Katalin Réthy

CHICKPEAS, PEAS, BEANS AND LENTILS

An inspiring handbook for beginners and advanced gardeners

Katalin Réthy

CHICKPEAS, PEAS, BEANS AND LENTILS

An inspiring handbook for beginners and advanced gardeners

Katalin Réthy

CHICKPEAS, PEAS, BEANS AND LENTILS

An inspiring handbook for beginners and advanced gardeners

Published and distributed by:
ÖMKi – Ökológiai Mezőgazdasági Kutatóintézet Közhasznú Nonprofit Kft.
(Hungarian Research Institute of Organic Agriculture)
Headquarters: 1033 Budapest, Miklós tér 1.
info@biokutatas.hu | www.biokutatas.hu

Publication title: Chickpeas, Peas, Beans and Lentils: An Inspiring Handbook for Beginners and Advanced Gardeners
Reference: Réthy K. (2024): Chickpeas, Peas, Beans and Lentils: An Inspiring Handbook for Beginners and Advanced Gardeners. Budapest. ÖMKi.
Author and editor: Katalin Réthy (Magház)
Contributing authors: Judit Fehér (Magház, ÖMKi), Orsolya Papp (ÖMKi), Attila Králl (Agri Kulti, ÖMKi), Balázs Horváth (NBGK)
Professional proofreading: Dr Ferenc Tóth (ÖMKi), Orsolya Papp (ÖMKi)
Language proofreading: Borbála Lipka (Magház), Andrea Pávay
Graphic editing: Kata Laura Tamás, László Harsányi
Printing: Pátria Nyomda Zrt.

ISBN 978-615-82450-1-2
Photographs by: Agri Kulti: 3c, 14-16, 25, 26b, 27c, 28; Judit Fehér: 13, 19b, 37d; Marika Fehér: 32c; Lajos Fodor: 32b; Getty Images: 36; Emese Gyöngyösi: 2b, 9, 26d, 27a, 32d, 35a,b, 37c; Júlia Horváth: 5, 8, 10, 33a, 37b; Zoltán Mészáros: 1, 2a, 3b, 4, 7, 21b, 23, 33b, 34b; ÖMKi: 17; Ági Palásti Kovács: 21c, 26a,c, 27d, 32a; Katalin Réthy: cover, 2c, 3a, 19a, 20, 22, 24, 30, 31, 35d, 37a; Róbert Szilágyi: 6, 11, 12, 18, 21a, 27b, 29, 33c, 34a,c,d, 35c; Nóra Várallyay: 33d.
The figures were made by Katalin Réthy and Kata Laura Tamás.

Our thanks to the contributing producers and professionals for the photographs!
We would like to thank all producers, researchers and experts who contributed to this book.

This publication was produced with the support of the CO-FRESH project.

This project was supported by the European Union's Horizon 2020 research and innovation programme under grant agreement no. 101000852.

This publication was produced with the support of the DIVINFOOD project.

This project was supported by the European Union's Horizon 2020 research and innovation programme under grant agreement no. 101000383.

TABLE OF CONTENTS

1 INTRODUCTION

1.1 Who is this book for and what is it about?

The purpose of our book is to encourage readers to grow and consume certain types of legumes that have been neglected in recent decades. It is also addressed to producers interested in sustainable farming, consumers trying to navigate environmental and health issues, and all professionals who come into contact with food systems or gastronomy in the course of their work.

We hope to show how small producers, arable farmers, researchers and growers, chefs, and consumers operate – sometimes collaboratively, sometimes independently – in seeking out, preserving, and improving the traditional varieties that can still be found, as well as introducing unknown varieties into local cultivation. To better understand the overall picture, it is essential to review the history of leguminous plants in local and global history, as well as to map the circumstances that led to the decline of this diverse group of plants.

Between 2015 and 2020, Agri Kulti and ESSRG, as members of the international consortium of the TRUE project, examined value chains related to leguminous plants and the opportunities for cultivation in Hungary. The results of the research showed a devastating picture of the research and breeding environment, which has become fragmented in some places and has completely ceased in others, both in terms of value chains and the decreasing cultivation area and volume of consumption. The negative effects of climate change have a particularly severe effect on leguminous plants and their cultivation. Among the traditional Hungarian landrace beans requested from the gene bank, during cultivation experiments, most fell short of our expectations in terms of yield, and in many cases, it was impossible even to replace the amount of seed sown. In addition to traditional common beans, we have also tried leguminous plants that are less well known or have already been forgotten in our Hungary – and we have already achieved promising results with them. During interviews with experts, we met dedicated professionals whose work can help boost the situation of leguminous plants in Hungary.

It is beyond doubt that the challenges of the 21st century in agriculture and food production will lead to an increase in the value of leguminous plants. Thanks to their extraordinary variety, they can be grown under diverse environmental conditions, and they play an important role in organic agriculture due to their ability to fix nitrogen; in addition, they are a staple of many cuisines, and a key ingredient in many dishes, both innovative and traditional.

In the first part of the book, we provide an overview of the consumption and cultivation trends of leguminous plants, the research results of the TRUE project, and the key players in the leguminous plant value chain. In the second part of the book, we describe in detail the information related to the cultivation, variety preservation, and plant protection of leguminous plant species, as well as those legume species that can be grown in Hungary and the acquired knowledge of small-scale cultivation. Although our book focuses primarily on fresh and dry legumes intended for human consumption, and on their small- and medium-scale organic cultivation, we also try to tangentially present their role as animal fodder and in sustainable farming. In the third part of the book, we give general guidelines for the use, storage, and preparation of legumes.

1.2. The large family of beans, peas, and lentils

Taxonomy – botany

Leguminous plants belong to the Fabaceae/Leguminosae family of the order Fabales, which is the third most populous plant family with 20,000 species and 700 genera. They are widespread everywhere in the world, except at the poles, and range from small herbaceous plants to huge trees. In the Latin terminology, "faba" refers to the name of the broad bean, while the term "legume" refers to the pods in which the beans grow, from which the name of this group of plants and their fruits originates in many languages. The petals of the nectar-producing flower, characteristic of the family, consist of an upright sail, side oars and a fused "canoe" underneath. It is from this that the pod develops, opening along the abdominal seam and the main dorsal vein. Many members of the Fabaceae/Leguminosae family are climbing plants, with correspondingly modified plant parts for clinging.

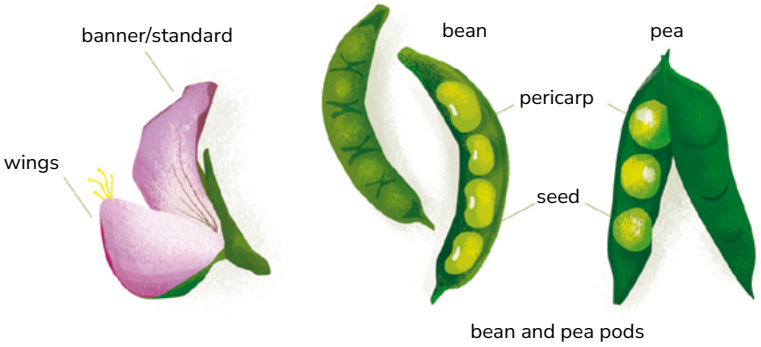


Figure 1: Legume flower and pod

A significant number of plants belonging to the family form a symbiotic – i.e. mutually beneficial – relationship with certain soil bacteria, such as the *Rhizobium* bacteria. A special formation on the roots of plants, the root tuber, enables this. The bacteria are able to fix atmospheric nitrogen, and as a result of the partnership, they supply not only their plant partner, but also the soil around it, with nitrogen. In return, the plants feed the bacteria with carbohydrate compounds (sugars).

Photograph 1: tubers on the root of a common bean plant

Domestication

Due to their extraordinary diversity, nutritiousness, and wide geographical distribution, leguminous plants were – like grains – among the main sources of food for mankind even before they were domesticated. Leguminous plants were among the earliest domesticated plant groups. Remains of pea, lentil and vetch seeds have also been discovered in Turkey from around BCE 7000-8000; around BCE 5000, green peas and horse beans were already grown in the Swiss lake region; In today's China, soy was domesticated around BCE 2000-3000 BC, and around BCE 1000, soybeans were already being grown on the American continent.[1] Thanks to ever-expanding trade, legumes travelled across continents and, far from their original centres of domestication, adapted to the local climatic and cultivation conditions and found a place among the staple foods of many nations. Before the colonization of America, broad beans, chickpeas, and green peas were staple crops in Europe.

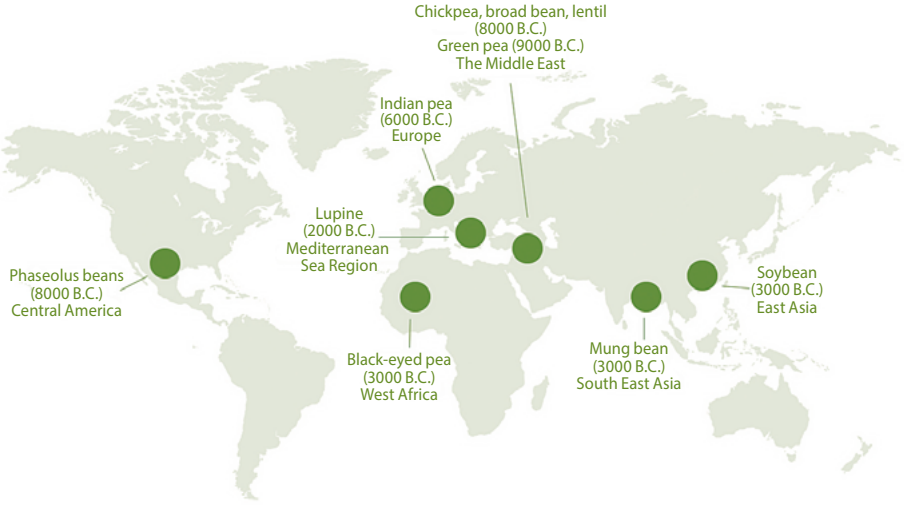


Figure 2: The centres of domestication of the most common leguminous plants and the estimated time of their domestication.

It is a well-known fact that the seeds of legumes have a high protein content, but they also contain large quantities of minerals, vitamins, and slowly absorbed carbohydrates and dietary fibre. Alongside grains, pseudocereals, and starchy plants, dry legumes are still considered a staple food in many parts of the world, especially in Africa, South America, and Asia.

Fresh or green legumes

These are legumes grown in intensive arable or horticultural cultivation, which are classified as vegetables either in their shells or shelled. They reach consumers either without processing as a fresh market product, or after processing in canned or frozen form. In Hungary, green peas, common or green beans, and fresh shelled beans are the most familiar forms, while sugar snap peas and pea shoots are also known as premium products. Among fresh, market products, it is also worth mentioning mung bean and soybean sprouts, which are usually grown in smaller food production plots. In addition, the flowers of beans and peas appear as decorative products in top gastronomy.

Photograph 2: Fresh pulses of black-eyed peas, broad beans, and sugar-snap peas

Dry legumes intended for human consumption

In the past, these were legumes grown in garden or small-plot conditions, but now more often in large-field agricultural conditions. In these cases, the seeds of will already have dried up in the pods when they are harvested. After cleaning and processing, packaged dry leguminous goods, canned goods, frozen goods, and other processed products (e.g. tofu, seed milk, and paste) are made from them. Depending on the protein content and other content values, they can also be used as food additives to replace meat, milk, or eggs, and to enrich finished products with protein. Dry legumes suitable for human consumption include various beans, lentils, split peas, chickpeas, and soybeans, as well as alternative plants that are less well-known in our country, such as the Indian pea or the lupine.

Photograph 3: Broad beans, lentils, and dry legumes

Legumes for livestock forage

In animal feeding, leguminous plants are present in the form of dry leguminous, fibrous, siloed, or grazing feed. The group of dry legumes for animal feed includes soybeans, fodder peas and horse beans; in terms of leguminous plants, the dominant fibrous and grazing feed plants are alfalfa and vetch.

Cover crops, green manure

Leguminous plants play an important role as green manure when included in a crop rotation (ploughed into the soil when green, even before the seed ripen) and as a cover crop during fallow times. In both cases, they also contribute to improving the structure of the soil. The use of cover crops and green manure crops is important primarily in organic agriculture, but it is also increasingly common in no-till and conventional large-scale field cultivation. Plants used alone or in combinations include, for example, lentil, brown hemp (Crotalaria juncea, a legume species of Indian origin, which is mainly used in frost-free ground cover mixtures), lupines, broad beans, and peas.

Photograph 4: Cover plant seed mix of lupine, brown pea, radish and phacelia

Traditions of legume use in Europe and Hungary

Hungary has a long tradition of growing and consuming legumes. Until the spread to Europe of bean species from the American continent (the *Phaseolus* species), i.e. roughly until the 17th century, broad beans, peas, and lentils were the types most commonly consumed in the Carpathian Basin. Common bean largely supplanted the broad bean, due to its higher yield and easier digestibility. Dry legumes were especially important as a food for the poorer strata of the population. The consumption of green peas as a vegetable spread in the 16th century, and of green beans in the 19th century.

György Forgó in his treatise on gourmet foods in *Tudományos Gyűjtemény*,[2] or Scholarly Collection, published in 1817, for example, writes the following:

> *"The leguminous crops (Legumina, Hülsenfrüchte) can all be ground into flour; but as they are more expensive than grains, and the flour produced is of much inferior quality, they are not used for bread, but only for vegetable stews, which may accompany bread. Nor do they seem intended for the daily consumption of the people, but nevertheless, in times of scarcity or when cooked at home, and perhaps seasoned with a little oil or fat and salt, they can fill a starving stomach; or, mixed with cereal flour, the amount of bread can be increased and even multiplied."*

Every nation throughout Europe has its legume crops adapted to local conditions, and corresponding traditional dishes. In the Mediterranean regions, it is predominantly chickpeas, black-eyed peas, and certain types of common beans that are typical, while in continental areas common beans and green peas, and in cooler, rainier regions lentils and broad beans are most commonly grown.

In addition to cereals, legumes were also among the first domesticated plants, so they have been continuously present in cultivation since the dawn of agriculture. Among dry legumes, Hungary was a leader in the cultivation of lentils, dry peas, and beans, and in the production of fresh legumes and green peas. There was a period in the 1970s when Hungary produced 2.5% of the world's dry pea crop and 7% of its green pea crop.[3] The lentil cultivation area reached 10,000 hectares in the 1980s, but this figure has now decreased to only around 300 hectares. Although chickpeas do not currently form an important part of our diet, based on written records from the 14th century, they were consumed green in Hungary in the same way as green peas, and when dry were used in vegetable and meat stews.

Photograph 5: Traditional Ponzichter bean curd on the menu of the Erhardt Restaurant in Sopron

Hungarian breeding traditions

Ödön Mauthner founded the Iregszemcsei Research Institute in 1936, which at first operated as a seed trading company, but from the 1970s, the breeding, research and cultivation of legume and oil crop seeds became the focus. From the very beginning, they were key players in soybean breeding work in Hungary, but research was also carried out on black-eyed peas, green peas and chickpeas. Juliska beans, a runner bean variety popular throughout the country, were bred at the institute. At the National Agricultural Research and Innovation Centre (NAIK-NÖKO Szeged) belonging to the Hungarian University of Agriculture and Life Sciences, they select leguminous species and varieties that are adapted to the local climatic conditions or have properties that are valuable for the food industry or as animal feed. As a result of their work, the cultivation of broad beans, chickpeas, or field peas may become more popular in Hungary in the future.

