The Prominence of Vicia faba and Pisum Spp. In
the Ethiopian Farming System

by

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Addis Ababa 1979
The importance of grain legumes as a major source of proteins in the human diet is a well documented fact that needs little explanatory treaties. In domestication of plants by man, grain legumes are next in order after cereals. This occurred probably some 6,000 years ago when seed from wild growing leguminous plants were collected and consumed by primitive man. The cultivated legumes vary greatly in tropical and sub-tropical areas. This is of high interest to the Ethiopian agriculture which has a favourable geographical position in both plant production ecology and external trade movement. The purpose of this treatise is to give a description of Ethiopian Vicia faba and Pisum spp. cultivar groups, ecological aspects as well as economic importance of the two crops in the Ethiopian farming system, and presentation of results of research trials and problems on aspects of diseases, pests and weeds. It should be understood that there has been considerable research progress to date on grain legumes in particular in Ethiopia and the present studies are based on these. Vicia faba and Pisum spp., Ecological Distribution and Ethiopian Agroclimate

In the climate of the tropics, Ethiopia shares both tropical woodland and desert as well as permanently humid climates with hot summers. Generally few countries in the tropics possess as good natural environment for agricultural development as Ethiopia does. The favourable bio-ecological system is mainly influenced by altitude. The division of Ethiopian climate into four zones seems mainly on the basis of the relations between elevation and temperature. The four zones are:

1. "Quola" or hot zones whose altitude is below 1800 m. with an average temperature above 20°C. In this zone both Vicia faba & Pisum spp. cropping is very much limited because of Uronyces spp., Botrytis fabae, and mildew of Leveillula spp. diseases.

2. "Weyn Aega" or Temperate zones, whose altitude is 1800-2400 m. and average temperature being 16°C. Here the importance of Vicia faba and Pisum spp. cropping increases with the increase of altitude.

3. "Dega" or cold zones, altitude running from 2400 m. to 3800 m. with average temperature of 10-16°C. In this geographical belt the economic cropping of Vicia faba and Pisum spp. mostly extends up to 3030 m. at altitudes between 2900 and 3200 m. Botrytis fabae in Vicia faba and Pisum spp. are the two main limiting factors, which otherwise would have been perfectly fitting into the barley cropping rotational system in this agro-ecology.

4. "Mountain zones" or the alpine climate, whose altitude is above 3800 m. Here the biotic habitat is mainly of a kind of alpine vegetation.
Temperature

At higher altitude with higher rainfall and variable degree of cloudiness, the temperature regime is affected. Therefore, in the highlands (the "Weyna Dega") diurnal variation in temperature during the periods of rainfall is about 6°C. Whereas in dry periods it frequently is as much as 22°C. (21,31;.

All-aka* "between 1800 m. and 2400 m. above maximum temperatures rarely rise above 24°C. In the period between November and the end of January night frost occurs at above 2000 m. and in some sheltered places even at lower elevations some years like four years cycle. The month of November could be critical for both horse beans and field peas, particularly in the regions of altitudes between 2500 m. and 3000 m. where moisture period is relatively longer than those of 1800-2400 m. altitudes (Map A)."

The period of March-May is the warmest season; in April most of the high lands (Weyna Dega) are usually surrounded by the 25°C. isotherm which for most part has taken over the place of the 20°C. isotherm of January. In this period both horses and field pease have been burred and the ground is fallow. The rain limiting factor of the two crops growth is lack of adequate moisture where little irrigation is practiced. In large parts of the country maximum temperature could be experienced during June-July due to heavy rainfall and high cloudiness. Here then plants growth rate is relatively slower than month of September or June. The period end of month of September to February is normally lower, but due to cloudiness and high solar radiation, maximum and minimum temperatures could be typical.

The lowland shows normal variation in temperature in both day and night periods, that is, nights cool and days warm, and the month of January is the coldest and May is the hottest.

Rainfall

The main climatic problem is the distribution of rainfall. The highest precipitation is during the months of June to middle of September which is called winter (rainy season). Presumably about 70-80 of the annual rainfall during this period in most parts of the country. the total rainfall on the average is more than 1000 mm at altitude above 2000 m. In some of the wet western region of the country, the rainfall is more than 2000 mm. (21) and Map B and C. (average annual rainfall decreases from the northwestern margin of the Eritrean island region Map D. Rainfall, except the western province and in the highlands of Bale in the Southeast, is extremely variable for the dry months and should be considered with great care when looking at the annual mean.

The seasonal character of the rainfall must be consider with much care in the rainfall might be high but of a short duration in December and January which is immediately followed by high solar radiation and wind serving no purpose except washing off dust from plants. In summary the following rainfall regimes are considered important in relation to Ethiopian agriculture.

1. Regime with maximum in March-May and June-August. This is a typical for most highland of the country (except the western part) whose average annual rainfall record is 950-1000 mm. A short transitional period marked by a decrease in rainfall occurs around May. This is the last period for "Gaye" burning of ploughed soils in the high lands for barley planting in June. The period of June-August experiences the heaviest rainfall, while that of December-February is normally dry with only small amount of precipitation. February’s precipitation in the highlands if lasted for 10—15 days can maintain barley plantation growth but not horse beans and field peas. Nevertheless, the high relative humidity and wind serving as purpose except washing off dust from plants. In summary the following rainfall regimes are considered important in relation to Ethiopian agriculture.

2. Regime with maximum in June to August. The high amount of rainfall in Western highlands usually occurs in August. A short transitional period marked by a decrease in rainfall occurs around May. This is the last period for "Gaye", burning of ploughed soils in the high lands for barley planting in June. The period of June-August experiences the heaviest rainfall, while that of December-February is normally dry with only small amount of precipitation.

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The soils are mainly of clay origins of different colours. Red to reddish brown on the mountains, reddish brown on the slopes, brown to dark in the rolling country and very dark grey in other parts. Ethiopian soils to date await a full detail study and appropriate classification. Most available information are incomplete and limited, Westphal (1974) attempting to give the following order of classification, namely:

1. Soils of the Coastal Plains
These types of soils are found, which in a sense are brown soils, desert soils and Xerozems. There is no particular interest in this area region's soil as far as horse bean and field peas culture is concerned.

2. Soils of the Danakil Plains and Rift Valley
The Danakil plains have arid soils with salinity occurring in the Kobar Sink. The Awash River Valley is in the Rift with exceptional soil types of a large plain of alluvial soils. Again because of high temperatures, horse beans and field pea production is not common in this rich alluvial soil valley.

3. Soils of the Highlands in General
This dominates Begemdir, Welo, Dogu Bicho and the Choa highlands in the coast. Here it is very common scene to come across fields of horse beans and field peas along the slopes. For this is an excellent part of the soil regarding drainage problems. It is interesting to note that the greatest concentration of production of the two pulses is in these parts of the country. Here however, both horse beans and field pea growth is of short stature, less tillering of longer maturation and low in return per hectare.

4. Soils of the Afar Trough
This is alluvial and colluvial materials of Vertisols and Incepti-soils found more to the west of the region and enti-soils in association with Vertisols in topographic depressions. In this region, it is only along slopes and hilly areas that horse bean and field peas are produced mainly due to excessive temperature and rust diseases.

5. Soils of the Guassa Plateau
This region has mainly sandy soils with areas of high gypsum content in the extreme southern part of the Gof. In this region, because of high temperatures, temperature and moisture practical horse beans and field pea production is limited in scope.

6. Soils of the Crystalline Highlands
This includes northern Eritrea, western parts of Tigrai, northern parts of Begemdir whose soils are stony, shallow and low in productivity. Nevertheless, these regions are known for their production of horse beans and field peas for the two crops are capable of growing in much poor and rocky soils. Villages in the west and Sidamo in the south possess similar soil types with relatively better fertility where horse beans and field peas are produced.

