Background information on agronomy, farming systems and ongoing projects on grain legumes in Ethiopia

Milestone reference number: S 1.2.1

Esther Ronner, Ken E. Giller

Submission date: July 2013

N2Africa
Putting nitrogen fixation to work for smallholder farmers in Africa
N2Africa is a project funded by The Bill & Melinda Gates Foundation by a grant to Plant Production Systems, Wageningen University who lead the project together with CIAT-TSBF, IITA and many partners in the Democratic Republic of Congo, Ghana, Kenya, Malawi, Mozambique, Nigeria, Rwanda and Zimbabwe.

Email: n2africa.office@wur.nl
Internet: www.N2Africa.org

Authors of this report and contact details
Name: Esther Ronner
Address: P.O. Box 430
6700 AK Wageningen
The Netherlands
E-mail: esther.ronner@wur.nl

Name: Ken E. Giller
Address: P.O. Box 430
6700 AK Wageningen
The Netherlands
E-mail: ken.giller@wur.nl

If you want to cite a report that originally was meant for use within the project only, please make sure you are allowed to disseminate or cite this report. If so, please cite as follows:


Disclaimer:
This publication has been funded by the Bill & Melinda Gates Foundation through a grant to Wageningen University entitled “Putting nitrogen fixation to work for smallholder farmers in Africa”. Its content does not represent the official position of Bill & Melinda Gates Foundation, Wageningen University or any of the other partner organisations within the project and is entirely the responsibility of the authors.

This information in this document is provided as it is and no guarantee or warranty is given that the information is fit for any particular purpose. The user thereof uses the information at their own sole risk and liability.
Table of contents

1. Introduction .................................................................................................................................... 5
2. General characteristics ................................................................................................................. 6
3. Production and import of grain legumes .................................................................................... 7
4. Agriculture in Ethiopia .................................................................................................................. 8
   4.1 Rainfall and agro-ecology ........................................................................................................ 8
   4.2 Population density and market access .................................................................................. 10
5. Grain legumes in Ethiopia .......................................................................................................... 14
   5.1 Faba bean ................................................................................................................................ 14
   5.2 Common bean ....................................................................................................................... 16
   5.3 Chickpea ................................................................................................................................ 18
   5.4 Soyabean .................................................................................................................................. 20
   5.5 Rhizobium research in Ethiopia ............................................................................................. 20
6. Projects on grain legumes in Ethiopia ...................................................................................... 22
   6.1 National initiatives .................................................................................................................. 22
   6.2 International initiatives .......................................................................................................... 23

References ........................................................................................................................................... 26

Appendix 1: Agro-ecological zones in Ethiopia .............................................................................. 28

Appendix 2: Improved chickpea varieties in Ethiopia ................................................................. 29

List of project reports ......................................................................................................................... 31
Table of tables

Table 1: Selected development indicators ........................................................................................................ 6
Table 2: Production, area cultivated and yield/ha of main grain legumes in Ethiopia in 2010 ..................... 7
Table 3: Status of tropical legumes production in Ethiopia (2008-2010 averages) .................................. 14
Table 4: Faba bean response to inoculation* .......................................................................................... 15
Table 5: Chickpea response to inoculation* ......................................................................................... 20

Table of figures

Figure 1: Long term annual rainfall (mm) in Ethiopia .............................................................................. 8
Figure 2: Length of growing period Western Ethiopia ............................................................................. 9
Figure 3: Length of growing period Central Ethiopia ............................................................................... 9
Figure 4: Population density Western Ethiopia ..................................................................................... 10
Figure 5: Population density Central Ethiopia ....................................................................................... 11
Figure 6: Accessibility to towns of >50,000 people in Western Ethiopia ............................................. 12
Figure 7: Accessibility to towns of >50,000 people in Central Ethiopia .................................................. 13
Figure 8: Land area in hectares under faba bean in Ethiopia ............................................................... 15
Figure 9: Land area in hectares under common bean in Ethiopia ........................................................ 16
Figure 10: Production trends of common bean in Ethiopia ................................................................. 17
Figure 11: Grain yield (t/ha) in common bean as affected by inoculation ............................................. 17
Figure 12: Land area in hectares under chickpea in Ethiopia ............................................................. 18
Figure 13: Production trends of chickpea in Ethiopia ............................................................................ 19
1. Introduction

As part of the supplementary grant received from the Bill & Melinda Gates Foundation, N2Africa is exploring the opportunities for extension of the project to Ethiopia, Uganda and Tanzania. For each of these countries, relevant background information on the importance of grain legumes, past research on legume agronomy and farming systems, as well as ongoing projects around grain legumes is gathered. This will increase N2Africa's relevance by building on key issues raised from these previous experiences. The report falls under Milestones S 1.2.1 – 1.2.3: Prepare review and background of previous relevant agronomic, farming systems and market research in each country. This report provides background information for Ethiopia.

The report starts with general information on economy, poverty and malnutrition in Ethiopia in Chapter 2, followed by statistics on production and import of grain legumes in Chapter 3. Chapter 4 presents a characterization of Ethiopia's agro-ecological zones and market access in different regions. More detailed information on relevant grain legumes in Ethiopia (faba bean, common bean, chickpea and soyabean) and results of previous research on these crops is given in Chapter 5. Chapter 6 lists ongoing projects around grain legumes in Ethiopia.
2. General characteristics

Ethiopia has a population of about 85,000 inhabitants. Population growth is high and increasing agricultural production is necessary to keep up with national food demand the coming decades. Currently, the agricultural sector comprises 50% of total GDP (Table 1). Compared to neighbouring Kenya, this is a large share. Gross net income per capita is lower than in Kenya, and the country has a higher share of its population living below the poverty line. Half of the population is stunted, and underweight is prevalent among 35% of the population. Other indicators for malnutrition such as wasting, mortality rate among children under five and women with low BMI are high as well.

