Research Paper

Effects of inter-cropping lablab (Lablab purpureus) with selected sorghum (Sorghum bicolor) varieties on plant morphology, sorghum grain yield, forage yield and quality in Kalu District, South Wollo, Ethiopia

Efectos de intercalar lablab (Lablab purpureus) con variedades seleccionadas de sorgo (Sorghum bicolor) en la morfología de las plantas y el rendimiento y calidad del forraje en Kalu District, South Wollo, Etiopía

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Abstract

An experiment was conducted to determine effects of inter-cropping lablab (Lablab purpureus) with 3 selected early-maturing sorghum (Sorghum bicolor) varieties (Teshale, Girana-1 and Misikir) on plant morphology, sorghum grain and forage yield and quality plus yield and quality of lablab forage, and to assess farmers’ perceptions of the crops in Kalu District, South Wollo, Ethiopia. Seven treatments, namely: T1 - sole lablab (SL); T2 - Teshale + lablab (TL); T3 - Girana-1 + lablab (GL); T4 - Misikir + lablab (ML); T5 - sole Teshale (ST); T6 - sole Girana-1 (SG); and T7 - sole Misikir (SM), were used with 3 replications in a randomized complete block design. The data collected from sorghum varieties were: plant height, number of leaves per plant, leaf area, dry biomass yield and grain yield; and for lablab was: plant height, number of leaves per plant, leaf area, number of branches per plant, number of nodules per plant and dry biomass yield. Grain yield was determined on sorghum at maturity, while lablab was harvested at 50% flowering. Inter-cropped Girana-1 produced yields of both grain and stover and lablab forage similar to those for pure stands of the 2 crops, while inter-cropping of Teshale and Misikir with lablab reduced height, grain and stover yields of sorghum and yields of lablab forage (P<0.05). However, crude protein concentration in sorghum stover was enhanced when grown as an inter-crop with lablab (P<0.05). Land equivalent ratios for inter-crop treatments were 54–87% higher than those for pure stands. Farmers readily identified the combination Girana-1 + lablab as superior to the other associations. While farmers can improve productivity of their farms by inter-cropping these sorghum varieties, preferably Girana-1, with lablab, more studies should be conducted to determine benefits from sowing other legumes with sorghum. Any improvements in soil N levels from planting the legumes should be quantified.

Keywords: Cropping system, forage biomass, forage cropping, farmers’ perceptions.

Resumen

Se realizó un experimento para determinar los efectos de intercalar lablab (Lablab purpureus) con 3 variedades seleccionadas de sorgo (Sorghum bicolor) de maduración temprana (Teshale, Girana-1 y Misikir) sobre la morfología de la planta, el...
Palabras clave: Biomasa de forrajes, cultivo de forrajes, percepción de los agricultores, sistema de cultivo.

Introduction

In Ethiopia, the dominant farming system is a crop-livestock system (Assefa et al., 2016), in which both crop and livestock production are economically important. In the country, natural pasture is the primary feed source, which has low biomass yield and nutritional value because of mismanagement (CSA, 2018). In addition, grazing land is being converted to crop production to provide food for the rapidly increasing human population in the nation. Consequently, the major feed resource for livestock during the dry season is crop residues (CSA, 2018), which have low nutritive value, resulting in poor animal performance unless concentrates or conserved hay is fed (Tolera, 2008). The average land holding of households is less than a hectare in different areas of Ethiopia (Gedefaw et al., 2019), so integrated usage of land by intercropping of food and forage crops would provide efficient resource utilization (Tarekegn and Zelalem, 2014). Intercropping legumes with cereal crops has multiple advantages in terms of improving biomass yield, nutritive value and land equivalent ratio (Jensen et al., 2020). In an investigation of the diverse potential of a multi-purpose legume, lablab [Lablab purpureus (L.) Sweet], for smallholder production systems, increased biomass yield and nutritive value of forage were recorded (Nord et al., 2020). Shehu et al. (2001) reported that intercropping of sorghum with lablab improved the protein concentration in cereal stem as well as leaf yield.

Lablab is adapted to most tropical environments (Grotelüschen, 2014), producing high yields of fodder with crude protein (CP) in whole plants of 15–21% (Murphy and Colucci, 1999). It is resistant to drought, diseases and pests and improves soil fertility; shade tolerance allows it to be grown successfully with tall cereal crops, including maize (Grotelüschen, 2014).