7. Soils of the Sudanese Lowlands
This is mainly in Illubabor province more known for Coffea arabica production eventhough insignificant amounts of both horse beans and field peas are produced.

Other aspects of the clay soil is its stickiness during the wet season and to such an extent difficult for mechanization, resulting in damage to soil structure and drainage system. After mentioning the problems and their distribution one can see the Ethiopian horse bean and field pea are produced along the slopes, on the hillside public areas, among densely populated areas, and unbalanced land one of light black soils, affording the need of good drainage, good fertility status, union of good soil structure and alternate of salt conditions.
Map A: The relationship between altitude and temperature.
Note how as elevation increases, the temperature

I. Average annual temperature
II. Average annual mean temperature
III. Average annual minimum temperature

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Map 8. Relationship between altitude and rainfall. Note how location in relation to the direction of the moist winds is more important than above sea level.

Source: Mesfin, Woldemariam (21)
Map C: Average Annual Rainfall, superimposed of isohyets on the 100 ms. contour line.

Sources: Mesfin Wolde Mariam (21)
Map D  The Average Monthly Distribution of Rainfall for Representative Stations of Each Region Shown Graphically
Map E

Some idea about Ethiopia Soils, seems based on Geology

Vicia faba in Ethiopian Crops

Genus

Vicia

Species

V. faba

Varieties

- Giant
- Small

Origin

Central Asia or South-Western Asia

Description

- Stems: stout, hollow, square, angled at angles up to 7 branches, with small tendrils
- Leaves: pinnated ending in small, round tendril, stipules half
- Flowers: up to 7 flowers per axil, up to 3-4 cm. long, blue, yellow, and red
- Pod: stout, sub-cylindrical or flattened, beaked up to 3 cm.
- Seeds: very variable in shape and size strongly compressed to

East

- Stem: Sinuous, not as strong as in V. faba
- Leaves: Pinnated ending in small, round tendril, stipules half
- Flowers: Axillary, 1-7 flowers per axil, flowers
- Pod: Sub-cylindrical, beaked up to 3 cm.
- Seeds: Very variable in shape and size strongly compressed to

West

- Stem: Stout, hollow, square, angled at angles up to 7 branches, with small tendrils
- Leaves: Pinnated ending in small, round tendril, stipules half
- Flowers: Up to 7 flowers per axil, up to 3-4 cm. long, blue, yellow, and red
- Pod: Stout, sub-cylindrical or flattened, beaked up to 3 cm.
- Seeds: Very variable in shape and size strongly compressed to

Habitat

- Tropics where the winters are fairly cool
- China, India, and Turkey

Cultivation

- In Ethiopia, it is grown in rotation with
- In Bale and Arsi provinces
- In the north and western parts of Ethiopia

Uses

- As a source of vegetable and pulses
- As an important crop in Ethiopia for centuries

Importance

- It is grown in Ethiopia for centuries
- It is a very common cultivar

Varieties

- Giant
- Small

Geographic Distribution

- Native to Central Asia or South-Western Asia
- Has spread to many other regions

Anatomy

- Stems: Stiff, indistinguishable anthocyanin, dark
- Stipules: Half or nearly so, very slender
- Pod: Stiff, sub-cylindrical or flattened, beaked up to 3 cm.
- Seeds: Variable in shape and size, strongly compressed to

Useful Parts

- Seeds: Used as a source of vegetable and pulses
- Leaves: Used as a source of vegetable and pulses
- Pod: Used as a source of vegetable and pulses

Crop Rotation

- Grown in rotation with other crops
- Used in crop rotation systems

Nutritional Value

- High in proteins and other nutrients
- Used as a source of vegetable and pulses

References

- Thakur (1973)
- Westphal (1974)
- Muratova (1969)
- Hopp (1975)
Fig. 1: *Vicia faba* ssp. *Cv. 200K* -
1 stem above ground with leaves,
true branch and pods 2 pod ventral
opened up with seeds attached to
seed carpel.
Map No. 4: Principal pulse - Distributions Zones compare with map Nos 5 and 6
HORSE BEAN PRODUCTION ZONES

SOURCE: FINAL REPORT OF CROP CONDITION SURVEYS FOR THE 1972-73 HARVEST; MINISTRY OF AGRICULTURE, ADDIS ABABA

1 ERITREA
2 TIGRAY
3 WOLLO
4 BEGEMDIR & SIMEN
5 GOJAM
6 WOLLEGA
7 CHAQ
8 ILUBABOK
9 KAFFA
10 GANUGOFA
11 SIDAMO
12 BALE
13 ARSI
14 HAPARGIE
The Area and Production of Horse Bean

<table>
<thead>
<tr>
<th>Location</th>
<th>Area in 1000 ha</th>
<th>Production in 1000 Tons</th>
</tr>
</thead>
<tbody>
<tr>
<td>The World</td>
<td>4,673</td>
<td>5,213</td>
</tr>
<tr>
<td>China</td>
<td>2,700</td>
<td>3,200</td>
</tr>
<tr>
<td>Italy</td>
<td>271</td>
<td>349</td>
</tr>
<tr>
<td>Morocco</td>
<td>190</td>
<td>190</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>172</td>
<td>258</td>
</tr>
<tr>
<td>Egypt</td>
<td>308</td>
<td>312</td>
</tr>
<tr>
<td>Latin America</td>
<td>204</td>
<td>382</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Area/ha.</th>
<th>Height</th>
<th>Total Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>1966/67</td>
<td>131.4</td>
<td>5.2</td>
<td>120.9</td>
</tr>
<tr>
<td>1967/68</td>
<td>156.0</td>
<td>5.5</td>
<td>129.8</td>
</tr>
<tr>
<td>1968/69</td>
<td>175.0</td>
<td>5.9</td>
<td>172.8</td>
</tr>
<tr>
<td>1969/70</td>
<td>157.0</td>
<td>5.8</td>
<td>129.5</td>
</tr>
<tr>
<td>1970/71</td>
<td>150.0</td>
<td>5.8</td>
<td>129.5</td>
</tr>
<tr>
<td>1971/72</td>
<td>137.0</td>
<td>6.1</td>
<td>172.7</td>
</tr>
<tr>
<td>1972/73</td>
<td>150.0</td>
<td>6.2</td>
<td>139.8</td>
</tr>
<tr>
<td>1973/74</td>
<td>130.0</td>
<td>6.6</td>
<td>139.8</td>
</tr>
<tr>
<td>1974/75</td>
<td>129.0</td>
<td>6.1</td>
<td>139.8</td>
</tr>
</tbody>
</table>

Source: Eugen Card, Tropical Agric. 20 points, Uppsala 1975

Ethiopia is also one of the leading nations in world horse bean production as shown in Table 1. Because of the wide variation in climate and soils, there is even off-season production of horse bean in some provinces of the country. In Ethiopian agriculture, the importance of pulse crops always stands more to cereals like wheat, of (Phaseolus vulgaris) Sorghum and maize. Therefore, areas planted to major pulses (chick peas, lentil, horse bean and field peas) are subjected to fluctuations according to the need of land to be put under rotation, compare maps. 1, 2, 3, 4, 5 and 6.

This is so because:-
1. Agricultural land so far is abundant.
2. The natural condition for agriculture is extremely favourable.
3. The Ethiopian plateau has climatic conditions that allow a wide variety of pulse production.

Husbandry.