Table 1: Selected development indicators

<table>
<thead>
<tr>
<th></th>
<th>Ethiopia</th>
<th>Kenya</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population (thousands)</td>
<td>84 734</td>
<td>38 765</td>
<td>UNDP (2011)</td>
</tr>
<tr>
<td>Gross net income (US$ per capita, PPP)</td>
<td>930</td>
<td>1 580</td>
<td>Worldbank (2011)</td>
</tr>
<tr>
<td>Population below poverty line (%)</td>
<td>39</td>
<td>20</td>
<td>Worldbank (2011)</td>
</tr>
<tr>
<td>GDP (billion US$)</td>
<td>28.5</td>
<td>34.5</td>
<td>Worldbank (2011)</td>
</tr>
<tr>
<td>Agriculture (%GDP)</td>
<td>51</td>
<td>21</td>
<td>Worldbank</td>
</tr>
<tr>
<td>Children under 5 (thousands)</td>
<td>13,323</td>
<td>6 540</td>
<td>UNICEF (2009)</td>
</tr>
<tr>
<td>Stunting prevalence (%)</td>
<td>51</td>
<td>35</td>
<td>UNICEF (2009)</td>
</tr>
<tr>
<td>Children stunted (thousands)</td>
<td>6,768</td>
<td>2 269</td>
<td>UNICEF (2009)</td>
</tr>
<tr>
<td>Underweight prevalence (%)</td>
<td>35</td>
<td>21</td>
<td>UNICEF (2009)</td>
</tr>
<tr>
<td>Wasting prevalence (%)</td>
<td>12</td>
<td>6</td>
<td>UNICEF (2009)</td>
</tr>
<tr>
<td>Children under 5 mortality rate (per 1000)</td>
<td>104</td>
<td>85</td>
<td>Worldbank (2011)</td>
</tr>
<tr>
<td>Women with low BMI (%)</td>
<td>27</td>
<td>12</td>
<td>UNICEF (2009)</td>
</tr>
</tbody>
</table>

Poverty line defined as people living on less than US$ 1.25 PPP per day.
3. Production and import of grain legumes

In Ethiopia, faba bean is the crop that has the highest absolute production, and the largest area cultivated (Table 2). Ethiopia is also the second largest producer of faba bean in the world (after China). Common bean and chickpea are also major legumes, with both a production of more than 200,000 MT grain. On the world market, Ethiopia ranks 6th in chickpea production, and 14th in production of common bean. Among African countries, Ethiopia is the largest producer of both chickpea and common bean (ICRISAT, 2011).

Table 2: Production, area cultivated and yield/ha of main grain legumes in Ethiopia in 2010

<table>
<thead>
<tr>
<th></th>
<th>Production (MT grain)</th>
<th>Area cultivated (ha)</th>
<th>Yield (t/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beans</td>
<td>244 000</td>
<td>263 000</td>
<td>0.9</td>
</tr>
<tr>
<td>Faba bean</td>
<td>512 000</td>
<td>607 000</td>
<td>0.8</td>
</tr>
<tr>
<td>Chickpea</td>
<td>213 000</td>
<td>310 000</td>
<td>0.7</td>
</tr>
<tr>
<td>Chickpea</td>
<td>42 000</td>
<td>56 000</td>
<td>0.8</td>
</tr>
<tr>
<td>Soyabean</td>
<td>6 000</td>
<td>9 000</td>
<td>0.7</td>
</tr>
<tr>
<td>Total</td>
<td>1 017 000</td>
<td>1 245 000</td>
<td></td>
</tr>
</tbody>
</table>

Ranking of producers in the world

<table>
<thead>
<tr>
<th></th>
<th>Faba bean 2nd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chickpea</td>
<td>6th</td>
</tr>
<tr>
<td>Beans</td>
<td>14th</td>
</tr>
</tbody>
</table>

Source: FAOStat, 2012

In total, the area cultivated with the selected legumes is more than 1 million ha. Production per ha is low and far below the potential production of e.g. 2.9 t/ha for chickpea and 4 t/ha for common bean and faba bean (IFPRI, 2010b, USAID, 2011).
4. Agriculture in Ethiopia

4.1 Rainfall and agro-ecology

The west of Ethiopia receives the highest amount of rainfall: more than 1000 mm (Figure 1). Towards the east and southeast this amount diminishes. In general, annual precipitation ranges from 800 to 2200-mm in the highlands (>1500 meters) and varies from less than 200 to 800-mm in the lowlands (<1500 meters).

![Figure 1: Long term annual rainfall (mm) in Ethiopia](source: UN-OCHA (2006))

Ethiopia’s agro-ecological zones range from warm to cool and from (semi-)arid to subhumid tropics (see Appendix 1 for an overview of agro-ecological zones in Ethiopia). The main agricultural production areas range between 3200 and 1500 m (highland and lowland) and they have either two or three seasons (FAO, 2006). The western half of Ethiopia has a wet season from June-September and a dry season from November-February (rainfall peak July-August), whereas the central and eastern part have two rainy periods and one dry period (the main Kiremt rains June-September, small Belg rains February-May and dry Bega season October-January) (USDA, 2003). The length of the growing season is more than 120 days in most of western Ethiopia, and between 60 and 119 days in central Ethiopia (Figure 2 and Figure 3) (FAO, 2006).
Figure 2: Length of growing period Western Ethiopia

Figure 3: Length of growing period Central Ethiopia
4.2 Population density and market access

Population density is highest in central and western Ethiopia (Oromia, Amhara and Tigray) (Figure 4 and Figure 5). This implies that most important markets for agricultural production are also found in these regions.

