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Mini Review

The Role of Youth Groups Forage Enterprise As a Strategy to Scale Multi-Purpose Legume, Lablab Purpureus (L.) Production and Entrepreneurship in Southwestern Ethiopia

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Abstract

The productivity of the livestock sector has hindered the shortage of feed in quality and quantity. The non-availability of quality seeds in the local market for farmers is one of the significant constraints in feed production, resulting in low productivity. For the broader dissemination of high-yielding forages, there is a need to strengthen the local seed production and supply system by offering youths opportunities to produce forages that fulfill the gap. To help youths raise their incomes, youth-based seed production (YBSP) was implemented to identify and enable them to be self-sufficient in quality seeds. These activities were carried out in 2020 in three districts of Southwestern Ethiopia. The complete randomized lock trials were carried out on 30 youths. Growth, biomass, seed yield, and nutritional quality measurements were recorded.

Lablab produces adequate dry (4.98-5.49 t/ha) forage, and the seed yield ranges from 2923 to 3001-kilo grams per hectare. The nutritional quality of the lablab is 19.04-20.17 %, which can fulfill the protein demands of small ruminants. After implementing the youth group forage seed production program, the seed and economic status of youths and farmers increased significantly, with an increased period of seed self-sufficiency and income from the same unit of land. It also helped to get feedback about promising varieties and popularize them before release.

Keywords: Forage, Youth enterprise, Lablab, Biomass, Digestibility

INTRODUCTION

Livestock subsectors in Ethiopia have been contributing 17–25.3% to the national Gross Domestic Product (GDP) 35.6% to the agricultural GDP **(Metaferia et al., 2011),** 15% to export earnings and 30% to agricultural employment **(Behnke R, 2010).** The productivity of the livestock sector is getting very low due to several limiting factors, including shortage and poor feed quality. According to a major constraint to livestock production in developing countries is the scarcity and fluctuating quantity and quality of the year-round feed supply. In Ethiopia, significant sources of livestock feed resources are natural pastures, crop residues, and aftermath grazing. Most farmers use natural grass and crop residues such as maize Stover, wheat straw, and becalms as a source of animal feed which is deficient in protein content. An adequate supply of livestock feed resources can convert low-quality feedstuff into livestock products.

Different technologies and strategies were demonstrated to enhance the utilization of improved forages and their production in Ethiopia for five decades **(Alemayehu, 2012).** According to integrating improved forages in the agricultural system has many advantages: soil conservation, weeds, pests, and disease control, besides their primary use as high-quality animal feeds. Stated that animal productivity will be improved if improved forages are integrated and produced at the household level sustainably. The availability of quality seeds is a major challenge in forage crop productivity. The adoption of improved forages at the farmers' level has remained very low due to a lack of forage seed and poorly organized extension services.

In Ethiopia, forage seed production is mainly limited to a few research institutes, leading to low utilization of selected and adapted species. An informal community-based seed production system involves selecting, managing, improving, multiplying, storing, planting, and exchanging seeds using smallholder farmers' experiences, knowledge, and skills **(Gurmessa, 2021).**

Lablab purpures (L.) are well adapted to a wide range of agroecology in southwestern parts of the country. It can be a good source of animal feed in the dry season if harvested at the right stage of growth, cured, and stored as hay. It is also a quick-growing, palatable, succulent, and nutritious fodder crop are known for their adaptation to a wide range of environmental conditions, found throughout the tropics and subtropics, and cultivated in arid, semi-arid, and humid climates. The altitude range stretches from sea level up to 3500 meters above sea level (masl) and thrives in regions where annual temperatures range between 18 and 30°C **(Tshwenyane, 2003)** due to the extensive geographic distribution of lablab; it has been recorded from areas with 200 to 2500 mm of annual rainfall. Lablab is a hardy, drought-resistant crop that continues growing, producing flower insole and rotational and intercropping production strategies. Incorporating lablabs into grass pastures also improves pastures quality, palatability, and digestibility. This allows lablabs to provide food, fodder, and soil protection when many other herbaceous plants have desiccated.

