Food Legume Improvement and Development Proceedings of a workshop held at The University of Aleppo, Syria, 2-7 May 1978

Geoffrey C. Hawtin and George J. Chancellor, Editors

Published by The International Center for Agricultural Research in the Dry Areas and International Development Research Centre
The International Development Research Centre is a public corporation created by the Parliament of Canada in 1970 to support research designed to adapt science and technology to the needs of developing countries. The Centre's activity is concentrated in five sectors: agriculture, food and nutrition sciences; health sciences; information sciences; social sciences; and communications. IDRC is financed solely by the Government of Canada; its policies, however, are set by an international Board of Governors. The Centre's headquarters are in Ottawa, Canada. Regional offices are located in Africa, Asia, Latin America, and the Middle East.

© 1979 International Development Research Centre
Postal Address: Box 8500, Ottawa, Canada K1G 3H9
Head Office: 60 Queen Street, Ottawa

Hawtin, G.C.
Chancellor, G.J.
International Center for Agricultural Research in the Dry Areas, Aleppo SY
IDRC-126e


/IDRC publication/. Compilation of workshop papers on /legume/ /food production/ in the /Middle East/ and /North Africa/ — discusses agro/bioclimateology/ and /cultivation system/s, /nutrition/al value and /food composition/; /plant production/ (particularly of /chickpea/s, /lentil/s, and /faba bean/s), /agricultural research/, /cultivation practice/s for /plant protection/; /plant disease/s, /insect/ /pest/s, /disease resistance/, /weed control/ problems (use of /herbicide/s in /arid zone/s); /plant breeding/ and /genetic improvement/. /IDRC mentioned/, /list of participants/.


Microfiche edition available
Food Legume Improvement and Development

Proceedings of a workshop held at the University of Aleppo, Aleppo, Syria, 2–7 May 1978

Editors: Geoffrey C. Hawtin and George J. Chancellor

Published by the International Center for Agricultural Research in the Dry Areas and the International Development Research Centre

The views expressed in this publication are those of the individual author(s) and do not necessarily represent the views of ICARDA or IDRC.
## Contents

Preface ................................................................. 4
Foreword ............................................................. 5

Section I  An Introduction to Food Legumes in the Region

Some aspects of the agroclimatology of West Asia and North Africa  
Hazel C. Harris ...................................................... 7
Food legume production: the contribution of West Asia and North Africa  
to the world situation  F.M. Hamawi .................................. 15
Food legumes in the farming system: a case study from Northern Syria  
David Gibbon and Adrienne Martin ................................ 23
Nutritional quality and importance of food legumes in the Middle Eastern diet  
Raja Tannous, Salah Abu-Shakra, and Abdul Hamid Hallab .............. 29

Section II  The Present Production and Improvement Situation

Food legumes in Algeria  Walid Khayrallah and Lounes Hachemi .......... 33
Production and improvement of grain legumes in Egypt  Ali A. Ibrahim,  
Abdullah M. Nassib, and Mohamed El-Sherbeeny .......................... 39
Food legume production in the Hashemite Kingdom of Jordan  M. Abi Antoun  
and A. Quol ..................................................................... 47
Food legume production and improvement in Iran  M.C. Amirshahi ....... 51
Food legumes in Iraq  Mahmoud A. Mayouf .................................. 55
Food legume research and development in the Sudan  Farouk A. Salih .... 58
Food legume improvement in Tunisia  M. Bouslama and M. Djerbi ... 65
Food legume production and improvement in Lebanon  R. Lahoud,  
M. Mustafa, and M. Shehadeh ............................................. 69
Grain legume production in Turkey  D. Eser ................................ 71
Food legume research and production in Cyprus  J. Photiades and G. Alexandrou ..................................................... 75
Broad beans (Vicia faba) and dry peas (Pisum sativum) in Ethiopia  
Asfaw Telaye .................................................................... 80
Food legumes in Syria  Sadek El-Matt ......................................... 85
Food legume improvement in the People’s Democratic Republic of Yemen  
Shafiq Mohsin Atta ................................................................ 88
Food legume production in Libya  Ali Salim .................................. 90
Status of food legume production in Afghanistan  N. Wassimi ............ 91
Food legumes in India  A.S. Tiwari ............................................. 94

