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Rediscovery of Common Bean Landraces in Tribal Regions of Balaghat (MP), India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Phaseolus vulgaris L. is one of the most important legume grains for human as well as animal consumption direct and indirect Internationally. This crop shows a great phenotypic variation, which enables its production in a wide range of agroecosystems and cropping systems. These species are considered superfoods, but yet many of them are not part of our diets. In the tribal blocks of Balaghat district of Madhya Pradesh (Baihar, Birsa, Paraswada, Lanji, and Kirnapur) A great genetic diversity in common bean (*P. vulgaris*) observed in wild populations, traditional varieties, and primitive landraces as well as been maintained at the College of Agriculture in Balaghat (MP). The importance of common bean landraces in agriculture cannot be neglected. Beans are rich in a variety of nutrients and a convenient plant source of protein and dietary fiber. Unbalanced food affects billions of people worldwide, leading to malnutrition and socio-economic complications as well. Many primitive landraces have medicinal properties, they contain folate, iron, thiamin, vitamin K, phosphorus, magnesium, manganese, and potassium it has an effective impact on human health such as promoting heart health, maintaining blood sugar, enhancing digestive functions, and

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repairing the body and supporting weight loss. Beans are edible in fresh, And canned forms. Dry beans are rich sources of iron also and this is so important for vegetarians and vegans as substitutes for nutrients from animal sources, especially iron. Conservation of genetic resources of common bean species in suitable banks is an important pillar for international food security.

Keywords: Common bean; conservation; genetic resources; species; nutrition; protein.

1. INTRODUCTION

“The common bean (*Phaseolus vulgaris* L.) is an important legume crop that has tremendous ecological and nutritional value. There are 76 species are reported from the New World [1] tepary bean (*P. acutifolius* A.), runner bean (*P. coccineous* L.), lima bean (*P. lunatus* L.), year-bean (*P. polyanthus*) and common bean (*P. vulgaris* L.), are five species those are commonly under cultivation in the world” [2,3]. Common beans are a New World crop with worldwide significance for human nutrition. Globally *P. vulgaris* L. is the highest cultivated species with a growing area ratio of 90% in the world, as compared to other species of beans [4].

“The Beans are used as dry beans, shell beans (seeds at physiological maturity), and green pods. When consumed as seed, beans constitute an important source of dietary protein 22% of seed weight that accompaniment cereals” [5,6].

Fig. 1 explains the (a) evolution of bean seed production and the area under cultivation from 2000 to 2019 (b) part shows the evolution of sale prices of a common bean seed and (c) its production share by continent in 2019 (d) map of production quantities of common bean seed by country in 2019.

“Common bean is an important landrace-rich grain legume widely produced for direct human consumption and it is known to be an affordable source of dietary proteins to low-income households in many developing countries” [8,9]. This crop is also called kidney bean, haricot bean, French bean and field bean. Understanding the nutritional properties, and positive impact on soil fertility as well as using values that allow its maintenance in our agricultural system is a prerequisite to developing efficient strategies for its conservation. The conservation of crop genetic resources is a fundamental step for further breeding of traits of interest.