However, the local sorghum varieties are becoming less relevant because of unprecedented climatic variability. Moreover, these local varieties are not highly productive and are failing to meet the alarmingly increasing human population’s food demand. The improved early-maturing sorghum varieties, Teshale, Girana-1 and Misikir, are adapted to the study area as reported by several authors (Tesfaye, 2013) and are commonly grown in farming systems. This early-maturing feature of sorghum leads to the possibility of sustainable production in moisture-deficient areas. To the best of our knowledge, no studies have been conducted where these sorghum varieties have been inter-cropped with lablab. Among the commonly available improved lablab accessions is cultivar Highworth (lablab accession ILRI 147). A report by Grotelüschen (2014) showed that ILRI 147 had higher protein concentration than 3 other lablab accessions. The growth habit of ILRI 147 is shorter and more horizontally spreading than cultivar Rongai Noir (ILRI 11609) and cultivar Jhansi (ILRI 6529) (Hunegnaw et al., 2016). This growth habit may makes ILRI 147 more compatible than other accessions for intercropping with Teshale, Girana-1 and Misikir sorghum varieties, which have shorter plant height than local sorghum landraces. Hence, we initiated this study to determine the outcomes from intercropping these sorghum varieties with lablab to improve productivity of cropping land on farms in the area.
Materials and Methods

Climate

The field experiment was conducted in Kalu district of South Wollo Zone at Harbu Agricultural TVET (Technical Vocational Education and Training) College (10°55' N, 39°46' E; 1,484 masl). The daily mean minimum and maximum temperatures are 8.1 and 23.2 °C, respectively, and average annual rainfall is 1,091 mm (National Meteorology Agency, Kombolcha Branch 2018). The average monthly minimum and maximum temperatures and monthly rainfall for the experimental site during the study are presented in Figure 1.

Soil characteristics

To evaluate the physico-chemical properties of the soil, a Vertisol, at the experimental site, soil samples were taken randomly before planting from 5 spots diagonally across the site to a depth of 20 cm and mixed to make a composite sample. The composite soil sample was air-dried, lightly crushed with a wooden pestle and mortar and screened through a 2 mm sieve for analysis of physical and chemical properties, i.e. soil texture, electrical conductivity, organic carbon, soil pH, cation exchange capacity, total nitrogen and available phosphorus (Olsen) at Sirinka Agricultural Research Centre Soil Laboratory (Table 1).

Trial design

A randomized complete block design was used to conduct the field experiment with 3 replications. Each plot measured 3.75 m long and 3 m wide (11.25 m²) and the gross area used in the experiment was 370.5 m². Each plot of intercropping consisted of 5 rows of sorghum and 4 rows of lablab.

![Figure 1](image-url). Mean monthly minimum and maximum temperature (°C) and rainfall distribution (mm/month) during 2018 in Kalu district at Harbu. Source: Annual report, National Meteorology Agency, Kombolcha Branch 2018.

Table 1. Physico-chemical properties of the soil at the experimental site before sowing.

| Parameter                                      | Value            | Rating          |
|------------------------------------------------|------------------|-----------------|
| Particle size distribution                     |                  |                 |
| Sand (%)                                       | 28.3             |                 |
| Silt (%)                                       | 39.2             |                 |
| Clay (%)                                       | 32.5             |                 |
| Textural class                                 | Silty clay loam  |                 |
| pH                                             | 6                | Slightly acidic |
| Cation exchange capacity (cmol+/kg soil)       | 23.2             | High            |
| Electrical conductivity (dS/m)                 | 2.33             | Low             |
| Total N (%)                                    | 0.16             | Medium          |
| Available P (ppm)                              | 23.6             | High            |
| Organic carbon (%)                             | 1.16             | Medium          |
| Organic matter (%)                             | 2                | Medium          |
Spacing between plots and blocks were 1 and 1.5 m, respectively. Three sorghum varieties (Teshale, Girana-1 and Misikir) were inter-cropped with lablab accession ILRI 147 (which was adapted to and recommended for the area), while pure stands of the sorghum varieties and lablab were also grown. This provided 7 treatment combinations consisting of: lablab (LL) only (T1); Teshale + lablab (TL) (T2); Girana-1 + lablab (GL) (T3); Misikir + lablab (ML) (T4); Teshale (TT) only (T5); Girana-1 (GG) only (T6); and Misikir (MM) only (T7).

