Pisum sativum: Biology, Ecology and Economic Importance

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Abstract - *Pisum sativum*, commonly known as the garden pea, is a leguminous plant widely cultivated for its edible seeds. This paper explores the biology of *P. sativum*, including its anatomy, physiology, and genetics, particularly highlighting its role in the foundation of modern genetics through Mendel's experiments. It also delves into its ecological interactions, environmental requirements, and role in agroecosystems. Furthermore, the economic and nutritional value of *P. sativum* is discussed, covering its applications in agriculture, food industry, and emerging roles in sustainable farming and biotechnology.

Key Words: *Pisum sativum*, biology, ecology, nutritional value

INTRODUCTION

Pisum sativum L., commonly referred to as green pea, dry pea, or field pea, is a widely cultivated legume valued for its high nutritional content, including proteins, vitamins, minerals, and bioactive compounds that promote human health [Fahmi *et al*., 2019; Han *et al*., 2022; Kumari *et al* 2021]. Grown across nearly every country, peas are considered a staple in the global human diet [Liu *et al*., 2018]. Canada leads global pea production, followed by China, Russia, and India [Raghunathan *et al*., 2017]. Peas typically occur in two main forms: smooth and wrinkled, with seed coat colors ranging from cream yellow and chartreuse to various shades of green, brown, and orange-brown [Gao *et al*.,2022; Santos *et al*.,2019]. These color variations are linked to differences in flavonoid biosynthesis, which can vary depending on the cultivar and environmental conditions. Dark-colored seed coats generally contain more flavonoids than lighter ones [Devi *et al*.,2019]. Although peas are rich in lysine, they lack sulfur-containing amino acids, which is why they are often paired with grains to ensure a complete amino acid profile [Shi et al.,2018]. In addition to being eaten as mature seeds, peas can also be consumed as sprouts or microgreens after germination [Wojdylo *et al*.,2020; Avezumet *et al*.,2022]. Since the onset of the COVID-19 pandemic in 2020, disruptions in the food supply chain have brought greater focus to food self-sufficiency [Babbitt *et al*.,2021]. In this context, germinating peas at home for sprouts or microgreens offers a practical option for supplementing domestic vegetable supplies.

This article aims to describe the main biological, ecological, and geographic aspects of the cultivation. This is one of the few scientific articles with in-depth, comprehensive, solid, and updated information.

Methodological Approach -This study was conducted through a comprehensive review of herbarium records, academic articles, and other scholarly sources related to. The primary search was performed on Google Scholar (https://scholar.google.com) using the keyword “*Pisum sativum*.” Initially, only materials with the species name in their titles were considered. However, additional relevant documents were identified through a snowball sampling technique, following citations and references within the initial sources.The extracted information was then synthesized into a cohesive narrative and further analyzed in light of supporting scientific literature.

Biology and Ecology of *Pisum sativum*

Grain legumes rank just behind cereals when it comes to global crop production. Within the legume family Fabaceae, five main genera—Pisum, Vavilovia, Lathyrus, Vicia, and Lens—include the largest number of cultivated species such as peas, lentils, vetch, and pea vines. Among these, the green pea (Pisum sativum L.) plays a prominent role and is considered one of the most important legumes crops worldwide.

Peas are known not only for their widespread use but also for their excellent nutritional value. They are rich in protein (about 23–25%), contain slowly digestible starch, and are packed with dietary fiber, essential vitamins, and minerals. Additionally, they provide health-promoting compounds like antioxidants, anti-inflammatory agents, carotenoids, and healthy fats such as omega-3 and omega-6 fatty acids (Bastianelli *et al*., 1998; Dahl *et al*., 2012).
Green peas are grown in many different climates around the world. Historically, their native range stretches from Iran and Turkmenistan to Asia Minor, North Africa, and Southern Europe (Makasheva, 1979; Jing, 2012).

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However, pinpointing the exact origin of peas is challenging due to early domestication and significant changes in the Mediterranean and Middle Eastern regions caused by both human activity and shifts in climate (Maxted *et al*., 2010).

The green pea is an annual plant that can be cultivated in both spring and winter. It develops a deep taproot that extends more than 1.5 meters into the soil. Most of its lateral roots are densely branched (reaching up to 1.0 meter) and located within the upper 40 centimeters of soil. These side roots are often so similar in appearance to the taproot that they are hard to differentiate. Additionally, the root system includes many fine rootlets (Vozowick I.S., 1983; Gareev D.B., *et al*., 1997). Nodules form on the roots where nitrogen-fixing bacteria (*Rhizobium leguminosarum*) enter. These bacteria convert atmospheric nitrogen into usable compounds and produce biologically active substances, such as B-group vitamins (Borisov A.Yu., 2011).

