

Full Length Research Paper

Forage productivity system evaluation through station screening and intercropping of lablab forage legume with maize under Irrigated lands of smallholder farmers

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On station, farm studies were conducted in the eastern zone of Tigray to improve feed resource through integrating forage and cereal crops, to identify suitable and compatible lablab accessions for maize lablab intercropping under smallholder farmers, to demonstrate maize/lablab intercropping on farm, and to see farmer's perception towards this technology. In the first study, eight lablab accessions were screened as monocrops adaptively, biomass and seed production. 1034, 912 and Dolichos lablab accessions were selected. Mean biomass production was estimated as 5.91, 7.12 and 8.31 DM (t/h) for 1034, 912 and Dolichos lablab accessions, respectively. These promising lablab accessions have wide adaptability and best compatible for intercropping. As follow up, 1034 and 912 lablab accessions were in farm trial, selected for intercropping with maize under irrigated lands to evaluate their contribution biomass production and adoptability. The selected legumes were row intercropped into maize and the average fresh biomass yield of maize was 18 kg under irrigated lands. The total average fresh biomass harvested from a single 10 X 10 m plot size was 18, 32 and 33 kg, for T₁, T₂ and T₃, respectively. The mean change in total fresh biomass yield for lablab accession 912 and 1034 was 19.75 and 15.75 kg, respectively. Based on the field observation lablab accession #912 has performed best during the trial period. Hence, the total fresh biomass harvested from intercropped lablab accessions has increased up to 49% and higher in total fresh biomass harvested in sole maize plots. In general, the tendency for adoption of the forage legumes was higher as compared to other forage species.

Key words: Forage development, lablab intercropping, forage yield improvement.

INTRODUCTION

Ethiopia has a diversified agro ecological and topographical feature, which serve as a home for different plant and animal species. There are promising indigenous and introduced forage plants adapted to different agro ecologies. Herbaceous legumes are

multipurpose forage plants which provide quality feed for livestock, serves as source of N for plant growth by improving soil fertility through the process of fixation of atmospheric Nitrogen. However, the utilization of improved forage species under smallholder farmers is still

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poor due to land scarcity which is the major constraint for intensive forage production system. As a result, livestock, feed scarcity also hinders the overall productivity of livestock in almost all part of the high land and lowland areas.

According to Tesema and Demekash (2001), one of the bottlenecks of livestock production in Ethiopia is shortage feed. Report on livestock feed resource study indicated that traditional feeding system is based on the dried pasture and crop residues, which are poor quality roughages, characterized by high NDF, low nitrogen contents, and slow fermentation rates (Yayneshet, 2010).

Feeding poor dietary combination leads to decreased intake, weight loss, increased susceptibility to health problem and reduced reproductive performance. Herbaceous legumes in these feeding regimes helps to solve some of the problems associated with low protein and high fiber diets. Lablab makes a better recovery after grazing, which demonstrates less susceptibility to disease and integrations of forage development strategies with cereal crop production, both at rain fed while irrigated lands is the best practices which improved livestock production during the dry season.

One of the most common goals of intercropping is to produce a greater yield on a given piece of land by making use of resources. Companion crop provides quick ground cover, helping to reduce wind and water erosion and resist invasion of weeds during forage establishment (Bula et al., 1995). As maize is the main cash crop in the area, intercropping of these crops with lablab improves feed availability for livestock. The objectives of the study were to improve feed resource through integrating forage and cereal crops, to demonstrate maize/lablab intercropping under irrigated land and to see farmers' perception towards this technology. Moreover, Introducing these improved forage legumes through intercropping is the best way for forage adoption.

MATERIALS AND METHODS

Description of the study area

On station, screening of eight lablab accessions was conducted for general adaptability and compatible with maize in Illala forage experimental site of Mekelle Agricultural Research Center.

The site is located in Mekelle Zone of Tigray regional state, 5 km North of Mekelle city. Its geographical location is 13°5'N altitudes and 39°6' E longitudes. It is found at an elevation of 1970 m above sea level. The center is laid on 40 hectares of land with a gentle slope and plan topography. The weather of the center is moderately hot and windy with mean annual maximum and minimum temperature of 27 and 10.1°C, respectively with relative humidity of 55.60%. It receives 528.8 mm mean annual rainfall.

Treatments and experimental design

A Randomized Complete Block Design was used with 3 replications. Each accession was planted in 6 rows plot at 3 m * 4 m. The space between plants and rows was 20 and 50 cm,

respectively. Data on establishment, biomass, seed production, and pest infestation were collected (Figure 1).

