomized complete block design with four replications (Soysal 1993). Plot size was 4m **X** 3m. Spacing between replications and plots was 1.5m and 1m, respectively. The experimental plots were fertilized with 40kg/ha P_2O_5. Seed was broadcasted at a rate of 25kg ha^{-1}.

Measurements

In this experiment, plant height, number of branches per plant, number of pods per plant, herbage yield and dry matter yield were recorded. During sampling each plot was divided in to two half crosswise with an effective plot size of 2m * 3m. One half was used for forage sampling and the other half for pod number determination. Forage and dry matter yield was determined by harvesting half the plot. Plants were harvested by hand. The dry matter yield was calculated after drying a sample of 500g green forage in an oven at 65^0c for 72hours.

The plant height measured by averaging the natural standing height of ten plants per plot. Forage legume harvested for herbage and dry matter yield were at the beginning of flowering. The main branch number was an average of primary branches on the stem of ten plants per plot.

The data collected was subjected to analysis of variance by using the general linear model (GLM) procedure in SAS (2003) and mean separation was done using LSD at 5% probability level.

Result and discussion

Plant height

The results of forage yield and yield components for the different vetch species evaluated is given in Table 1. Plant height at harvest of *V. dasycarpa, V. villosa, V. atropurpurea,* and *V. benghalensis* different from *V.sativa*. This could be attributed to the differences by the different species. The highest plant height was obtained from *V. atropurpurea* while the lowest plant height from *V.sativa* (Table 1). Tuna and Okra (2002) pointed out the plant height of common Vetch were obtained 56.54cm and 23.90cm in the first and second year, respectively which is by far lower than the result we obtained while (Basbag et al 1999) found similar results.

Dry matter percentage

The dry matter percent of vetch species were statistically different (Table 1). From the vetch species tested *V.sativa* and *V. benghalensis* gave the highest and least dry matter percent (DM %). This could be attributed to the differences in leaf to stem ratio by the different species.

Herbage and dry matter yield

Mean forage dry matter yield in tonnes per hectare (DMYt ha^{-1}) of the five vetch species evaluated was different. An identical trend, to that of dry matter yield was observed for the herbage yield (Table 1). The highest herbage yield was obtained from *V. villosa* while the lowest herbage yields from *V. sativa*. Dry matter yields also were taken similar results like herbage yield. This may be due to higher plant height at harvest and more number of branches per plant by the species *V. villosa*. The mean value for the dry matter yield was as 6.02t ha^{-1}, which is higher than the result obtained by (Lloveras et al 2004). Variations in the yields could be attributed to the level of soil fertility, climatic zones, seasons and agronomic practices adopted.

Table 1: Mean value of yield and yield components of different Vetch species evaluated at Gumara- Maksegnit watershed.

Treatment	Dry Matter Percentage (DM %)	Herbage yield (t ha^{-1})	Plant Height at Harvest (cm)	Number of pods per plant	Number of branches per plant
Vicia dasycarpa	24.7^{bc}	26.5^{ab}	125^{a}	8.2	2.8
Vicia villosa	25.7^{b}	32.0^{a}	144^{a}	10.4	3.1
Vicia atropurpurea	23.3^{bc}	29.7^{ab}	132^{a}	6.8	2.8
Vicia benghalensis	22.7^{c}	25.5^{b}	114^{a}	10.2	2.9
Vicia sativa	28.3^{a}	9.6^{c}	65.3^{b}	8.6	2.4
SEM	0.37	1.21	5.12	0.10	0.02
p value	0.002	0.000	0.002	0.054	0.061

^{abc} *Means followed by different superscript letters within treatments differ at $p<0.01$*

t ha^{-1} = tonnes per hectare.

