



On Farm Evaluation of Pigeon Pea (*Cajanus cajan*) Varieties as Livestock Forage at the Irrigation Schemes of Ahsea and Adwa Districts in Central Zone of Tigray, Northern Ethiopia

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The demonstration was conducted over two years from 2019 to 2020 in irrigation areas of Ahsea and Adwa districts of central zone of Tigray region, northern Ethiopia, with the specific objective of evaluating the agronomic yield performance of Tsigab and Maitsebri-Bako pigeon pea varieties, and determine their acceptability as livestock feed by farmers in the demonstration area. During the demonstration trial, 180 and 90 farmers from Ahsea and Adwa districts, respectively, were participated, with a planting of 100 seedlings from each pigeon pea variety per household. The

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agronomic and yield parameters such as plant height, fresh biomass yield, dry biomass yield, and leaf stem ratio and grain yield were measured. Farmer's perception data were also collected to assess their preferences for the pigeon pea varieties. The result indicated that there was no significant difference ($P>0.05$) in plant height and dry biomass yield between the two varieties (Tsigab and Maitsebri-Bako) in the Ahsea district. However, in the Adwa district, the Tsigab variety had a higher plant height (162.55cm) and dry biomass yield (12.25ton/ha) compared to Maitsebri-Bako variety (9.25ton/ha) there was also a significant difference ($P<0.05$) in leaf stem ratio and grain yield between the varieties in the Adwa district, with Tsigab performing better in both parameters. Based on the agronomic performance and farmer's perception data, the Tsigab variety was preferred over the Maitsebri-Bako variety. It showed higher dry biomass yield (12.25ton/ha), leaf stem ratio (1.79), and grain yield (15.97qui/ha) and was perceived as having a good survival rate, high biomass yield, palatability to animals, and fast regeneration rate. Moreover, Maitsebri-Bako variety was valued for its contribution to soil conservation and grain yield. In conclusion, pigeon pea was found to be a valuable source of protein for both livestock feed and human consumption. Based on its superior performance and positive perception by farmers, the Tsigab variety was recommended for wider dissemination and cultivation in the demonstration areas and similar agro ecologies of the region.

Keywords: Pigeon pea; plant height; fresh & dry biomass yield; leaf stem ratio; grain yield and farmers perception.

1. INTRODUCTION

Livestock production is a critical component of agricultural systems in many regions [1], including the central zone of Tigray in Northern Ethiopia. However, the availability of high-quality forage for livestock is often limited, leading to nutritional deficiencies and reduced productivity [2]. To address this challenge, it is important to explore alternative forage options that are well adapted to local conditions and can provide sufficient nutrition for livestock [3].

Pigeon pea (*Cajanus cajan*) is a leguminous crop that has gained attention as a potential forage source for livestock. It is known for its ability to fix atmospheric nitrogen and its high protein content, making it a valuable feed option. Pigeon pea can be grown as a dual-purpose crop, providing both grain for human consumption and forage for livestock [4]. In addition, pigeon pea is a tropical grain legume and is among the important pulses grown for food, feed, and soil fertility improvement. It is a deep rooted and drought-tolerant leguminous crop used in several countries as a source of dietary protein [5] thus makes it as a highly attractive to smallholder farmers of rural areas in many developing countries [6]. Moreover, pigeon pea can be grown in a wide range of soil textures, from sandy soils to heavy clays. It grows best at a soil PH of 5.0-7.0 but tolerates a wider range (4.5-8.4) it does well in low fertility soils, making it a favorite among subsistence farmers. As with most legumes, it does not tolerate water logged

or flooded conditions for very long [7]. Therefore, Ahsea and Adwa Districts in the central zone of Tigray offer suitable agro-ecological conditions for pigeon pea cultivation. Hence, there are recently released pigeon pea varieties for livestock forage in the lowland and midland agro ecologies of Tigray. Therefore, this study aims to evaluate and demonstrate the two pigeon pea varieties, Tsigab and Maitsebri-Bako, as livestock forage in the Ahsea and Adwa Districts. The specific objectives of this study include evaluating the agronomic and yield performance of Tsigab and Maitsebri-Bako pigeon pea varieties, and determining their acceptability as livestock feed by the farmers in the central zone of Tigray, Northern Ethiopia.