Section III  Disease Problems on Legume Crops

Diseases of major food legume crops in Syria  S.B. Hanounik .............. 98
Food legume diseases in North Africa  M. Djerbi, A. Mlaiki,  
and M. Bouslama .................................................................. 103
Food legume diseases in Ethiopia  Alemu Mengistu ......................... 106
Diseases of broad beans (Vicia faba) in the Sudan  Mustafa M. Hussein  
and Sami O. Freigoun ....................................................... 109

Section IV  Major Pests and Weeds of Food Legumes

Insect pests of food legumes in the Middle East  Nasri S. Kawar ............ 112
Insect pests of chick-pea and lentils in the countries of the Eastern  
Mediterranean: a review  G. Hariri ........................................ 120
Some insect pests of leguminous crops in Syria  Ara A. Kemkemian .... 124
The biology and control of Orobanche: a review  A.R. Saghiri and F. Dastghieb  
Broomrape (Orobanche crenata) resistance in broad beans: breeding work in  
Egypt  Abdullah M. Nassib, Ali A. Ibrahim, and Hamdy A. Saber .......... 133
Accentuation of weed control problems in the dry areas with relevance to  
herbicides in food legumes  F. Basler ....................................... 136
Section V  Food Legume Development
Genetic resources of grain legumes in the Middle East
   L.J.G. Van der Maesen ........................................... 140
Strategies for the genetic improvement of lentils, broad beans, and chick-peas, with special emphasis on research at ICARDA  Geoffrey C. Hawtin .......... 147
Some agronomic and physiological aspects of the important food legume crops in West Asia  M.C. Saxena .......................................................... 155
The role of symbiotic nitrogen fixation in food legume production
   Rafiqul Islam .......................................................... 166
The ICRISAT chick-pea program with special reference to the Middle East  K.B. Singh ............................................................ 170
Methods of population improvement in broad bean breeding in Egypt  Abdullah M. Nassib, Ali A. Ibrahim, and Shaaban A. Khalil .......... 176
Pollinating insects: a review  Ara A. Kemkemian ...................... 179

Section VI  Cooperative Approaches to Food Legume Improvement at the National Level
The training and communications program at ICARDA  S. Barghouti .......... 181
FAO food legume programs in the Middle East and North Africa  Hazim A. Al-Jibouri and A. Bozzini .................................. 185
The food legume improvement and development program of the field crops section at ACSAD  L.R. Morsi ................................................. 190
The role of IDRC in food legume improvement research  F. Kishk .................. 192

Section VII  Recommendations for Future Research Priorities .............. 194
Bibliography .................................................................. 199
Participants .................................................................. 214
Food Legumes in India

A. S. Tiwari
J. N. Agricultural University, Jabalpur, India

India possesses the largest area in the world under grain legume cultivation. Grain legumes have proved to be the mainstay of Indian agriculture for the past few decades, enabling the land to produce reasonable quantities of food grains despite the almost total lack of manuring or fertilization. This has primarily resulted from the legumes’ ability to fix atmospheric nitrogen, which gives them a comparative advantage under these growing conditions. In addition to this, as a group the legumes exhibit considerably higher drought tolerance than other crops and have thus found a niche in areas characterized by regular moisture stress. Because of these characteristics, legume crops are invariably included in rotations throughout the country and also figure prominently in crop mixtures.

Apart from these agronomic advantages, grain legumes occupy an important place in dietary considerations, supplying, as they do, most of the protein requirements of India’s predominantly vegetarian population. Some of the crops also serve as excellent forages and grain concentrates in the feed of the country’s large cattle population and others are favoured for use as green manures.

Production Position

In 1976, the area under pulse crops was approximately 24 million ha, or 20% of the total area under food grain crops, and the production from this was about 13 million tonnes. The major pulse crops and their relative importance to Indian agriculture are given in Table 1.

Chick-pea is by far the most important food legume crop in India, occupying an area of 8.37 million ha throughout the country. The others are of less importance overall, but

<table>
<thead>
<tr>
<th>Crop</th>
<th>% of total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Botanical name</td>
</tr>
<tr>
<td>------</td>
<td>----------------</td>
</tr>
<tr>
<td></td>
<td>Cicer arietinum Linn.</td>
</tr>
<tr>
<td></td>
<td>Cajanus cajan (Linn.) Millsp</td>
</tr>
<tr>
<td></td>
<td>Lathyrus sativus Linn.</td>
</tr>
<tr>
<td></td>
<td>Vigna mungo</td>
</tr>
<tr>
<td></td>
<td>Dolichos biflorus Linn.</td>
</tr>
<tr>
<td></td>
<td>Phaseolus aconitifolius Jacq</td>
</tr>
<tr>
<td></td>
<td>Pisum arvense Linn. and Pisum sativum Linn.</td>
</tr>
<tr>
<td></td>
<td>Vigna radiata (L.) Wilczek</td>
</tr>
<tr>
<td></td>
<td>Lens culinaris Mebic.</td>
</tr>
<tr>
<td></td>
<td>Other pulses*</td>
</tr>
</tbody>
</table>

