FABA BEAN: A POTENTIAL ALTERNATIVE GRAIN LEGUME OF FUTURE

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Faba bean particularly in India, has largely been considered as underutilized pulse crop, however, it has adequate reason to let off the tag of underutilized one. The faba been (*Vicia faba* L.) is one of the oldest crop grown by men providing high protein seeds for human and animal feed. They are an excellent source of protein, carbohydrates, and good source of iron, magnesium, potassium, zinc, copper, selenium, and many vitamins. It is an important food legume in China, Egypt, Italy, Brazil and Ethiopia. China is the major *V. faba* producing country in the world which now grows almost two-thirds of the world's production of the crop. In India, the major pulse crops grown are chickpea, pigeonpea, urdbean, mungbean, lentil, field pea whose production shares are 40%, 18%, 11%, 9%, 8% and 5% respectively with an average productivity of 600-650 kg/ha. These pulse crops are mainly grown in Madhya Pradesh (23%), Uttar Pradesh (18%), Maharashtra (14%), Rajasthan (11%), Andhra Pradesh (9%) and Kartanaka (6%) as rainfed crops with very fluctuating yield trend which attained its peak of 14.94 million tons in 2003-04 and again started declining. India despite being the largest producer in the world, it is in short supply of pulses as its domestic requirement leading to import of pulses to the tune of 1.47 million tons. Moreover, in rainfed areas where pulses are grown extensively are often marred by frequent occurrence of drought and other abiotic stresses which are believed to play a major role in widening the gap between demand and supply and hence a huge import price.

One of the possible ways to narrow down this gap between demand and supply could be the utilization of this underutilized pulse crop which has been observed to be grown in MP, eastern UP, Chattishgarh, Punjab, Haryana, Bihar etc. When we compare its nutritional properties as well as its productivity that too with less agricultural inputs with other important pulse crops, it stands at par. Some of the faba bean genotypes have been reported to have potential to yield significantly higher than other pulse crops viz. chickpea, lentil and pea and matured earlier than these three pulse crops. Thus, faba bean appears to be a good alternative pulse crop to the other rabi legumes. Considering the high potential yield of faba bean and the need for diversification of cereals dominated cropping pattern with a potential legume crop, it is found desirable to study the agricultural potential, performance and prospects of faba bean in India also, to be used as an alternative pulse crop and hence to increase the overall pulse production of our country.

However, a drawback to the more widespread use of the faba bean stems from its toxicity because it contains some antinutritional factors *viz*. condensed tannins located in the testa and pyrimidine glycosides (vicine and convicine), which accumulate in the cotyledons, negatively affect digestibility, other nutritive quality and favism respectively in human.

Vicine and convicine (v-c) are hydrolyzed by the intestinal microflora to highly reactive free radical generating compounds divicine and isouramil. These compounds have been associated with the aetiology of favism, an acute form of hemolytic anemia. It is a very rare inherited condition in a small percentage of people in which a person lacks an enzyme called glucose-6-phosphate dehydrogenase (G6PD) in red blood cells.

Moreover, breeding of varieties with tannin-free (zero tannin) seeds and, more recently, with low vicine–convicine content, offers new perspectives in human and animal consumption. However, a spontaneous mutant allele named vc- has been discovered, which induces a 10-20 times reduction in v-c contents. But high cost and difficult chemical detection of v-c contents restrict breeding-selection process. Gutierrez *et al*. developed CAPs marker to assists selection for low vicine and convicine contents in faba bean which will allow the correct fingerprinting of faba bean plants and can be efficiently used in breeding

selection to track the introgression of the vc- allele to develop cultivars with low v-c content and improved nutritional value. On the other hand, the zero-tannin character in faba bean is monogenetically inherited and two complementary genes, zt-1 and zt-2, control the absence of tannins in the crop. Homozygous mutations in either of these genes block the synthesis of anthocyanins or of their precursors at different steps in the metabolic pathway, giving rise to zero-tannin plants. Therefore, tannin free genotypes of faba beans can be obtained by breeding and selection of one of the two recessive alleles. In this direction SCAR markers have been identified which linked to these two genes. The resulting markers will greatly facilitate the task for breeders to choose appropriate genitors in breeding programs and to perform efficient selection of zero-tannin genotypes using MAS strategies. On the other hand, key genes viz. anthocyanidin reductase (ANR), leucoanthocyanidin reductase (LAR), leading to condensed tannin (proanthocynidins) biosynthesis have recently been isolated and characterized in several plants including legumes. Characterization of these genes offers a new paradigm in generation of low tannin content faba bean using recombinant DNA technology.

Faba bean (*Vicia faba* L.) was thought unsuitable for commercial dryland production but Loss *et al*. performed extensive studies on faba bean cv. Fiord, and demonstrated its adaptation to dryland Mediterranean-type environment. Faba bean produced large seed yields even in areas that receive 350 mm annual average rainfall or less, when sown early. With early sowing, faba bean develops large green area and rapid ground cover, and absorbs a significant proportion of photosynthetically active radiation early in the season when vapour pressure deficits are low. Consequently, it produces large biomass by maturity. Its water use efficiency (based on dry matter production) is comparable to cereals and greater than those for other grain legumes in similar environments. The key to the adaptation of this cultivar to short-season environments is that it flowers early, and sets and fills pods soon after first flower. As a result of early pod set, faba bean minimizes soil evaporation and uses most of the soil moisture after anthesis, thus partitioning biomass into pods and seed. In this way faba bean has a consistently high harvest index and water use efficiency (for grain production). As mentioned earlier pulses are grown mainly as rainfed crop in India, the adaptation of faba bean to dryland environment may also be exploited in our major pulse growing areas as this is one of the major bottlenecks in achieving high pulse productivity in India.

Furthermore, faba bean has been attributed with its certain medicinal values and in this direction research is going on the potential use of faba bean as a treatment in Parkinson's disease. People with Parkinson's disease are unable to manufacture dopamine, which serves as a chemical messenger in the brain and helps regulate important motor and cognitive functions. Fava beans are a source of levodopa, a natural precursor of dopamine. Levodopa was identified in the seedlings, pods and beans of the faba bean (*Vicia faba*) by Guggenheim in 1913. When taken orally, levodopa is absorbed into the blood stream and carried to the brain where it is converted into dopamine.

Conclusion:

It seems it may revolutionize the overall pulse production of the country, if different available germplasms of this crop are tapped and characterized properly as far as its tremendous genetic potential for high yield, nutritional values and for developing resistance to disease and abiotic stress are concerned with concomitant effort towards lower down its toxicity and so that this pulse crop can be used as main commercial crop rather than a neglected one.