One of the important players in domestic gene conservation is the Plant Gene Conservation Institute (NGI), a gene bank in the small town of Tapiószele. The gene bank operates as part of the National Centre for Biodiversity and Gene Conservation, which, among other things, manages the conservation, maintenance, and distribution of propagating material for leguminous plants that can be grown in Hungary. In addition to state actors, profit-oriented enterprises deal with variety domestication, maintenance, and breeding, particularly of soybean, green pea, and green bean varieties. The state-operated Zöldségkutató Intézet (Vegetable Research Institute – ZKI), which is part of NAIK, carries out the breeding of green peas, while Szójamag Kft. breeds soybeans. The breeding and preservation of special varieties of leguminous species that are currently not cultivated or are cultivated only at a small-scale level takes place in state research institutes and universities.

The leguminous gene bank collection of the National Centre for Biodiversity and Gene Conservation

Different field crops react to climate change in different ways. Leguminous plants are very strongly affected by the development of climatic conditions, including the amount and distribution of precipitation. In particular, as a result of extreme weather events such as drought, especially atmospheric drought, the cultivation of our staple legumes can become impossible. In particular, common beans are in an increasingly critical situation. Cultivation of new or previously neglected species, varieties, and landrace types that are better adapted to the changed conditions is becoming increasingly necessary. This certainly sharpens our awareness of the importance of the preservation and breeding work conducted by gene banks. The gene bank has the biological tools with which we can respond to these challenges.

The third largest collection of the Tapiószele gene bank is made up of leguminous plants – a collection consisting of almost 10,000 unique items. Almost a third of this, more than 3,000 items, comes from Hungarian collections. The main plant species belonging to this collection and the number of individual units are listed in Table 1.
Common beans have the largest number of gene bank units among legumes. Due to this species' specific genetic properties, numerous varieties have been developed. The high number of

Species	Number of units (pcs)
Common bean	3 960
Pea	1 233
Chickpea	1 130
Lentil	1 067
Soy	773
Black-eyed pea	352
Broad bean	345
Indian pea	306
Runner bean	271
Peanut	79
White lupin	52
Lima bean	47
Adzuki bean	26
Mung bean	13

Table 1: The main plant species and unit numbers of the gene bank's legume collection

gene bank items also shows that many regions, sub-regions and even households had and still have their own landrace variety.
Peas are also strongly represented, as they are a species which can be used in many different ways – green, from the pod (sweet peas), dry (yellow peas), and processed, as an important food crop. Due to their outstanding nutritional value, they also play an important role in livestock feeding (field or fodder peas).

In the chickpea collection, which is also very large, there are relatively few landrace varieties, but those few landscape varieties collected in the local Hungarian environment may be extremely important from the point of view of climate change.

The cultivation of lentils, which have been used almost exclusively as human food, was significant in some regions until the middle of the last century. Since then, this has stagnated or fluctuated strongly, so domestically collected items must be given great importance from a gene bank perspective.

Due to its high protein and fat content, soy is a very important fodder crop. Its direct use in the kitchen is less common, and it is mainly found in processed products. Hungary is at the northern limit of its zone of cultivation, which is why every variety adapted to these conditions has outstanding genetic value.

Climate change will primarily determine the future cultivation of the drought-tolerant black-eyed pea, or cowpea, as well as the utilization of domestically collected gene bank items.

Photograph 6: The National Biodiversity and Gene Preservation Centre's common bean presentation

1.3. The importance of legumes in environmentally friendly farming, climate change mitigation, and adaptation

Food challenges

From the point of view of our planet and our own health, natural resources, especially the long-term sustainable use of agricultural land and sustainable nutrition, are crucial. In the 20th century, as a result of the industrialization of agriculture and the explosive development of technology, the amount of food and calories produced increased at an astonishing rate, but our eating habits and agricultural production methods are endangering our environment and our health. Based on the results of a comprehensive 2017 global study,[4] poor nutrition has now overtaken smoking as the leading cause of death worldwide. Every fourth adult death worldwide is caused by a chronic disease related to nutrition. The most serious problem is low fibre and vitamin intake, as well as the excessive consumption of salt, sugar, red meat, and processed meat products. Meanwhile, in 2023, 800 million people in the world will be malnourished,[5] meaning that they will not have access to an adequate amount of food.

By 2050, the world's population is expected to reach 9 billion, and many of them will want to consume more dairy products and meat. This trend can currently be observed in China and India, where the consumption of animal products is increasing in parallel with economic development. Coupled with climate change, this puts an ever-increasing burden on farmland and water resources. While meat, milk, and eggs are almost unattainable for the populations of many countries, legumes are an affordable and nutritious source of protein and calories, and together with grains, they play an important role in the fight against hunger and malnutrition at a global level. Nor should we overlook the fact that to produce 100g of beef protein, greenhouse gas emissions are approximately fifty times higher than for the cultivation of 100g of legume protein, while emissions from producing chicken protein are approximately six times higher.[6]

In contrast to perishable animal products, dry legumes contribute to the generation of food waste to a much lesser extent, since they can be kept for many years if stored properly. In addition to covering the food needs of small producers at home, dry legumes can also be used as fodder, cover crops, or green manure, are a good reserve food in extreme weather conditions, and their cultivation can mean extra income for farmers. Due to their ability to fix nitrogen, leguminous plants reduce the need to use artificial fertilizers, thus reducing production costs. Legumes can also be grown in areas that are excessively dry, or where rainfall distribution is too unreliable for cereals.

Photograph 7: Kitchen storage of landrace Baja black-eyed peas and Markóc common beans

Our cultural traditions, social status, and place of residence also play a role in the development of our eating habits. It is not easy to make conscious decisions, even if virtually all food types are physically and financially available to us, as in addition to the endless choice, it is often difficult to navigate among the many often contradictory, sources of information related to healthy and environmentally friendly eating. Due to their variety, dry leguminous plants can be included in all forms of eating, and based on the current scientific consensus, their consumption has many health benefits:[7]

- they reduce the likelihood of developing circulatory diseases and diabetes, so they can play an important role in the treatment of obesity and can reduce the risk of inflammatory conditions and the development of cancer;
- due to their high protein and fibre content, they are a suitable replacement for animal proteins and for feeding the intestinal microbiome;
- they increase the feeling of satiety through their slowly absorbed carbohydrate and dietary fibre content;
- they are rich in micronutrients;
- with the exception of soy and peanuts, they are low in fat.

The bioactive substances and enzyme inhibitors found in legumes, such as lectins, oligosaccharides, saponins, and tannins, can make digestion difficult. These compounds are responsible for the bloating effect of legumes, and in the case of dry legumes, consumption in the raw state is not advisable. However, digestibility can be improved with a number of simple kitchen technical solutions, which are discussed in chapter 3. Green leguminous plants – the seeds of which have not yet reached full maturity – are considered vegetables in terms of consumption. The protein content of green peas and green beans is lower, while the vitamin content is higher than in their dry legume counterparts.

	Energy (kcal)	Fat (grams)	Carbohydrate (grams)	Protein (grams)
Beans	347	1,2	63	21
Lentils	352	1,1	53	24
Soy	446	20	30	36
Beef	250	15	0	18
Eggs	155	11	1	13
Chicken	239	14	0	17
Milk	42	1	5	3

Table 2: Nutritional value of animal products and legumes per 100 grams of dry legumes, meat, milk, eggs

The EAT Lancet consortium asked 37 leading researchers from 16 countries to compile a globally valid dietary recommendation that benefits both human health and the environment, as well as meeting certain scientific criteria. The recommendation presents a predominantly plant-based diet, while also urging drastic reductions in food waste and improvements in agricultural food production practices. Based on the researchers' recommendations, a bowl of healthy and sustainable food should contain 50% fruit and vegetables, 50% whole grains, plant proteins, and unsaturated vegetable oils, and a moderate amount of animal protein. Based on the recommendations, we should consume an average of about 100 grams of dry legumes and only about 50 grams of meat per day.

	Kcal/day
Wholegrain cereals	811
Starchy vegetables	39
Vegetables	78
Fruit	126
Dairy products	153
Meat, fish, eggs	151
Legumes	426
Oilseeds	149
Unsaturated vegetable oils	440
Sugar, honey	120

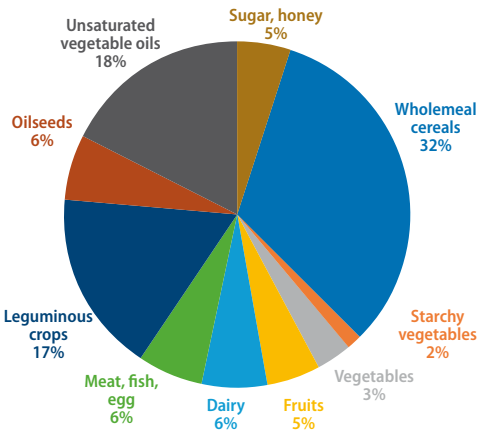


Figure 3: A diet compiled by EAT Lancet researchers, which is environmentally sustainable and nutritionally balanced. Recommended daily intake based on calorie source 2500 kcal/day for a representative diet

Environmentally friendly farming

Agricultural production, as well as the transportation, storage, and processing of food, places a significant burden on our environment, and is closely related to gas emissions that cause climate change. 40% of the Earth's land[9] is under agricultural cultivation, so the methods we use to farm in these areas are of the utmost importance. Agriculture is responsible for nearly half of the world's CO2 emissions and about 26%[9] of greenhouse gas (GHG) emissions. In the latter case, for example, the production of fertilizer, the operation of agricultural machinery, and the packaging and transportation of products are significant factors. However, agricultural production is not only a cause of climate change, but also a victim, as production conditions also change under changing climatic conditions. Our tried-and-tested practices lead to failure more and more often, while the cultivation of our previously reliable plants is becoming increasingly uncertain.

Photograph 8: Unirrigated field of black-eyed peas at the Gál Farm in Bugac

The fight against climate change must therefore be fought on two fronts simultaneously: mitigation, to alleviate the harmful effects, and adaptation, to adapt to constantly changing growing conditions. In Hungary, recent years have seen phenomena related to climate change become more and more drastic: winters and transition periods are becoming shorter and shorter; average temperatures are rising, while the amount of precipitation is decreasing, and precipitation distribution is changing. These changes significantly complicate the work of farmers. In addition, increases in the price of fossil energy carriers and the disruption of global supply chains – for example in the case of fertilizers – necessitate a radical rethink of agricultural production. This applies, among other things, to the introduction of new plant species and varieties, a re-evaluation of the goals of breeding, issues of nutrient management, and water retention and the development of water-saving production methods.

The Great Protein Dilemma

One of the central challenges on the agricultural front in the fight against climate change is the type and production method for the protein consumed by mankind. The production of animal proteins is responsible for 60% of food production emissions and 16% of the world's total GHG emissions. Methane released during ruminant animals' digestion, deforestation to create pastures and arable fields, and the large-scale transcontinental trade of animal feed, mainly soy, all play a decisive role in this. There is now a clear scientific consensus that the environmental footprint of agricultural production must be reduced, including the environmental and climatic effects of cultivating animal products. There are several options for reducing this ecological footprint: for example, the use of regenerative grazing systems instead of industrial animal husbandry, the introduction of locally grown alternative feed instead of soy, or the involvement of local livestock farmers in the economic or regional nutrient cycle. In addition, meat consumption must be moderated on a global level and humanity's needs must be met from alternative protein sources. Innovative solutions such as insect protein or laboratory meat are gaining more and more traction, but in addition to these, traditional leguminous plants and the convenience products made from them will also play an important role in the future, precisely because of their diversity and their embeddedness in food cultures.

All members of the legume family have a high protein content. Compared to animal products, the GHG emission per unit amount of protein produced from them is 0.6–4%, and the amount of water used is 30–50%. Nitrogen is the basic building block of proteins, and thanks to nitrogen bound from the atmosphere, the seeds of leguminous plants contain a large amount of protein, two to three times as much as in grains per unit of dry weight.[8]

After World War II, Europe's agriculture was characterized by intensification and the increased use of artificial fertilizers, while the integration of European production into the global food and feed market also began. At the same time, the amount of nitrogen washed into waterways increased, which caused and still causes serious pollution. In addition, nitrogen dioxide is released from nitrogen-based fertilizers, which acts as a greenhouse gas. European agriculture is still heavily dependent on nitrogen-based fertilizers. In addition, farm animals consume 75% of the protein crops produced in the European Union, and 20% of the feed comes from other continents,[10] which significantly exceeds the protein content of wheat and meat exported from Europe.

Reducing nitrogen pollution is a priority goal of the EU's Farm2Fork / CAP 2023–2030 strategy, but there is a danger that we will simply outsource pollution to other continents in the name of protecting the European environment. Agricultural production must focus much more on ecological interactions. Agroecological practices prioritize the support of energy and nutrient circulation within the farm, increasing the nutrient content of the soil, improving its biological function, maintaining q diversity of genetic resources, and integrating plants and animals into the nutrient supply processes of the farm. Instead of input-intensive systems that seek to maximize the yield of certain crops, in the agroecological approach, production systems are based on interactions, and productivity is interpreted at the system level.

Ecosystem services

Ecosystem services are the benefits that nature and healthy ecosystems provide to people. Their role is unavoidable in agricultural production, providing clean drinking water or supporting the circulation of organic waste.

Photograph 9: The flowers of leguminous plants are an attractive source of food for pollinators

The ability of leguminous plants to fix nitrogen reduces the need for nitrogen fertilizers and has a direct, positive impact on soil biodiversity. Through symbiotic atmospheric nitrogen fixation by means of *Rhizobium* bacteria, legumes can deliver 30–40 kg of atmospheric nitrogen per hectare to the soil. Legumes grown as fodder, green manure, or cover crops can fix up to 300kg of nitrogen per hectare. With their deep-penetrating roots, some legumes also draw up phosphorus from the deeper layers of the soil. Their plant remains can be used as animal feed and compost material. They act as a catalyst for the diversity of soil microbiota, leaving behind a healthier soil. They can show their beneficial effects most clearly if they are part of a varied crop rotation – be it in an arable, horticultural, or small-garden setting. Built into the crop rotation, they also help with weed and nutrient management. Cultivation of cereals and legumes together with legumes not only reduces the need for nitrogen fertilizers, but also suppresses soil erosion through mulching. Such diversely associated polycultures give a more stable yield in periods of drought. In low-till or no-till systems, partial or complete abandonment of ploughing increases the efficiency of nitrogen use, reduces GHG emissions, binds carbon in the soil more easily, and improves soil quality. In addition to nitrogen fixation, legumes play an important role in providing ecosystem services and preserving agricultural diversity. Their flowers of different colours, sizes, and flowering times provide food for diverse communities of pollinating insects, especially bees, from spring to autumn.

Photograph 10: Pairing pulses and grains: Black-eyed peas in rolled rye and chickpeas in emmer at the Gál Farm in Bugac

1.4. The current state of legumes

Cultivation, processing, and trade

In 2016, 2% of European arable land was used to cultivate legumes, while the global proportion was 4%. The EU produced 7.3% of the world's dry legume harvest in 2016. Dry bean production is led by Myanmar, yellow pea and lentil production by Canada, and chickpea production by India. European markets are largely supplied with dry legumes by Canada, Argentina, China, and Russia.

In Hungary, since 1989, the area used to cultivate dry and fresh leguminous crops has been steadily declining: though it was 3.5% in 1989, today it does not even reach 1%, and this cultivation takes place almost exclusively on small farms. One exception to this is soy, the cultivation of which has spread mainly in large farms thanks to the EU agricultural support system.