The land was ploughed 3 times to provide a good seedbed and divided into plots. Sorghum varieties were sown into holes within rows with 75 cm between rows and 25 cm between plants within rows; pure lablab was also sown at the same spacing (Mpairwe et al. 2002). Fifteen days after emergence sorghum plants were thinned to a single healthy plant per hole. Inter-cropped lablab was sown down the center of the sorghum inter-row spaces, i.e. 37.5 cm from the rows of sorghum; with 20 cm between plants, at 18 days after sorghum was sown. All plots of sorghum received a basal application of 100 kg N:P:S fertilizer (19:38:7) per ha at sowing and were topped with 50 kg urea/ha when knee-high (40 days after sowing), while all plots were weeded at 45 days after sowing. Sole lablab plots received a basal application of N:P:S (19:38:7) at 46 kg/ha at sowing according to FAO (2012) recommendations.

Plant height, leaf area and number of leaves, branches and nodules of lablab were assessed on 10 randomly selected plants from the middle 2 rows of each plot at 50% flowering stage (at about 3 months after sowing) (ILRI 2013). Plant height, leaf area and number of leaves of sorghum varieties were taken from 10 randomly selected plants from the middle 3 rows of each plot at milk stage (about 15 days after flowering). Leaf area was calculated as Leaf area = leaf length × maximum width × 0.75 using the method described by Stickler et al. (1961).

When sorghum seed-heads were mature, 10 plants were selected at random from the middle rows. Seed-heads were harvested by hand using sickles, were sun-dried and threshed and the grain was weighed to estimate grain yields. After grain harvesting sorghum stove was harvested by cutting at 10 cm above ground level. Similarly, the whole plot of lablab was harvested at 5 cm above ground level for biomass yield determination. Harvested material was weighed fresh using a balance with sensitivity of 0.1 g. Sub-samples (500 g) were taken from each plot, chopped into small pieces and air-dried until constant weight was recorded.

Dried forage samples from each plot were ground and subjected to chemical analyses at Debre Birhan Agricultural Research Center, Animal Nutrition Laboratory to determine: ash concentration by combusting in a muffle furnace at 500 °C for 6 hours; N concentration by Kjeldahl method; and neutral detergent fiber (NDF), acid detergent fiber (ADF) and acid detergent lignin (ADL) by the procedures of Van Soest et al. (1991).

The land equivalent ratio (LER) for inter-cropping was calculated, using the formula: LER = (IYS/SYS) + (IYL/SYL) (Mead and Willey 1980),

where:
SYS = yield of pure sorghum; IYS = inter-cropped yield of sorghum; IYL = inter-cropped yield of lablab; and SYL = yield of pure lablab.

Farmers were invited to visit the experimental area during the vegetative stage to form their views and perceptions about the forages when inter-cropped. The perceptions of 8 male and 4 female farmers were recorded through participation using 6 evaluation criteria set by farmers themselves. The criteria were: biomass yield; speed of growth; compatibility of sorghum with lablab; drought tolerance; grain yield; and ability to stay green.

Data analysis

Analysis of variance was used to analyze data on morphological characteristics, forage dry matter yield and chemical composition, grain yield and LER. Fisher’s LSD test (P<0.05) was employed for separation of means carried out using the procedure of SAS (2002).

The model used for data analysis was:

\[ Y_{ij} = \mu + B_i + T_j + e_{ij}, \]

where:
\[ Y_{ij} = \text{all dependent variables}; \]
\[ \mu = \text{overall mean}; \]
\[ B_i = \text{effect of } i^{th} \text{ block}; \]
\[ T_j = \text{effect of } j^{th} \text{ treatment}; \] and \[ e_{ij} = \text{the random error}. \]

Results

With the exception of Girana-1, sorghum varieties and lablab were affected morphologically by inter-cropping (Table 2). Girana-1 outperformed Teshale and Misikir in terms of plant height, number of leaves/plant and total leaf area, whether grown as a pure stand or when inter-cropped with lablab (P<0.01; Table 2). Similarly, height and number of leaves per plant for Girana-1 were not affected by intercropping with lablab (P>0.05), while both parameters for Teshale and Misikir were reduced by growing in association with lablab (P<0.01). Surprisingly leaf area of Girana-1 was not affected when grown with lablab (P>0.05), while leaf
area was reduced in the case of Teshale and Misikir (P<0.01). For lablab, intercropping with Teshale or Misikir reduced plant height and total leaf area per plant (P<0.01). Number of branches per plant and number of nodules per plant for lablab were reduced when lablab was grown with any of the sorghum cultivars (P<0.01).