In livestock production, lablab is used as a fodder crop rather than provided in the form of hay, crop residues, silage, or directly grazed and can be mixed with other feed to sheep, goats, and cattle additionally lablab is high leafy biomass proportion, the hay is palatable and nutritionally comparable with alfalfa **(Medicago sativa L.)**.

However, this crop remains confronted by many constraints: low access to good quality seeds, problems with quality assurance/quality control (purity maintenance), and lack of market information, allowing weak seed systems. Therefore, the objective of this study was to evaluate the growth performance and seed productivity through the youth groups' lablab seed production system and to extend seed production into the management system of community-based seed production.

MATERIALS AND METHOD

Study Area

The study was conducted in three districts of Southwestern Ethiopia, in Gimbo, Bita, and Andracha districts.

Farmers' Selection

A total of 30 youths, ten from three sites, were selected based on land availability and willingness to participate in the study. In attempting to overcome the gender gap, females participated to be empowered through agricultural research and development work. The farmers and development agents were trained in forage seed production and management.

Manual Preparation and Training

The manual was prepared to serve as a guideline for establishing and implementing youth group forage production (YGFP), starting from the concept and including local and national experiences. Agronomic techniques of biomass and seed production of forage crops were included in the trial. Additionally, the roles of stakeholders are explained in detail. The training was given to potential stakeholders and end-users, farmers, development agents, extension experts, and seed quality control authorities.

Planting and Field Management

A 100 m2 plot was prepared for each youth included in the project before planting previously tested lablab accession at the Bonga agricultural research center. The seed source was the Ethiopian Institute of Agricultural Research (EIAR), sown at the rating of 20 kg/ha. A 100 kg/ha of NPS (N:19%, P_2O_5:37%, P:7%) fertilizer was applied at planting. Weeds were removed manually until the plants were established, at which point the plants outcompeted the weeds.

Experimental Design and Treatments

The study was conducted using a randomized complete block design (RCBD). Treatments comprised improved forage lablabs in three locations as a treatment group (Gimbo, Bita, and Andracha).

An experimental unit with row to row distance of 40 cm, i.e. was carried out on the plot size 5m x 5m and a distance of 1.5m between replication. Fertilizers were replied at a rate of 100kg/ha DAP during establishment for all experimental units. Weeding was done as early as possible to eliminate the re-growth of undesirable plants and promote fodder re-growth by increasing soil aeration will also be done. The plots will be weed-free throughout the growth period **(Orodho, 2006).**

Data collection

Date of emergence, day to flowering, and days to physiological maturity were recorded for each location.

Additionally, biomass samples were collected by selecting two random plants from each plot and separating them into their plant parts, meaning leaf and stem.

The leaf leaf-to-stem (LSR) is especially useful for assessing the aptness of livestock feed. The efficiency of existing biomass to produce new biomass should be quantified, and differences among locations were distinguished using the relative growth rate (RGR) approach. Plant height, leaf area, and the number of lablab leaves, branches, and nodules were assessed on ten randomly selected plants from net rows of each plot at 50% flowering.

The entire herbage from the net plot area (1m x 1m) was cut close to the ground to determine biomass yield. The harvested green forage was weighed plot-wise using a hanging scale of 50 kg capacity, and the total sample fresh yield (TSFW) in q ha-1 was estimated. Sub Samples of about 100 gm were taken from each plot and dried in an oven at 60 °C to constant weight from which dry matter yield (DMY) was determined by dividing the oven-dried weight by its fresh weight expressed as a percentage. The dry matter yield (DMY) in the-1 was estimated by multiplying the green forage yield (qha-1) with the sample dry matter content divided by 100.