	1993	2022
Soy	42	62
Dry beans	135	12
Green beans	2,8	1,1
Green peas	12	17

Table 3: Area devoted to legume cultivation in Hungary /1000 hectares[12]

Soybean is the most important leguminous plant on the global feed market, including in Hungary, as it is soy that provides the highest amount of protein – and thus nutritional feed value – per unit area. Soy is the only one among a number of leguminous plants that have a global value chain similar to that of cereals. There are currently more than 60 recognized, non-genetically modified domestic soy varieties developed using traditional breeding methods. Despite the fact that Hungary has a significant growing tradition of many fodder plants (e.g. fodder peas, broad beans) in addition to soy, interest in them is decreasing, and there are no established product lines. With the change in climatic conditions, fodder peas, for example, can no longer be grown as reliably as they were even 20–30 years ago.
This downward trend in leguminous crop cultivation in Europe coincides with the intensification of agriculture, the simplification of crop rotations, and the disappearance of mixed farms that both grow crops and keep livestock. A study summarizes the reasons for the decline below:[13]

1) It is more worthwhile for farmers to grow cereals due to their high productivity and the price guarantees provided at the national and EU level.
2) Cheap, imported feed from other continents, especially soy, has become widespread, so local feed supply chains have been rendered less important.
3) Techniques enabling the cultivation of high-profit crops grown in large, seamlessly connected fields is developing rapidly.
4) Due to the availability of nitrogen fertilizers, the ability of legumes to fix nitrogen has seemingly become less important.
5) Calorie and protein intake has shifted towards meat, animal products, and grains, while in the eyes of consumers, legumes are lower-prestige foods.
6) The lower productivity of legumes has not been compensated for by technological innovation; neither climatically adapted, high-yield varieties, nor an advanced value chain, nor agronomic knowledge or targeted agrotechnical solutions have been employed to increase yields.

According to the experts interviewed, the factors most hindering production in Hungary are low profitability, the lack of technical or breeding improvements, and the shift of cultivation to other countries. Given targeted improvements elsewhere (e.g. lentil cultivation in Canada, or green beans in the Netherlands), Hungarian producers could not compete. The decrease in domes-

tic consumption, the lack of integrated product paths, and variable yields all led to the reduction, or in some cases to the complete disappearance, of legume-cultivating regions. Since 1989, the structure of Hungarian arable output has been transformed; there are now four or five primary crops, each of which have their own market, product and delivery chains have been developed, and tested varieties are available which provide a more or less predictable income. Despite agri-environmental management subsidies, mandatory fallow periods, and diversification efforts, the cropping structure is increasingly shifting in favour of cereals, and marginal crops are being pushed out of cultivation.

Photograph 11: Soy has now become the most important leguminous plant: a soybean field in Nagynyárad

Among the major product path challenges, the time required for breeding is the most serious: the return of rare varieties that have fallen out of commercial circulation is slow, and variety preservation efforts often result in only a very small amount of seed. The breeding of leguminous plants therefore cannot respond quickly enough to rapidly changing market demands. In addition, the breeding process is quite expensive, since the breeding materials need to be grown and analyzed for a long time, in many different varieties, and the evaluation requires serious expertise. For this reason, in the case of alternative leguminous plants, the breeding activity is not economical, and state or international funds are required to finance experiments.

Regarding packaged dry leguminous and alternative products, domestic trade relies to a significant extent on imported goods. In terms of production, dry legumes have been progressively removed from cultivation since 1989. The reason behind this is a change in the production structure: dry legumes are difficult to fit into the modern sowing pattern due to their technical peculiarities. During the 1990s, lentil cultivation ceased completely, and domestic varieties ceased to be available. The cultivation of dry beans and dry peas has still survived to a minimal extent under large-scale conditions. It is also possible to grow chickpeas and broad beans in our country, and Hungarian varieties are available, but cultivation is currently minimal.

Photograph 12: Soybean breeding in Bóly

Recently, the development of canned and frozen products has moved in the direction of ready meals and health products: consumers are looking for products without additives, preserved only by freezing or heat treatment. Among fresh green legumes, green peas are the most popular domestically, both in terms of cultivation and consumption. In the case of fresh green peas, unlike in the canning industry, larger-grain varieties dominate, which are grown at a small-scale, horticultural level, usually involving manual labour. At the moment, green beans and fresh broad beans also appear in cultivation, although broad beans and sweet peas, which can be consumed from the pod, could potentially be grown at a small-scale level. In addition to the low level of mechanization in hor-

ticultural crops, a fundamental problem with legumes is the high labour demand and the high cost of mechanization. Fresh green legumes are highly seasonal products that are on the market from late spring to early fall.

Processing companies produce the necessary raw materials with specific varieties and pre-contracted producers; Hungarian green peas, green beans, and dry beans are used in the canning and refrigeration industry.

Consumption

Dry legumes can be found in the dietary traditions of almost all European peoples. In Hungary, we consume an average of 68.6 kg of meat and 0.7 kg[14] of dry pulses per person per year, while at the European level, the annual average consumption is 64kg of meat and 3kg of dry pulses.[15] After declining over recent decades, the demand for leguminous plants in Europe has started to rise sharply, but for the time being this process can be observed in Hungary at most among more conscious urban consumers.

One of the obstacles to the consumption of dry legumes is the widely known bloating effect, which, however, can be reduced by the method of preparation. Traditional, cheap, dry pulses require a long soaking and cooking time, but prepared meals made from them are often expensive. In our country, leguminous plants – with the exception of one or two traditional dishes – exist in the public consciousness more as side dishes or, in the worst case, as food for the poor, so they are culturally and historically considered low-prestige foods.

The bad eating habits common to the Hungarian population keep the majority of consumers uninterested in legumes. Conscious consumers can be confused by conflicting nutritional and health information about legumes. For example, the paleo diet, which prioritizes animal proteins and is widespread in Hungary, does not recommend the consumption of legumes. At national strategic level, the goal is to increase meat consumption, so substitute products, such as legumes, are relegated to the background. The dietary recommendation compiled by the Hungarian Dietetic Association (the Smart Plate) recommends that adults consume dry legumes only twice a week.[16]

However, an increase in the demand for legumes can be observed throughout Europe, primarily due to the spread of health-conscious eating habits and related information, as well as the increasing diversity of processed products available. Although cheese, meat, and eggs are the defining elements of the European diet, plant-based diets are also increasingly popular. Health and environmental considerations are leading to a steady reduction in meat consumption. One of the central issues in the conscious transformation of nutrition is the intake of adequate proteins, and legumes are an indispensable element in plant-based nutrition. One third of the European population follows a flexitarian diet, i.e. they consume products of animal origin, but are consciously trying to increase the proportion of plant-based ingredients in their diet. In Germany, the United Kingdom, and France, 5–10% of the population is already vegetarian.[11]

As a result of the increase in demand, European food industry players are constantly expanding the range of products made from legumes. Pre-boiled and pre-steamed pulses, for example, simplify consumption by shortening the cooking time. As consumer awareness increases and food companies invest in technological innovation, the demand for pulses is likely to continue to grow. Consumers of organic products are often early buyers of innovative, environmentally friendly and healthy foods, including legumes.

Opportunities for innovation

In a survey carried out in 2017 as part of the 'TRansition paths to sUstainable legume-based systems in Europe' (TRUE) project, supported by the European Union's Horizon 2020 program, we asked the main domestic players in the legume value chain about what innovation opportunities they see for breaking out of the previously outlined negative spiral. In the field of research and development, the resources available for innovation can be increased through strategic partnerships and EU research projects. From the point of view of production, it is beneficial that

GMO-free production is guaranteed throughout the country, which guarantees good quality and a high price premium. Greater utilization of area-based and greening subsidies, beyond soy, can improve the profitability of production. The diverse varieties found in the country serve as a good starting point for climate adaptation product innovations. In the field of processing, the growing demand for healthy, plant-based products opens up market opportunities for innovative products.

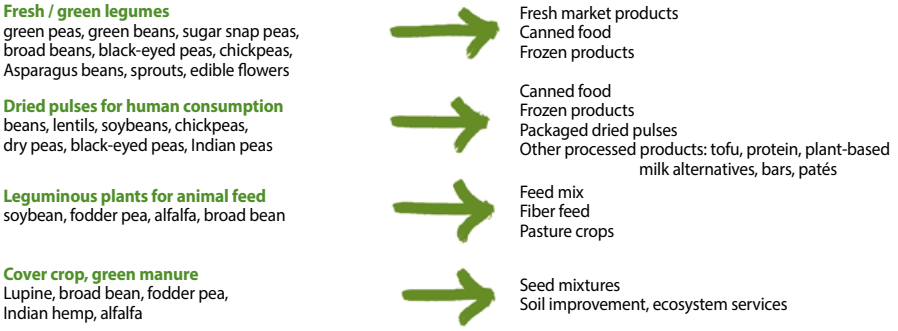


Figure 4: Grouping of leguminous plants according to use and the products that can be made from them

It is extremely important that the role of legumes in the protein strategies of the European Union goes beyond soy and animal feed. Development across the entire value chain is needed. The cultivation of legumes faces many agrotechnical obstacles, for which applied research and knowledge transfer can be the solution: new varieties are needed that are resistant to pests, can be harvested more quickly, and optimize nitrogen fixation. However, the opportunities offered by legumes are currently not being sufficiently exploited in agriculture or in the food industry to adequately support the development of sustainable food chains. Innovative uses and products can greatly contribute to an increase in legume consumption.

Innovation is important not only in product development, but also in production. Breeding now, for example, targets not only plants, but also the *Rhizobium* bacteria living in symbiosis with them. During breeding, they are optimized for different legume species, varieties, and growing areas. In the case of soybeans, this is already widespread, but soil inoculation can also be used for other species, which can improve the efficiency of biological nitrogen fixation, further reducing the need for external nitrogen fertilizers. Leguminous plants can also play an important role in increasing the efficiency of horticultural and arable crops.

However, high-tech product innovation is not always necessary: dedicated producers are playing an important role in reviving traditional dry legumes, while gene banks can be crucial in providing propagating materials, and a good marketing strategy is vital for market penetration. The dedicated team of long-standing research institutes and market players operating in the field of research, breeding and development, as well as the still existing genetic heritage covering a wide range of legumes, provide a good basis for future innovation in the field of breeding.

2 INTRODUCING GROWERS AND AUTHORS

2.1. Presenting the organizations on which this book is based

Agri Kulti Kft.

Agri Kulti Nonprofit Kft. is an independent research and development company founded in 2010. The focus of their activity is the research, modelling, and implementation of sustainable food chains. From the beginning, they have been operating on the frontiers of sustainable agriculture and gastronomy; their most important goal is to strengthen urban-rural connections by establishing short supply chains that are ecologically sound but also economically viable. They look for solutions for players in the HORECA sector, give advice to local governments, and also help establish for-profit businesses. This is how HÁZIKÓ Catering, the Funky Forest brand, the Nagymaros Growers' Market, and Szimpla Market were born. They believe in small-scale farms, and that the countryside can sustainably supply both itself and the cities with high-quality food. In recent years, as part of their work focusing on sustainable food systems, edible legumes have been given an increasingly important place. They are convinced that beans, lentils, and peas will play a prominent role in solving global agricultural and food security problems in the coming decades. The many thousands of available leguminous varieties are key to a colourful, varied, and environmentally friendly diet, and their cultivation greatly contributes to the preservation of cultivated and natural diversity, as well as to the health of our soils. That is why they work in domestic and international projects aimed at channelling hidden and underutilized leguminous varieties back into cultivation and consumption.

The Research Institute of Organic Agriculture (ÖMKi)

The Research Institute of Organic Agriculture is Hungary's first research institute specializing in organic farming and was established in 2011 to promote the domestic development and wider application of organic farming. As a result of environmental, social, and economic challenges, the research and development of sustainable food production has become extremely important, and close cooperation with the most important actors in the agricultural sector, including farmers, is essential. The arable cultivation research topics it engages with include the potential inherent in the cultivation and consumption of ancient grains, as well as the cultivation of underutilized grains and legumes, the latter of which is of particular importance due to changes in growing conditions caused by climate change. In Hungary, as a result of the increasingly long dry spells in summer, changes are also needed in organic farming, which includes the cultivation of plant species and varieties that are unfamiliar in the domestic context.

National Centre for Biodiversity and Gene Conservation (NBGK)

The National Centre for Biodiversity and Gene Preservation (NBGK) was established in 2019 as the base institution for domestic gene conservation, though the merging of the former NöDiK (Plant Diversity Centre) in Tapiószele and HáGK (Livestock Gene Preservation Centre) in Gödöllő, and it now functions as Hungary's largest gene bank and the national hub for gene preservation.

The Tapiószele gene bank, the NBGK Plant Gene Conservation Institute (NGI), carries out full-scale plant gene conservation activities. It carries out tasks related to the database for the conservation of genetic resources for domestic cultivated plants, as well as the preservation of the genetic resources of commercial and wild plant species as a genetic reserve. In addition, it seeks out, assesses and collects genetic resources for arable crops, vegetable crops, fruit and vine species, as well as domestic cultivated and natural flora, with particular regard to Hungarian landrace varieties and elements of the domestic flora which are particularly important from the point of view of agriculture, food, and nature conservation (table 4).

The work of the Institute also covers the agro-botanical assessment, documentation and publication of gene bank collections, as well as their medium and long-term preservation in refrigerated seed stores or planted in plots, and sometimes in in-vitro cultures. A closely related task involves the preservation and maintenance of domestic landrace varieties and ecotypes adapted to local conditions in their original place of cultivation – (known as "in situ" or "on-farm" preservation).

In parallel, the gene bank engages in research, development, and innovation, as well as rural development, education, and information-dissemination activities.

Form of preservation	Plant group	Number (pcs)	
Generative	cereals	21 347	54 085
	vegetables	10 739	
	legumes	9 999	
	industrial crops	3 038	
	forage legumes	2 822	
	grasses	2 298	
	PMB wild species	1 992	
	herbs	1 164	
	other	686	
Vegetative	root and tuberous plants	63	272
	bulb-forming species	209	
In vitro	potatoes and their wild relatives	676	676
Planting out	fruit	1 048	2 163
	ornamentals	996	
	grapes	119	
Total			57 196

4: Distribution of the Tapiószele gene bank collection according to the method of preservation

The Tapiószele gene bank participated in the TRUE Landrace Bean project between 2018 and 2020, with 33 different gene-bank seed pod varieties, such as broad beans, lentils, chickpeas, field beans, common beans, Lima beans, black-eyed peas, and cow peas, from which seed samples were also provided to the other participants of the project for small-plot yield-comparison experiments. The gene bank is also participating in the currently ongoing DIVINFOOD project, with small and large plot experiments and multiplication of batches of different leguminous plant species.

Magház Egyesület (Magház Association)

The Magház Community Network for Agricultural Diversity was established in 2012 with the aim of working to preserve the agro-biodiversity of the Carpathian Basin. Magház sees its primary mission as linking together organizations and individuals who are working to preserve and expand the diversity of cultivated plants in the Carpathian Basin. One of its main goals is to create local communities (hubs), thereby promoting the preservation and integration of a wide range of varieties into the local agricultural, social, and cultural environment. Members of their core community network also act as a local community knowledge centre and seed bank, so anyone can join a functioning community locally. The hubs collect, grow, propagate, and preserve old and new free-range varieties for variety maintenance. By sharing the varieties and providing education, they also support small producers in seeking out new varieties, while also working to ensure access to and appreciation of traditional and special plants on the market. Members of the Magház Egyesület grow many leguminous plants in their gardens and farms, and in recent years have actively participated in small and large plot variety testing and cultivation technology experiments in ÖMKI, NBGK, and Agri Kulti projects.

2.2. Producers and authors

Judit Fehér (researcher) and her parents, Mária and Gyula Fehér, both farmers

The family has been farming for generations; their one-hectare organic family farm in Nagyszékely has been in operation since 2011. Judit is one of the founding members of the Magház Association, an enthusiastic tester of new edible plant species and varieties, and a collector and preserver of varieties preserved as a part of the family heritage, including many common bean and other old, local varieties. The driving force behind the farm's operation is the testing of different varieties and the preservation and propagation of proven varieties. The surplus is processed and sold locally. In the second year of the TRUE project, Mária and Gyula joined in legume variety testing, which they expanded with their own well-proven varieties, such as the Markóc yellow common bean, the Szentjános haricot bean, the asparagus bean with purple pods, and the tepary bean, which grows even in desert conditions.