Both grain and stover yields of Teshale and Misikir were reduced (P<0.001) by intercropping with lablab (Table 3; P<0.001). Sowing lablab with sorghum reduced forage yields of lablab but differences were significant (P<0.05) only for Teshale and Misikir.

Intercropping of sorghum varieties with lablab increased both ash and CP concentrations in sorghum stover but lowered NDF, ADF and ADL concentrations (P<0.001; Table 4). Crude protein levels in stover of Girana-1 reached 7% when grown with lablab.

Intercropping lablab with sorghum varieties significantly (P<0.001) increased ash concentration but reduced CP, NDF, ADF and ADL concentrations of lablab (Table 5).

While land equivalent ratios (LERs) for biomass yield (non-grain component) for intercropping lablab with sorghum varieties were less than unity for each species, the combined LERs were significantly (P<0.001) greater than unity, with increases of 54–87% (Table 6). Girana-1 + lablab produced the greatest yield advantage over pure stands.

Farmers’ perception of the intercropping technology was assessed during a field day. Farmers preferred intercropping to planting pure stands of sorghum and lablab and ranked Girana-1+ lablab as the preferred option (data not presented). They said that: Girana-1 intercropped with lablab had largest heads and seed size; its superior plant height provided physical support for climbing lablab; and it was more suitable for lablab growth and development as compared with Teshale and Misikir.

### Table 2. Plant morphology of 3 sorghum varieties and lablab sown alone or intercropped.

| Treatment | PH (cm) | NLPP | LA (cm²) | NBPP | NNPP |
|-----------|--------|------|----------|------|------|
|           | Sorghum | Lablab | Sorghum | Lablab | Sorghum | Lablab | Sorghum | Lablab | Sorghum | Lablab |
| SL        | -       | 238a | -        | 58.4a | -      | 138a  | 11.9a   | 17.4a |
| TL        | 189c    | 198b | 10.5c    | 45.5c | 602c  | 118b  | 6.4bc  | 13.8b |
| GL        | 245a    | 231a | 11.3a    | 52.0b | 631a  | 127ab | 8.4b   | 14.2b |
| ML        | 176e    | 172c | 9.6e     | 41.8c | 579e  | 103c  | 4.4c   | 10.0c |
| ST        | 192b    | -    | 10.9b    | -     | 608b  | -     | -      | -     |
| SG        | 247a    | -    | 11.4a    | -     | 633a  | -     | -      | -     |
| SM        | 183d    | -    | 10.0d    | -     | 595d  | -     | -      | -     |
| LSD       | 3.5     | 26.0 | 0.16     | 6.35  | 6.4   | 8.22  | 1.85   | 1.96  |
| Prob.     | ***     | ***  | ***      | ***   | ***   | ***   |

1Within columns means followed by different letters differ significantly (P<0.01; P<0.001). SL = sole lablab (T1); TL = Teshale + lablab (T2); GL = Girana-1 + lablab (T3); ML = Misikir+ lablab (T4); ST = sole Teshale (T5); SG = sole Girana-1 (T6); SM = sole Misikir (T7); PH = plant height; NLPP = number of leaves per plant; LA = leaf area; NBPP = number of branches per plant; and NNPP = number of nodules per plant.

### Table 3. Forage yields of lablab plus stover and grain yields of sorghum sown alone or intercropped.

| Treatment | Sorgum stover | Lablab | Grain yield (quintal/ha) |
|-----------|---------------|--------|-------------------------|
| SL        | -             | 5.65a  | -                       |
| TL        | 7.75c         | 4.08b  | 54.6c                   |
| GL        | 9.08a         | 5.01a  | 59.5a                   |
| ML        | 5.84e         | 3.47b  | 49.1 e                  |
| ST        | 7.90b         | -      | 56.6b                   |
| SG        | 9.08a         | -      | 59.5a                   |
| SM        | 6.24d         | -      | 52.5d                   |
| LSD       | 0.005         | 0.635  | 0.365                   |
| Prob.     | ***           | ***    | ***                     |

1Means within columns followed by different letters differ significantly (P<0.01; P<0.001). 1 quintal = 100 kg. SL = sole lablab (T1); TL = Teshale + lablab (T2); GL = Girana-1 + lablab (T3); ML = Misikir + lablab (T4); ST = sole Teshale (T5); SG = sole Girana-1 (T6); SM = sole Misikir (T7).
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Table 4. Chemical composition (%) of stover from sorghum varieties sown alone or inter-cropped with lablab.