![Population density map of Western Ethiopia](image)

**Figure 4: Population density Western Ethiopia**
Accessibility of different areas is largely related to population density. The Benishangul-Gumuz region in Western-Ethiopia, for instance, has a low population density and a large part consists of remote areas in which the time to travel to towns of more than 50,000 people is between 8-16 hours (Figure 6).
Accessibility is higher in the Amhara and Oromia regions, around Bahir Dar and Jimma, and in Central Ethiopia (Figure 7). These areas therefore have advantages in production of cash crops for regional, national or export markets.
Figure 7: Accessibility to towns of >50,000 people in Central Ethiopia
5. Grain legumes in Ethiopia

Grain legumes occupy about 13% of cultivated land in Ethiopia and their contribution to agricultural value addition is around 10%. Pulses are the third-largest export crop of Ethiopia after coffee and sesame, contributing USD 90 million to export earnings in 2007/08 (IFPRI, 2010b). Apart from the selected legumes presented in Table 2, field pea and grass pea are also important grain legumes (Table 3). Faba bean and common bean together account for half of the total area under production of legumes.

Table 3: Status of tropical legumes production in Ethiopia (2008-2010 averages)

<table>
<thead>
<tr>
<th>Legume</th>
<th>Crop name</th>
<th>English/common</th>
<th>Scientific</th>
<th>1000 HH</th>
<th>1000 Ha</th>
<th>Kg/Ha</th>
<th>1000 MT</th>
<th>Percent of area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faba bean</td>
<td>Vicia faba</td>
<td></td>
<td></td>
<td>3661</td>
<td>503</td>
<td>1335</td>
<td>668</td>
<td>34.1</td>
</tr>
<tr>
<td>Common</td>
<td>Phaseolus vulgaris</td>
<td></td>
<td></td>
<td>2287</td>
<td>249</td>
<td>1385</td>
<td>344</td>
<td>16.9</td>
</tr>
<tr>
<td>Chickpea</td>
<td>Cicer arietinum</td>
<td></td>
<td></td>
<td>948</td>
<td>218</td>
<td>1407</td>
<td>307</td>
<td>14.8</td>
</tr>
<tr>
<td>Field pea</td>
<td>Pisum sativum</td>
<td></td>
<td></td>
<td>1514</td>
<td>220</td>
<td>1153</td>
<td>253</td>
<td>14.9</td>
</tr>
<tr>
<td>Grass pea</td>
<td>Lathyrus sativus</td>
<td></td>
<td></td>
<td>706</td>
<td>142</td>
<td>1434</td>
<td>202</td>
<td>9.6</td>
</tr>
<tr>
<td>Lentil</td>
<td>Lens culinaris</td>
<td></td>
<td></td>
<td>676</td>
<td>93</td>
<td>1070</td>
<td>100</td>
<td>6.3</td>
</tr>
<tr>
<td>Fenugreek</td>
<td>Trigonella foenum-graecum</td>
<td></td>
<td></td>
<td>465</td>
<td>23</td>
<td>1205</td>
<td>28</td>
<td>1.6</td>
</tr>
<tr>
<td>Lupine</td>
<td>Lupinus album</td>
<td></td>
<td></td>
<td>100</td>
<td>20</td>
<td>1293</td>
<td>26</td>
<td>1.3</td>
</tr>
<tr>
<td>Soybean</td>
<td>Glycine max</td>
<td></td>
<td></td>
<td>67</td>
<td>8</td>
<td>1336</td>
<td>12</td>
<td>0.5</td>
</tr>
<tr>
<td>Total/avg.</td>
<td></td>
<td></td>
<td></td>
<td>10424</td>
<td>1477</td>
<td>1291</td>
<td>1940</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Source: ICRISAT (2011)

Legumes are mostly grown in rotation or intercropped with cereals. The most important cereals are (CSA, 2011):

- Amhara: barley (more than 55% of total production of cereals in this region), teff and maize.
- Oromia: maize (50% of cereal production in this region) and barley.
- Benishangul-Gumuz: maize and sorghum.
- SNNPR: maize, teff, barley and wheat

Major production constraints for legumes are the absence of links to seed suppliers/ value chains and hence a lack of improved seeds and a high use of local varieties (on more than 95% of the total cropped area) (IFPRI, 2010a), inadequate farm management practices, underdeveloped infrastructure, and population pressure and land fragmentation (in dry areas average farm size is 5 ha, in sub-humid maize-legume based areas 2.5 ha) (USAID, 2011, CIMMYT, 2009). Low soil fertility in the high potential areas is another problem, while fertilizer use on legume crops is usually low (Asfaw and Shiferaw, 2009). In general, major soil fertility issues in Ethiopia include (IFPRI, 2010a):

- Depletion of organic matter due to the use of animal dung as fuel and crop residues as feed;
- Topsoil erosion, aggravated by high population densities in fertile areas;
- Macronutrient depletion due to little fertilizer use, continuous cropping, removal of crop residues, etc.;
- Acidity, reducing responses to phosphate and urea fertilization.

5.1 Faba bean

Amhara and Oromia are the areas in Ethiopia where production of faba bean is highest (Figure 8). Together these two regions account for 85% of the national faba bean production (IFPRI, 2010b). Faba bean is grown in the main season, on both red and black soils. Most of the faba bean production
is grown for consumption (e.g. 64% in 2007), and 18% is sold, primarily for export (IFPRI, 2010b). Over the past years, improved varieties have been introduced, for instance varieties that are tolerant to root rot and to waterlogging, which can be grown on Vertisols. Together with the introduction of improved management practices this led to a 47% increase in production between 2001/02 and 2006/07 (ICARDA, 2010). Disadvantages of faba bean production include its sensitivity for diseases (particularly chocolate spot) and the high seed rate (200 kg/ha) (IFPRI, 2010b).