Intercropping of legumes with cereal crops under irrigated lands was conducted in K/Awlaelo and H/Wagerat districts selected by IFAD project, with similar agro ecologies of the on station sites. Maize was first planted under the irrigation condition and lablab accessions were sown after four weeks (knee stage of the maize). Maize was planted as a mono-crop and intercrop with lablab accessions in a row intercropping types.

The study was conducted in a single plot observation in one farmer's field and replicated in to 4 farmers. Each farmer allocated 10 * 10 m plot size of land for each treatment (300 m² total areas). Spacing between rows and plants for both sole and intercropping maize in row-planting pattern was 75 and 15 cm, respectively. The spacing for lablab plants was 20 cm between plants (Figure 2).

The treatments are as follow:

Sole maize -----T₁
Maize + lablab acc# 1034-----T₂
Maize + lablab acc# 912- -----T₃

Data analysis

The collected data were analyzed using SAS version 9.2, for simple calculation of the arithmetic mean of forage yield during screening.

RESULTS AND DISCUSSION

Screening of lablab forage legume

The agronomic data for Lablab accession are presented in (Table 1). There was no significant difference ($P < 0.05$) among the eight lablab accessions in terms of date of emergency and tiller number at harvest. The mean value of total forage biomass yield (ton/ha) for Dolichos lablab, accession number 912 and 1034 was 8.3, 7.2 and 5.6, respectively. There was no significant ($P > 0.05$) difference between the biomass yield of Dolichos lablab and 912 lablab accessions.

The on station screening of lablab accession observed a significant ($P < 0.05$) difference in forage biomass yield, among the eight lablab accessions from which Dolichos lablab, lablab accession number 1034 and 912 were best performing forage legume. The main factor for the observed difference in forage biomass yield was the variation towards tendency of trailing growth on the ground producing adequate forage biomass.

The on station study observed a significant difference between accession number 1034, and with Dolichos lablab and accession number 912. Those three Lablab accessions are best adaptive and promising forage legumes for improving forage production under smallholder farmer.

Lablab plant growth characteristic

Establishment

Lablab grows well where annual rainfall is 650 to 3000 mm.



Figure 1. Screening of lablab forage legume for compatibility and biomass yield.



Figure 2. Inter row-intercropping system of lablab legume forage with maize.

It is drought tolerant when established but loses leaves during prolonged floods (Mullen et al., 2003).

Dry periods tolerates short periods of flooding, but is intolerant to poor drainage and prolonged floods. As a single crop, seeding rates for Lablab are between 12 and 20 kg/ha. Rows should be 60 to 120 cm apart with 30 to 60 cm between plants. Lablab germinates and stabilizes easily when sown into sub-surface soil to a depth of at

least 5 to 10 cm.

Management For optimum feeding value, the first cutting should be done at the beginning of flowering. The following cuttings provide forage with more stem than leaf, which has lower feed value. The recommended cutting height is about 30 cm above ground level and above the branches, to allow regrowth. If properly cut, it is possible to harvest lablab foliage (leaves and young stems) three times a year.

Table 1. Agronomic parameters of lablab accessions tested at Illala site.

Lablab accession	Emergency days	Tiller number at harvest	Plant height at harvest (cm)	DM yield (Kg/ha)	DM yield (t/ha)	Vigour score (1-5)	Disease and pest score (0-5)
147	5	3	57 ^a	4401.5 ^c	4.4 ^c	5	0
507	5	3	53 ^{ab}	6074.9 ^{ab}	6.1 ^{ab}	5	0
912	5	3	54 ^{ab}	7158.1 ^a	7.2 ^a	2	0
1034	5	3	51 ^{ab}	5914.1 ^b	5.9 ^b	1	0
6529	6	4	50 ^b	6374.3 ^{ab}	6.4 ^{ab}	5	0
10979	7	3	50 ^b	5093.3 ^{bc}	5.1 ^{bc}	4	0
11609	5	3	48 ^c	5786.4 ^b	5.8 ^b	5	0
Dolichos lablab	6	3	56 ^a	8307.8 ^a	8.3 ^a	5	0
SE	0.54	0.21	2.03	-	-	0.18	0
P < 0.05	-	-	-	-	-	-	-

SE= Standard error. Means within a column not connected by same letter, are significantly different at P <5 %.