Photograph 13: Mária, Gyula, and Judit Fehér

Katalin Réthy, agroecologist, farmer

Katalin Réthy runs her 2,000-square-meter small organic vegetable farm in Páty, Hungary, under the name Szezon Kert. A member of the Magház Association, she is committed to agricultural diversity and seed conservation. She grows landrace varieties of drought-tolerant vegetables and special leguminous plants native to the Zsambék Basin. Of these, she is particularly interested in *Vigna* beans, such as black-eyed peas and asparagus beans, as they have proved to be more able to survive dry summers. Szezon Kert sells its produce to, among others, restaurants in Budapest, where the chefs and owners are committed to supporting producers and learning about unique ingredients. In this way, interesting items such as green chickpeas, asparagus beans, and black-eyed peas can be added to the menu.

Photograph 14: Katalin Réthy

Since 2017, Katalin has been actively involved in the legume research led by Agri Kulti and ESSRG. She has also worked on mapping the domestic value chain, and on testing leguminous plants from the national gene bank. She is currently working on the propagation and market-scale production of well-performing Fvarieties, such as the Jászberény landrace variety of black-eyed pea and the Italian black chickpea. Szezon Kert is the demonstration and experimental farm of the RADIANT and DIVINFOOD projects, where research involving leguminous plants is integrated with the growing produce.

Lajos Fodor, farmer

Lajos Fodor has been farming with his mother on two hectares in Siófok since 2000. Vegetables and fruit are grown using traditional manual methods and using small machines. Their products are sold to public catering companies, the Kistücsök restaurant, and at markets. They grow several varieties of common bean, including the Törek and majbab (liver bean) varieties, as well as Gipsy and Sonesta green beans, kidney beans, pinto beans, and cranberry beans. His favourite is the chestnut-flavoured pinto bean, which is excellent for soup. In 2018, the international team of the TRUE project visited his farm, where they learned about the small-scale cultivation and cleaning of beans, and even enjoyed a bean lunch made from Lajos's produce in the Kistücsök restaurant.

Photograph 15: Lajos Fodor

Ági Palásti Kovács, farmer

As a fourth-generation farmer, Ági has been producing organic fruit, grapes, and vegetables on 26 hectares since 2011. In addition to growing, she also processes food, making jams and syrups. Her products are sold to catering establishments, both wholesale and via her online shop. In terms of leguminous plants, she grows black-eyed peas, common beans, and runner beans. As part of the TRUE project, she has tried growing 22 different varieties of legume. Her favourite variety is the Verpelét common bean, from which she makes a delicious soup, and she has experimented with hummus made from black-eyed peas.

Photograph 16: Ági Palásti Kovács

Photograph 17: Orsolya Papp

Orsolya Papp, farmer, researcher

Since 2020, she has been managing her Orsiherba Biokert farm in Zsámbok, where she practices certified organic farming on a 2,500m^2 plot. In addition to organic vegetable cultivation, research, variety maintenance, presentation, education, and processing also play important roles: in her small workshop she makes pickles, vegetable creams and juices, and dried herbs. She sells her products primarily to vegetable box communities. Among leguminous plants, she grows asparagus beans, broad beans, and various types of common bean. Her favourite is arparagus bean, which can replace green beans in times of drought, and broad beans, which are difficult to protect from aphids, but are very tasty.

As an employee of the Research Institute of Organic Agriculture, Orsolya participated in the preparation, evaluation and summarization of the yield data sheets, and worked on the variety descriptions and the presentation of cultivation methods in our book.

3 CULTIVATION GUIDE

3.1. Nutrient management, plant protection

Legumes have a reputation for being relatively easy-to-grow plants, even though many pests and diseases hinder their successful cultivation, and in recent years, spring and summer droughts have likewise made production difficult. We can respond to the challenges posed by pests and climate change by choosing the most suitable species and varieties for our region, by sowing at the correct time, by carefully managing nutrients, and by using preventive plant-protection methods. Below, we describe the basics of nutrient management for leguminous crops, as well as the most common pests and diseases.

Nutrient management

Due to their ability to fix nitrogen, leguminous plants play an important role in crop rotation. They are good preceding crops for nitrogen-hungry plants such as pumpkins, cabbages, tomatoes, or peppers. It is important to note that enriching the soil with nitrogen in this way is most effective if the leguminous plant is turned into the soil after harvesting or left to compost in place as part of the mulch. When planning the crop rotation, it is important that at least 4 years pass between the sowing of leguminous plants in the same area. Leguminous plants that are sown too often in succession suffer from so-called "legume-fatigue", i.e. they perform worse due to pathogens multiplying in the soil and nutrient depletion.

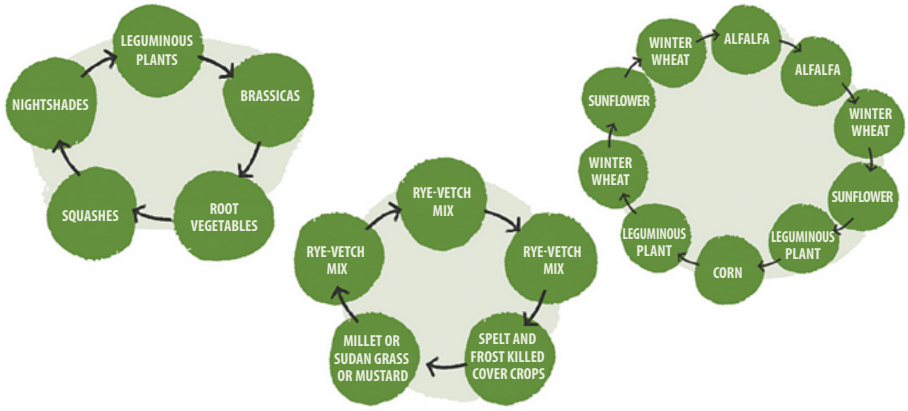


Figure 5: Intensive horticultural and arable crop rotation patterns including legumes

As part of a mixed cultivation plan, legumes can be incorporated into low-nutrient-input farming, as this way more of the limited available nitrogen goes to the non-leguminous species, while the low nitrogen content encourages the formation of root nodules in the legumes. However, the ability to fix nitrogen does not mean that leguminous plants do not need nutrient supplementation. Young plants do not develop their root nodules for a few weeks, and need readily available nitrogen for the development of healthy foliage. The supply of phosphorus and potassium is especially important during flowering and fruit-setting, as a lack of these nutrients can result in failure to set fruit.

In organic farming, the nutritional supplementation of legumes is typically covered using compost, and mature compost can be spread around the "hungry" crops preceding the legumes. Below is a summary of the substances suitable for nutrient replenishment used by our producers.

- Compost: 2–6 wheelbarrows of compost per 10 m^2 raked across the soil surface before sowing.
- Wood ash: suitable for supplementing potassium and phosphorus, preferably spread on the soil surface in small quantities, because otherwise it can damage green plant parts.
- Pelleted animal manure: a product with a high nutrient content that can be absorbed in a few months. Its use is good for legumes with higher nutrient requirements, e.g. broad beans, green peas, or common beans. Amount: 0.5–2 kg/m^2 sprinkled in the seedbed or lightly worked into the soil when sowing.
- Alginite: mined mineral fertilizer suitable for replacing microelements. Amount: when sowing, 0.2–0.5 kg/m^2 sprinkled in the seed bed or lightly worked into the soil.

Cultivation conditions

Leguminous plants have adapted to different climatic conditions as a result of having been domesticated in different geographical areas and bred in different directions. These factors greatly influence their cultivability during different seasons. From the point of view of domestic cultivation, the following groupings should be taken into account when planning the crop rotation:

Cold-loving, frost-tolerant: these leguminous plants do well in the autumn and spring growing season, typically in rainy or irrigated conditions. Depending on the variety, they may be suitable for winter sowing, i.e. if sown in late autumn and allowed to germinate, they will survive the frosty months without growth, then start to develop rapidly in the spring. Even in the case of spring cultivation, it is worth sowing them as soon as possible after the soil has thawed. In dry spring conditions, supplementary irrigation is necessary, especially during flowering and fruit setting. The pea is a well-known cold-loving, heat-intolerant plant. It must be sown as early as possible in the spring in order to produce an abundant harvest. With late sowing, both vegetative growth and yield will be very limited. This group includes broad beans, green peas, sugar-snap peas, and lentils.

Heat-loving, less drought-tolerant: frost-sensitive plants which should be sown after the danger of frost has passed, from mid-May. Varieties with a short growing season, especially green legumes, are also suitable re-sowing until the end of June. They struggle to survive the dry summer months, and so require a lot of watering. Based on our experience, if they successfully survive the summer heat, they will continue to produce until October in prolonged, wet, warm autumn weather. However, in cool weather, growth and development of the beans stops, and weakened plants can easily become targets of various pathogens. *Phaseolus* beans belong to this group.

Heat-loving, relatively drought-tolerant: frost-sensitive plants which should be sown after the danger of frost has passed, from mid-May. Sufficient irrigation is necessary, but they are more resistant to dry weather and produce crops even in dry summers. Chickpeas and *Vigna* beans belong to this group.

It is especially important to protect germinating seeds from birds in the early spring. Crows, pigeons, and pheasants can cause significant plant loss by scratching out germinating seeds. The beds can be covered with Raschel netting, or a low polytunnel can be made using a fleece or polyethylene cover. This solution also warms the soil, so can speed up early spring development, but also provides protection against late frosts and rabbits.

Photograph 18: Frost-damaged broad beans

Photograph 19: We can also protect leguminous crops with bird netting, Raschel netting, or fleece covering to protect against frostbite and birds, but also against weevils

Leguminous plants have relatively good shading properties in their developed state, with the exception of chickpeas and bush-type black-eyed peas. In terms of plant water and nutrient supply, mechanical weeding in the weeks after emergence is important in all cases. By covering and mulching the soil, we can help retain water and suppress weeds. Mulching should be done after the first weeding after germination, for example with straw or chaff.

Photograph 20: Mulched green pea beds in May and June

Green peas, sugar-snap peas, and climbing *Phaseolus* and *Vigna* beans require support. A cucumber frame, a support system made of stakes, or even a more substantial wooden framework can be suitable for this. Under arable growing conditions, we can provide support for leguminous plants by intercropping green peas with wheat, for instance, or lentils with oats.

Photograph 21: Different support systems for runner beans and peas

Harvesting and post-harvest treatment

Photograph 22: Green leguminous black-eyed pea and chickpea crops

Getting the harvest time right is an important element in achieving the right quality. Green legume (*Phaseolus* and *Vigna*) and sugar snap pea pods are suitable for harvesting when the pods snap and break and are not yet fibrous. In the case of crops that have to be shelled, such as green peas, green broad beans or green chickpeas, it is worth timing the harvest based on the tenderness and size of the grains. At the peak of a good harvest, it may be necessary to harvest every 4-5 days due to continuous ripening. Green leguminous plants are harvested by hand in small-scale farming, while specialized picking machines are profitable on larger farms. The crops must be stored in refrigerated or cool conditions until they are sold: in a refrigerator or freezer for two to three days, or in a cellar for a maximum of one day.

Dry legumes should be harvested when the pods have already dried to a crisp. Due to the prolonged ripening, it is rarely possible to harvest the entire crop at once, but due to their ability to ripen after harvest, this is not necessary. Most dry legumes can be harvested when the pods begin to yellow and dry. In such cases, the most important thing is to be able to carry out post-ripening and drying in a dry location protected from moisture. Smaller quantities should be dried in a crate lined with paper, while larger quantities should be spread out on a tarpaulin and covered at night.

Photograph 23: Post-harvest ripening of Markóc dry beans in a crate, drying and turning of chickpeas on a tarpaulin

After drying, threshing can be done by machine or by hand. When put into a sack or a tarpaulin folded in half, the seeds can be pressed from the rattling pods or threshed by hand. The cleaning can be carried out by air winnowing, whereby they are tipped from several feed up from one crate or bucket to another in windy weather, separating the heavier beans from the lighter shells. As a last step, we can clean the dry leguminous grains of smaller debris by sieving and sifting.

Photograph 24: Hand sorting black chickpeas after winnowing

Plant Protection

In organic plant protection, support for agro-biodiversity, improving the general condition of plants, and disease prevention with agro-technical methods all play a prominent role. If possible, the substances allowed in organic farming are only used in a targeted manner and based on specific forecasts! The general aspects of preventive plant protection in the organic cultivation of legumes are as follows:

implementation of at least a four-year crop rotation for all legumes,

provision of adequate nutrient supply, supporting soil life,

removal of other plants from the area, weeding,

maintenance of ecological zones, uncut lawn areas, and hedges around the garden or farm, providing habitats for the natural enemies of pest,

thermos-composting, i.e. professional composting at high temperatures, during which plant pathogens and larvae are destroyed,

in small garden conditions, poultry can significantly reduce insect pests and their larvae during soil work in autumn and spring,

when collecting seeds, only take seeds from healthy plants,

plant association: root secretions and essential oils produced by certain plants help keep pests away. For example, marigolds are effective against nematodes, and cruciferous flowers are effective against wireworms.

Preparations and products used to protect legumes can be grouped as follows:

Pheromone traps and sticky traps for monitoring and reducing the swarming of insect pests.

Preparations containing beneficial organisms (scavenger wasps, predatory mites, predatory bugs) against aphids, thrips, and caterpillars. They can also be sensitive to organic insecticides, so protection must be planned accordingly.

Microbiological preparations, e.g. *Pythium oligandrum* and *Bacillus mojavensis* against rust, Alternaria, phytophthora, and bacterial diseases, *Beauveria bassiana* against nematodes, thrips, and wireworms.

Oil preparations against aphids.

Copper-containing agents against bacterial and fungal diseases, with the exception of powdery mildew. They can be used before flowering.

Sulphur-containing products against powdery mildew and mites.

Photograph 25: Cotton bollworm pheromone trap

Potassium soap, which attacks the skin surface of insect pests, can be used against aphids and mites. It is necessary to repeat every 1-2 days.

Physical plant protection with insect nets, the weave gaps of which do not exceed 0.2 mm.

Insect Pests

Photograph 26: Pests on leguminous plants a) Cutworm b) Green stink bug larvae c) Cotton bollworm caterpillar d) Ladybirds help control aphids

Leguminous plants can be damaged by many soil-based and free-living insect pests, and in recent years, new invasive species have appeared that make life miserable for farmers. Polyphagous pests damage a wider group of plant species, even in different phases of their life cycle. Due to their multiple host plants, the use of crop rotation is less effective in controlling them. Monophagous pests, by contrast, only damage a narrow group of plants, and their reproduction can be prevented to some extent by observing crop rotation principles.

Among the insect pests that live in the soil, the larvae of wireworms and spider beetles initially feed on a wide variety of organic matter, and in the later stages of their development, they feed largely on roots. As a result of wireworm damage, plants develop poorly, wither, or even fall to the ground; the pest is often observed on the roots. Since they are highly polyphagous pests, they also like to feed on the roots of grassy areas, and their damage can be reduced by providing a large amount of organic matter in the soil. The number of wireworms can be reduced by using cruciferous plants as green manure.

Nematodes are tiny soil-dwelling worms that cannot be seen with the naked eye. They form lumps on the roots, which can be mistaken for root nodules in legumes, so recognizing their presence is not easy. As a result of their damage, the development of the plants is retarded, and they may begin to wither. A liquid produced in the roots of the marigold keeps nematodes away, so it is recommended for plant companionship. *Beauveria bassiana*, which contains fungal parasites of insects, can be used to treat against nematodes and wireworms.