*a Includes: Vigna unguiculata L. (cowpea), Cyamopsis tetragonoloba L. (clusterbean), Dolichos lablab L. (Indian bean or field bean), Phaseolus vulgaris L. (French bean), Phaseolus trilobus L. (pillipesara), Glycine max. L. (soybean).
each crop has its own unique place in the agriculture of the country dependent upon its
suitability for particular rotations and crop mixtures and/or its adaptation to specific
agroecological conditions. Among the less widely cultivated pulses for example, cowpea
and *Phaseolus* bean are grown in most regions of the country, whereas soybean is a staple
pulse only in the temperate regions of the Himalayas. Similarly, french bean cultivation is
restricted to regions with a cool monsoon season; guar is an important field crop in the
western part of the Indo-Gangetic Plain in the north; and pillipesara assumes more
importance in the south of the country. The cultivation of some crops (e.g., soybean),
which are relatively more productive and tolerant to adverse conditions, is now tending to
spread from their more traditional niches into the plains of northern and central India.

Madhya Pradesh, Uttar Pradesh, Rajasthan, Maharashtra, and Bihar are considered to be the most important food legume-growing areas in the country (Fig. 1).

**Agronomic and Nutritional Uses**

**Pulses as Food and Fodder**

In most parts of India, pulses form an essential part of the daily diet of the population
and serve as the major source of dietary protein. They are thus used as food in a wide

![Fig. 1. Provincial divisions of India; Madhya Pradesh, Uttar Pradesh, Rajasthan, Maharashtra, and Bihar are the most important food legume-growing areas in the country.](image-url)
variety of forms. The most common of these is soup; the split grains are boiled in spiced water and seasoned to form "dal" or "sambar." The grains may also be ground and boiled, roasted or fried; sprouted and then cooked; made into sweetmeats; or used as a flour in the preparation of bread and other foodstuffs. The grain and pods of some pulses (e.g., pea, guar, cowpea, and Phaseolus beans) are often cooked and eaten in the green condition. It is largely the brown seeded desi types of chick-pea that are cultivated for human consumption in India; the pink, green, and black kabuli types are used only to a very limited extent in the country.

Some of the pulse crops, such as guar, cowpea, pea, chickling vetch, horse gram, and pillipesara, are commonly used as fodder for draft and milk animals. Legume grains are also used to some extent as concentrates in the diets of animals. Guar grain is especially preferred for this purpose for draft animals and chick-pea is held in high esteem for feeding bullocks and horses.

**Pulses as Green Manures**

Legume crops, such as green gram, clusterbean, cowpea, and pillipesara, are excellent green manure crops, although their use for this purpose is secondary to that of the well-recognized green manure sunn hemp (*Crotalaria juncea*). This is mainly because they provide less organic matter, and hence possibly also less nitrogen, to the soil when turned in. However, they are considered to be very useful as manures because, by virtue of their rapid rate of decomposition, they become thoroughly incorporated into the soil at a much faster rate than the more woody, conventional green manure crops.

**Pulses in Crop Mixtures and Rotations**

Their ability to thrive under a wide range of soil and climatic conditions ensures the legumes an important place in a large number of crop mixtures and rotations throughout India.