In describing the systems of Agriculture of Ethiopia Westphal (1974) divided it into:-
1. The seed farming complex, the characteristics of which is the production nearly all crops by seed.
2. The present planting complex, located in the highland zone between 1500-2000 m. in southwest Ethiopia.
3. The pastoral complex. This is usually in the lower and drier parts of the country. The main areas are in the north, Amhara, the Addis Ababa plains, the southern parts of Sidamo and north of Lake Rudolf.

Naturally horse bean husbandry is in the seed farming complex, dominantly central, north-east and all provinces in the geographical range of 1800-2800 m. Such a wide and complex distribution of horse bean over the whole country is the result of climatic and soil factor. The Ethiopian highland farmer is in general, well suited to the work involved and knows his job very well. In several ways the cultivation practices, he has evolved to suit his environment bearing resemblance to modern farming methods.

Horse bean is usually considered as the second ranking pulse in importance to chick peas. Like chick pea horses beans are grown over a large part of the Ethiopian highlands. The bulk and exclusively all production of horse bean of the country comes from small farmers using a very old and out of date system of farming. Because nearly 60-80 % of the population is engaged in farm occupation this simple and out-dated farming system is able to provide the country's pulse need.
Sources: Ethiopian statistical abstract 1968-73

Pulses in Ethiopia is the second major crop, next to cereals. Nevertheless the total land allotted to the horse bean does not seem to extend beyond 1.5% every year, as the total land under general pulses is not also beyond the range of 7.9-8.2% while cereals command 70.3%. Map 3, 4 and 5 show distributions of most important types of pulses.

Seed Bed Preparation:

Farming practices are still simple and old. A great drain on his working time is his wooden, steel pointed plow which breaks the soil but cannot adequately turn it. Because of such crude implements the "Ethiopian farmer plow for horse been maximum three times, and for field peas at most two times only. The scot sometimes fall deep in the soil and sometimes too near the surface is not probably it discimages of the seed in the recommended practice. This information is quite true for the following peas. And yet an adequate return is obtained from such culture, for it is bollowed that the two crops, as long as the drainage is adequate, can do well on soils where most cereals fail to grow. However, must be one of the reasons for low yield on horse bean of much. However, leaving the land for a season some organic soil and a reasonably been developed in a low seems not for his field to mainly hor

If fertilizer has to be applied then the rate is DAP (18, 46). The lower limit rate for planting horse bean was most probably conforms with the traditional rate of broad-casting. The Ethiopian bulk producer, the farmer, through long experience, knows very well that his broad-cast will give him an approximate rate of 150 kg/ha, with a return of 7-10 q/t/ha. The yields obtained under trial conditions are also variable between 5 to 50 q/ha. Therefore, there seems to be much to be done in order to find out the right production methods and to get the farmers to realize the importance of weed and controlling disease and pests.

Weed Control:

Weed control is necessary for higher yields. Horse bean fields are generally low in weeds. However, some weeds harvested with the bean and picked up from threshing ground might be included in the seeds and therefore, the problems of weeds would decrease if all farmers cleaned the seeds prior to planting.

It seems to increase yield if the horse bean are sown in rows instead of being broad-cast, weeding should then be easier. Weed control could be done by hoeing, pulling or other means of tillage in this, but hoeing encourages tillering of weeds particularly if the space between plants is quite wide. Twice weeding and cultivation is quite adequate until harvest time unless weed growth and intensity is too high. After the plant is in full bloom mechanical disturbance is unnecessary for blossom fall would be enhance resulting in low yield.

Major pests:

Horse bean, may be attacked by various insects that can cause serious damage.

Aphid (Aphis faba)

This can be devastating some times, but easily controlled by heavy rainfall wash-off. This is an insect that may serve as virus vector unless controlled by systematic sprays in areas of threat.

In the Ethiopian highland bulk production zone this insect has never been reported as disastrous but in experimental sites unless controlled could be damaging.
Map No. 1: Principal food production belts; for more detail refer to maps Nos. 2, 3, 4.
Map No. 2: Principal sorghum, maize, small millet growing region
Source: Mesfin Wolde Mariam: An Atlas of Ethiopia
Addis Ababa, 1970
Map No.3: Principal Tef (Eragrostis abyssinica) Wheat and barley; compare with map No.1.

Thrips (Taeniothrips striolcedt trybora)
This insect attacks the reproductive organs interfering with fertilization which results in total yield reduction. It has been suspected that these insects might be one of the causes for low yield in the country but this is not confirmed by research so far.

Diseases
There are a number of fungal diseases which cause extensive damage to horse bean in tropical and sub-tropical regions. The most important control measures are:

1. Planting resistant varieties
2. Field sanitation
3. Use of suitable agronomic practices.

In Ethiopia horse bean growing regions the most serious fungal diseases are:
1. Rust (Uromyces fabae)

This is a very devastating fungus at altitudes below 1800 m. No resistant variety has been obtained so far.

2. Chocolate spots (Botrytis fabae)

The Botrytis spp is also another single devastat­ ing organism, particularly at an altitude greater than 2500 m. This is a number one and a major limiting factor at higher altitudes preventing horse bean from entering into the rotation scheme where barley is grown year after year.

Between 2000 and 2500 m, altitude the rust and chocolate spot infection is moderate.

3. Powdery Mildew (Erysiphe polygona)

The infestation and damages occur at an altitude lower than 1600 m. Off-season growing to the higher altitudes experienced infestation by this pathogen. However, infestation normally occurred late in the plant life and caused no considerable reduction in yield. Over all powdery mildew at the bulk production zone, in higher altitudes during normal growing season has never been reported as a serious set back for total yield.

4. Root-Rots (Fusarium spp. and Rhizoctonia spp.)

This might be a serious problem in areas where water and soil relation is in acute one. However, as most crops are grown on hilly to gentle slopy areas drainage problem is naturally minimized and it has never been reported as a serious set back in the bulk producing regions.

5. Virus

Horse bean is also susceptible to a number of virus diseases including broad bean mosaiv virus (BBMV), bean yellow mosaic virus (BYMV), pea leaf roll mosaiv virus (PLRV) and alfalfa mosaic virus (AMV). Normal these viruses are transmitted through insect vector, aphid being one of them. Some of these virus have been noticed at experimental fields though no proper identification is documented so far. At the farmers’ fields it has not been reported so far as a serious problem probably aphid population is sirarm in these areas.

Harvesting and Threshing

The beans are fully formed by the time pods begin to turn yellow colour, but seeds should dry down to about 10% moisture storage. Standing plants are allowed to dry to assured 10% moisture level is attained. If the variety is a shattering type, earlier harvesting is better to avoid loss. Most varieties however, should be harvested while some pods are black and some are still green and allowed to ripe after cutting.

The traditional Ethiopian farmer through centuries experience knows when his horse bean has to be harvested. By the time he believes the crop is ready for cutting most of the leaves are shattered, majority of the pods have turned black while the upper parts of the pods are completely or partially yellow.

In most cases he does cutting early 6:30 am. to 11 am. or in late afternoon 4:30 pm. to 6:30 pm. Season for cutting is from late October to early January. At 2000-2500 m, altitudes cutting is started in December and January. The harvested crop is left in the field for nearly 6 weeks in various sizes of stacks. The stacks are arranged in such a way that harvested top is left in an upright position which allows proper air circulation and direct exposure to solar radiation and save left to dry in a field within nearly 6 weeks. The dried crop wrapped with a reed of smooth leather is transported to the threshing ground by human labour or on the back of donkey. Most of the threshing is done by cattle or horses which trample on the pods until the grain drops out. This takes 3-4 hours depending on the degree of dryness of the crop. Wooden forks and sheaves are then used to separate chaff from the grain by tossing it in the air.
In many parts of Ethiopia pulses are major parts of the daily diet and an important source of protein especially during lent. The bulk of farmers' production is for local consumption but export is also done to various countries like the Middle East, Europe and Asia.