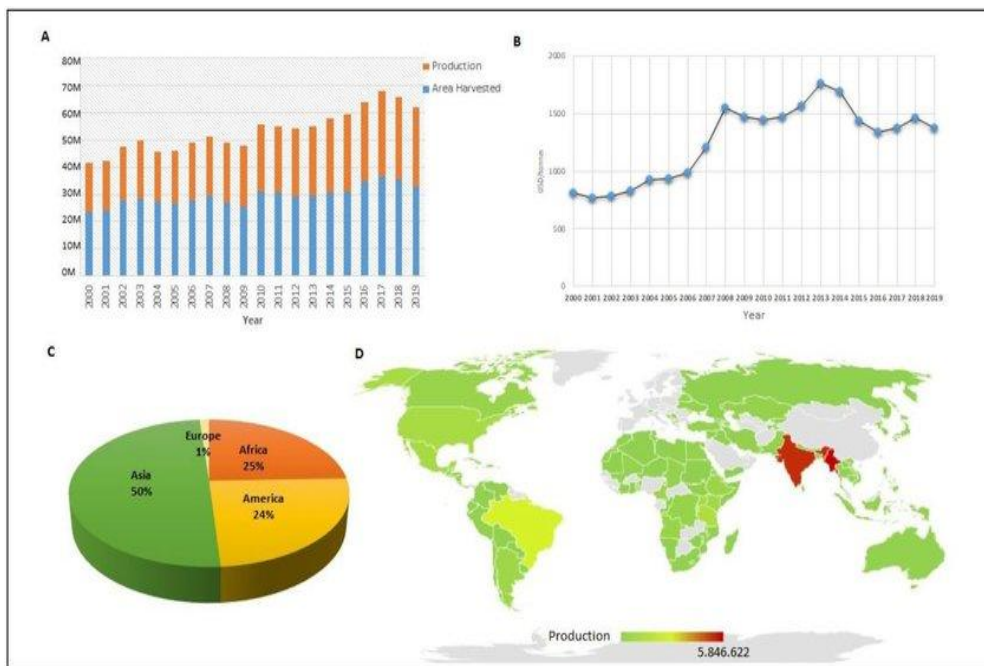


Fig. 1. Common bean production in the world [7]

“The common bean is a self-pollinated diploid annual plant that belongs to the Fabaceae family in the genus *Phaseolus*, which has about fifty species globally and is joined by two other species (lima bean, *Phaseolus lunatus*, and scarlet runner bean, *Phaseolus coccineus*), in beans some degree of out-crossing is also reported” [10,11]. Common bean is widely and commonly cultivated throughout the world for multiple functions. White, yellowish, pink, or violet-purple colour of flowers are observed with ovate or ovate-rhombic, acuminate, pubescent leaflets and a mosaic of seed colors, sizes, and shapes. Data Collection, identification, characterization, and documentation of common bean landraces is essential for future utilization, conservation, and their improvement. Understanding the extent and distribution of common beans in the bean-growing tribal region of Balaghat. This study focused on the diversity found and the ethnobotany of common bean landraces in the tribal zones of its high-production areas in Balaghat.

2. BACK TO THE WILD

Locally cultivated diverse landraces are repositories of gene pools that enrich biodiversity, are highly climate resilient, and sustainably stabilize ecosystems to make them functional. Over-exploitation of some plant species with utter neglect to others either deliberately or otherwise through modern agricultural systems that promote the cultivation of a few high-input and high-yielding crop species caused disaffection to biodiversity with consequences of the reduction in its regulatory services. Beans are proven superfoods, but still many of those *Phaseolus* species are not

mainstreamed in our Indian food system. “The landrace of beans is distinguishable by its adaptability to a particular environment, resilience, cultural values, and organoleptic properties. It is a population having a historical origin, and distinct identity and lacks formal crop improvement being locally adapted and associated with conventional farming systems” [12].

3. BEANS DIVERSITY IN A TRIBAL REGION

Traditional agriculture Knowledge of tribes is very valuable and their farming practices are truly sustainable in many ways. As the world increasingly switch to sustainable farming practices, tribal communities such as Gond and Baiga of Balaghat District appeared to be the pioneers of the technique. They grow conventional varieties such as millet, rice, legumes, and vegetables. The incredible diversity is observed in 60 landraces of common beans collected from Baihar, Birsra, Paraswada, Lanji, and Kirnapur tribal blocks of Balaghat district of Madhya Pradesh, India.

The high diversity in morphological traits like seed color, shape, size, twining habit, time of flowering, anthocyanin pigmentation in the stem, leaflet size, flower color, flower size, and 100-seed weight was observed in common beans. Many of them have developed tolerance to particular abiotic and biotic stresses, [13] many of which show resistance to pathogens, pests, and various biotic stresses [14]. “They are distinct morphological, growth, food quality as well as ecological adaptation to delimit one block the other” [15].