Several pods per plant were recorded for ten randomly selected plants in the plot and expressed as the average number of pods per plant. From these pods, seeds were counted to determine the average number of seeds per pod. A hundred seeds were counted from each plot, and their weights were recorded. Oni Ekoch 700, Italy, at 20°C constant temperature and photoperiod of 12 hr in the light and 12 hr in the dark **(Bacchetta et al., 2006).**

Nutritional composition analysis

Moisture content, total ash, crude protein (N × 6.25), crude fiber, and crude fat were determined using the official methods 925.09, 923.03, 979.09, 962.09, and 4.5.01 respectively AOAC (2000). Moisture content was determined based on weight loss after oven-drying at 105° C for 3 hours. Ash was determined by incineration of known weights of the lablab samples in a muffle furnace at 550° C (Gallenkamp, size 3) for 6 hours. Total nitrogen was measured using the Kjeldahl method, and protein content was calculated as N × 6.25. After digesting the lablab samples, the crude fiber was determined by refluxing 1.25 % boiling sulphuric acid and 28 % boiling potassium hydroxide. In proximate analysis, the crude fiber represents the insoluble carbohydrate while the Nitrogen Free Extractives (NFE) represent the soluble components, which together form the total carbohydrate of food material. Crude fat was determined by exhaustively extracting a known sample weight in diethyl ether (boiling point, 55 °C) in a Soxhlet extractor, and the ether evaporated from the extraction flask.

Economic return

The analyses estimated the total gross income (GI), the total variable cost of production (TVC), and net income (NI). The marginal rate of return (MRR) and benefit-to-cost ratio (BCR) were calculated using the data for the lablab seed-producing community group. Market prices averaged across the time of application were collected for seed selling price and variable input costs such as labor, seed, fertilizers, and pesticides. The farmers' gross income, total variable costs of growing cash and forage crops, and net income were calculated per-hectare using the formulae of Shah et al. (2011).

Data analysis

The data were checked for outliers by Shapiro–Wilk's and Levene's tests for the analysis of the normality of data and homogeneity of variances, respectively. All collected data were statistically analyzed using the analysis of variance (ANOVA) technique used for the data analysis using SAS 9.3 software. The effects of different locations were evaluated at a 95% confidence level ($P < 0.05$) using the least significant (LSD) test method.

The statistical model for the data analysis was: $Yijk = \mu + Fi + Vj + Fi *Vj + Eijk$

Where Yijk= all dependent variables (morphological data, forage yield, and forage nutritive value)

μ = Overall mean

Fi = the effect of location levels

Vj = effect of lablab accessions (11640)

Fi *Vj = interaction effect of fertilizer and accessions

RESULT

Growth and biomass yield performance

Table 1 shows the agronomic trait of Lablab purposes in three different study areas. There was no significant ($P > 0.05$) variation across the three locations for all agronomical and phonological parameters.

Seed yield and yield components

However, no statistical variation among production locations for seed yield and yield components, with the seed yield ranging from 2923 to 3001-kilo grams per hectare, hundred seed weights 23.9 to 24.5 grams, number of seeds per pod, and pods per plant were 4.9 to 5.7 and 20.9 to 21.6.

Table 1. Jimma Metrology station.

Parameters	Study sites		
	Gimbo	Bita	Andracha
Latitude	7.3333	7.2767	7.5613
Longitude	36.1667	35.7739	35.4060
Altitude (masl)	1917.39	1973.24	2000.16
Annual rainfall (mm)	1710 to 1892	1725 to 1804	1891 to 1921
Annual Temperature (°C)	18 to 22	17 to 23	19 to 24

Nutrient composition

Mean values for forage quality traits for the lablab across the locations in terms of ash, crude protein (CP), crude fiber (CF), ether extract (EE), neutral detergent fiber (NDF), acid detergent fiber (ADF), and acid detergent lignin (ADL) concentrations plus in vitro dry matter digestibility (IVDMD), gross energy and total digestible nutrient (TDN) are presented in **Table 2-3.** No significant variation (P>0.05) was detected in concentrations quality parameters, whereas the value gained for crude protein ranging from 19.61 to 20.17 with lower fiber contents and excess of 60% in-vitro dry matter digestibility was higher and sufficient to supplement for ruminants.