The caterpillar of the turnip moth lives in the upper 1-2 cm layer of the soil. Its colour is dark grey, it is large, and its host plants include many horticultural plants and weeds. The larvae chew around the stem of young plants, raising 2-3 generations per year. If the harvested plots are kept weed-free, they will not be suitable for laying eggs. In the case of existing damage, manual

collection or possibly agents containing *Bacillus thuringiensis* can be effective. Appropriate application time can be determined with the help of pheromone traps.

Among the caterpillars that damage the above-ground part of plants, it is important to single out the polyphagous cotton bollworm. This invasive pest only overwinters in small numbers in Hungary, but during the summer, they make a mass migration northward from the Mediterranean region. Its food plants include many vegetables, including tomatoes and peppers. With sex pheromone traps, swarming can be tracked and pests can be reduced to a limited extent. After swarming, large-scale damage can be prevented by using products containing *Bacillus thuringiensis* and by laying *Trichogramma* wasp larva. Cotton bollworm can threaten all legumes, and based on our experience to date, in the case of chickpeas, for example, they can even cause a complete loss of yield.

Insect pests that damage the above-ground part of plants include various species of aphid, including both polyphagous and monophagous species. Aphids typically overwinter on woody host plants. Aphids feed on tender plant parts and stems by sucking plant juices. They also promote the spread of viral diseases and fungal infections. The damage caused by aphids to beans, peas, and broad beans is significant, and they can cause serious crop loss in these legumes. One of the cornerstones of aphid control is support for biological diversity, as there are many natural enemies among native insects, such as ladybirds, hornets, and lacewings. Beneficial living organisms can also be introduced, for example aphid wasps belonging to the genus *Aphidius*. Plant protection products made from vegetable oils, as well as potassium soap, prevent aphids from breathing through their skin or dry out their chitin armour.

Spider mites (genus *Tetranychus*) are spider-like arthropods which are extremely polyphagous and barely visible to the naked eye. A white web on the back of the leaves and in the veins, as well as a fading leaf surface along the suction marks, indicate their presence. As a result of damage caused by this pest, fruit setting is hindered, and the ripening of already set fruits is delayed. It can cause damage especially in summer, when the weather is very hot. Apart from broad beans, all leguminous plants and many other vegetable plants are susceptible. Since young bindweed plants are also an important food source for spider mites, removing this weed can help interrupt their reproduction. In organic farming, it is possible to protect against them by introducing predatory mites which feed on the spider mites.

In recent years, invasive stink bugs have caused considerable damage to horticultural, arable, and fruit crops by sucking on the ripening fruit and green plant parts. The southern green stink bug and the brown marmorated stink bug are now common pests throughout Hungary, and they do not spare legumes: they can cause significant damage to the crops of late-ripening green peas, broad beans, green beans and black-eyed peas in particular. They raise 3-4 generations per year, and the different stages of development can often be observed side by side on vegetable plants. As with aphids, it is possible to protect plants against the younger larval generations with oil preparations and potassium soap. Their number can be significantly reduced by manual thinning, especially if overwintered, mating adult individuals can be eliminated.

Various species of weevils (pea weevil [*Bruchus pisorum*], bean weevil [*Acanthoscelides obtectus])* damage the flowers and ripe fruits of leguminous plants, even after harvest. Their damage is characterized by circular chewing marks on the dry leguminous seeds, as well as excrement that can be observed in stored crops, but the fully grown, plump insect is also clearly visible to the naked eye. Small black dots and then bumps on pea and bean kernels indicate the presence of the larva. In order to avoid storage damage, properly dried legumes should be placed in the freezer for 48 hours. Pea pods are also damaged by *Tychius quinquepunctatus,* the pea moth (*Cydia nigricana*) and *Contarinia pisi*.

Fungal and microbial diseases

Fungal and bacterial diseases prefer warm, humid weather. Careful watering and stocking density also play an important role in preventing their spread. Groundwater from well mulched soil is less likely to rise up stems during rain or irrigation. The removal and professional composting of infected plant parts is also important, since otherwise new waves of infection may start in the following years.

The causes of rust diseases are *Uromyces* fungi, which can be recognized by their reddish-brown to black spore colonies and the yellowing leaf tissue around them. White mould is caused by a polyphagous, soil-dwelling fungus that attacks many vegetable plants, including legumes. Indications of its presence include withering, wilting foliage and the white mycelium web that forms at the stem. It reproduces from the soil by mycelia and by spores from infected, dead plant parts. *Colletotrichum lindemuthianum* is likewise a fungus that attacks the entire plant and causes Anthracnose, or black spot disease, of the common bean plant.

Photograph 27: Microbial diseases of leguminous plants a) Bean rust (Uromyces appendiculatus) on broad beans (b) Colletotrichum disease (Colletotrichum lindemuthianum) and symptoms of stink bug damage on broad beans (c) Symptoms of variable origin (necrotic lesions, leaf deformation) on Phaseolus bean leaves (d) Secondary pathogens (mainly moulds) on the pods of Verpelét beans

Powdery mildew in peas primarily damages late-sown pea stands that bear fruit in early summer. It can be recognized by the whitish, flour-like discoloration of the leaves and pods. Rust diseases of peas and beans are also heat-loving and multiply on older leaves. The intermediate food plant of pea rust is cypress spurge, and so control of this weed plays an important role in protecting against the disease. These fungal diseases can be a problem especially if peas and beans are grown for seed or dry legumes, in which case we can protect against them with products containing sulphur and copper.

Pathogenic soil fungi and bacteria are less able to multiply in soils with good microbiological activity. Thus, in order to protect against them, plant conditioning and adequate nutrient supply are also important. Microbiological preparations containing various antagonists can be used prophylactically.

Bacterial diseases that damage leguminous plants can also occur on moist soils and in hot, humid conditions. Their causative agents are, for example, Pseudomonas and Xanthomonas species, which can infect both seeds and soil. A plant germinating from an infected seed may die at the cotyledon age. It is therefore important to avoid the use of mottled or unhealthy-looking seeds and to prevent oversaturation of water. Treatments against these diseases include microbial preparations and copper-containing agents.

Photograph 28: Bean mosaic virus

Viruses

These are spread primarily by aphids, other stinging and sucking insects, and infected seed. The best protection against viral diseases is the use of resistant or tolerant varieties and virus-free propagating material. Viral diseases affecting leguminous plants can multiply considerably in the vicinity of clover and alfalfa fields. The symptoms of mosaic viruses are mosaic mottling and blistering of the leaves, as well as distorted pods containing few seeds. The tobacco mosaic virus also attacks legumes, as a result of which a red discoloration and then drying can be observed between the veins. An important and effective control method is protection against the insects which spread the virus, especially aphids. Unfortunately, it is not possible to treat already infected plants, so it is important not to take any seeds from them.

3.2. Seed saving, variety maintenance, propagation

Small-scale seed conservation and variety maintenance are particularly important when it comes to propagating landrace varieties and exotic specialties, as well as in order to ensure the continuous cultivation of varieties adapted to one's own area. The following chapter will help with this.

Seed saving basics

The most important rule is to take seeds only from healthy plants, as a significant number of pathogens are also spread through seeds. For this purpose, it is worth harvesting the seeds from the first, strongest crop wave.

Being pollinated by insects, leguminous plants are to a greater or lesser extent prone to cross-pollination, meaning that they can cross within a species or between varieties. Isolation distance refers to the distance required to safely prevent cross-pollination between varieties. Landscape obstacles and strips of flowering plants can reduce this distance, and an insect net can also be used to cover plants of varieties we want to protect from cross-pollination. Cross-pollination is more common in organic gardens with ecologically diverse and varied insect populations, as one of the many insect species may be able to spread the flower apart before self-fertilization occurs. In times of drought, pollen production is inhibited, so there is a greater chance of cross-pollination between individuals that produce pollen and individuals that do not produce pollen and are thus unable to self-pollinate. As a result of heat, the inhibition of pollen formation occurs much sooner than does damage to the female gametes.

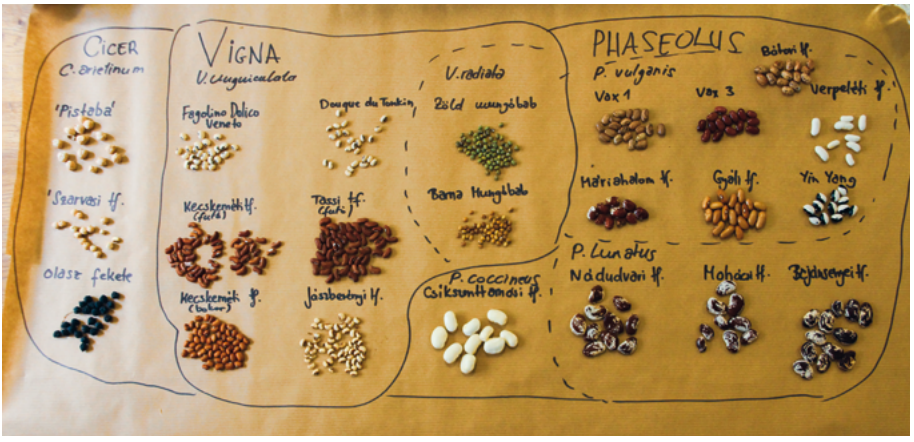
Photograph 29: Harvesting from seed-saving plots

The minimum seed number indicates the number of seeds that is recommended to avoid inbreeding. It may be necessary to create seed-saving plots, especially if we want to collect seeds from plants grown as fresh legumes. The process of seed ripening requires nutrients and water, so plant the plants in the seed plots at a slightly (10-20%) greater distance between plants than recommended, supply them with plenty of nutrients, and water even drought-tolerant species as well. In such cases, plant protection is extremely important! When it comes to plants with a long growing period, or when the goal is to collect seeds, it may be worth planting seeds early under cover and planting them out when conditions allow.

After-harvest ripening is characteristic of leguminous plants. For example, in the case of *Phaseolus* and *Vigna* beans, the pods can already be picked when they turn yellow. Regardless of harvesting time, the crop should be left to dry in the pod, or even by cutting the whole plant above the ground and hanging it in a dry, airy place.

From the gene bank freezer to the plate - propagation

A small amount of seed from the gene bank, seed exchange, or foreign supplier should be propagated in the first 1–2 years. In such cases, isolation is extremely important. If a sufficient quantity of seeds is already available, ensure the preservation of the genetic material in seed plots every year, and reserve 50-100 seeds so that if production fails for some reason in a given season, there will be a reserve. When growing a hitherto unfamiliar species, when learning the cultivation methods, it is worth starting production with well-proven varieties from seed companies and getting to know the needs of the plant, so that when it comes to growing a particular landrace variety, we can grow it with confidence. Based on our experience, this process can take 4–5 years, so be patient! The information required for seed saving (number of seeds, method of pollination) is contained in the species and genus presentation data sheets.



Photograph 30: Experimental varieties in the TRUE project

3.3. Species and variety descriptions

Chickpea

Name (most common): chickpea
Scientific name: *Cicer arietinum*

Other names: garbanzo bean

Photograph 31: Chickpeas

Description
Chickpeas were domesticated on the territory of present-day Turkey around 7000bce, making it one of our oldest cultivated crops. 9,500-year-old traces of it have also been found in the Middle East, and in Europe it spread chiefly in Mediterranean regions. Three quarters of the world's chickpea crop is produced in India, and within the European Union it is grown in Italy, Spain, Portugal, and Greece. Although it is also suitable as animal feed, it is typically used as human food. It contains no anti-nutritive substances. The green plant and the stem cannot be eated due to the high malic and oxalic acid content produced by its glandular hairs; for this reason, wild animals do not usually damage them either. The stems and pods are suitable as green manure. The peas themselves can be eaten both green and dry. In Middle Eastern cuisines, falafel, hummus, and toasted snacks are made from it, and in East and South Asia it is typically used as a base for stews. Young pods and leaves are also edible.

Hungarian aspects
Written records from the 14th century already note that chickpeas were present in Hungary. As in the case of green peas, its unripe peas were eaten, after drying, as a vegetable, side dish, or roasted. Later, it was grown in Iregszemcse and Kompolt, and the local Hungarian varieties Dónia, Dóra, and Pax are still grown today. In 2016, only around 200 hectares was used to cultivate chickpeas in all Hungary.[12]

Botany
It is an annual, herbaceous plant. It takes root 1–1.5 meters deep, thanks to which it tolerates drought well. The stem is 35-50 cm high, erect, branched, and square. Its leaves are alternately pinnate and compound. The entire plant is glandular. The flowers are single, and bluish-white or purple in colour. It is a self-pollinating plant, and cross pollination only rarely occurs. Its pods are pendulous, oval, small, and inflated. They are 2–3 cm in length, and contain 1–3 seeds. The seed is whitish, yellowish, brown, or black. Its seed weight is 200-300g, and retains germination capacity for 2–3 years.

Variations
Kabuli variety: paler colour (beige, yellow)
Desi variety: darker colour (brown, green, black)

Cultivation
Environmental requirements: the chickpea is a drought-tolerant, heat-loving plant, but requires rainfall during the period of emergence and initial development. It grows well even without irrigation, but 1-2 irrigations during fruit setting will increase the yield. It has a moderate heat requirement and requires warmer weather than peas. It needs sunlight. Its nutrient requirement is medium, and it is not necessary to sow the plant in fertilized soil.

Soil preparation: spring seed bed preparation: cultivate 6-8 cm deep, immediately before sowing.

Sowing time: end of March, first half of April (soil temperature of 8–10 °C required).

Sowing: should be sown in rows: the row spacing is usually 30–36cm, but it can also be sown as closely as 24cm or as broadly as 50cm; take into account the method of mechanical cultivation when deciding on row spacing. Seedling spacing: 3–4 cm. Sowing depth: 4–5 cm (in the furrow). Plant emerges 7–10 days after sowing.

Cultivation period: short cultivation period (80–120 days), so it can be a pre- or post-crop. When sowing in summer, irrigation to initiate germination may be necessary.

Plant protection: keeping the plot weed-free at the beginning, while the plants are small, is very important, though as the stand grows taller (up to one meter high) it will already be a good weed suppressor. During ripening, its shading capacity again diminishes. Cotton bollworm can damage and destroy a large part of the crop. Swarming can be monitored with pheromone traps, and agents containing *Bacillus thuringiensis* have proven to be effective in biological plant protection. It is not attacked by the pea weevil, so weeding after harvest is not necessary. Among its diseases, fusarium wilt and *Ascochyta fabae* stem and leaf spot are the most significant. In rainy weather, the seeds can become mouldy. The stem of the chickpea develops more green foliage on firm but nutrient-rich soil, which in some cases may cause it to topple over.

Harvesting: the crop can be harvested from the end of July. Seeds are ripe when they reach their full size and rattle in the pod. There are only one or two seeds in each pod, but there are many (70-80) pods on the stems. The pods do not open even when they are overripe, so you can wait for the seeds to "ripen". If the seeds are already ripe and the pods are yellowish, be careful not to let them get wet, because in this case they will start to shrivel. If A significant amount of precipitation falls on the crop at the time of ripening, it also reduces the quality of the seeds, because they can easily become mouldy and germinate in the pod. Around the time of harvest, it is worth watching the weather forecast and adapting to it. When picking fully ripe, dry pods, the whole plant can be cut and harvested from the base of the stem. They can then be separated at home by stuffing the chickpea plants into a bag and then trampling them thoroughly. The crushed material is winnowed out with a machine, or in the absence of a machine, the seeds can be separated from the smaller, inedible parts by winnowing them in the wind or by using a sieve. Also, remove the mouldy seeds before storage.