Horse bean culture is dominantly a culture of rotation. It will give fair return even from poor, rocky soils where other crops fail to give adequate yield. The Ethiopian highland farmer has learnt from long experience that whenever his land is depleted either he has to fallow it or plant it to pulses which is normally followed by cereals so that they would be benefited from fixed N

Horse bean is also one of the major pulses exported to the Arabian peninsula, western Europe and south-east Asia for at least more than 30 years. For instance, in September-November 1973 alone horse bean with other pulses constituted 13.1% of Ethiopia's export to various countries. As far back as 1948-1961, the average horse bean exported to various countries was 36 followed by lentil 33%

Table 3, shows the importance of horse bean and other in the export markets.

Table 3. The Export of Horse bean with other Pulses 

<table>
<thead>
<tr>
<th>Year</th>
<th>Chick peas</th>
<th>Horse beans</th>
<th>Haricot beans</th>
<th>Lentils</th>
<th>Field peas</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>2.2</td>
<td>15.6</td>
<td>17.4</td>
<td>15.8</td>
<td>0.6</td>
<td>51.4</td>
</tr>
<tr>
<td>1972</td>
<td>6.7</td>
<td>16.1</td>
<td>20.1</td>
<td>18.0</td>
<td>0.2</td>
<td>69.7</td>
</tr>
<tr>
<td>1975</td>
<td>8.0</td>
<td>26.7</td>
<td>17.0</td>
<td>25.2</td>
<td>2.6</td>
<td>141.5</td>
</tr>
<tr>
<td>1977</td>
<td>5.7</td>
<td>29.4</td>
<td>16.1</td>
<td>23.5</td>
<td>10.6</td>
<td>105.0</td>
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<td>1979</td>
<td>10.0</td>
<td>22.0</td>
<td>18.1</td>
<td>17.3</td>
<td>1.6</td>
<td>102.0</td>
</tr>
<tr>
<td>1976</td>
<td>6.3</td>
<td>25.6</td>
<td>16.7</td>
<td>22.3</td>
<td>6.7</td>
<td>103.1</td>
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<tr>
<td>1977</td>
<td>10.0</td>
<td>26.7</td>
<td>17.6</td>
<td>17.1</td>
<td>5.4</td>
<td>157.4</td>
</tr>
</tbody>
</table>

Source:- EPID publication No. 32 (7) and Ethiopian Grain Agency.

Ethiopian families eat pulses nearly every day, and many different kinds of preparation are produced. Horse beans are consumed as green, as green and roasted, as green and cooked, as green and boiled and roasted, as boiled and roasted, as boiled and salted, as thick sauce called net, as thick sauce called mish, as thick sauce called injera, as thick sauce called wot, as thick sauce called akam, and as thick sauce called injera. The main uses of this sauce is during the lent, &

Horse bean as pulse crop provides the major essential food elements. It consists of water 14.3%, protein 25.4%, fat 0.4, 48.5%, fiber, 7.1%, minerals 3.2% (20). Comparison with other pulses is made in table 5.

Table 5. Horse bean food component in comparison with pulses 

<table>
<thead>
<tr>
<th>Crops</th>
<th>Water</th>
<th>Protein</th>
<th>Fat</th>
<th>Carbohydrates</th>
<th>Fiber</th>
<th>Ash</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chick peas</td>
<td>0.4</td>
<td>0.9</td>
<td>0.2</td>
<td>61.2</td>
<td>3.2</td>
<td>3.7</td>
</tr>
<tr>
<td>Lentils</td>
<td>1.2</td>
<td>2.5</td>
<td>1.0</td>
<td>55.8</td>
<td>3.7</td>
<td>3.7</td>
</tr>
<tr>
<td>Haricot beans</td>
<td>1.1</td>
<td>2.5</td>
<td>0.5</td>
<td>54.5</td>
<td>5.0</td>
<td>3.6</td>
</tr>
<tr>
<td>Field peas</td>
<td>1.0</td>
<td>2.5</td>
<td>1.0</td>
<td>55.8</td>
<td>3.7</td>
<td>3.7</td>
</tr>
<tr>
<td>Horse beans</td>
<td>1.0</td>
<td>2.5</td>
<td>1.0</td>
<td>54.5</td>
<td>5.0</td>
<td>3.6</td>
</tr>
<tr>
<td>Ground nut</td>
<td>5.4</td>
<td>1.0</td>
<td>0.5</td>
<td>46.7</td>
<td>7.1</td>
<td>3.0</td>
</tr>
<tr>
<td>Soybeans</td>
<td>0.6</td>
<td>0.4</td>
<td>0.2</td>
<td>61.2</td>
<td>3.0</td>
<td>3.7</td>
</tr>
</tbody>
</table>

Source:- R. Sigridt (26)
Horse bean research and development programs in Ethiopia are still at their infancy stage, although the crop is one of the major pulses of the country cultivated for centuries. The research activities and achievements are far behind the current needs and other pulses like the haricot bean. The major research work on horse bean was started out at Kulumsa station. One of the coordinated research programs was the National Yield Trial on horse bean carried out in 1977.

For instance, the National Yield Trial of Horse bean was coordinated at locations shown below.

<table>
<thead>
<tr>
<th>State Location</th>
<th>Altitude</th>
<th>Location Soil type</th>
<th>Total Rainfall mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debre-Zeit</td>
<td>1800 m</td>
<td>Central Clay loam</td>
<td>567</td>
</tr>
<tr>
<td>Balassa (ARDU)</td>
<td>2000 m</td>
<td>Sabat-let heavy clay</td>
<td>500</td>
</tr>
<tr>
<td>Elleta (ARDU)</td>
<td>2200 m</td>
<td>Red clay</td>
<td>600</td>
</tr>
<tr>
<td>Refi (ARDU)</td>
<td>2300 m</td>
<td>South Red clay loam</td>
<td>350</td>
</tr>
</tbody>
</table>

**Areas of Research Efforts on Horse bean in Ethiopia**

The collection and evaluation of indigenous genetic material has been initiated since the end of 1960. The various collections were more or less 10% P. and 30% of the total. It seems that all were nearly market samples in which few necessary information were included.

Nevertheless, this has been substantial contribution in screening trials for various agronomic parameters. Limitation of staff and financial constraint have so a restricted thorough coverage of the most concentrated areas of production. Some of the highest yielding lines in 1972 yield trials were from collection of indigenous collections evaluated at various testing sites. Table 7.

In 1977 October—December systematic collection has been affected in which more than 300 samples were collected from major parts of eastern and two sub-provinces from Gojam. This would be documented and screening for evaluation at various locations for all agronomic characters and will continue in 1978-79 growing seasons. Collections from all horse bean growing areas are in progress. A complete documentation, characterization and evaluation is a high priority for horse bean improvement and development which is envisaged to continue.

### Horse Bean Trials

1. **Spacing—** A spacing trial was carried out on horse bean in which 20 cm, by 5 cm, gave the highest yield (CADU publication No. 6, p. 29, 1965 results). To determine the correct spacing, of horse bean, between 62 and 375 kg/ha, was planted with different spacing and width with 20 cm, and 15 cm, in a row gave the best economic results. Broadcasting gave a lower yield than sowing the amount of seeds in rows (CADU publication No. 6, p. 25).

### 2. Yield and Variety Trials

- In a trial at Balassa 20 of 75 horse bean samples collected were tested. The results were rather promising as one third of the tested bean yielded more than 30 kg/ha. There were small differences regarding the length of time from sowing to date of maturity. 119 to 198 days. The late maturing one gave the highest yield (CADU publication No. 6, p. 33). Results of National Yield Trial is shown in Table 6.