The average of three different studies in Ethiopia on the need for inoculation in faba bean shows that the response to inoculation alone was limited, but that in combination with P fertilizer grain yields were three times as high as in the control (Table 4). Application of P-fertilizer only also improved yields, but to a lesser extent.

**Table 4: Faba bean response to inoculation***

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Grain yield (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>670</td>
</tr>
<tr>
<td>20 kg P</td>
<td>1085</td>
</tr>
<tr>
<td>Inoculation</td>
<td>593</td>
</tr>
<tr>
<td>Inoculation + 20 kg P/ha</td>
<td>2023</td>
</tr>
<tr>
<td>20N + 20P (kg/ha)</td>
<td>1570</td>
</tr>
</tbody>
</table>

* Average of strains # 18, 51 and 64 (collected and isolated in Ethiopia)

5.2 Common bean

Common bean is widely grown in Ethiopia in areas between 1400-2000 m altitude. The main production areas include eastern Ethiopia, the south and the south west, the west and the Rift Valley (Figure 9). The latter area accounts for more than half of the country’s bean production, mainly of the white pea bean type that is grown for export (Ali et al., 2006). Other bean types are for national use.

Beans are grown as sole crop or intercropped with sorghum, maize or other crops. Production of common beans has increased over the last years, while the area planted remains more or less stable. Hence, yields per ha have improved (Figure 10). Important constraints for further yield increase is the lack of improved varieties (Gurmu, 2007a), low soil fertility (N and P), moisture stress, pests and diseases and weeds (Ali et al., 2006).

In mono-cropping systems, bush types are grown (mainly in central and southern Ethiopia). In west and southwestern Ethiopia, areas with higher rainfall and an extended growing seasons, climbing beans are intercropped with maize, planted along the borders of maize fields, or along homestead fences (Gebeyehu et al., 2006). In Southern Ethiopia, an experiment with climbing beans found higher yields for bush types than climbing types (Worku, 2008). A study in Eastern Ethiopia showed that in intercropping, climbing varieties were not preferred because they caused lodging in maize (after which evaluation in sole stands followed) (Assefa et al., 2005).

Planting dates between mid- and end-June gave highest grain yields around Hawassa, with a plant density of 400,000 seeds/ha. In the belg season, sowing between mid-February and mid-March resulted in the highest grain yields. Further agronomic data on haricot beans in the Rift Valley can be found in Ali et al. (2006), pp.157-165.
An experiment in Alemaya (Eastern Ethiopia, Vertisol) on the effects of Rhizobium inoculant (strain consisting of a mixture of the CIAT isolates 384, 274, and 632) or N-fertilizer (50 kg urea/ha) showed increased grain yield, number of nodules and dry matter production in common bean (Daba and Haile, 2000). A field trial in Boricha (SNNPR) also showed positive effects on grain yields of common bean by different Rhizobium strains (Figure 11).
5.3 Chickpea

Chickpea production is concentrated in Amhara and Oromia, although this crop is grown in many other parts of Ethiopia as well (Figure 12). The area around Debre Zeit is particularly an area with potential for upscaling improved chickpea varieties and marketing (Asfaw et al., 2010). Chickpea is typically grown on Vertisols, in rotation with wheat and teff, using the residual moisture at the end of the rainy season. Double cropping increases the productivity of scarce land and provides an additional source of income (Kassie et al., 2009).

![Figure 12: Land area in hectares under chickpea in Ethiopia](source)

Traditional varieties, grown for national use, are the Desi varieties. Kabuli types are both for national use and for export. Research from EIAR in cooperation with ICRISAT and ICARDA has led to release of improved Desi and Kabuli varieties (see also Appendix 2), although adoption among farmers is only 5% (Shiferaw and Teklewold, 2007). In the area around Debre Zeit early planting (early to mid-August) resulted in highest grain yields, with an optimum seed rate of 110-120 kg/ha (Ali et al., 2006). Harvesting time is from October to January (green pods) and February to March (dry seeds) (Dadi et al., 2005).

In general, as with common beans, chickpea production and yields per ha show an upward trend (Figure 13). Volume and value of chickpea export has increased considerably over the last five years (ICRISAT, 2011) and the market outlook for chickpea production is favourable as well. In a ‘business as usual scenario’ chickpea production and area is forecasted to increase by 8% and 21% by 2020 (Kassie et al., 2009). With increased prices for fertilizer, cultivation of crops that do not require much fertilizer becomes even more attractive.
A study in the Shewa region showed that about 80% of farmers that grow chickpea participate in marketing, indicating that it is primarily a cash crop. Moreover, a gross margin analysis showed that among legumes, chickpeas provide the highest net-returns. However, since mainly traditional Desi varieties are grown and productivity is low, farmers’ competitiveness in high value (export) markets is limited. The system needs to become more market oriented, starting with higher adoption rates of improved varieties (Asfaw et al., 2010). In addition, the state controlled seed system produces insufficient amounts and quality of seeds, and there are problems with timely delivery. A revolving seed scheme could improve accessibility for farmers. Another constraint for growing chickpea is that large seeded Kabuli varieties are popular for their green pod consumption, so that additional labour is required for guarding the fields (Asfaw et al., 2010).