Pigeon pea is generally grown in a mixture with millets or cotton, or as a border crop in sugarcane fields. In the northern and central parts of the country, where late (250-day) or medium (200-day) maturing varieties are grown, they are almost invariably mixed with millets such as "jowar" (*Sorghum vulgare*), "bojra" (*Pennisetum typhoides*), or "kodon" (*Paspalum scrobiculatum*). Sometimes a small proportion of other crops, such as green gram, black gram, or sesamum, are also added to the mixture. These mixtures are normally broadcast sown in the months of June or July, depending upon the onset of the monsoon. During the first 4 months, the more rapidly growing millet is the dominant crop, but after the millet harvest in October–November the pigeon pea crop grows rapidly to give complete field cover by the end of the winter season. As it flowers and forms pods after the associated millet crop is removed, and has a full season in which to complete its growth and development, the pigeon pea crop recovers well from its earlier cramping, giving reasonable yields. The sowing of this mixture is popular throughout the country as it enables two, or sometimes more crops to be grown within one season under dryland farming conditions; it also causes a marked reduction in the incidence of wilt disease in pigeon pea plants. Although generally grown as a single crop, chick-pea is often sown in a mixture with wheat, barley, linseed, or mustard in the unirrigated areas of Uttar Pradesh and Madhya Pradesh. This is primarily because, having a deeper rooting system than cereal crops, the chick-pea component of the mixture provides a certain amount of guarantee against crop failure in the event of the winter rains being insufficient to support the cereal component. Similarly, horse gram is usually grown as a single crop, but is often grown in a mixture with castor, groundnut, or cotton in Karnataka and other areas. Other legume crops commonly included in mixed cropping regimes include short duration varieties of black gram with maize; field bean (*Dolichos lablab*) in "ragi" (*Eleusine coracana*) mixtures; and cowpea and black gram with millets and oilseeds.

Grain legume crops figure prominently in rotations all over India. They may occupy a field once in every 2 or 3 years or often even more frequently, because of their ability to grow well under conditions of limited soil moisture and at the same time improve soil fertility. In Northern India rotation of dryland paddy, which matures in 80–90 days, with
chick-pea is a widespread practice. Where the paddy crop is of a long duration, however, field pea (Pisum sativum) or Lathyrus sativus replaces the gram crop in the rotation.

To ensure good germination of the legume crop in this rotation it is customary in the important paddy-growing areas of Bihar, Orissa, and Madhya Pradesh to sow the pulse into a standing paddy crop just prior to harvest when the soil is still wet. However, the crop most commonly involved in this rotation, Lathyrus sativus, contains a neurotoxin, which may accumulate in the body and cause paralysis of the lower limbs (lathyrism). It has proved hard to identify an alternative to replace Lathyrus in the rotation, as this crop is ideally suited to growing in paddy soils, which on drying become as hard as steel and when wetted are quickly waterlogged. Such conditions preclude the utilization of chick-peas, lentils, or peas, which are sensitive to both drought and overwatering. Investigations continue and results to date indicate that some lentil varieties that are better adapted to these conditions might be used to replace the currently grown Lathyrus cultivars. A recently developed low-neurotoxin Lathyrus line (Pusa 24) might also be used as a replacement.

Under rainfed conditions chick-pea and lentil are almost invariably grown as a single crop in rotation with a cereal, millet, oilseed, or cotton, depending upon the region. In irrigated areas, however, double cropping is frequently practiced. This has been made possible through the evolution of short duration genotypes of green gram, black gram, and cowpea, which are also tending to popularize multiple cropping under rainfed conditions, especially on land that usually remains fallow for 5–6 months of the year.

**Pulses and Soil Improvement**

The value of leguminous crops to Indian agriculture, by virtue of their ability, in symbiosis with Rhizobium bacteria, to fix atmospheric nitrogen and supply it to the soil, is immense. Some of the nitrogenous compounds formed in this way are able to pass into the soil in the vicinity of the plant roots. These compounds are easily assimilable by nonleguminous plants, and the advantages obtained by crops grown in association with legumes may be one of the major reasons for their popularity in crop mixtures.

Besides their undoubted contribution to soil fertility, grain legumes have a considerable improvement effect on soil structure, their deep and extensive rooting systems opening out the subsoil layer and providing a large amount of organic matter to this layer upon death or shedding. Such deep rooting systems and spreading growth habits also mean that the legumes are important for their erosion-resistant properties. This attribute is often exploited by planting legumes either singly or between spaced rows of other crops on erosion-prone soils.

Unfortunately, however, the fact that food legume crops possess such important agronomic advantages is tending to mitigate against achieving yield improvements in many parts of India. This results from the farmers’ traditional and continuing reliance upon legumes to replenish soil fertility, to assist other crops, to reduce soil damage and erosion, and to produce yields from very marginal lands, under minimum input conditions. In using legumes in this way it is often forgotten that, in common with other food crops, high soil fertility is required for the production of high yields. There is thus considerable potential for yield improvement in India, and indeed throughout the Middle East, through the widespread introduction of improved methods of agronomy, especially phosphate fertilization, coupled with an inherent change in the way that legume crops are perceived at the farmers’ level.