- In variety trials seven local' horse bean selected samples, were planted and compared with seven introduced varieties of horse bean. The yields ranged from 5600 to 500 kg/ha. Several of the local lines did better than introduced ones showing that substantial increase could be obtained in yield by selection and finding out appropriate agronomic practices. Observing local cultivars and some genetic characters of horse bean were tested for their adaptability character like resistant to chocolate spot rusts, tolerance high and medium plant and yield. Balassa (1968) has a major responsibility for coordinating this crop's improvement. The endeavor of the 1971-1975 years' yield trial assessments are shown in Table 7.

### 3. Fertilizer Trials

- In 1966, different spacings of horse bean were tested with and without fertilizers of lygus, P. The phonocarb does not increase the yield significantly. (195, Auger 1972).

<table>
<thead>
<tr>
<th>Varieties</th>
<th>BU/12</th>
<th>C3NU</th>
<th>BU/13</th>
<th>Total Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 BE</td>
<td>31.4</td>
<td>37.2</td>
<td>14.5</td>
<td>50.9 25.7</td>
</tr>
<tr>
<td>16 BU</td>
<td>21.7</td>
<td>22.5</td>
<td>18.9</td>
<td>27.7 24.4</td>
</tr>
<tr>
<td>Italian Car (BU)</td>
<td>21.8</td>
<td>25.3</td>
<td>18.7</td>
<td>24.4 23.7</td>
</tr>
<tr>
<td>Local Malita</td>
<td>22.0</td>
<td>24.0</td>
<td>12.0</td>
<td>17.1 18.0</td>
</tr>
<tr>
<td>Local Sheno</td>
<td>25.2</td>
<td>22.4</td>
<td>17.2</td>
<td>22.0 17.2</td>
</tr>
<tr>
<td>Italian &amp; Malita</td>
<td>-</td>
<td>-</td>
<td>17.9</td>
<td>17.9 17.9</td>
</tr>
<tr>
<td>Horse-Debt Horse</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Italian &amp; Fuzzy Horse</td>
<td>-</td>
<td>-</td>
<td>11.0</td>
<td>-</td>
</tr>
<tr>
<td>Date 2x2x3</td>
<td>-</td>
<td>-</td>
<td>31.3</td>
<td>-</td>
</tr>
<tr>
<td>143</td>
<td>-</td>
<td>-</td>
<td>33.4</td>
<td>-</td>
</tr>
<tr>
<td>Location Mean</td>
<td>32.9</td>
<td>33.7</td>
<td>14.2</td>
<td>40.4 21.7</td>
</tr>
</tbody>
</table>
Table 6 Continued.

<table>
<thead>
<tr>
<th>Varieties</th>
<th>HSU D.zeit</th>
<th>CADU Kulumsa Holetta</th>
<th>IAR</th>
<th>MADU Kokate</th>
</tr>
</thead>
<tbody>
<tr>
<td>LSD 5 %</td>
<td>7.1</td>
<td>8.1</td>
<td>5.9</td>
<td>N.S</td>
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<tr>
<td>LSD 1 %</td>
<td>9.7</td>
<td>11.5</td>
<td>8.3</td>
<td>N.S</td>
</tr>
<tr>
<td>SEM</td>
<td>2.4</td>
<td>-</td>
<td>2.0</td>
<td>-</td>
</tr>
<tr>
<td>CV %</td>
<td>20.0</td>
<td>12.0</td>
<td>27.0</td>
<td>29.0</td>
</tr>
<tr>
<td>Altitude (m)</td>
<td>1800</td>
<td>2200</td>
<td>2600</td>
<td>2100</td>
</tr>
<tr>
<td>Sowing date</td>
<td>29/6</td>
<td>10/6</td>
<td>18/7</td>
<td></td>
</tr>
<tr>
<td>Soil type</td>
<td>Clay</td>
<td>Dark</td>
<td>Red</td>
<td>Red</td>
</tr>
<tr>
<td></td>
<td>loam</td>
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<td>clay</td>
</tr>
<tr>
<td></td>
<td></td>
<td>clay</td>
<td></td>
<td>loam</td>
</tr>
</tbody>
</table>
Table 7. Yield Trials Results of Horse Beans 1971-1975 in ARDU kg/ha.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Kulumsa</td>
<td>Bekoje</td>
<td>Kulumsa</td>
<td>Bekoje</td>
<td>Kulumsa</td>
</tr>
<tr>
<td>Kuse 2-27-33</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3190</td>
</tr>
<tr>
<td>CS 20 DK</td>
<td>2000</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3720</td>
</tr>
<tr>
<td>CS 11 AK</td>
<td>1920</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3810</td>
</tr>
<tr>
<td>CS 38 BK</td>
<td>1680</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3530</td>
</tr>
<tr>
<td>Italian fava</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3630</td>
</tr>
<tr>
<td>Italian x Holetta</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Local Assela</td>
<td>1270</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Local Holetta</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Local Sheno</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2920</td>
</tr>
<tr>
<td>F 305 Morocco</td>
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<td>-</td>
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<tr>
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</tr>
<tr>
<td>IAR</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
4. Horse bean Regional and National Nursery Programme

Continuous research efforts are being exerted to evaluate several hundreds of horse bean lines or varieties for yield, disease resistance, maturity date, and high quality protein content. The germ-plasm material used for the programme in the screening nursery is from both indigenous and international sources. In 1977-78 screening programme, the nursery observation trials included varieties or lines from:

- ICARDA 817
- US Collections 81
- Local 432

In 1978-79 screening programme, the indigenous germ-plasm is expected to dominate the lines or varieties in screening, for the need is felt that variability of germ-plasm of the native material is not yet explored and exploited for the characters already mentioned.

Promising lines or varieties are always promoted and included in National Yield Trials Programmes for further evaluation, particularly for yield, maturity and disease resistance in different regions of Ethiopia.

5. Selection of Cultivars

The selection of high yielding cultivars such as Kusel 2,21,33, CS 20 DIC, CS 11 AK, CS 38 BK is a significant research output. A record yield is being achieved as high as 40-50 Q/ha -

Under Chillalo climatic conditions and agronomic practices, all these local cultivars have shown 2-4 times higher yield potential than farmers' cultivars. More serious research efforts in other parts of the country under comparable climatic conditions to that of Chillalo have to be yet extended and publicity campaign for farmers' acceptance of the proven cultivars with improved technology has to be emphasised.

FIELD PEAS

Domestication

Old World

Helbaek 1966 reports the occurrence of peas and lentils at Hucilar, Beidha and later Jaricho, which have been dated at 9,500 to 8,000 BC.

Renfrow 1966 reported seeds of pisum, Vicia faba and Lens from Neolithic sites in Greece.

Cultivated peas (Pisum sativum)

There are two forms of cultivated peas:

1. The field pea - Pisum arvense
2. The garden pea - Pisum sativum

- both can be crossed very easily and are quite inter-fertile,
- seems probable that the garden peas were derived by selection from the field peas,
- forms fairly closely resembling field peas are found in the wild state in Georgia, Russia (palaeo Plhr 1974).

Zhukovsky 1950 has suggested that Pisum elatius Steven, may be the ancestral form and that some recombination of Pisum sativum and wild peas may have occurred subsequent to domestication and establishment of field peas. This increased genetic variability could perhaps have given a sufficiently broad genetic base for selection of garden types.

The cultivation of the field pea is apparently as ancient as that of horse bean, the earliest archaeological remains have been found in the same neolithic levels in Jericho, as those of the horse bean (Hopf 1969).

Greece, cultivated in Peloponnisos, Austria and Czechoslovakia in Bronze ages. Settlerers in Stone and Bronze ages in Germany in Iron Age. As far as evaluation is concerned Pisum and phaseolus must have abandoned exogamy before domestication.