Research at EIAR Debre Zeit focused on application of synthetic fertilizer combined with irrigation, variety development, crop protection and technology popularization. In 1990, a study on the effect of rhizobium strains and NPK fertilizers on chickpea found that indigenous Rhizobium in non-inoculated and non-fertilized control plants did better than inoculated (source of strains unknown) and fertilized plants (Table 5). However, other studies by Ali et al. (2006) in Oromia, Gondar and SNNPR show some to strong responses to inoculation (source of strains unknown) for chickpea. Studies in other countries also indicate that chickpea generally responds well to inoculation, with increases in grain yield from 8 to 40% found in Iran and Canada (Gan et al., 2010, Namvar et al., 2011) and an 8 to 10% increase in stover yield in Iran and Pakistan (Ali et al., 2004, Namvar et al., 2011). In combination with P-fertilizer (90 kg/ha), grain yields in Pakistan even increased from 1600 to 3100 kg/ha and stover yields from 4350 to 7500 kg/ha (Ali et al., 2004). Inoculation with rhizobium and mycorrhiza improved both grain and stover yields by about 60% in Turkey (Erman et al., 2011).
### Table 5: Chickpea response to inoculation*

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Number of nodules</th>
<th>Dry matter yield (kg/ha)</th>
<th>Grain yield (kg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>3.6</td>
<td>5070</td>
<td>3350</td>
</tr>
<tr>
<td>120 N + 35.2 P + 48 K (kg/ha)</td>
<td>3.8</td>
<td>5710</td>
<td>3710</td>
</tr>
<tr>
<td>35.2 P + 48 K (kg/ha)</td>
<td>3.3</td>
<td>4940</td>
<td>3380</td>
</tr>
<tr>
<td>Strain 31 + 35.2 P + 48 K (kg/ha)</td>
<td>3.0</td>
<td>5500</td>
<td>2980</td>
</tr>
<tr>
<td>Strain 36 + 35.2 P + 48 K (kg/ha)</td>
<td>3.3</td>
<td>5800</td>
<td>3230</td>
</tr>
<tr>
<td>Strain 39 + 35.2 P + 48 K (kg/ha)</td>
<td>3.3</td>
<td>5470</td>
<td>3070</td>
</tr>
<tr>
<td>120 N (kg/ha)</td>
<td>1.5</td>
<td>5620</td>
<td>3270</td>
</tr>
<tr>
<td>LSD 5%</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>CV %</td>
<td>3.7</td>
<td>15.7</td>
<td></td>
</tr>
</tbody>
</table>

* Source of strains unknown


## 5.4 Soyabean

Soyabean in Ethiopia could be grown from sea level up to 2200m altitude and with annual rainfall as low as 500-700mm, but performs best between 1300 and 1800m altitude with an annual rainfall of 900-1300mm, an average annual temperature between 20-25°C and a soil pH of 5.5 to 7 (Gurmu, 2007b, Tesfaye, no date). The growing season ranges from 90 to over 150 days and three different soyabean varieties can be distinguished (Gurmu, 2010):

1. Early maturing group with 90-120 days (Awassa-95, Williams, Crawford and Jallale)
2. Medium maturing group with 121-150 days (Clarck-63K, Cocker-240, Davis, Cheri and AFGAT)
3. Late maturing group with >150 days (Belessa-95 and Ethiougozavla)

Agronomic recommendations for production include a seed rate of 60-80 kg/ha; row spacing for early maturing varieties of 40 cm x 5 cm and 60 cm x 5 cm for medium maturing varieties; 2 to 3 times of hand weeding and fertilizer rate of 100 kg/ha DAP (Gurmu, 2010). Potential crop yields are as high as 3.5 t/ha (Tesfaye, no date). A variety trial (early maturing varieties) in SNNPR shows that variety Crawford gave highest yields, although all varieties performed well in the study areas (Gurmu, 2007b).

Soyabean can be grown in rotation with e.g. cotton, maize and sorghum. Its nutritional value is high, with a higher protein content than other grain legumes (40% compared to 20-25%) (Gurmu, 2007b). Cultivation and production of soyabean is currently constrained by a lack of awareness about the crop by farmers and private sector and by a lack of knowledge on its potential uses and processing methods. Moreover, there is a lack of linkages between the small produce of farmers and soyabean demand from factories (Gurmu, 2010). Finally, use of improved varieties and fertilizer is low and better agronomic management practices need to be developed (Tesfaye, no date).

Regions with high potential for soyabean are Benishangul-Gumuz and SNNPR. Around Jimma, soyabean is grown by smallholder farmers (on average 0.5 ha). Farmers in this area are connected to cooperatives, where they sell their grain. As poor soil fertility is a major issue around Jimma, farmers appreciate soyabean in their rotation. Farmers here are not commercially oriented, however, and there is no union for soyabean (only cooperatives). High potential areas for upgrading of commercial soyabean production are Bedele and Chawaakka. In Pawe, farmers are not well organized (there are many cooperatives but no union), but there is potential for upscaling production, especially considering the mix of small scale and large scale soyabean producers (Sopov, 2011).

## 5.5 *Rhizobium* research in Ethiopia

Research on biological N₂-fixation in Ethiopia is carried out in e.g. laboratories at Holetta Agricultural Research Center, the National Soil Testing Center in Addis Ababa and at Hawassa University. The research focuses on *Rhizobium* population size and need for inoculation; collection & exploration for
genetic and symbiotic biodiversity; screening of rhizobia for N₂-fixing effectiveness and host range; screening of pulse varieties (common bean, chickpea, soyabean, cowpea, pigeonpea and groundnut) and trees/shrubs (Sesbania, Leucana and Acacia spp.) for N₂-fixation; management practices and farmers’ adoption of legumes and inoculants. At Hawassa University, a biobank of more than 600 authenticated and 300 well characterized isolates exists, which show a great genomic diversity. Greenhouse experiments and field experiments on the accumulation of N in common bean, soyabean, chickpea and cowpea after inoculation by different rhizobia strains have been carried out by the university as well. Strains for common bean have also been tested on their effectiveness under soil moisture stress and different pH levels (Wolde-Meskel, 2012).
6. Projects on grain legumes in Ethiopia

This section summarizes some of the ongoing projects on grain legumes in Ethiopia. During the stakeholder workshop held in Ethiopia, more detailed information on relevant projects in the potential intervention areas was collected and presented as well. This information can be found in the workshop report nr. 41: Opportunities for N2Africa in Ethiopia (http://www.n2africa.org/workshops_training).