Table 2. Effect of intercropping on total forage biomass yield/10 m*10 m plot size

Cropping system	Replication	Mean ±SE	Min	Max
Sole maize (control)	4	18.0 ± 0.9 ^c	16	20
Lablab acc #1034 intercropped with maize	4	33.7 ± 0.5 ^b	33	35
Lablab acc #912 intercropped with maize	4	37.7 ± 0.9 ^a	36	40

On farm evaluation of intercropping lablab accessions with maize

Lablab accession number 1034 and 912 were evaluated as best compatible for intercropping with maize. These lablab accessions had trailing behavior on the ground yielding huge foliage biomass. The mean forage biomass yield for 912 and 1034 lablab accession was 15 and 14 kg, respectively from 10 * 10 m plot size. The total mean forage biomass yield harvested from 10 * 10 m plot size was 18.0 ± 0.9, 33.7 ± 0.5 and 37.7 ± 0.9 kg, for T₁, T₂ and T₃, respectively. There was a significant (P<0.05) difference between the mean forage biomass, harvested from the plot of lablab accession 1034 and 912 intercropped with maize and sole crop maize (Table 2).

The mean improvement over the sole maize cropping in the total fresh biomass yield for lablab accession 912 and 1034 was 19.7 kg (52.4%) and 15.7 kg (46.7%), respectively. According to the farm evaluation of intercropping forage legume with maize, the total mean fresh biomass for lablab accession 912 was significantly (P<0.05) higher (10%) than the total mean forage biomass of lablab accession 1034. Lablab accession 912 was best compatible for intercropping with maize of Lablab accession 1034 (Figure 3).

During the first 1 month, lablab grows slowly between the maize rows. When the maize begins to ripen, lablab start to grow more vigorously and obtain their greatest development (Figure 3). The result of the current study indicated that, intercropping of lablab forage legume has a possibility to reduce pest infestation and to retain

moisture for the component crop. The finding of the current study is in line to the previous findings reported by Abreham (2013), who observed that intercropping of Lablab with maize is best compatible.

About 38 smallholder farmers participated in evaluation of forage legume intercropping with maize. The intra raw maize intercropping of lablab forage legume was demonstrated under smallholder farmer's irrigated lands. During demonstration, the participant suggested that intercropping of lablab forage legume has a potential to enhance the availability of improved forage for improving livestock production. It resulted in higher forage yield than maize crop alone. Providing animals with green foliage of lablab is needed as a supplement to crop residue of Maize Stover, in order to produce a feed composition capable of meeting the basal nutritional requirements of ruminants (Figure 4).

Nutritional importance of Lablab forage legume

The broad leave of lablab forage legume has a potential DM yield for improving livestock feed. The study done elsewhere reported that lablab varieties produce forage biomass of "70% DM with 18% CP and 60% digestibility of the DM" (Mullen et al., 2003). It yields about DM 10.9 tons per hectare at flowering stage with protein content of 14 to 19% (Tesfaye et al., 2010). The Fresh lablab forage has off-flavor feeding lablab as hay, which might help to avoid this problem during supplementary feeding. After the maize is harvested, cattle may be turned out to graze



Figure 3. Intercropped lablab accession 1034 (left) and 912 (right) images, with maize demonstration of lablab intercropping.



Figure 4. Potentiality of intercropping to improve livestock feeds under smallholder farmer.

the maize Stover / lablab field or used to cut and carry feeding system (Figure 5). Lablab has a potential in grazing land productivity improvement strategies. It is compatible for grass-legume mixture to over sow in degraded grazing land.

Relavance of lablab to sustainable agricultural production

Lablab forage legume has a potential for improving soil organic matter as well as Nitrogen and minerals in the

soil (Figure 6). Lablab is a companion crop for maize, important in enhancing soil conservation through greater ground cover than sole cropping (Nnadi and Haque, 2008).

Intercropping, offers farmers the opportunity to engage nature's principle of diversity on their farms (Humphreys, 1994). The study observed that, forage legume intercropping produced more forage biomass than the sole cropping, as a mixture of legume and crop residue for smallholder livestock. In addition, intercropping has a potential to improve soil fertility through Nitrogen fixation and organic matter in environmentally friendly manner



Figure 5. Demonstration of improved utilization of crop residue.



Figure 6. Potentiality of forage legume intercropping for soil fertility improvement.

(Bula et al., 1995; West and Griffith, 1992) (Figure 6).

Conclusions

The study shows that lablab accessions 1034 and 912 are compatible for row intercropping with maize, in the high and mid land agro ecology for both irrigated and rain fed conditions, fitting into the existing maize based farming system.

The promising lablab accession are well adapted to the agro ecology which provide ample amount of fresh biomass under irrigated lands at 5 smallholder level. But their adoption rate is very low as per the plan. So continuous extensional fellow up together with enough

planting materials are the key concepts for wide adoption.

CONFLICT OF INTERESTS

The authors has not declared any conflict of interests.

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