Pisum L

The germ includes 5 spp of the Mediterranean area and West Asia of which one is cultivated P sativum L, ample chromosome No. 2n = 14. In the present consideration P. sativum and P. arvense are taken to be conspecific since they are completely inter-fertile.

The Plant

1. Leaves - Pinnate with up to 3 pairs of leaf-like leaflets and a terminal branched tendril. Stipules large and leaf-like, ovate, lower portion dentate up to 6-5 cm long, larger than leaflets, stipules absent leaflets ovate or elliptic, up to 6 in number, entire or with indeterminate margin up to 5 x 3 cm.
Flowers

Axillary solitary or in racemes up to 3 flowers; bracts very small, calyx oblique, lobes unequal about 1 cm in length.

Calyx

White, pink or purple, hood short in curved ovate.

Stamens

Filaments broad and uniform.

Petal

Paler, flattened, broad on inner surface, stigma minute, terminal.

Pedicel

Stem up to 10 x 20 cm, with 10 to 20 seeds, distinct by the sutures.

Seeds

Angular or globose, smooth or wrinkled on endosperm. Green, gray, or brown sometimes mottled. (Fig. 2).

Height of 100 seeds is 15-25 g.

The species includes what are commonly called field peas and garden peas. The growth of garden peas is more luxuriant than that of field peas although the latter are considerably harder.

The field peas is grown as a dry pulse whereas garden peas can be harvested immature and used as a vegetable. The garden pea lacks the permanent tissues on the inner seed walls and the whole pod is edible. Depending on the purpose for which they are grown, seed rates vary between 60 and 300 kg/ha. For garden peas, lower seed rates are used for green vegetable production, higher rates for dry pea production. In subsistence cultivation of the field peas seed rates are probably lower and seeds may be broadcast or sown in rows. Seed yields of about 300 kg/ha are possible in good conditions with plant populations of the order of 200,000/ha to obtain satisfactory yields.

Geographic Distribution

Phaseolus sativus is probably originated in Ethiopia from which it spread in prehistoric times to the Mediterranean region, and thence to Asia and the temperate zones throughout the world. Westphal (1976) puts south-western Asia as a probable native area where the crop has been cultivated since ancient times. According to S. West, the crop reached the Greeks via the Black Sea and the Latin and Germanic tribes got it through the Greeks. Thus spread to India and China. It was known in the Buddhist region of Tibet and China. It was known to the Chinese 2000 years before the arrival of the Europeans.

Field pea growth has also been adapted to cool weather and does not thrive in hot and dry regions, but does well in subtropical and tropical areas during the cold season.

Similar to Vicia faba field pea grow in the mountain areas with altitude between 900-2000 m above sea level, during the monsoon rainfall (Ethiopia's winter season June 11 - September 11). Extensive and highly concentrated cultivation areas exist in central, northern, and western highlands of the country. In any market of Ethiopia field pea are available all the year round.
Fig. 3: Pisum sativum L - 1 branch with leaves inflorescence and vines 2. staminal sheath and pistil; 3 standard, from vien; 4 pod, section opened to show seed attached.
Peas are best adapted to cool climates with moderate rainfall. The seed must be protected from frost injury. Peas are grown in winter period of subtropical zones, or in the cooler season of the true tropics. Water requirement is high during the most of the rainy season; however, most important at higher elevations in the true tropics. Peas prefer soils that are not strongly acid, and are well supplied with calcium. Soils derived from limestone are well-suited for peas. Peas are grown in mid-June and first week of July and harvested between mid-October and early part of November. In central north, west and south west of the country the crop is grown, either in rotation with small cereals or on poor sometimes badly eroded soils and yet fair yields can be produced. Peas are very early to mature and most of the crop is used for seed the same year. Threshing is done with sickles by cutting the whole plant at the ground level. The harvested stuff is put in a stack for drying up completely. Early ploughing is done between February and March to remove all trash removed or ploughed under, and large clods broken up, Early plant ing is done between February and March to make the surface rough for retention of early rainfall moisture, facilitate rapid penetration and retard run off. In the hill areas, especially near the research stations, residues of horse bean and field peas grown together but never frequent with chick pea, or barley as intercrops (19%) is used in it. This is the traditional bulk producers, there is invariably a tendency or producing the crop in relatively small areas, but very poor soil because of the conviction that the crop might be given excessive vegetative growth at the expense of much yield in a soil in relatively fertile soils. This is probably one of the horizontal farmers reasons to cure it currently or after completion and investigation, for there might be too much high yielding varieties in relation to mineral soils in areas where the soil is considered fertile.

Seed Bed Preparation

Field peas need seed-bed preparation has to be done well to obtain good yields. It has to be free of growing weeds, all trash removed or ploughed under, and large clods broken up. Early ploughing is done between February and March to make the surface rough for retention of early rainfall moisture, facilitate rapid penetration and retard run off. In the hill areas, especially near the research stations, residues of horse bean and field peas grown together but never frequent with chick pea, or barley as intercrops (19%) is used in it. This is the traditional bulk producers, there is invariably a tendency or producing the crop in relatively small areas, but very poor soil because of the conviction that the crop might be given excessive vegetative growth at the expense of much yield in a soil in relatively fertile soils. This is probably one of the horizontal farmers reasons to cure it currently or after completion and investigation, for there might be too much high yielding varieties in relation to mineral soils in areas where the soil is considered fertile.

Sowing Date

The bulk production of the crop is planted by broadcast, the tradition has been carried through centuries of experience that he almost perfect broadcast invariably. This rate of broad-cast is estimated to be at the rate between 100-200 kg/ha, to 150 kg/ha. The upper limit is the maximum recommended one from the research people. Soon after the broad-cast the crop is covered by broadcasting homogenous seed material to ensure good stand. Growing, one to three seeds are planted by birds and insects.

Harvesting and Threshing

Field peas generally well mature between mid-October and early November and this is a very peak harvesting period. Harvesting is done with scimitar by cutting the whole plant at the ground level. The harvested seed is put in a winch for 5-6 weeks to dry up completely.

After the winch(s) has been dried for considerable period of time it has to be transported to especially prepared threshing ground. Sections through the headlands could come from along nearly area where the crop has been harvested, but normally for ease of transportation it has to be done by horse-drawn, Threshing invariably is done by tramping with cattle for 2-4 hrs. Easy the material and the seed are then winched up with the help of wooden fork. Last winnowing is done with the help of wooden shovel or dust blades may be 50-55 cm. in length and 20-25 cm. width, with a handle of 60-70 cm. The grains are stored in a day-usage storage made of mud plastered under wood, The average yield is between 5 and 8 Q/ha.
FIELD PEA PRODUCTION ZONES


1. ERITREA
2. TIGRAY
3. NOLLO
4. BEGEMDIR & SIMEN
5. GOJAM
6. WOLLEGA
7. SHOA
8. ILUBABOR
9. KAFA
10. GAMUGOFA
11. SIDAMO
12. BALE
13. ARSI
14. HARRAGE
Peas are best adapted to cool climate with moderate rainfall. The seeds swell and burst without injury. Peas are grown in winter period of sub-tropical zones, or in the coldest season of the true tropics which begins with the onset of the rainy season, however, most important at higher elevations in the true tropic zones. Peas prefer soils that are not strongly acid, and are well supplied with calcium. Soils derived from lime stone are well suited for peas. The crop is not well suited to highly leached soils normally found in rainfall areas of the tropics and sub-tropics. They are not adapted to shallow soils, nor to those that are poorly drained, although the crop is not considered to be a deep rooted one.