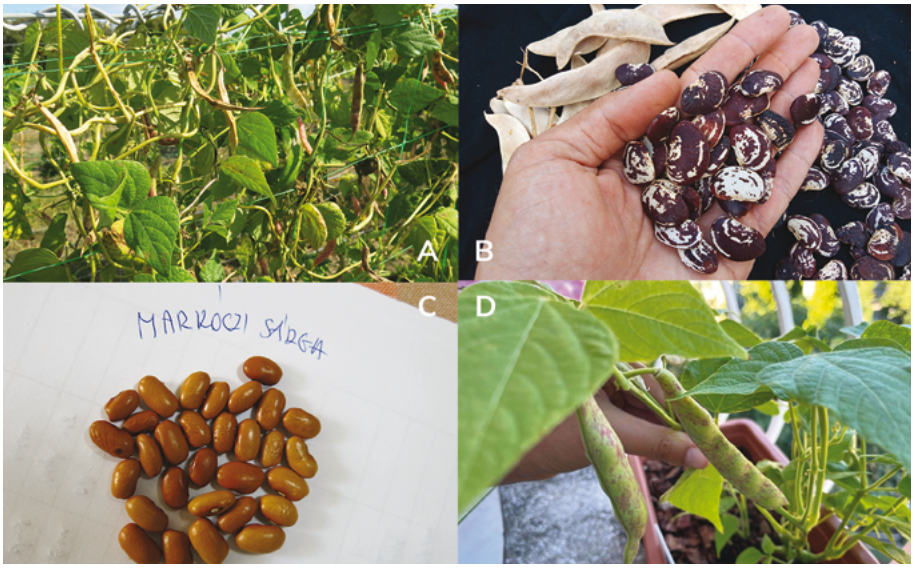
Seed Saving Number: 10-15

It is self-pollinating, but prone to cross-pollination to some extent. Harvesting of seeds depends on the variety; in case of prolonged flowering, it is necessary to continuously harvest the ripe fruits; otherwise, the whole plant can be pulled out and dried before threshing. Harvest before any possibility of frost.

Common beans, runner beans, Lima beans (genus *Phaseolus*)

Scientific name: *Phaseolus vulgaris* (common bean), *Phaseolus coccineus* (runner bean), *Phaseolus lunatus* (Lima bean)

Other names: pole beans (*Phaseolus vulgaris*), butter beans, Madagascar beans (*Phaseolus lunatus*).



Photograph 32: Phaseolus beans a) Scarlet runner bean b) Töreki Zalán bean c) Markóci yellow bean d) Phaseolus bean variety grown in pots

Description
Members of the genus *Phaseolus* are native to Central and South America, and spread to Europe after Europeans discovered the American continent. The temperature requirements of runner beans are lower than those of common beans, so they can also be grown in more northern areas. Economically, this is among the most important groups of leguminous plants, can be grown in tropical, Mediterranean and temperate climates, and is part of the traditional food culture in many parts of the world. We eat its fruit as dry beans, and its green leguminous fruit as a vegetable. The varieties grown for green beans were bred to be thornless. The leaves of some *Phaseolus* species are eaten as leafy vegetables, and their plant remains are used as hay for animal feed.

Hungarian Aspects
According to the records, *Phaseolus* beans were present in Hungary as early as the 16th century. Presumably the medical botanist György Purkircher introduced their first representatives. They became a staple food in the 18th century, and the consumption of green beans, following the Western European model, also came into vogue at that time. Haricot beans suitable for large-scale cultivation were bred by Rudolf Fleischmann in Kompolt in 1926. The Nyíregyháza Research Institute is currently breeding dry bean and green bean varieties. In the Hungarian national breed list, approximately 30 Hungarian varieties have been introduced to date. White *pacsi* beans cook quickly, white *gesztenyebab* or chestnut beans are popular because of their taste similar to chestnuts, and *Juliska* beans are popular because of their high productivity.

Botany
The genus *Phaseolus* is extremely diverse. Thanks to the work of breeders, these originally climbing beans now also have bushy types. Their stems are branched. Bush beans grow to a height of 40-50 cm, runner beans up to 3 meters. The latter climb up onto the support by twisting from left to right. Lima beans have annual and (grown as annual) perennial, bush, and runner versions. The broad bean is a perennial, continuous growing plant grown as an annual in Hungary, which can reach a height of 3–4 meters. It is interesting that in the tropics, where it is grown as a perennial, it grows a tuber of considerable size, which is also edible.

The leaves are trifoliate. The flowers are in clusters and can be of many colours. The common bean is exclusively self-fertilizing, while the Lima bean is self-fertilizing, but cross-pollination is also significant, and the runner bean is a cross-pollinating, bee-pollinated species. Individual species do not interbreed. The size and colour of the pod and the seeds are very diverse (1000 seeds may weigh 80–1000 g). They retain their ability to germinate for 4-5 years.

Variations
Common bean *(Phaseolus vulgaris),* runner bean *(Phaseolus coccineus),* Lima bean / butter bean *(Phaseolus lunatus),* tepary bean *(Phaseolus acutifolius)*

Cultivation
Environmental requirements: these are frost-sensitive tropical plants, and early spring frosts can damage the newly emerged stock. They require soil with a neutral pH, good water management, and are sensitive to soil salinity. They are not demanding when it comes to watering, but at the beginning of flowering, it is worth supplementing precipitation if it does not rain. With second-sowing green beans, supplemental irrigation may be necessary. It is worth watering all beans on sandy soil. The dry summers of recent years make it difficult to grow *Phaseolus* beans, as they are particularly sensitive to atmospheric drought at fruit set. Based on experience, they appreciate irrigation with a micro-sprinkler.

Soil preparation: spring seed bed preparation 8–10 cm deep, immediately before sowing.

Sowing time: in May at a soil temperature of at least 10°C. Sowing time for second-sowing green beans is 1–20 June. Lima beans have slightly higher heat requirements than common beans, and germinate faster at higher soil temperatures, so sow them in mid-May.

Sowing density: minimum row spacing 30 cm, plant spacing: 5–7 cm (in the furrow). For Lima beans, the plant spacing is 10–15 cm.

Sowing depth: 4–5 cm. Runner and Lima bean sowing plugs of at least 500g and 1000 seeds can be sown 6–8 cm deep.

Growing period: 80–140 days for common beans, 65–150 days for Lima beans, and >140 days for runner beans. Dry beans should be grown as the main crop, while leguminous beans can grown in phases.

Supports: climbing beans (Lima beans, runner beans, and climbing varieties of common bean) require support. This can be made using approximately 2.5-metre-long flexible stakes, in this case four stakes planted 50 cm deep, driven into the ground in a square shape 60–80 cm wide. The tops are then tied together, and two seeds 5 cm deep on the outside of each stake. In the case of net cordoning, sow in a row at a distance of 10 cm. Row distance: depending on the support system, at least 45–50 cm.

Harvesting: green beans with pods can be harvested when the longitudinal growth of the pod is complete and the seeds cannot yet be squeezed out. Dry beans are ready when the stems and leaves are dry, the seeds are hard, and their moisture content is 16-20%. In the case of Lima beans, continuous flowering and fruiting is typical, so they can be picked continuously, and it is not particularly prone to rotting. Unlike common beans and runner beans, they cannot be eaten as leguminous green beans, but can only be eaten in their ripe state, as dry beans, or in their unripe seed state as seed beans. Since the seeds are slightly toxic, it is worth changing the cooking water after the first boil and cooking them longer (30 minutes for unripe seeds, 40-60 minutes for dry seeds). Runner beans flower and ripen until the first frost. They can be consumed both as a legume and as a dry bean. If it is unclear whether a given variety is more suitable as a green or

a dry bean, then in the vast majority of cases the number of seeds in the pod and how easily the seeds pop out of the dry pod helps. If we find relatively few seeds compared to the size of the pod, which is also difficult to open, it is most likely a green bean, whereas if the pod is filled with seeds, and is easy to crack and open, we are probably dealing with dry beans.

Plant protection: beans can be infected by several viruses. Varieties vary in susceptibility, and there are more resistant and tolerant varieties. The virus can come with the seed, but it can also be spread by aphids. Its major causative agent is bacterial bean blight (*Xanthomonas*, *Pseudomonas*), but susceptibility varies here as well. Among the fungal pathogens, *Colletotrichum* and bean rust can pose a threat. Runner beans are less susceptible to diseases than common beans. Pests of beans include aphids, bean weevils, common spider mites, *Anthomyia* flies and the cotton bollworm.

Seed saving number: 10

In almost all cases, self-pollination, typically cleistogamy, takes place; that is, pollination takes place even before the flower opens. Despite this, large-bodied pollinators, e.g. bumblebees and woodpeckers, may cross-pollinate them, especially in flower-poor areas.

Isolation distance: 5–10 metres

In the case of species with a long growing period, such as Lima beans and runner beans, the first pods are left at the base for the purpose of seed saving, because they ripen with greater certainty. This, however, may cause them to stop flowering, so it is recommended to keep separate plants for seed saving.

Seed saving: the seeds are ripe when the pod has already dried to a crisp, dry state. If frost is predicted, pull the whole plant out of the ground and hang it up! Harvesting should preferably be carried out in dry weather, and the seeds should be dried and allowed to continue ripening for a further three weeks.

Bean weevils: can be treated by freezing. Only freeze completely dry beans, otherwise they lose their ability to germinate!

Black-eyed peas and asparagus beans

Scientific name: *Vigna unguiculata*

Other names: yardlong bean, pea bean, long-podded cowpea, Chinese long bean, snake bean.

Photograph 33: Vigna beans a) Törtel landrace variety black-eyed peas b) Baja landrace variety black-eyed peas picked as green beans c) Mung bean plot d) Asparagus beans

Description
Black-eyed peas are thought to have been domesticated in Africa 5,000–6,000 years ago. Today they are popular in Africa and Asia, and their cultivation spread to the American continent with slavery. They remain one of the defining ingredients of 'Southern' cooking in America to this day. In Europe, they are used in Greek, Cypriot, Turkish, and Portuguese cuisine. They can be eaten both as a dry legume and as a green legume vegetable, and the leaves can be eaten like spinach. In addition to its nutritional value, it is a good fodder plant. The protein component can be easily digested when the peas are ground in a fodder mixture. Its by-product is fodder straw. After flowering, the green parts can be used as fodder in a silage mixture or dried as hay. Its straw, when ploughed in, improves the nitrogen supply of the soil, and is also used as a green manure crop. The genus also includes mung beans (*Vigna mungo*), which are less well known in Hungary, and adzuki beans (*Vigna angularis*). The *Vigna* species may come to the fore in the near future due to their drought tolerance.

Hungarian aspects
They were widespread in Europe and Hungary until the appearance of *Phaseolus* beans, but since then they have been pushed back to sandy growing areas. The research surrounding the black-eyed pea also focuses primarily on its ability to grow on poor soils and, in recent years, on its resistance to climate change. Renowned Hungarian researchers included Ferenc Somorjai and József Antal, who investigated the cultivation of black-eyed peas in the Great Plains region at the Szeged Research Institute. In recent years, it has appeared as a green manure plant in domestic seed mixes. In the Tapiószel gene bank, among other things, in the early 2000s, within

the framework of the Homokhátsági Target Program, its domestic cultivation was investigated together with several other drought-tolerant and alternative plants. In recent years, in addition to the seed yield, the green yield of some harvests has also been examined. In addition to being used as a dry leguminous crop grown agriculturally, both the green pod and the edible flower can be an interesting new horticultural curiosity. The first green pods are tasty and can be eaten like green beans.

Botany
An annual, exceptionally heat-demanding plant. In terms of growth, it can be determinate (bush, 35-40 cm), semi-determinate (branching/crescent, 60–70 cm, therefore prone to toppling over) or indeterminate (climber, 2–3m). Its leaves are trifoliate. The flowers are in clusters. It is self-fertilizing. The fruit is a straight or slightly curved pod, located in small groups above the level of the leaves, some varieties are prone to dropping their leaves. The pods of asparagus beans can be up to 40 cm long, and typically contain fewer seeds (typically 6–8). The seed can be kidney-shaped, spherical, or diamond-shaped, and the colour varies, but is typically light brown with a black spot (1000 seed weight 70–160g). It retains germinative capacity for 3–4 years. It is prone to cross-pollination, so must be isolated for seed collection.

Varieties
Vigna unguiculata subsp. unguiculata (black-eyed pea), *Vigna unguiculata subsp. sesquipedalis* (asparagus bean)

Cultivation
Environmental requirements: thanks to its deep taproots, it has good drought tolerance compared to other bean species. Primarily a plant for loose, light, sandy soils, and good drainage is also important on more compact soils. It can be grown with little irrigation but does requires rainfall for a short period before germination. It likes heat but does not tolerate frosts or prolonged cooling.

Soil preparation: spring seed bed should be cultivated 6–8 cm deep, immediately before sowing.

Sowing time: 5–20 May, with optimal soil temperature around 15-18 °C.

Sowing density: should be sown in rows: row spacing 30–36 cm, plant spacing: 6–8 cm. Sowing depth max. 4–6 cm (into the furrow). The asparagus bean and other indeterminate varieties are grown in the same way as *Phaseolus* beans with a support system.

Growing season: 80–100 days for green legumes, 100–110 days for dry legumes.

Harvesting: due to its prolonged ripening, it requires continuous manual harvesting both in the green and dry legume states. It ripens in late August or early September. Ripening is protracted and lasts 8-10 days, with the plant prone to second flowering after picking. Non-determinate varieties bloom and bear fruit continuously until the first major cold snap. In some varieties, when ripe, the pod opens easily, and the peas can easily be moved inside the pod. Peas can be eaten both in pods and shelled. They should not be eaten raw. To decide whether to eat as a fresh legume or dried bean, the guidelines for common beans can be used here as well.

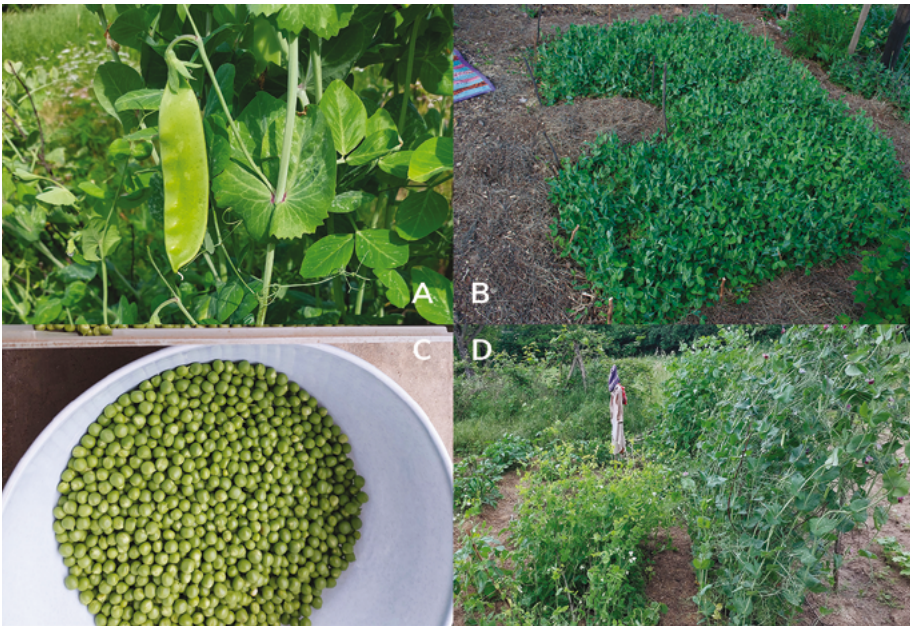
Plant protection: it can become infected by bean rust, *Colletotrichum*, and bean blight (*Xanthomonas*, *Pseudomonas*). Its pests are the bean weevil and the common spider mite.

Seed collection number: 10

It is typically self-pollinating, but based on our experience, it is highly prone to cross-pollination. It is worth isolating by at least 150 meters for seed collection. It is strongly prone to post-harvest ripening, so the pods can already be picked for the purpose of harvesting seeds when they turn yellow.