| Treatment | Ash  | CP      | NDF    | ADF    | ADL    |
|-----------|------|---------|--------|--------|--------|
| TL        | 12.1a| 5.8b    | 52.5d  | 39.1d  | 10.1d  |
| GL        | 12.1a| 7.0a    | 51.0e  | 37.6e  | 9.7e   |
| ML        | 11.2b| 5.8c    | 53.2c  | 40.9c  | 10.2c  |
| ST        | 9.1d | 3.5e    | 68.8a  | 50.5a  | 12.1b  |
| SG        | 9.4c | 5.6d    | 63.4b  | 47.2b  | 12.1b  |
| SM        | 8.0e | 2.2f    | 68.8a  | 50.5a  | 12.2a  |
| LSD       | 0.0048| 0.0044 | 0.0017 | 0.0079 | 0.0043 |
| Prob.     | ***  | ***     | ***    | ***    | ***    |

Means within columns with different letters differ significantly (P<0.001). CP = crude protein; NDF = neutral detergent fiber; ADF = acid detergent fiber; ADL = acid detergent lignin; SL = sole lablab (T1); TL = Teshale + lablab (T2); GL = Girana-1 + lablab (T3); ML = Misikir + lablab (T4); ST = sole Teshale (T5); SG = sole Girana-1 (T6); SM = sole Misikir (T7).

Table 5. Chemical composition (%) of lablab forage sown alone or inter-cropped with sorghum varieties.

| Treatment | Ash  | CP      | NDF    | ADF    | ADL    |
|-----------|------|---------|--------|--------|--------|
| SL        | 8.7b | 15.9a   | 35.4a  | 27.8a  | 6.4a   |
| TL        | 9.8a | 14.8e   | 32.2c  | 24.3c  | 6.1c   |
| GL        | 9.8a | 15.6b   | 32.2c  | 24.3c  | 6.1c   |
| ML        | 9.8a | 14.5d   | 33.3b  | 25.8b  | 6.3b   |
| LSD       | 0.012| 0.2     | 0.0067 | 0.0046 | 0.01   |
| Prob.     | ***  | ***     | ***    | ***    | ***    |

Means within columns with different letters differ significantly (P<0.001). CP = crude protein; NDF = neutral detergent fiber; ADF = acid detergent fiber; ADL = acid detergent lignin; SL = sole lablab (T1); TL = Teshale + lablab (T2); GL = Girana-1 + lablab (T3); ML = Misikir + lablab (T4); ST = sole Teshale (T5); SG = sole Girana-1 (T6); SM = sole Misikir (T7).

Table 6. Land equivalent ratio for biomass yield (non-grain component) of inter-cropping sorghum varieties with lablab.

| Treatment | Sorghum | Lablab | Total | Yield advantage (%) |
|-----------|---------|--------|-------|---------------------|
| TL        | 0.98b   | 0.72b  | 1.70b | 70                  |
| GL        | 0.99a   | 0.88a  | 1.87a | 87                  |
| ML        | 0.93c   | 0.61b  | 1.54c | 54                  |
| LSD       | 0.0014  | 0.143  | 0.1417| -                   |
| CV        | 0.0623  | 8.5101 | 3.6486| -                   |
| Prob.     | ***     | *      | **    | -                   |

Means within columns with different superscripts differ significantly (P<0.05). TL = Teshale + lablab; GL = Girana-1 + lablab; ML = Misikir + lablab; SL = sole lablab (T1); TL = Teshale + lablab (T2); GL = Girana-1 + lablab (T3); ML = Misikir + lablab (T4); ST = sole Teshale (T5); SG = sole Girana-1 (T6); SM = sole Misikir (T7).

Discussion

This study has shown the substantial benefits in terms of total yields of forage to be obtained from inter-cropping lablab and sorghum in comparison with sowing the 2 crops as pure stands. Not only was total DM yield of forage increased but also the CP concentration in the sorghum stover was increased. It was of interest that growth of Girana-1 was not significantly affected by being grown in association with lablab, while both Teshale and Misikir suffered depression in yields of both stover and grain. This finding was in spite of the fact that Girana-1 was the tallest sorghum accession but did not significantly suppress the growth of lablab in terms of plant height or total leaf area, although it did reduce the number of branches per plant. Musa et al. (2012) reported that dry forage and grain yields of sorghum varieties (S1007, Pioneer and local Shahlaa) varied between varieties when inter-cropped with cowpeas.