In Ethiopia peas are equal brave beans in importance after chick peas and lentils with average yields of 7-9 q/ha. Peas are usually seen at beginning of the big rains between mid-June and first week of July and harvested between mid-October and early part of November. In large areas of central north, west and south west of the country the crop is grown, either in rotation with small cereals or on poor sometimes badly cropped soils and yet fair crop can be produced. Good soil fertility is too low for commercial peas to be grown as the green manure to be green. It can be because of the composition of the crop that the crop might be given excessive vegetation especially at the expense of economic yield if grown in relatively fertile soils. This is probably one of the horizon risks associated with the crop. It is necessary to curtail itself for exploitation and investigation, for there might be too much high means in relation to mineral soils in areas where the soil is considered fertile.

In Eastern Highlands, like the Chercher highland, peas are one of chief culture. The crop is considered as the best to be grown on the first year on fallow land cleared for sorgum or maize production. In south and south-east highlands of the country peas together with beans, peas and barley constitute one of crops—pea zone. This is an altitude between 3,000 m. to 4,000 m. As a rule the crop is grown as a non—cereal, but very common, a mixture of horse beans, field peas grown together but never frequent with chick pea, or barley or oatmeal (1970) to the it is. The traditional bulk producers, there invariably is a tendency or producing the crop in relatively well drained but very poor soil because of the composition that the crop might be given excessive vegetation especially at the expense of economic yield if grown in relatively fertile soils. This is probably one of the horizon risks associated with the crop. It is necessary to curtail itself for exploitation and investigation, for there might be too much high means in relation to mineral soils in areas where the soil is considered fertile.

Seed Bed Preparation

Field peas need—bed preparation has to be done well to obtain good yields. It has to be of great weed control, all trash removed or ploughed under, and large clods broken up. Early ploughing is done in February and March to make the seed bed shallow enough for easy surface moisture, facilitate rapid penetration and retard run off. In the bulk production zone this practice is done by the middle of the crop in relatively well drained but very poor soil. In Ethiopia farmers infest love less attention to this practice. Field peas can be ploughed on soils that are only ploughed only once or twice at most and very little weeds are seen in every practiced in field peas from planting to harrowing.

Seeding Rate

The bulk producer of the crop is planted by broad-cast. The traditional farmers have learned through generations of experience that he almost perfect broad—cast invariably. This rate of broad-cast is estimated to be at the rate between 100 kg/ha to 150 kg/ha. The upper limit is the most recommended rate from the research people. Soon after the broad-cast the area ploughed done the covering of the seed unevenly, the result of which penetration is not uniform and sprouting seeds are picked up by birds and insects.

Harvesting and Threshing

Harvesting generally would nature between mid-October and early November and this is a very peak harvesting period. Harvesting is done in a similar way as to a green manure. The crop is harvested when the top most pods, 1-3 pods are just turned yellow while the bottom ones are almost dried. Harvesting is done with sickles by cutting the whole plant at the ground level. The harvested stuff is put in a stack for drying up. The average yield is between 5 and 8 q/ha.
Diseases and Pests

Diseases
Numerous diseases caused by fungi, viruses, and nematodes could affect the leaves, stems, pods, seeds and roots of peas grown, resulting in reduced yields and inferior quality seeds. Pest pathogens could be transmitted by various means, including wind, insects, drainage water, plant refuse and seeds.

Powdery mildew (Erysiphe polygoroi DC)
This is the most widely spread and most serious disease of peas. In certain years when there is heavy cloud and some rainfall moisture in the months of September and October infestation of the pathogen could be very high. Mostly the disease sets in later part of the plant growth and it does not seem much in the way of limiting the overall yield. It seems there is no available data on the amount of loss due to this pathogen. The prevalence of the disease is directly associated with temperature.

Wilt (Fusarium spp.)
This is a very serious problem if there is much drainage problem. The whole crop could be lost due to this disease. The Ethiopian highland farmer avoids planting waterlogged areas instead plants his peas on gently slopy sites where drainage problem is solved naturally.

Ascochyta blight
This could be the most dominant disease in areas with high rainfall. The disease attacks the leaf, stem and pods may result in reduction of both yield and quality of the seed. There seems to be no available information how much crop is lost due to this disease as no assessment has been done so far.

Insects
No overall assessment has been done on losses due to various field pea pests. Both in the field and storage losses due to insects could be considerable.

American bollworm (Heliothis armigera) It is probably the most serious insect attack. High numbers of this pest have been reported on the plants. It is usually the damage caused by the caterpillars which feed on the leaves of the plant. It seems, during heavy rainfall, most eggs are washed off and destroyed and much crop damage might not be experienced.

Weeds
Several kinds of weeds including perennial grasses could prevail in field pea. Weed competition may seriously reduce yields. Research authorities advocate that band placement of fertilizers avoids undue stimulation of weeds between rows of pea. Weeds should be killed while still young, before there is significant competition with peas for moisture and nutrients. This is by pulling or hoeing of the weeds at early growth stages.

In the bulk producing zone field peas are broadcast. No weeding is practiced even after sowing until the crop is harvested, as the result of this century's culture Ethiopian field peas are tall and viny in growth prostrating on the ground. So once the crop uniformly covers the ground the weeds are automatically controlled by the prostrating plants. However, this does not suggest that there are no losses due to weeds. To date research has confirmed that a single hand weeding is quite adequate for economical production of Ethiopian field pea.

Uses
What can be mentioned about field pea economic and consumption has already been stated under horse bean uses. See under horse bean and table 34.5.

Pulses are one of the major food crops for the majority of Ethiopians. Pulses can be pulses nearly every day in many different kinds of preparations. Mode of consumption can be enumerated in the order of their magnitude. Therefore, field peas are consumed as:

- Wot, a kind of sauce used in eating injera.
- Roasted
- Soaked and roasted
- Cooked
- Fresh green
- Fresh green roasted or cooked
- Injera (fermented dough baked flat bread) mixed with the above or with错 (arugwata abiyenjat) flour.
- Purridge.

Field peas provide some of the major essential food elements. The whole dry mature seeds contain:

<table>
<thead>
<tr>
<th>Element</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>10.6%</td>
</tr>
<tr>
<td>Protein</td>
<td>22.5%</td>
</tr>
<tr>
<td>Fat</td>
<td>1.0%</td>
</tr>
<tr>
<td>Carbohydrate</td>
<td>58.5%</td>
</tr>
<tr>
<td>Fiber</td>
<td>3.0%</td>
</tr>
<tr>
<td>Ash</td>
<td>0.9%</td>
</tr>
</tbody>
</table>

Comparison with other important Ethiopian pulses (not soybean is made in table 5).

<table>
<thead>
<tr>
<th>Element</th>
<th>Field Pea</th>
<th>Horse Bean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein</td>
<td>22.5%</td>
<td>21.0%</td>
</tr>
<tr>
<td>Fat</td>
<td>1.0%</td>
<td>1.5%</td>
</tr>
<tr>
<td>Carbohydrate</td>
<td>58.5%</td>
<td>58.0%</td>
</tr>
<tr>
<td>Fiber</td>
<td>3.0%</td>
<td>3.0%</td>
</tr>
<tr>
<td>Ash</td>
<td>0.9%</td>
<td>1.0%</td>
</tr>
</tbody>
</table>
Indication has already been made that nearly all produced field peas are consumed locally, small portion is exported and in some years there might not be any export at all because of local market demand. Table 4 could give some idea on yearly land allotted to field peas total production and return per unit of land.

