

The Potential of Faba Beans in Agricultural Systems and its Wild Relatives

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ABSTRACT

Faba bean (*Vicia faba* L.) have emerged as a promising crop with multifaceted potential in modern agricultural systems. This review says about the diverse roles of faba beans can play in sustainable agriculture, encompassing aspects such as soil health, crop rotation, yield improvement, and nutritional benefits. *Vicia narbonensis*, *Vicia palaestina*, and *Vicia kalakhensis* these are wild relatives of Faba bean. Faba beans are potential to improve soil fertility and fix atmospheric nitrogen, offer substantial ecological advantages as a rotation crop. Moreover, their adaptability to diverse climatic conditions and relatively low input requirements makes them an attractive option for farmers aiming to mitigate environmental impacts while maintaining profitability. Beyond their agronomic benefits, faba beans also exhibit nutritional qualities, contributing to food security and human health. Faba beans are rich in protein (20–35%), carbohydrates (55-65%), dietary fiber (10-15%), vitamins, and minerals, making them a valuable source of essential nutrients. Their unique profile, including high levels of lysine and other amino acids, distinguishes them as a complementary protein source, particularly in vegetarian and vegan diets. Furthermore, bioactive compounds like flavonoids and phenolic acids are present in faba bean, which have properties like antioxidant and anti-inflammatory, potentially reduces the risk of chronic diseases like cardiovascular ailments and certain cancers. Despite these advantages, challenges such as disease susceptibility and limited market demand pose obstacles to

widespread adoption. This review identifies areas for further research and emphasizes the need for integrated approaches to fully harness the potential of faba beans in modern agricultural systems.

INTRODUCTION

Faba bean (*Vicia faba* L.), as the third most significant feed grain legume, following soybean (*Glycine max*) and pea (*Pisum sativum* L.). (Mihailov *et al.*, 2005). The synonyms such as broad bean, field bean, faba bean, bell bean or tic bean which indicates the variations in the species. In Hindi, Faba bean is commonly called as “Bakla”. Arab traders introduced Faba bean to India. The name Faba bean is derived from Arabic name “Baquila”. It is also called “Kala Mattar” (Bond *et al.*, 1985). The faba bean (*Vicia faba* L. $2n = 12$) is considered as an essential legume crop for animal and human health, because of its high protein content. (Essa *et al.* 2023). faba bean is cultivated in North India. It grows in hilly and mountain region during monsoon (Kharif) and in plain regions during winter (states of seasons). Faba bean is agronomical substitute to cereals (Singh *et al.*, 2010).

In world, faba bean have ranked sixth with 4.5 Mt from 2.5 Mha after common bean (*Phaseolus vulgaris* L.), pea (*Pisum sativum* L.), chickpea (*Cicer arietinum* L.), cowpea (*Vigna unguiculata* L. Walp.), and lentil (*Lens culinaris Medik.*) (FAOSTAT. Crop Statistics 2020), (N Bimurzayev, 2021). In India total area of Faba bean (*Vicia faba* L.) is beneath cultivation of 2.63 m ha and total production is 4.87 with 2.12 t/ha productivity as reported by Indian Council of Agricultural Research (International Journal of Agriculture Statistics, 2020).

Despite being top promising crops in the world's population, regrettably still regarded as a small legume and an underutilized crop in India (Singh *et al.*, 2009; 2001). Although the crop has received good coverage, relatively

little work has been done to improve varieties and agronomic management. Lack of high-quality seeds and inappropriate cultural methods are two limitations that lower faba bean productivity by causing suboptimal plant stands and low yields (Singh *et al.*, 2009) (*Vicia narbonensis*, *Vicia palaestina* and *Vicia kalakhensis*) are similar species. Variations in seed size among faba beans is so extensive that certain taxonomists once classified the earliest, small-seeded 'paucijuga' forms or the small-seeded 'minor' forms as distinct subspecies from the medium to large 'faba' types. Because there are no reproductive barriers among these forms, they considered as botanical types. Hence, long-term human selection on growth habit and seed size is over millennia. In India, Due to a lack of improved varieties and technology, faba beans are only cultivated on a small scale and are regarded as a minor vegetable; however, some locally modified varieties are planted primarily in Uttar Pradesh, Bihar, Rajasthan, Madhya Pradesh, West Bengal, and Assam (ICRISAT, 2010).

In developing countries, produced it is used as food for humans, whereas in industrialized nations, it is fed to pigs, horses, chickens, and pigeons. It can be canned, dried, fresh, or used as a vegetable. In the central portion of the planet, Faba bean is important winter crop grown to human use. It can be used as cattle feed and as green manure. Vegetables are produced from large-seeded varieties. Faba bean straw is used excessively and is therefore regarded as cash crop (Bond *et al.*, 1985). one of the first domesticated legumes and is widely grown for human use, animal feed, and fodder in regions of temperate and subtropical of the world. Faba bean is a productive nitrogen

fixer. It increases soil fertility by symbiotic nitrogen fixation (Bishnoi *et al.*, 2018). It is regarded as promising legume in India that could serve to people and animals as an alternative source of protein (Kumar *et al.*, 2016). An entire faba bean has 20–35% protein, 1-2% fat, 55–65% carbohydrates, 10-15% fiber, several vitamins and minerals like magnesium, calcium, potassium, iron, and zinc (Badjona *et al.* 2023). Faba bean also grows to prevent soil erosion. It has capacity to resist severe winter. It is useful in nitrogen fixation. These legumes are grown in the hills especially for its protein rich green pods which are used as vegetable (Raiger *et al.* 2012). In addition, good for agriculture, faba beans are also valued for their industrial applications due to being rich in levodihydroxy phenylalanine, or L-dopa, it is dopamine precursor. It increases blood levels of L-dopa and, without causing any negative side effects, enhance the motor function of Parkinson disease patients (Apaydin 2000).