This finding of an overall lack of response of Girana-1 to inter-cropping with lablab is in contrast to the results with Teshale and Misikir, which behaved according to results from other published studies. Shehu et al. (2001) found that inter-cropping of lablab with sorghum caused a marked reduction in yields of sorghum stem, leaves and grain, while Isaacs et al. (2018) found a reduction in height of maize following inter-cropping with lablab. Similarly, significant reduction of number of leaves and leaf area of sorghum was shown when inter-cropped with legumes (Arshad et al., 2014). This suppression in growth would normally be expected when two crops are interplanted because of increased competition for light, nutrients and moisture.
The increased CP concentration in sorghum stover when inter-cropped with lablab is in agreement with the findings of Akhtar et al. (2013) and Mbahe et al. (2017), who reported increases in CP concentration in sorghum when inter-cropped with lablab and groundnut, respectively. This response is probably due to increased soil N availability resulting from atmospheric N fixation by rhizobia on lablab root nodules. Significantly higher CP concentration in Girana-1 than in Teshale and Misikir, regardless of whether pure stands or inter-cropped with lablab, suggests that Girana-1 had better ability to extract nitrogen from soil than the other varieties, as it also presented higher grain and stover yields.

The lower NDF, ADF and ADL concentrations in inter-cropped sorghum stover were in line with reports that showed inter-cropping sorghum with lablab significantly reduced NDF concentration in forage produced (Mpairwe et al. 2002; Amole et al. 2015), while ADF concentration in sorghum was lower when inter-cropped with groundnut and lablab than when sorghum was grown as pure stands (Zhang et al. 2015). Zhang et al. (2015) and Amole et al. (2015) reported lower fiber levels in sorghum inter-cropped with legumes than in pure sorghum.

The consistently lower concentrations of NDF and ADF in Girana-1 than in Teshale and Misikir, regardless of whether grown as pure stands or inter-cropped with lablab, is further evidence of the superiority of this variety over Teshale and Misikir.

The reduction in number of leaves per plant and number of branches per plant for lablab when inter-cropped with sorghum conforms with the findings of Redfearn et al. (1999) and Iqbal et al. (2018) that inter-cropping sorghum with soybean reduces the number of leaves and branches of soybean, respectively. Similarly, Ngongoni (2007) found that inter-cropping maize with lablab and cowpea significantly reduced number of nodules per plant of both legumes.

The reduction in biomass yield of inter-cropped lablab relative to pure lablab might be a function of competition for light, soil moisture and nutrients. Growth of lablab was depressed more by competition with sorghum than sorghum growth was depressed by competition with lablab, indicating that sorghum was more competitive than lablab under the conditions of the study. Since sorghum was much taller than lablab, one might suspect that competition for light played a significant role in differences which occurred.

Inter-cropping lablab with the 3 sorghum varieties was more advantageous than sole cropping, since 54–87% more land would be required with sole cropping to produce a similar quality of dry forage as obtained with inter-cropping. This finding is in line with reports that LER values greater than 1 occurred when sorghum was inter-cropped with cowpea and rice bean (Singh Pal et al. 2014). The highest LER value obtained with inter-cropped Girana-1 + lablab is further evidence of the benefits of planting sorghum and lablab under an intercropping system in this environment. In a study of intercropping of maize with vetch, berseem clover and beans, LER exceeded 1 in combinations of both maize hybrids studied (704 and 301) and vetch (Ozpınar 2009).

Girana-1 was so superior to other sorghum varieties, in terms of greater height, larger seed heads, largest seed size and compatibility with lablab, that it was not surprising that most participating farmers identified Girana-1 + lablab as the preferred combination.

Conclusion and recommendations

The findings showed that of the 3 sorghum varieties intercropped with lablab, Girana-1 was superior to Teshale and Misikir in overall performance. Even when planted as a pure crop Girana-1 was superior to the other 2 varieties and continued to produce at the same level when intercropped with sorghum, while Teshale and Misikir had reduced performance relative to their performance as pure stands. It is obvious that farmers in the area can improve productivity of their land by inter-cropping Girana-1 with lablab. Further studies should be conducted to test findings with other legume species and to quantify any improvements in soil N produced by the legume.

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