Table 8. Ethiopian field peas production status

<table>
<thead>
<tr>
<th>Year</th>
<th>Area (000 ha)</th>
<th>Yield (kg/ha.)</th>
<th>Total production (000 ha.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1967</td>
<td>130.0</td>
<td>9.2</td>
<td>119.6</td>
</tr>
<tr>
<td>1968</td>
<td>131.8</td>
<td>9.6</td>
<td>125.6</td>
</tr>
<tr>
<td>1969</td>
<td>133.5</td>
<td>10.3</td>
<td>135.9</td>
</tr>
<tr>
<td>1970</td>
<td>135.0</td>
<td>10.4</td>
<td>139.6</td>
</tr>
<tr>
<td>1971</td>
<td>136.2</td>
<td>10.5</td>
<td>140.2</td>
</tr>
<tr>
<td>1972</td>
<td>137.1</td>
<td>10.7</td>
<td>143.6</td>
</tr>
<tr>
<td>1973</td>
<td>137.0</td>
<td>11.0</td>
<td>147.0</td>
</tr>
<tr>
<td>1974</td>
<td>138.0</td>
<td>11.3</td>
<td>151.4</td>
</tr>
<tr>
<td>1975</td>
<td>138.0</td>
<td>11.5</td>
<td>151.5</td>
</tr>
<tr>
<td>1976</td>
<td>138.4</td>
<td>11.7</td>
<td>152.4</td>
</tr>
</tbody>
</table>


The first step in any improved programme is to assemble germ-plasm collections of indigenous and introduced varieties to be used as a source of breeding materials. Introduced varieties may be used for direct growing as a source of germplasm for further selections or for further utilization in a hybridization programme. The collection and evaluation of indigenous genetic material has been initiated about 8 years ago. However, due to limitation in trained manpower and financial support and continuous effort in this line of work has not been serious. In 1977 however, a very serious programme of systematic collection has been launched which is expected to go on until all the provinces in the country have been thoroughly covered. Between late October and early December 1977 more than 300 samples of indigenous materials have been collected raising our material stock considerably higher. These would be used in adaptation and performance screening at various regional level in 1978.

The next five years collection and introduction of genetic materials for systematic characterization and evaluation are the highest priority action for field pea improvement programme in the future.

VARIetal TriAl Yields

Some annual progress reports like that of Arssi Rural Development Unit (ARDU) show that field research programme started since 1967. Different local selections and varieties of field peas in observation plots at Kulumsa ARDU gave 930 kg to 100 kg/ha. Insect cause a serious damage to the seeds, CADU publication No. 12). At Bekoji (ARDU) station 21 pea varieties were tested at a nursery observations. They yielded in average 2290 kg/ha. The best pea yielded 2600 kg/ha. CADU publication No 63 p. 54).

A variety adaptation trial carried out with three varieties at Nazareth Research Station gave poor yields. The incidence of mildew in all varieties indicated that Nazareth is probably too warm for good results of field peas. (Institute of Agricultural Research, National Agricultural Centre, Nazareth Progress Report for the period April 1971-March 1972 page 9).

In Arssi region, central south, there has been a serious yield trial recording since 1971. The following table 9 might be an indicative for the on going correlated work.
Field Peas Regional and National Nursery Programmes

Continuous research programmes are now being launched to evaluate several hundreds of lines or varieties for yields, adaptation, disease resistance and maturity date. The programme consists of lines or varieties of grain pulse of international as well as indigenous collections, the main international sources being USDA, USA and few introductions from India and Sweden.

Cultural Practice Studies

Plant population, date of planting and weeding methods are also being studied. Data of planting seems to have a definite influence on yields. Mid-June planting on red clay soils is favoured while early July is most favourable on black clay soils.

With 2-3 plowing and thorough weed removal, one time hand weeding or hoeing is quite adequate for Ethiopian field pea varieties. With such cultural practice adaptations the station can make some tentative recommendation for varieties like Pressino, 1505 and CA 456 Kulumsa in the climatic condition similar to that of Ared region (AMH).

Highland Pulse Research Stations in Ethiopia

Ethiopian Agro-ecosystem is highly complex in its variability. It is not at all uncommon, particularly in the highlands, to experience different ecology and weather conditions within a 20-30 km. distances. In such variable and complex ecosytem it is both a must and indispensable to have as much as possible representative research locations all over the country. To this effect there are a number of trial sites in the country for both lowland and highland crop improvement studies. The locations where highland pulse (chick pea, horse-bean, field pea, green pea, lentil and sunflower) are generally considered (highland pulse) work is carried out are the following:

<table>
<thead>
<tr>
<th>Site</th>
<th>Altitude</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bokoje</td>
<td>2,000</td>
<td>Central Ethiopia</td>
</tr>
<tr>
<td>Assasa</td>
<td>2,000</td>
<td>South</td>
</tr>
<tr>
<td>Beldibir</td>
<td>1,900</td>
<td>Central</td>
</tr>
<tr>
<td>Bokoje</td>
<td>1,900</td>
<td>South</td>
</tr>
<tr>
<td>Debubiskit Exp. Station</td>
<td>1,900</td>
<td>Central</td>
</tr>
<tr>
<td>Bokoje</td>
<td>2,150</td>
<td>South</td>
</tr>
<tr>
<td>Bokoje</td>
<td>2,100</td>
<td>South</td>
</tr>
<tr>
<td>Bokoje</td>
<td>2,050</td>
<td>South</td>
</tr>
<tr>
<td>Bokoje</td>
<td>2,000</td>
<td>South-Western Ethiopia</td>
</tr>
</tbody>
</table>

In addition to these sites various other Extension Project Implementation Departments’ sites are also used occasionally. This however, is just a step towards realisation of the need to spread out stations to include more of the various complex ecosystmes of the country.
Varieties:

Trial results have shown that the yields vary considerably between the varieties and ecological zones. The yields will probably increase when good and the right varieties for respective ecological zones are more common and when it is possible for the farmers to obtain them.

Variety trials in different parts of Ethiopia are important in order to find out at what altitudes the different varieties of pulses can be grown best. It is important to a farmer to get cultivars and varieties which will suit the area where he lives.

Frost:

In every fourth year cycle at the high altitudes frost burn is also a set back for good harvest of horse bean. The traditional farmer has no answer to this. Research in the line of frost resistance variety development and date of planting must be intensified to solve the problem. The problem might be quickly covered if seeds from temperate regions particularly spring types are introduced and systematical screening is done.

Summary

The world-known plant breeder and botanist, N. Vavilov describing centres of diversity for some of economic plants puts Ethiopia as a probable secondary Centre for Vicia faba and one of the centres far. Horse bean and field peas production occurs all over the country. Of the 500,000 ha. land, total pulse complex, field pea and horse bean take about 30-104.

The highest concentrated areas of production are in the provinces of Shoa, Welo, Gozam, Gojam, Tigre and Wollega where high diversity of the crop are grown.

Since Ethiopia is located favourably for external trade she can benefit from the ever increasing external demand for the two crops. The sad story of the pulse in general in Ethiopia is that there is still little transference of modern technology to affect the average yield 9-10 Q/ha.

The recent realisation, towards the improvement of the two concentrated effort to define research activities and attention to the above mentioned areas. Therefore, to this date the Ethiopian agraro-technology has little to offer to the bulk producing zone for a high return per hectare of cultivated land.

1. Systematic collection, documentation, classification and screening of the valuable indigenous materials.


3. Study of the crop under various Ethiopian ecological zones.

4. Development of resistant varieties to chocolate spot, rust, poddy mildew, root rot, wilt anachyta blight and lodging and frost hardness.

5. Creating a working environment with international research organisations for exchange of germ-plasm and technical know-how.

6. Study of the benefits of N,, fixing of Mesobium spp. to fit into Ethiopian cropping pattern.

The aim of all the objectives is to raise the present yield 9-10 Q/ha, to a minimum of 15-15 Q/ha.
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