6.1 National initiatives

National Soybean Research Project
*Lead organization:* Pawe Agricultural Research Center
*Objectives:*
- Variety development for different maturity group’s and cropping systems,
- Cultural practice and cropping systems,
- Pest management,
- Technology transfer,
- Socio-economic studies and post-harvest technologies and utilization
*Areas:* Awassa, Pawe, Bako, Jimma and Asosa
*Coordinator:* Tizazu Degu
*Ongoing activities:* soyabean variety/ plant density/ nutrient/ tillage/ double cropping trials; assessment weeds and pests; community based seed multiplication; CBA/ promotion material/ impact assessment, etc.

Pulses and oilseed programme - chickpea
*Lead organization:* ATA
*Coordinator:* Dr. Y. Mussie
*Year:* 2012
*Areas:* Amhara (Dembia) and Oromia (Ada’a + Becho)
*Objectives:*
- Secure inputs: supply improved seeds + chemicals to farmers in Becho, Dembia and Ada’a (access to improved seed and pesticides is identified as major constraint for farmers).
- Production for export market (building farmers to market linkages). Includes also training of farmers on best agronomic practices for chickpea.

Bottlenecks identified for chickpea include:
- Insufficient research in value chain, particularly in on farm production
- limited seed availability (and quality for export) + affordability
- no extension system for chickpea
- poor farming practices reduce yields
- inadequate post-harvest processing + lack of storage facilities (post-harvest losses)
- weak links to markets

Pan-Africa Bean Research Alliance (PABRA)
PABRA-ECABREN has already done a lot of work on common bean. In cooperation with CIAT’s bean programme, pest and disease resistant germplasm has been developed, as well as varieties that are tolerant to abiotic stresses, have improved nutritional values and are acceptable to farmers. Next to that, important work on seed systems and dissemination has been done in the so-called ‘concerted partnership approach’, which started in 2003. This approach introduced non-conventional approaches to disseminate seed of improved varieties by national researchers and extension workers, involving outlets as health centres, grain traders or even soft drink kiosks (PABRA, 2006). In Ethiopia alone, in one year’s campaign, 137 tonnes of improved seed were disseminated to farmers, including poor farmers who were testing improved germplasm for the first time. Critical to this approach and its success has been the packaging of seed in small, affordable quantities such as 50 g packs.
6.2 International initiatives

Sustainable Intensification of Maize-Legume cropping systems for food security in Eastern and Southern Africa (SIMLESA)

Lead organization: CIMMYT
Year: 2010-2013
Objectives:
- to characterize maize-legume production and input and output value chain systems and impact pathways, and identify broad systemic constraints and options for field testing;
- to test and develop productive, resilient and sustainable smallholder maize-legume cropping systems and innovation systems for local scaling out;
- to increase the range of maize and legume varieties available for smallholders through accelerated breeding, regional testing and release, and availability of performance data; to support the development of regional and local innovations systems;
- capacity building to increase the efficiency of agricultural research today and in the future

Areas: Central Ethiopia (sub humid East Wellega and West Shewa, and drought stress East Shewa, Gurage, Arsi and Sidama)

Ongoing activities: In both regions, three communities are chosen and local production options are defined, tested and selected (“options include improved farmer resource allocation, maize-legume systems which are based on the principles of conservation agriculture, more productive, stress tolerant and farmer-preferred maize and legume varieties or Rhizobium strains, and opportunities for improved input and out marketing, rural financing and processing”) (CIMMYT, 2009).

Activities in 2011: input and output market surveys and selection of input market opportunities; household typology; farmer resource allocation; exploratory and variety trials.

Activities in 2012: selection of output market opportunities; improved resource allocation and risk management strategies identified; trials; data available on first farmer experiments.

Agricultural Growth Program – Agribusiness and Market Development (AGP-AMDe)

Lead organization: ACDI/VOCA
Coordinator: IFDC, Abey Meherka
Year: 2011-2012
Areas: Amhara, Tigray, SNNPR, Oromia
Objectives: 1: improving the competitiveness of selected value chains; 2: improving access to finance; 3: improving the enabling environment of selected value chains; 4: stimulating increased innovation and investment.

Ongoing activities (until September 2012): beans and pulses have been added to value chain activities.

Activity 1: Select cooperative unions and trader/processors with capacity to process and distribute for domestic, regional and export markets. Conduct assessment of each cooperative to determine needs, strategies, interventions.

Activity 2: Develop business and investment plans for selected primary coops and cooperative unions, based on assessments. Employ SMFM ToT for primary cooperatives.

Activity 3: Establish direct links among unions, exporters and other buyers to develop a long-term plan for supply of quantity and quality; establish a basis for forward contracts at the export and supply levels.

Activity 4: Establish a plan for seed selection and multiplication for each selected site and partner (i.e., co-op unions).

Activity 5: Develop plan for demonstration plots for varieties, fertility, seeding and tillage practices at selected sites.

Activity 6: Continue work with PepsiCo on chickpea pilot and demonstration; provide assistance in identifying modalities for seed multiplication and selection of additional production sites and marketing co-operators.

Activity 7: Support EPOSPEA in the development of long-term market development strategy for dry bean and pulse exports.