Economic return

Partial budget analysis (Upton, 1979) presented in **Table 4** showed the higher net revenue recorded at Gimbo. The marginal rate of return also showed that there was a high rate of return at Gimbo for each unit of management variability.

DISCUSSION

Lablab produces adequate dry (4.98-5.49 t/ha) forage and seed (29.23-30.01) yield **(Amole et al. (2013); Bowen et al. (2018) and Tulu et al. (2018).** The differences in dry matter yield in this study could be attributed to distribution and soil fertility within the three sites Kebede et al., (2016). Higher seed yield with better yield components such as number of pods per plant, number of seeds per pod,d, and hundred seed weight may show that yield components were contributing to seed yield. This report is online with other scholars who studied common beans.

The fiber content qualifies the standard according to some scholars it was reported that high-quality legume forage

Table 2. Phenological and agronomical parameters of lablab production.

Location	Agronomic trait on lablab				
	Date of emergency	Day to flowering	Leaf-to-stem ratio	Plant height	DMY t/ha
Andracha	5.88	50.47	0.78	294.75	5.49
Bita	5.67	50.68	0.86	290.69	4.98
Gimbo	5.90	50.76	0.73	289.05	5.18
SEM	0.29	0.64	0.45	0.71	0.23
p-value	0.06	0.07	0.08	0.059	0.056

Table 3. seed yield and yield components of lablab at different locations.

Location	Seed yield and components				
	Number of pods	Number of seeds per pod	Hundred seed weight(gram)	Seed yield kg/ha	Germination %
Andracha	20.9	4.9	23.9	2923	97.5
Bita	21.5	5.2	24.1	2981	99
Gimbo	21.6	5.7	24.5	3001	98
SEM	0.67	0.64	0.45	0.35	0.71
p-value	0.051	0.07	0.08	0.07	0.059

Table 4. Partial budget analysis of lablab production at small-scale farmers' field management condition.

Parameters	Treatments		
	Gimbo	Bita	Andracha
Seed rate/ha (Kg)	20	20	20
Seed cost (Birr/kg)	80	80	80
Seed purchasing cost	1600	1600	1600
Costs(ETB/sheep)			
Land rent	2000	1500	1500
Labor	700	500	500
Fertilizer	1500	1500	1500
TVC (ETB/sheep)	4200	4000	4000
Lablab yield (Qt/ha)	30.01	29.81	29.23
Seed selling price per kg	100	100	100
Seed selling price	300100	298100	292300
Total return (TR) (ETB/ha)	298500	296,500	290,700
Net return(NR) (ETB/sheep)	294300	292,500	286,700
Change in total return (ΔETB/sheep)	7600	75800	-
Change in net income (ΔNI)	290,100	288,500	282,700
Change of total variable cost (ΔTVC)	200	-	-
MRR (ΔNI/ ΔTVC)	1,450.5	-	-

contains >190 g CP/kg dry matter, <310 g ADF/ kg dry matter, 400 g NDF/kg dry matter and the variation promises instantly due to the management difference among the trial farmers as reported the variation of yield could be management, genotype, or the interaction for any genotypes yield.

CONCLUSION AND RECOMMENDATION

The low productivity of Ethiopian livestock is a consequence of numerous factors among which shortage of feed in quality and quantity is the main restrictive factor. Due to the serious feed shortage problem, the importance of high-yield forage crops is being well-realized by farmers, and demand for improved forage seeds by different stakeholders is increasing in the country. Solid prominence should be given during appropriate site selection, seedbed preparation, field management, and post-harvest handling of forage seeds for successful forage and pasture research and development in Ethiopia. A reliable supply of seeds from domestic sources especially youth/farmer-based seed production is very important for forage and pasture development programs and it should be strengthened. Generally, national efforts to increase domestic production of forage seeds can be enhanced by regional and international support which includes training, germplasm exchange, and strengthing seed-producing groups.

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