Green pea

Scientific name: *Pisum sativum* **Other names:** field pea, garden pea



Photograph 34: Green peas a) Swedish giant sweet peas b) Round peas in mulched beds c) Shelled green peas d) Pea plots for seed saving

Description
The pea was domesticated in Southwest Asia, and the oldest traces of it were found in the Nile Delta area, dating from around 4800bce. The wild relative can still be found growing in the Mediterranean region. It spread primarily in Asia and Europe, and was traditionally grown in the cooler, northern, mountainous areas due to its short growing season and tolerance for cold. At first it was consumed as a dry legume. Its popularity as a vegetable started in England in the 17th century, where the first varieties of green peas were bred. It also played an important role in the development of the science of modern genetics, since Gregor Mendel laid the foundations for our understanding of genetic inheritance by crossing peas in the 19th century. He crossed and raised as many as 28,000 green peas for his scientific experiments. The biggest growers are currently China, India, and Albania (green peas), as well as Canada (yellow peas). In the form of split peas, they spread in Asian and European cuisines. In Europe they may form part of a stew, while in India they are typically cooking into a spicy dahl. In recent years, versions that can be consumed as sprouts or micro-greens have also appeared on the market, and in this form, they have found their place primarily in modern restaurant culture.

Hungarian aspects
Based on finds from the Bronze Age, Hungarians may have become familiar with this plant when they migrated into the Carpathian Basin. The Hungarian word for pea (borsó) is of Old Turkish origin. In the 20th century, it was the most widely cultivated vegetable crop in Hungary: it used to be that 7% of the world's cultivation took place in Hungary, and before 1989 the area used to grow them covered 30,000 hectares. Today, this proportion has decreased to around 1%.

Its production area currently ranges from 15,000 to 20,000 hectares, and Hungary remains the third largest grower of green peas in Europe. Of this, approximately 5% is fresh market production, for which varieties with larger grains are suitable. In the 1980s, the fodder pea production area covered 100,000 hectares, but the role of peas as fodder was significantly reduced due to the spread of soy. Green pea breeding continues to this day at the ZKI Újmajor site, where they breed stress-tolerant industrial varieties resistant to powdery mildew and fusarium, with a variety of grain sizes and ripening times.

Botany
It is a hypogeic plant, meaning that its seed remains in the soil during germination. Its roots do not penetrate too deeply, so its drought tolerance is limited. The stem is angular and erect; both bushy and climbing versions are available, so supports may be needed – a low support made of tree branches crosswise may be sufficient, or, in the case of tall varieties, twine, netting, or cordon cultivation.

Varieties
- Medullare (convar. *medullare*): the surface of the seeds is wrinkled, the pod has a fibrous inner membrane, and it is suitable for green harvesting, fresh consumption, and canning.
- Sativum peas (convar. *sativum*): ripe seeds have a smooth surface, are yellow or green in colour, rich in starch, and can be eaten fresh only after shelling. They are more suitable for dry peas and fodder and are called yellow peas when shelled.
- Sugar pea (convar. *axiphium*): a pea that can be consumed in the pod due to the absence of the inner parchment layer. Hungarian market sellers often refer to sweet *Mellulare* peas as sugar peas, so the terminology can be misleading. The green pods are eaten raw, boiled, or flash-fried.

Cultivation
Environmental requirements: this is a cold-loving plant, and sowing time in Hungary is October–November (sow before winter) or March–April. For fresh leguminous cultivation, it is advisable to sow every 1–2 weeks as long as the soil temperature is above 10°C, or to extend the harvest time by using varieties with different growing seasons. By the time the plant reaches maturity, it has a hard time bearing the hot, dry weather, quickly ageing and becoming stringy. A moderately water-demanding plant, it can only be reliably grown with irrigation. Its nutrient requirements are average, and it likes loose, calcareous, well-drained soils.

Soil preparation: spring seed bed should be cultivated 6–8 cm deep, immediately before sowing.

Sowing time: October–November (winter sowing), or in March–April. It germinates at temperatures above 4°C, but suffers from frosts.

Sowing density: should be sown in rows: row spacing 10–20 cm, plant spacing: 6–8 cm. Sowing depth max. 4–6 cm (into furrow).

Cultivation period: 80–100 days for green legumes, 100–110 days for dry legumes.
Harvesting: during the few weeks of ripeness, both green and dry pods require continuous manual harvesting. They ripen at the end of May and the beginning of June. Its period of ripeness can be prolonged, lasting 8–10 days, but senescence usually sets in before any second flowering.

Plant protection: pea pods are damaged by the pea weevil, pea borer, pea moth and pea midge. In rainy, humid springs, powdery mildew can cause serious problems.

Seed saving number: 50. From these, a selection should be made.

Almost exclusively self-pollinating. Isolation of 15 metres recommended for variety maintenance seed saving.
After threshing and shelling, remove any seeds infected with weevils – signs of infection include black spots or holes in the seeds. Freeze the dry seeds.

Broad bean

Scientific name: *Vicia faba*

Other names: fava bean, faba bean

Photograph 35: Broad bean (Vicia faba) a) Shelled Sofia broad bean b) Sofia broad bean with green pods c) Broad bean plant d) Broad bean in flower

Description
Broad bean is one of our oldest cultivated plants and was domesticated as early as the 1st century ce. Its cultivation may have begun around 10,000 bce in the Mediterranean region and Central Asia. It is an easy-to-grow, high-yield plant that is still widely cultivated around the world. Until the appearance of American *Phaseolus* beans, it was one of the most important legumes in Europe, and its cultivation was spread by the Romans. An alternative name, "horse bean", comes from the fact that, in addition to human consumption, it was also fed to horses, and in Western Europe it was used to bake "horsebread", used as fodder. The ancient Egyptians referred to the broad bean's black-spotted flower as the flower of death, and several cultures used the broad bean in traditions surrounding death. It can be eaten as a dry bean, or cooked in its green state, in the pod. Due to the nutty and creamy taste of the dry bean, it is used as a confectionary ingredient, and in the 20th century it was also widespread as a substitute for chestnuts. As a result of a genetic disorder, favism, the consumption of horse beans can cause a serious hematopoiesis disorder in some people. It can also be grown as a cover plant, as it provides cover even in winter due to its frost tolerance and loosens the soil thanks to its deep-penetrating roots. In Europe, it is grown in larger quantities in Germany and Poland, while globally China and Ethiopia are the largest producing countries.

Hungarian aspects
Modern cultivation methods in Hungary were developed at the Plant Cultivation Experimental Station in Magyaróvár. Its most significant breeders were Elemér Székács and Rudolf Fleischmann. In the 1980s, with the growth of animal husbandry, it became a dominant fodder crop,

and in 1988 broad bean cultivation in Hungary covered almost 20,000 hectares, though this has now decreased to a few hundred hectares.

Botany
The broad bean is an annual, sown in winter or early spring. Its stem is upright and hollow, its leaves are trifoliate, and its taproot penetrates deeply, with many lateral roots. In its cluster inflorescence, the flowers are partly self-fertilizing, but prone to cross-pollination. Its pod contains 2–4 seeds.

Varieties
- tick bean or pigeon bean (*var. minor*)
- horse bean (var. *equina*)
- fava or faba bean (var. *faba*)

Cultivation
Environmental requirements: a cold-tolerant, frost-tolerant, water-loving plant. Good water supply is important, especially during flowering. It has moderate nutrient requirements.

Soil preparation: seed bed should be cultivated in spring or autumn, 6–8 cm deep, immediately before sowing. It appreciates organic nutrients, with larger amounts of compost and mature organic manure.

Sowing time: during winter in October–November, or in early spring, in February–March, as soon as the soil has thawed.

Sowing density: 15–20 cm between plants and 50–-75 cm between rows, planted 6–8 cm deep.

Cultivation period: 80–90 days for green beans, 110–130 days for dry beans.

Harvest: from the end of June to the beginning of August, dry beans may require post-harvest ripening.

Plant protection: a plant highly prone to attack by aphids, as a result of which it can become infected with microbial and viral diseases.

Seed saving number: 10

It is typically self-pollinating, but cross-pollination can occur, so isolation is necessary. The lower pods are best suited for seed saving, as they contain larger and stronger seeds with higher germination capacity. The time to harvest for seed is when the pods have turned black. They typically do not open, and so can be left to dry on the plant. In case of rainy, humid weather, harvesting and post-harvest ripening of half-ripe pods is recommended.

Lentil

Scientific name: *Lens culinaris*

Photograph 35: Lentil (Lens culinaris)

Description
One of our most ancient crops, it was domesticated in the Middle East around the same time as barley and wheat. Its variegated seeds are considered small in the legume group, and can be yellow, orange, brown, or greenish in colour. In Europe, it is grown in the Mediterranean region, but globally the largest producer is Canada. Due to the small size of the seeds, it does not require soaking and cooks quickly. The lentil is an ancient symbol of abundance, and its round shape is also reminiscent of money. The tradition of eating lentils at New Year is widespread in Hungary, as it is held that this will lead to prosperity in the coming year. Lentils were also found in the tombs of the Egyptian pyramids, as it was believed that they help in enlightenment even after death.

Hungarian aspects
In Hungary, it was a common peasant food along with beans, but its popularity began to decline in the 20th century. It is a plant of hilly areas and poor soils. In the 1990s, its cultivation area was around 1,200 hectares, but today this has decreased to around 300 hectares. The most widespread are the large-seeded varieties, although there are also small-seeded, colourful, and mottled Hungarian varieties. At the University of Debrecen, overwintering lentil varieties are currently being bred, which are better adapted to the challenges of climate change.

Botany
An annual, herbaceous plant with a short growing season. It grows low, to only approximately 50 cm, and the plant is slender and fragile. Its evenly pinnate leaves end in a tendril. Its flowers form in clusters, and the colour of the flowers is white or pale purple. The tiny fleshy pod contains 1–2 seeds. It tolerates poor soils and drier summers well.

Varieties

- large-seeded *(macrosperma)*
- Small-seeded *(microsperma)*

Cultivation

Environmental requirements: frost-tolerant, a plant of moderately warm and not excessively dry areas. Small-seeded varieties are more drought-tolerant. It prefers well-drained, loose soils.

Soil preparation: the lentil plant requires phosphorus and potassium but does not like soil that is too rich in nutrients. It requires an area free of weeds and weed seeds.

Sowing time: from mid-March to mid-April.

Sowing: 15-20 cm row spacing or broadcast. Good companion plants include rye and oats.

Cultivation period: 100–130 days.

Plant protection: due to its short and fragile stature, it has poor weed suppressing ability and is prone to toppling over. Fungal diseases can attack during wet summers, especially if the planting is excessively dense. Weevil infestation can be a serious problem, though small-seeded varieties are more resistant due to their shorter cultivation period.

Harvesting: in June or July, when the grains in the lower pods are fully ripe. Trimming or manual harvesting is required, followed by post-harvest drying before threshing.

Seed saving number: 10-15

It is self-pollinating, but cross-pollination can occur to a limited extent. It is worth pulling out the plants as a whole, when the seeds start to rattle in the yellowing pods. Can be dried on a tarpaulin, as the seeds easily roll out.

4 USE OF LEGUMES IN THE KITCHEN

Nutritional value, antinutrients

Due to their high nutritional value, fibre, and protein content, as well as their low-fat levels, dry leguminous plants are important elements in a balanced diet. They contain twice as much protein as whole grains and three times as much as rice. In addition to oilseeds, therefore, they can play a prominent role in a plant-based diet or a diet containing fewer animal products. However, legumes are not complete proteins, meaning that they do not contain all the amino acids that the human body needs. At the same time, they complement rice, grains, and vegetables well. Their magnesium, potassium, zinc and vitamin B content is also significant. Due to their high fibre content, dry legumes are considered a slow-absorbing carbohydrate, and slower digestion helps stabilize blood sugar levels, which can be beneficial for preventing insulin resistance and diabetes.

Phytoestrogens, found chiefly in soy, are controversial elements in dietary advice. However, research results show that the phytoestrogens in soy are more beneficial than harmful, especially if red meat is replaced with soy-based products.

Hard-to-digest plant proteins, lectins, are responsible for the bloating effect of cooked dry legumes. Lectins are destroyed by soaking, cooking, and fermentation, so their bloating effect can be reduced or eliminated. The high fibre content can also contribute to the bloating effect, especially in those who otherwise consume little fibre. If you do not have a serious digestive disease, intestinal flora can be acculturated to a high-fibre diet by gradually increasing portions.

Fresh legumes – such as green peas or green beans – are nutritionally classified as vegetables. Their protein and lectin content are lower than that of dry legumes, so they can be eaten with less cooking or, in the case of green peas, even raw.

Storage, soaking, cooking

Fresh legumes
Fresh legumes are widely available ingredients in the summer season. Since they tend to quickly spoil, it is worth consuming them quickly or storing them in the refrigerator. In the case of fresh legumes, a much shorter cooking time should be expected than in the case of dry legumes. Suitable methods for their preparation include steaming, blanching (soaking in cold water after briefly cooking in hot water), and roasting in fat, but they can also be grilled. In the case of sugar peas, green beans, and broad beans, it is possible that the beans will be slightly overripe and stringy, in which case the woody fibres must be removed during cleaning.

Consumable as fresh legumes:
- green peas,
- sugar peas or snap peas,
- green beans and broad beans (*Phaseolus* and *Vigna* species),
- shelled beans (*Phaseolus* species: half-ripe *Phaseolus* species with larger beans can be eaten),
- broad beans, shelled in a green or semi-ripe state,
- green chickpeas.

Freezing is the most suitable method for preservation at home. For this, it is worth scalding the fresh legumes and then drying them completely before freezing. Domestic canning of fresh legumes is not recommended for food safety reasons; to do this safely a pressure canner is needed.

Dry legumes
The following plants, among others, can be eaten as dry legumes:
- *Phaseolus* beans,
- *Vigna* beans,
- yellow peas (split peas),
- broad beans,
- chickpeas,
- lentils.

Most dry legumes can be stored for years, but they generally retain their optimal quality for 1–1.5 years. They should be stored in a pantry, larder, or on a shelf, protected from light and pests (e.g. in a mason jar or screw-top glass). Weevils and food moths can also be a problem: if these pests appear, dry legumes should be put in the freezer for 1–2 days. 100 grams of dry legumes will result in approximately 220–250 grams of cooked legumes.

To prepare dry legumes, we recommend the following steps:
1. Wash in a colander or sieve under running water. This helps remove impurities.
2. Soaking: 8–12 hours of soaking significantly shortens the cooking time, and with even longer soaking raw legumes can start to ferment. Split peas and small-grain lentils can be prepared without soaking.
3. Cooking: after replacing the water, start cooking the legumes in plenty of cold water, though chickpeas are an exception here: they only really soften if placed into already hot water. The older and drier the raw ingredients, the longer the cooking time. According to a proven practice, adding a teaspoon of baking soda to the cooking water significantly speeds up the softening of even the hardest beans. It is a good idea to cook with the lid on over a low flame and regularly top up the water, but the fastest way to prepare dry legumes is in a pressure cooker. Add salt only when it is cooked, otherwise the beans may remain hard.

If the dry legumes have not been pre-soaked, add half a teaspoon of leavening agent to the cooking water and change the water after 40 minutes. If you are preparing a stew, try to boil off as much water as possible during cooking, then, to thicken, separate some of the cooked legumes

then purée them with a stick blender and return this to the stew to thicken it. Dry spices can be added to the cooking water. Of these, cumin, bay leaves, and coriander seeds also have digestive properties.

Boiled dry legumes must be stored refrigerated. If they are still hot when put into a sterilized mason jar or vacuum-sealed contained, they will last up to one week, otherwise it is advisable to consume them within 2–3 days. Frozen cooked legumes can be stored for several months, so you can cook a larger batch at once.