Activity 8. Integrate beans and pulses in other value chains as viable rotation and cash crop.
Tropical Legumes (TL) II
**Lead organization**: ICRISAT
**Year**: 2011-2014
**Objectives**: (i) to exploit the improved germplasm that already exists, by using ‘fast track’ evaluation and seed production; (Lambers et al.) to encourage farmer-participatory varietal selection; (Lambers et al.) to develop improved crop cultivars (including hybrids in the case of pigeonpea) by combining conventional plant breeding with modern breeding tools and techniques developed at the participating institutes and by the Tropical Legumes I Project; and (Tavasolee et al.) to strengthen national programs’ capacity for plant breeding
**Areas**: Oromia
**Ongoing activities**: apart from breeding also improving seed systems (e.g. making bean seed available in smaller quantities); seed distributed + recovered in kind + cash through unions and NGOs.

Commercial Products (COMPRO) II
**Lead organization**: IITA
**Year**: 2012-2016
**Coordinator**: Cargele Masso
**Objectives**: 
- To screen, evaluate, and scale up innovative chemical and biological commercial products, among which biological nitrogen-fixing products (rhizobial products).
- To share experiences, information and building institutional capacity on top quality effective commercial products
- To support implementation processes aimed at strengthening quality monitoring and capacity building for commercial products to ensure that farmers have access to information on high quality soil improvement technologies

Integrated Innovations for Improving Legume Productivity, Market Linkages and Risk Management in Eastern and Southern Africa
**Lead organization**: ICRISAT
**Coordinator**: Franklin Simtowe
**Year**: 2007-2010
**Areas**: 
**Objectives**: addressing supply and demand side constraints in the legumes sub-sector:
- Institutional innovations for improving markets and reducing transaction costs for smallholder farmers
- Market-preferred low-risk varieties and complementary management practices
- Institutional innovations for improving access to and utilization of quality seeds of improved varieties and complementary inputs
- Decision support tools for better targeting of improved varieties and management practices
- Capacity strengthening for service providers and agro-enterprises to better utilize legume innovations

Breeding Chickpea for Drought Tolerance and Disease Resistance
**Lead organization**: ICARDA
**Year**: 2007-2013
**Objectives**: develop efficient and reliable field and laboratory screening techniques for the evaluation of germplasm and breeding materials for biotic and abiotic stresses, understand their genetic bases and develop efficient and high yielding cultivars with combined resistances to these stresses through conventional and molecular breeding approaches.
Feed the future
Lead organization: USAID
Links: focus on value chains. In Ethiopian Highlands. Crop/livestock components for intensification of the system.

CGIAR research programmes:

CRP 1.1: Integrated Agricultural Production Systems for the Poor and Vulnerable in Dry Areas
Lead organization: ICARDA
Website: http://crp11.icarda.cgiar.org/crp/public/

CRP 1.2: Integrated Systems for the Humid Tropics
Lead organization: IITA

CRP 3.5: Grain Legumes: enhanced food and feed security, nutritional balance, economic growth and soil health for smallholder farmers
Lead organization: ICRISAT

CRP 3.7: More Meat, Milk and Fish by and for the Poor
Lead organization: ILRI
Links: forage legumes

CRP 5: Water, Land and Ecosystems
Lead organization: IWMI
Links: crop residues – livestock; water productivity
References


CIMMYT 2009. Program document: Sustainable intensification of maize-legume cropping systems for food security in eastern and southern Africa (SIMLESA). CIMMYT.


GEBEYEHU, S., SIMANE, B. & KIRKBY, R. 2006. Genotype 


Appendix 1: Agro-ecological zones in Ethiopia

Legend

AEZs

- H3 - Cold to very cold humid sub-afralpine to afroalpine
- M3 - Cold to very cold moist sub-afralpine to afroalpine
- Sm3 - Cold to very cold sub-humid sub-afralpine to afroalpine
- Sm3 - Cold to very cold sub-moist sub-afralpine to afroalpine
- A1 - Hot to warm and lowland plains
- H1 - Hot to warm humid lowlands
- M1 - Hot to warm moist lowlands
- PH1 - Hot to warm per-humid lowlands
- SA1 - Hot to warm semi-arid lowlands
- SH1 - Hot to warm sub-humid lowlands
- SM1 - Hot to warm sub-moist lowlands
- A2 - Tepid to cool and mid-highlands
- H2 - Tepid to cool humid mid-highlands
- M2 - Tepid to cool moist mid-highlands
- PH2 - Tepid to cool per-humid mid highlands
- SA2 - Tepid to cool semi-arid mid highlands
- SH2 - Tepid to cool sub-humid mid highlands
- SM2 - Tepid to cool sub-moist mid highlands
- WS - Water Body