Objectives:

- To evaluate the agronomic and yield performance of pigeon pea varieties
- To demonstrate and select the best pigeon pea variety at the farmer level
- To determine the acceptability of pigeon pea varieties as livestock feed by the farmers in the central zone of Tigray

2. MATERIALS AND METHODS

2.1 Description of the Study Area

The demonstration of pigeon pea varieties was conducted during 2019-2020 at Ahsea and Adwa districts (Sebaha and Maitsehlo) and (Maitoum and Addis Alem) irrigation schemes, respectively. Axum Agricultural Research Center, with

financial support of the IFAD /PASSDIP-II Project, conducted the demonstration. Ahsea district is located at a latitude of 14° 40' 38" N and longitude of 38° 35' 45" E in semi-arid lowlands with an altitude of 1390 m.a.s.l. The mean annual temperature of the areas ranges from 12.13°C to 27.88°C and the mean annual rainfall of 700mm. While Adwa is located at 14° 15' N and 38° 52' E with an elevation ranging from 1500-2700 m.a.s.l and annual temperature ranges from 7.8°C-30.9°C. Mean annual rainfall is 799mm (National metrological service agency, unpublished, 2018).

2.2 Treatments and Data Collection

Two recently released pigeon pea varieties of Tsigab and Maitsebri-Bako were recently obtained from Humera and Shire-Maitsebri Agricultural Research Centers, respectively. These varieties were demonstrated at Ahsea (Sebaha and Maitsehlo) and Adwa (Maitoum and Addis alem) irrigation schemes. On the demonstration, 45 farmers consisting of 30% female households were selected from each irrigation scheme, and a total of 180 farmers were participated and grouped on a FREG (Farmers Research and Extension Group) approach, having 45 farmers in each group. Each farmer was given seed for planting of 100 seedlings of Tsigab and 100 seedlings of Maitsebri-Bako pigeon pea varieties. A total of 20kg (10 kg of Tsigab and 10kg of Maitsebri-Bako pigeon pea varieties) seed were distributed and planted at the irrigation schemes, mostly on border of farmlands, grazing land, and gully areas. Practical training was given to the participant farmers that were organized on FREG. The demonstration was conducted in the irrigation season for a consecutive of two years (from 2019-2020). Planting was made with a spacing of 50cm between plants and 1m space between rows. Generally, from the demonstration data on agronomic and yield parameters such as plant height, fresh biomass yield, dry biomass yield, leaf stem ratio and grain yield from 20 representative sample farmers of each irrigation schemes were collected and farmers' perception data were collected through individual interview and focus group discussion based on the settled ranking criteria. The representative farmers were asked to respond to give score 1-5 for each preference criteria very

good (5), good (4), satisfactory (3), poor (2) and very poor (1).

2.3 Data Analysis

Both agronomic and yield performance data was analyzed using SPSS Version 20 independent samples T-test and the farmers perception data was analyzed using Likert scale method.

3. RESULTS AND DISCUSSION

3.1 Agronomic, Forage and Grain Yield Performance of the Pigeon Pea Varieties

The agronomic, forage and grain yield performance of the pigeon pea varieties were presented in Table 2. The results showed that there is no significant difference ($P>0.05$) on plant height on the demonstrated varieties but there is slight significant difference ($P<0.05$) at Adwa district, Tsigab (162.55cm) is higher in plant height than Maitsebri-Bako. On the other hand, there is no significant difference on fresh biomass yield, dry biomass yield and grain yield among the demonstrated varieties at Ahsea district. However, there is a significant difference ($P<0.05$) on dry biomass yield of Tsigab variety with better yield of 12.25 ton/ha than Maitsebri-Bako at Adwa district.

Moreover, there was also significant difference ($P<0.05$) on leaf stem ratio among the demonstrated pigeon pea varieties at both districts. There were Leaf Stem Ratio values of 1.79 and 1.64 for Tsigab and Maitsebri-Bako varieties at Ahsea and Adwa, respectively. The difference in leaf stem ratio among the pigeon pea varieties might be attributed due to variation on agro ecology, variety and plant growth stage. There was no significance difference ($P>0.05$) on grain yield of the pigeon pea varieties at Ahsea but there was a significant difference ($P<0.05$) among the demonstrated varieties at Adwa. Tsigab variety shows better grain yield of 15.50qui/ha than Maitsebri Bako variety. The results of the grain yield in the current study is lower and higher than the result in Gamo and Konso zones of southern Ethiopia which is 18.6 qui/ha for Ashenafi variety and 10.65qu/ha yield for local pigeon pea varieties respectively [8].