The stem of the pea plant is either round or faintly four-angled, hollow, and varies in thickness from medium to thick. Its internodes can range in length (Fadeeva A.N., Shurkhaeva K.D., 2007). There are two main types of stems: simple (also called ordinary) and fasciated (standard). Simple stems have long internodes and taper toward the top, with flowers and pods spaced evenly along the stem. In contrast, fasciated stems have short internodes and are broadened and flattened toward the upper section, with closely spaced nodes that result in clustered flowers and pods. The lower part of a fasciated stem remains unfused, making it prone to lodging (Ellis T.H., *et al*., 2011).

Mainly, pea leaves are paripinnate consisting of a petiole and one to three pairs of leaves and an odd number of tendrils (three, five, seven). Less often, the leaf ends with an odd leaf (tendrilless, acacia-like or multi-leaf), then their total number is 7-15. Very rarely, the leaf repeatedly odd-pinnate ends in an odd, very small leaf (Clemente A., *et al*., 2004; Clemente S.L., *et al*., 2009).

The pea plant is usually covered with a waxy coating, which performs a protective function against insects and fungal diseases (Kirichenko V.V., *et al*., 2009)

Inflorescence in pea is tassel; a false umbel is in fasciated forms (Bryzgalov V.A., 1982). Flowers, one-two, rarely two-three or more, are placed on a long peduncle coming from the axilla of the stipule.

The fruit of the pea plant is a bean, which develops from a single carpel and features two pod walls (wings). Peas are classified into hulling, semi-sugar, and sugar types based on the structure of these wings. In hulling peas, the wings contain a tough inner parchment layer made up of two to three layers of lignified (woody) sclerenchyma cells and one to two layers of non-lignified sclerenchyma cells. Semi-sugar peas have partial parchment layers, appearing as fibrous strands, while sugar peas lack this layer entirely. The presence of the parchment layer makes the pods prone to cracking when dry and leads to poor threshing efficiency (Govorov L.I., 1937; Makasheva R.Kh., 1971, 1973, 1979; Kirichenko V.V., *et al*., 2009).

The shape of pea pods varies and includes: straight with blunt, pointed, or elongated tips; slightly curved with blunt or pointed tips; curved with blunt or pointed tips; saber-like with blunt or pointed tips; crescent-shaped with pointed tips; concave with blunt tips; and bead-like forms found in sugar varieties (Krylatova S.A., Lurie B.D., 1964; Gareev D.B., *et al*., 1997).

Ecology of *Pisum sativum*

1 Habitat and Distribution

Native to the Mediterranean and Western Asia, *P. sativum* is adapted to temperate climates. It grows best in well-drained, loamy soils with neutral pH and moderate rainfall.

2 Interactions with Microorganisms

Peas form mutualistic relationships with rhizobia, promoting biological nitrogen fixation. Mycorrhizal fungi also associate with their roots, enhancing phosphorus uptake.

3 Role in Agroecosystems

As a legume, *P. sativum* enhances soil fertility by contributing nitrogen to crop rotations. It suppresses weeds when used as a cover crop and supports beneficial insect populations due to its floral resources.

Uses of *Pisum sativum*

Field pea (*Pisum sativum* L.), commonly known as 'matar' in Hindi, is a key component of vegetarian diets. These legumes, which produce pods containing seeds or beans, thrive in cool seasons and belong to the *Pisum* genus within the Fabaceae family. They are cultivated in over 100 countries for both their fresh and dried seeds, as well as for fodder. Field peas are valued for their rich nutritional profile, offering an economical source of easily digestible protein, carbohydrates, fats, vitamins, and minerals [Gueguen *et al* 1988].

A 100-gram serving of dried edible peas contains approximately 62.1 grams of carbohydrates (19.2%), 22.5 grams of protein (7.2%), 1.8 grams of fat, 64 milligrams of calcium, 4.8 milligrams of iron, 0.15 milligrams of riboflavin (vitamin B2), 0.72 milligrams of thiamine (vitamin B1), 2.4 milligrams of niacin (vitamin B3), along with significant amounts of phosphorus, vitamin C, and around 0.8% mineral content [Swiatecka *et al* 2010,Dahl *et al* 2010,Gemechu *et al* 2013].

The high protein content enhances their value as a nutritious vegetable. Additionally, field peas contribute to environmental sustainability by improving soil fertility through nitrogen fixation. They are also used in crop rotation systems to reduce the negative effects of continuous monoculture farming [Anonymous 2020-21].

Conclusion

Pisum sativum remains a crop of immense scientific, ecological, and economic importance. From its foundational role in genetics to its modern applications in sustainable agriculture and nutrition, peas continue to be a model species. With climate change and population pressures, breeding and management innovations are crucial to maximize its potential in global food systems.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declares that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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