Source: FAO (2006)
Appendix 2: Improved chickpea varieties in Ethiopia

<table>
<thead>
<tr>
<th>No</th>
<th>Variety</th>
<th>Year of release</th>
<th>Days to maturity</th>
<th>Growth habit</th>
<th>Seed color</th>
<th>100-seed weight (g)</th>
<th>Planting date</th>
<th>Seed rate (kg ha&lt;sup&gt;-1&lt;/sup&gt;)</th>
<th>Altitude (m)</th>
<th>Rainfall (mm)</th>
<th>Yield (t ha&lt;sup&gt;-1&lt;/sup&gt;)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DZ 10-4</td>
<td>1974</td>
<td>111–135</td>
<td>Semi-erect</td>
<td>White</td>
<td>10.2</td>
<td>Early September</td>
<td>65–75</td>
<td>1800–2300</td>
<td>700–1100</td>
<td>1.6–2.2</td>
</tr>
<tr>
<td>3</td>
<td>Dubie</td>
<td>1978</td>
<td>110–115</td>
<td>Semi-prostrate</td>
<td>Gray</td>
<td>22.0</td>
<td>Mid August to early September</td>
<td>80–90</td>
<td>1800–2300</td>
<td>700–1100</td>
<td>1.7–2.8</td>
</tr>
<tr>
<td>4</td>
<td>Mariye</td>
<td>1985</td>
<td>106–120</td>
<td>Semi-erect</td>
<td>Brown</td>
<td>25.5</td>
<td>Mid August to early September</td>
<td>120–140</td>
<td>1500–2300</td>
<td>700–1300</td>
<td>1.8–3.0</td>
</tr>
<tr>
<td>5</td>
<td>Wroku</td>
<td>1994</td>
<td>100–149</td>
<td>Semi-erect</td>
<td>Golden</td>
<td>33.0</td>
<td>Mid August</td>
<td>100–120</td>
<td>1900–2600</td>
<td>700–1200</td>
<td>1.9–4.0</td>
</tr>
<tr>
<td>6</td>
<td>Akaki</td>
<td>1995</td>
<td>97–147</td>
<td>Semi-erect</td>
<td>Golden</td>
<td>21.0</td>
<td>Mid August</td>
<td>90–120</td>
<td>1900–2600</td>
<td>700–1200</td>
<td>1.8–4.0</td>
</tr>
<tr>
<td>7</td>
<td>Aretti</td>
<td>1999</td>
<td>105–155</td>
<td>Semi-erect</td>
<td>White</td>
<td>25.7</td>
<td>Mid August</td>
<td>100–115</td>
<td>1800–2600</td>
<td>700–1200</td>
<td>1.6–5.2</td>
</tr>
<tr>
<td>8</td>
<td>Shasho</td>
<td>1999</td>
<td>90–155</td>
<td>Semi-erect</td>
<td>White</td>
<td>29.9</td>
<td>Mid August</td>
<td>100–125</td>
<td>1800–2600</td>
<td>700–1200</td>
<td>1.6–4.6</td>
</tr>
<tr>
<td>9</td>
<td>Chefe</td>
<td>2004</td>
<td>95–150</td>
<td>Semi-erect</td>
<td>White</td>
<td>35.4</td>
<td>Mid August</td>
<td>110–140</td>
<td>1800–2600</td>
<td>700–2000</td>
<td>1.2–4.8</td>
</tr>
<tr>
<td>10</td>
<td>Habru</td>
<td>2004</td>
<td>91–140</td>
<td>Erect</td>
<td>White</td>
<td>31.7</td>
<td>Mid August to early September</td>
<td>110–140</td>
<td>1800–2600</td>
<td>700–2000</td>
<td>1.4–5.0</td>
</tr>
</tbody>
</table>

Source: Dadi et al. (2005)
List of project reports

1. N2Africa Steering Committee Terms of Reference
2. Policy on advanced training grants
3. Rhizobia Strain Isolation and Characterisation Protocol
4. Detailed country-by-country access plan for P and other agro-minerals
6. Plans for interaction with the Tropical Legumes II project (TLII) and for seed increase on a country-by-country basis
7. Implementation Plan for collaboration between N2Africa and the Soil Health and Market Access Programs of the Alliance for a Green Revolution in Africa (AGRA) plan
8. General approaches and country specific dissemination plans
9. Selected soyabean, common beans, cowpeas and groundnuts varieties with proven high BNF potential and sufficient seed availability in target impact zones of N2Africa Project
10. Project launch and workshop report
11. Advancing technical skills in rhizobiology: training report
12. Characterisation of the impact zones and mandate areas in the N2Africa project
13. Production and use of Rhizobial inoculants in Africa
18. Adaptive research in N2Africa impact zones: Principles, guidelines and implemented research campaigns
19. Quality assurance (QA) protocols based on African capacities and international existing standards developed
20. Collection and maintenance of elite rhizobial strains
21. MSc and PhD status report
22. Production of seed for local distribution by farming communities engaged in the project
23. A report documenting the involvement of women in at least 50% of all farmer-related activities
24. Participatory development of indicators for monitoring and evaluating progress with project activities and their impact
25. Suitable multi-purpose forage and tree legumes for intensive smallholder meat and dairy industries in East and Central Africa N2Africa mandate areas
26. A revised manual for rhizobium methods and standard protocols available on the project website
27. Update on Inoculant production by cooperating laboratories
28. Legume Seed Acquired for Dissemination in the Project Impact Zones
30. Memoranda of Understanding are formalized with key partners along the legume value chains in the impact zones
31. Existing rhizobiology laboratories upgraded
32. N2Africa Baseline report
33. N2Africa Annual country reports 2011
34. Facilitating large-scale dissemination of Biological Nitrogen Fixation
35. Dissemination tools produced
36. Linking legume farmers to markets
37. The role of AGRA and other partners in the project defined and co-funding/financing options for scale-up of inoculum (banks, AGRA, industry) identified
38. Progress Towards Achieving the Vision of Success of N2Africa
39. Quantifying the impact of the N2Africa project on Biological Nitrogen Fixation
40. Training agro-dealers in accessing, managing and distributing information on inoculant use
41. Opportunities for N2Africa in Ethiopia
42. N2Africa Project Progress Report Month 30
43. Review & Planning meeting Zimbabwe
44. Howard G. Buffett Foundation – N2Africa June 2012 Interim Report
45. Number of Extension Events Organized per Season per Country
46. N2Africa narrative reports Month 30
47. Background information on agronomy, farming systems and ongoing projects on grain legumes in Uganda
48. Opportunities for N2Africa in Tanzania
49. Background information on agronomy, farming systems and ongoing projects on grain legumes in Ethiopia
Partners involved in the N2Africa project

- Bayero University Kano (BUK)
- Caritas Rwanda
- Diobass
- Eglise Presbyterienne Rwanda
- Resource Projects-Kenya
- Sasakawa Global, 2000
- Université Catholique de Bukavu
- University of Zimbabwe
- IITA
- Murdoch University
- NASFAM
- WASINGENEN UNIVERSITY