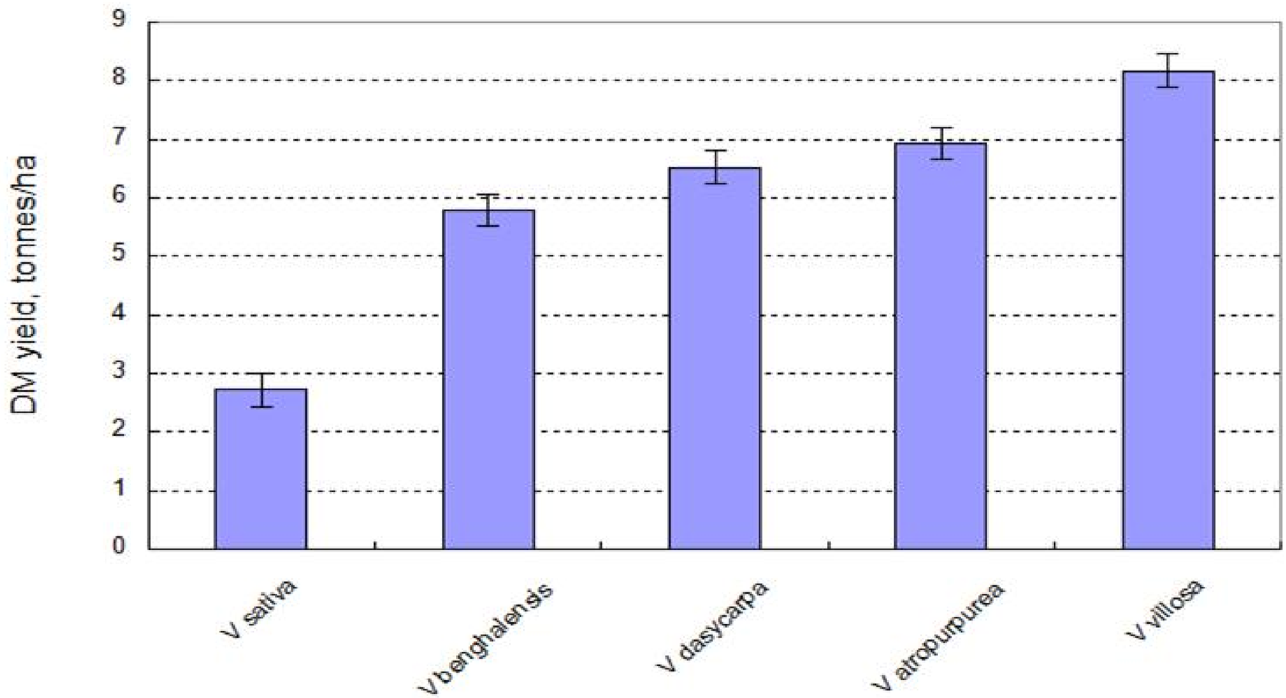

Figure 1. Forage DM yield of the different Vicia species

Number of pods per plant

There is no statistical difference between vetch species in number of pods per plant (Table 1). Table 1 show that the number of pods per plant was found to be highest for V. villosa and lowest for V. atropurpurea. The pod number of the vetch species varies in different papers. Atsan (1998) and Acikgoz et al (1989) reported that pod number of common vetch was 18.2 and 9.1- 15.3 respectively while (Tosun et al 1991) reported the pod numbers of common vetch and hairy vetch as 19.7- 22.4 and 13.7- 33.7 respectively.

Number of branches per plant

There is no variation between the vetch species in number of branches per plant (Table 1). The mean value for the number of branches per plant is given in Table 1. Tosun et al (1991) found the mean number of branches to be 4.0- 5.4, 4.4- 5.4 for common vetch and hairy vetch respectively which is by far higher than the result we obtained.

Conclusions

- According to the results of this study *V. villosa* followed by *V. dasycarpa* and *V. atropurpurea* gave the highest herbage and dry matter yield. Thus we concluded that these vetch species are adaptive and productive species for Gumara-Maksegnit watershed area.
- Hence these vetch species can be used as an alternative home grown protein source for livestock feed to minimize the burden of livestock feed shortage problem in the study area.

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