Table 1. Plant height, forage biomass yield and leaf to stem ratio of pigeon pea varieties at irrigation schemes of Ahsea (Sebaha and Maitsehlo) and Adwa (Maitoum and Adiselam) Districts

Variables	Tsigab		Maitsebri Bako		SE		T -Value		P-Value	
	Ahsea	Adwa	Ahsea	Adwa	Ahsea	Adwa	Ahsea	Adwa	Ahsea	Adwa
Plant height at harvest (cm)	175.80	162.55	167.61	142.50	2.88	3.53	1.296	0.95	0.082	0.044
FBMY (ton/ha)	29.92	34.66	26.13	23.94	1.34	1.04	1.341	1.27	0.122	0.21
DBMY (ton/ha)	10.95	12.25	9.25	7.59	0.63	0.57	1.256	1.49	0.746	0.026
LSR	1.79	1.54	1.14	1.64	0.8	0.77	4.669	1.101	0.002	0.034
Grain Yield qui/ha	15.97	15.50	15.49	14.50	0.47	0.22	0.934	0.258	0.183	0.034

FBMY; Fresh biomass yield, DBMY; Dry biomass yield, LSR; Leaf to stem ratio, LSD P<0.05

Table 2. Perception of participant farmers on improved forages Pigeon pea varieties (N=29)

Preferred attributes of the forage varieties	Average score	
	Tsigab	Maitsebri-Bako
Survival rate	5	4.34
Biomass yield	5	4.08
Palatable by animals	4.83	4.63
Regeneration rate	4.69	4.86
Soil conservation contribution	4.56	3.69
Resistance to moisture stress	4.92	5
Grain yield	3.09	4.56
Total	32.09	31.13
Mean score	4.58	4.45
Rank	1st	2nd

Overall Tsigab pigeon pea variety shows significantly higher ($p < 0.05$) in plant height (175cm), grain yield (15.50 qui/ha) and leaf stem ratio (1.79) in Ahsea and shows higher dry biomass yield of 12.25ton/ha at Adwa District. The results of plant height and dry biomass yield for Tsigabe variety in this study were lower than the results reported by [9] at the lowland areas of South Omo western Ethiopia 233.74cm and 15.75ton/ha, respectively. On the other hand, the leaf stem ratio was higher than the leaf stem ratio of 0.59 reported in the same study. The variation in plant height, fresh biomass yield, dry matter yield, leaf to stem ratio and grain yield among the demonstrated varieties might be due to varietal difference, soil type, moisture and environmental factors.

3.2 Farmers Perception Result of the Demonstrated Pigeon pea Varieties

The results of farmer’s perception data were presented on (Table 2). The participant farmers

highly preferred the improved pigeon pea variety (Tsigab) by its good survival rate, high biomass yield, palatability to animal and fast regeneration rate. On the other hands, the participant farmers expressed positively to Mytsebri-Bako variety on its’ value to soil conservation and grain yield.

4. CONCLUSION AND RECOMMENDATION

Pigeon pea is a good source of protein for both livestock feed and a human food. The dry biomass yield data of the pigeon pea varieties indicates non-significant at Ahsea but Tsigab variety results significant difference in its dry biomass yield, leaf stem ratio and grain yield over Maitsebri-Bako variety at Adwa. Both varieties were performed well at the area however based on the results of dry biomass yield, Leaf stem ratio, grain yield and farmers perception data Tsigab variety is more preferred than Maitsebri-Bako and therefore Tsigab variety is recommended for wider dissemination,

popularization and cultivation at the demonstration area and similar agro ecologies of the region.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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APPENDIX-1. LIST OF FIGURES



Fig. 1. Pigeon Pea (Tsigab Variety) at Maitsehlo irrigation scheme Ahsea District



Fig. 2. Pigeon Pea (Tsigab Variety) at Mai Toum irrigation scheme Adwa District



Fig. 3. Pigeon Pea (Maitsebri-Bako Variety) at Sebaha irrigation scheme Ahsea District

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