Botanical Description

It is annual crop, sown in spring or autumn. The stem is upright, strong, hollow that is tetragonal in shape. The basal leaf axis gives rise to zero, five, or even more basal branches. At the tip of the leaf, there are merely ineffective primitive tendrils. Stipules are smaller than peas and have a characteristic black mark on the underside of the stipule. The bean contains several branched secondary roots in addition to a strong tap root. Though the root system is not large that of cereals like oats or wheat. The root has characteristic nodule produced by *Rhizobium leguminosarum*, expected to being a leguminous species. Two leaflets are present on the initial, juvenile leaves. The highest number of leaflets is attained with four nodes or more. First, lowest inflorescence is found in the axis of a leaf, with four leaflets. Inserting the stem lower down, at the fourth node or many nodes later (higher). There are 2-8

flowers in each inflorescence. The wild type flower has white colour with obvious satin black patch on both wing petals and a soupcon of pink traces (Figure 1).

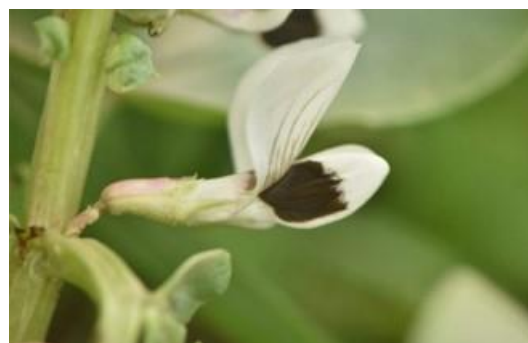


Fig. 1: Faba bean flower

There are several flower color grades, such as brown, violet, red, and so on. The allele pleiotropic impact for zero tannin in the seed testa, along with the stipule spot is absent in wild type and the testa's grayish coloration rather than buff, results in completely white flowers. An inflorescence will produce one to two pods containing three or four seeds each; however, a single plant has the potential to yield much more than 12 pods, dispersed over more than six nodes (Cubero, 1974).

Nutritional Qualities of Faba Bean

Farmers grew this plant extensively because it produces a higher yield and and it stored for a long time. Faba bean plant has an ability to regulate atmospheric nitrogen, which eventually improves soil fertility. It is also well-known for being a covered crop since it prevents soil erosion in addition to, the *V. faba* is economical in cost and good source of protein. The reason for its medicinal property because of the polyphenols presence, with a high antioxidant activity (Ramos, 2007).

In the Mediterranean region the fruit is commonly used as animal feed and is a staple in high-protein diets for humans, Because of its higher production and nutritional content. It is important crops in Egypt is *V. faba*, which is eaten by the populace as cakes, pastries, and

soup (Hendawey and Younes, 2013). Nutritional value of Faba bean is high. It is abundant in proteins, carbohydrates, vitamins, folic acid, niacin, and vitamin C, dietary fiber and macro and micro nutrients. Faba bean's seed parts are rich in carbohydrates (51-68%) and proteins (20-41%), it contains globulins (79%), albumins (7%) and glutelins (7%). Also found anti-nutrition contents such as vicine and convicine in low amount, ABTS radical-scavenging activity, high lipid content (Vioque et al., 2012). In the seeds abundant amount of Poly phenols were present (Pastor et al., 2011). The major and micro nutrients are present in the fruit. The important minerals such as Ca, P, K, Mg, Na, S, Al, B, Ba, Co, Cr, Cu, Fe, Ga, Li, Mn, Ni, Pb, Sr, Zn. It is designated that *V. faba* was an important diet for the consumption of humans and to the animals (Hacıseferoğulları et al., 2003; Hossain, et al., 2006; Yang et al., 2011; Giménez et al., 2012).

Health Benefits of Faba Bean

Faba bean have various medicinal values. It is used as ingredients and applications to soften stiff limbs. L-DOPA is obtained from Faba bean seeds, which is precursor of dopamine. It is used in the treatments of Parkinson's disease. It also has antioxidant activities. It is also used as medicine for the treatment on Parkinson's disease. A nutritional supplement that may aid in the management of hypertension. Faba beans are cultivated as a crop for green manure and help in the fixation of nitrogen. Its tannin-free varieties could be fed to chickens and pigs after processing (Nanda et al. 2023).

COUNCLUSION

Faba bean is a versatile and nutritious legume that offers numerous benefits. As a valuable source of protein, fiber, vitamins, and minerals, it plays a crucial role in improving human health and combating malnutrition,

especially in regions where protein deficiency is prevalent. Additionally, its nitrogen-fixing abilities contribute to soil fertility and reduce the need for synthetic fertilizers, promoting sustainable agricultural practices. With its adaptability to various climates and soil conditions, faba bean stands as a promising crop for enhancing food security, fostering biodiversity, and mitigating environmental degradation.

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