Boiled dry legumes can be used for the following foods:
- stews, ragouts, and soups: they can be prepared to be eaten in the cooking water (e.g. chili con carne, bean stew, bean soup) or after draining;
- sandwich creams, spreads: made from legumes boiled very soft. This is possible with all kinds of legumes – blend until smooth or mash into a rougher, more rustic paste. To this can be added spices and oil (e.g. Middle Eastern hummus, Transylvanian bean zakuska, but nowadays there are many new recipes);
- dumplings/falafel/hamburger patties/pancakes: with the spread of vegetarian and vegan diets these preparations are becoming more and more popular, and many processed products are made from legume protein, but there are also many variations of cooked legume. It is important to hold patties together with something – finely ground oatmeal is perfect for this. The mixture can then be shaped and cooked, in oil in a pan or baked in the oven. For red lentil or chickpea pancakes, soak the dry seeds overnight in double the amount of water. The swollen and softened raw seeds are blended until smooth with a hand blender the next day. After adding a pinch of salt and seasoning to taste, fry the pancakes in butter or oil over low heat (the dough can be made with or without eggs). They can be filled with seasonal fried/steamed vegetables/cheese.

Photograph 37: Vinegar stewed green beans in the Krisna Valley, hummus made from Bor chickpeas, a dish made from asparagus beans, stuffed red lentil pancakes.

Chickpea cooking stock or canned juice can also be used as a substitute for egg white foam, and it has become popular under the name aquafaba, mainly among people who follow a plant-based diet. In Japanese cuisine, sweetened bean paste is used to fill desserts, such as mochi made from rice, but other modern cuisines also enrich various cakes with beans.

Chickpeas *(Cicer arietinum)*

Erdőkürt landrace variety
Its average height is 40–70 cm, and it is not prone to toppling. Its general pest/disease resistance is medium. Its seeds are beige in colour, small in size, and the weight per thousand seeds is 200 g. It is suitable as a green or dry legume.

Ceri neri, **or Italian black chickpea**
Its average height varies between 30 and 70 cm, depending on the place of cultivation, and it is not prone to toppling. Its general pest/disease resistance is good to excellent. Its core is black, and its weight also varies (0.2-1.6 g/pea). According to experience, it grows better on fertilized soil. Suitable as a dry legume.

Pista bácsi (Uncle Pista) landrace variety
Its average height is 60-70 cm, it is not prone to toppling. Its general resistance is good. Its seeds are beige in colour, larger in size, and weigh 120-150 g per thousand seeds. It is suitable as both a green and dry legume.

Szarvas landrace variety
Its average height is 60-70 cm, slightly to moderately prone to toppling. Its general pest/disease resistance is medium, varying from year to year. Its seeds are beige and small, weighing 200 g per thousand seeds.

Common bean *(Phaseolus vulgaris)*

Bátor landrace variety
Depending on growing location, it will either grow as a climber (150–200 cm in height) or as a bush (30–50 cm tall). Its lower pods are in contact with the ground. Its general pest and disease resistance is good. Depending on its habit, it can be eaten as a green legume, freshly shelled, or as a dry bean. Its greenish-yellow pod is straight or slightly curved, with a round-oval cross-section, 10–14 cm long and 1.1-1.6 cm wide, with variable tendency to become stringy. Harvesting begins in mid-August, though in dry summers it may bear fruit in September. Its seeds are oval, shiny, variegated beige-cream and brown, 0.4-1.5 cm in size, and the weight of 1000 seeds is 200–250 g.

Gyál landrace variety
Bush bean, grows to a height of 40 cm. Its lower pods are in contact with the ground. Its general pest/disease resistance varies from weak to good. The harvesting period can last from the beginning of July to the middle of August. The pod is yellow or green, straight or slightly bent in shape, oval in cross-section, 10-15 cm long, 0.8-2.5 cm wide, with variable stringiness. The seed is oval, beige-yellowish-green or greenish-brown in colour, with a shiny surface, 1.2–1.9 cm in size, and the weight of 1000 seeds is 180–300 g. It can be eaten in its pod in its green state or shelled as beans.

Kozárd one-bean landrace variety
Depending on growing location, it may grow as a climber (220 cm in height), semi-determinate (160–170 cm) or as a bush (30–60 cm). Its lower pods are in contact with the ground. Its general pest/disease resistance is moderate. Harvest time is from July to August–September. The pod is green or yellow, straight or slightly curved, oval in cross-section, prone to becoming stringy,

10–15 cm long and 1.0–1.5 cm wide. Its seed is oval, black and white in colour, with a matte surface, 0.5–1 cm in size, weighing 0.2-0.3 g/bean, suitable for eating fresh and for shelling.

Markóc yellow landrace variety
Depending on growing location, it may grow as a climber (height 250–300 cm) or bush (30-40 cm). Its lower pods do not touch the ground. Its general pest/disease resistance is medium to good. The harvest period starts from the second half of July and continues until October. The pod is green or yellow, straight or slightly curved, its cross-section is round–oval, 10–13 cm long, 1.2–1.5 cm wide, and fibrous. Its seeds are oval-shaped, yellowish-brown, with a shiny surface, 1.0–1.4 cm in length, weighing 120–300 g per thousand beans. It is a drought-tolerant, high-yield variety. It should not be eaten as a green bean, but it is suitable as a dry bean for cooking.

Verpelét landrace variety
Grows as a bush, to 30–60 cm in height. Its lower pods are in contact with the ground. Its general pest/disease resistance is medium to good. Harvest time is from mid-July to the end of September, in several waves. The pod is green-yellow, straight or slightly curved, with an oval-flat cross-section, 8–15–20 cm long, 1.0–1.6 cm wide, strongly fibrous on both sides. Its seeds are kidney- or oval-shaped, whiteish-pink in colour, with a shiny surface, 0.8–1.7 cm in size, weighing 50–100 g per thousand seeds. Robust and giving large yields, it is excellent as both a green legume and a shelled bean.

Runner bean *(Phaseolus coccineus)*

Csíkszenttamás landrace variety
A climbing bean, with stems 2.5–3 meters long. The lower pods do not touch the ground. Its general pest/disease resistance proved moderate in one year of testing (2018). The colour of the pod is green, its shape is straight, 8–12 cm long and 1.5–2 cm wide. Its seeds ripen in mid-October.

Lima bean *(Phaseolus lunatus)*

Csókakő landrace variety
A climbing bean, with stems that grow to 2–3 metres in length. The lower pods do not touch the ground. Its general pest/disease resistance varies from medium to excellent. Harvest time is from July to late autumn. Its pods are green, flat, curved, and sometimes stringy. Pods are 7–15 cm long and 2–3 cm wide, kidney-shaped, flat, with purplish-white variegated seed, 1.5–2 cm in size. Despite the rich harvest in 2018, the pods dried up and the beans withered in 2019 and 2020. However, it stores very well and is an excellent ingredient for any bean dish.

Moha landrace variety
A climbing bean with stems 2–3 metres long. The lower pods do not touch the ground. Its general pest/disease resistance proved to be excellent in one year of testing (2018). The pod is green, curved, flat, 10–15 cm long, and 2.5–3 cm wide. Its seeds can be harvested from mid-October, and are flat, shiny, mottled white and purple in colour, and 1.5 cm in length.

Black-eyed pea *(Vigna unguiculata)*

Jászberény landrace variety
Its growth is determinate (50–60 cm) or indeterminate (1.5–2 m) depending on growing location. It is sensitive to temperature during germination, and heat-demanding; in a cold spring, some plants may not germinate. Its pest/disease resistance is medium to good, although it can be attacked by the southern green stink bug. Its pods are green, 10–18 cm long, cylindrical, 0.5–1 cm in diameter, and not typically stringy. The primary harvest time is August. Its seeds are small, 0.5–1 cm in size and beige-brown in colour. The main wave of crops is produced in the first two weeks of August, and subsequent harvests quickly shows signs of senescence.

Kecskemét landrace variety
It grows as a determinate (40–60 cm) or indeterminate (1.5–2 m) plant depending on the growing location. It is sensitive to temperature during germination, and heat-demanding; in a cold spring, some plants may not germinate. Its pest/disease resistance is medium to good, although it can be attacked by stink bugs. Its pods are green, 10–20 cm long, cylindrical, 0.5-1.3 cm in diameter, and not typically stringy. The primary harvest time is August but can be extended into September. Its seeds are small, 0.5–1 cm in size and beige-brown in colour. Both the green pod and the edible flower can be an interesting horticultural novelty. The first green pods are tasty and can be eaten as green beans. Later harvests quickly senesce.

Pilis landrace variety
Its growth is determinate (40–50 cm) or semi-determinate (85 cm) depending on the growing location. It is sensitive to temperature during germination, and heat-demanding; in a cold spring, some plants may not germinate. Its pest/disease resistance is medium to good, but a significant part of the crop can be damaged by sap-sucking insects. Its pods are green, 12–20 cm long, cylindrical, 0.7–1 cm in diameter, and not typically stringy. Harvest time begins at the end of July and lasts until the end of August. The seed is small, 0.7–1 cm in size, and mocha-coloured. The first green pods can be used as green beans, but later harvests quickly senesce, and there is no standard fruit-setting.

Törtel landrace variety
Its growth is determinate (50 cm) or semi-determinate (150 cm) depending on the growing location. Its resistance can range from weak to good, and it is susceptible to bean rust. Its pods are green, 25–30 cm long, cylindrical, 0.5 cm in diameter, and of variable stringiness. It grows as a determinate until mid-August, as as a semi-determinate from September until the end of October. Picked early, it is tender and very tasty. The seed is small, 0.3–0.7 cm in size and brown in colour.

Asparagus bean *(Vigna unguiculata ssp. sesquipedalis)*

Bátor
A climbing bean, growing 2–2.5 m on a support. Its pest/disease resistance is good to excellent. Its thin, green, cylindrical pods are very long, from 35 cm to 80 cm, with a diameter of 1 cm. They do not become stringy at first, only later, towards the end of the season. Harvest can last from July to September. At the beginning of the season, the pods are full and crunchy, but from the first week of August the empty pods are sealed without seeds, by which time they lose their tenderness. The beans are extremely tasty when freshly steamed.

Black-seeded Bátor
Growth depends on the year and location, but in optimal conditions it can grow to 2 metres in height. Its pest/disease resistance is excellent, but when it emerges in a cold spring, it remains only 30 cm tall, grows only tendrils, and has weak pest/disease resistance. Its pods are green, cylindrical, 60–100 cm long, are harvested in August, weighing 1kg per metre of bean growth, and it is not stringy.

Bibliography

Referenced sources

1. Kris Hirst, 2021, "Plant Domestication" ThoughtCo, Sep. 1, 2021, thoughtco.com/plant-domestication-table-dates-places-170638
2. Forgó György, 1817, „Rendkívűl való szűkség idején, a közönségesen szokásban lévő Gabona fajokon kívül, miből készíthetni még Kenyeret Hazánkban, 's mit találhatni még, a mivel ollyankor táplálhassa magát a Szegénység?" [In times of extreme scarcity, apart from the commonly used types of grain, what else can be used to make bread in our country, and what else can be found to feed the poor?] Tudományos Gyűjtemény [Scientific Collection], 1817, vol. IX.
3. Gondola István, 2010, „Az alternatív növények szerepe az Északalföldi Régióban." [The role of alternative plants in the Northern Great Plains region], Nyíregyházi Kutatóintézet.
4. Afshin, Ashkan et al., 2019, "Health effects of dietary risks in 195 countries, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017." The Lancet 393.10184 (2019): 1958–1972.
5. Willett, Walter et al., 2019, "Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems." The Lancet 393.10170 (2019): 447–492.
6. Our world in data, 2023, Greenhouse gas emissions per 100 grams of protein, https://ourworldindata.org/grapher/ghg-per-protein-poore
7. FAO, 2016, Pulses: Nutritious seeds for a sustainable future, ISBN 978-92-109463-1
8. U.S. Department of Agriculture, 2023, Food data central, https://fdc.nal.usda.gov/
9. Katherine Colette et al., 2021, "The climate impact of alternative proteins." Smith School Final 25% Series Paper
10. Billen Gilles et al., 2021, "Reshaping the European agro-food system and closing its nitrogen cycle: The potential of combining dietary change, agroecology, and circularity." One Earth 4.6 (2021): 839–850.
11. Karen Hamann, 2019, A map of value chains for legumes used as food, TRUE Project Deliverable 4.1
12. Központi Statisztikai Hivatal [Central Statistical Office], 2023, „A Mezőgazdaság teljesítménye" [Agricultural Performance], tables, https://www.ksh.hu/stadat?lang=hu&theme=mez
13. George Cusworth, Tara Garnett and Jamie Lorimer, 2021, "Legume dreams: the contested futures of sustainable plant-based food systems in Europe." Global Environmental Change 69 (2021): 102321.
14. Központi Statisztikai Hivatal [Central Statistical Office], 2023, „Az egy főre jutó éves élelmiszer-fogyasztás mennyisége jövedelmi tizedek (decilisek) szerint" [Annual food consumption per capita by decile], https://www.ksh.hu/stadat_files/jov/hu/jov0026.html
15. Karen Hamann, 2019, "Ten example business-cases on the successful marketing of legumes as food." TRUE Project Deliverable D4.2
16. Hungarian Dietetic Association (MDOSZ), 2023, Okostányér (Smart Plate) https://www.okostanyer.hu/

Other recommended literature and projects

Corrado, G., Food history and gastronomic traditions of beans in Italy. *J. Ethn. Food* 9, 6 (2022). https://doi.org/10.1186/s42779-022-00122-x

Miguel Altieri, Clara I. Nicholls and Rene Montalba, 2017, "Technological approaches to sustainable agriculture at a crossroads: an agroecological perspective." Sustainability 9.3 (2017): 349.

Nemzeti Biodiverzitás- és Génmegőrzési Központ [National Centre for Biodiversity and Gene Conservation], 2019, A tápiószelei génbank története, feladatai és gyűjteményei;
A könyv szerzői: a tápiószelei génbank munkatársai [The history, tasks, and collections of the Tapiószele gene bank; The book's authors: the staff of the Tapiószele gene bank]; ISBN 978-615-00-5919-8

Billen Gilles et al., 2021, "Reshaping the European agro-food system and closing its nitrogen cycle: The potential of combining dietary change, agroecology, and circularity." One Earth 4.6 (2021): 839–850.

Global Bean Project, www.globalbean.eu

Ahmed Salman and Hasan Mohtasheem, 2014, Legumes: an overview. Journal of Pharmacy and Pharmaceutical Sciences 2311-4673. 2. 34–38.

TRansition paths to sUstainable legume based systems in Europe (TRUE) projektanyagok, https://true-project.webarchive.hutton.ac.uk/

Dr. Udvardy Péter, 2010, Növény és állattani ismeretek [Plant and zoological knowledge] 3.: Fehérjenövények termesztése, Nyugat-magyarországi Egyetem [3.: Cultivation of protein plants, University of West Hungary]

CHICKPEAS, PEAS, BEANS AND LENTILS

The challenges of the 21st century in agriculture and food will lead to a revaluation of pulses. They are extremely versatile, can be grown in a wide range of environmental conditions, play an important role in organic agriculture because of their nitrogen fixing capacity, and are the basis for traditional and innovative dishes and foods. The aim of this book is to encourage the cultivation and consumption of pulses, which have been neglected in recent decades. It is aimed at farmers interested in sustainable farming, consumers concerned about environmental and health issues, and all professionals whose work involves some contact with food systems or gastronomy. The book provides an overview of consumption and production trends of leguminous crops, details on their cultivation, breeding and plant protection, and finally some general advice on the use, storage and preparation of legumes.