Fig. 2. Diversity in bean landraces



Fig. 3. Variation in shape size and colour of dry bean

4. NUTRITIONAL VALUE OF BEANS

“Beans were pearled to evaluate the feasibility of increasing antioxidant activity and phenolic antioxidants and they are highly nutritious fresh as well as in dried form. There is no cholesterol in beans, which makes them heart-healthy vegetables. Beans are high in both soluble and insoluble fibers, and the health benefits of beans are endless. Beans absorb the bad cholesterol present in the body” [16]. “According to a survey, a person can lower the bad (low density) cholesterol level by 10% in 6 weeks by eating one cup of cooked beans on daily basis. This consumption of beans automatically reduces the risk of heart disease by 20%” [17,18]. “In common beans, lectins/hemagglutinins are a type of carbohydrate-binding protein which abundantly stored and the eminent pH stability allows them to survive digestion and remain active in the intestine where they may have direct contact with colorectal tumors” [19].

5. FRESH BEANS

“Green beans are the richest source of vitamins C, K, and A. In a study by USDA, it is reported that a single cup of green beans (100g) contains 31 calories, 1.8g of protein, 7g of carbohydrates, and 0.2g of fat” [20]. “Green beans are similar to other vegetables’ healthy addition to almost any

eating plan because they are a low-calorie, low-fat energy source. They are also nutrient-dense, providing many beneficial vitamins, minerals, and antioxidants without many calories. This combination makes them an ideal food for a diet promoting a balanced weight” [21]. “The B vitamins found in green beans can help lower levels of a compound called homocysteine in the blood and it can impair cognitive function” [22]. “They have a high fiber content, and therefore are helpful for controlling diabetes by reducing insulin generation and glucose levels that enter the bloodstream. As well, those with non-insulin-dependent diabetes can prevent the requirement of insulin by up to 40% by consistently consuming green beans, according to researchers” [23,24].

6. DRY BEANS

“Maximum Indian people prefer common beans in dry form and they are rich in both soluble and insoluble fibers” [25]. “Dry beans are preserved and stored for long periods and also provide substantial amounts of insoluble fiber, which help attract water to the stool and keep you regular. This may help to combat constipation, colon cancer, and other digestive health conditions” [26]. It contains Complex carbohydrates which are rich in fiber and referred to as dietary starch and made of sugar molecules strung together

like a necklace. The majority of the calories in dry beans come from carbohydrates in the form of starch, resistant starch, and small amounts of non-starch polysaccharides. "Being rich in complex carbohydrates, as well as a good source of protein, beans have a low glycemic index. This makes them an ideal food for the management of insulin resistance, diabetes, and hyperlipidemia" [27,28]. "Dry Beans contain oligosaccharides, which are non-digestible, fermentable fibers and broken down by beneficial bacteria in the colon, which may result in gas production and flatulence. There is increasing research and attention on the health of the gut or gastrointestinal (GI) tract, and how certain foods benefit or harm the gut" [29,30].

7. IMPACT OF BEAN CULTIVATION ON SOIL HEALTH

"All legumes are very important for improving soil quality they grown using different soil management practices, moreover and are often inoculated before sowing. Microorganisms (*Rhizobium* sp.), introduced in the soil as an inoculum, affect not only inoculated plants, but these microorganisms can remain in the soil for the next growing season their root nodules are positively enhanced soil" [31]. "Beans are widely grown as a component of different cropping systems to improve soil quality due to their ability to form nodules, legumes can fix the atmospheric nitrogen in the soil, and thus they contain one or more types of microorganisms" [32].

"Beans in association with *Rhizobium* can fix from 25 to 120 kg N / h and it supplies nitrogen to the soil by forming a symbiotic or mutually beneficial partnership with rhizobia through the biological nitrogen fixation process. These biofertilizers provide quality products for human consumption by way of reduction of the chemical residues and also reduce the risk of environmental pollution which cause serious health issues" [32]. "These legume-growing practices are also effective in organic farming goals. Nowadays the use of biofertilizers such as consortia, *Rhizobium*, *Azotobacter*, *Azospirillum*, PSB, and *Pseudomonas*, etc. have been found to be very effective tools for improving yield and quality of the crop as well as maintaining fertility status of the soil" [32].

8. CONCLUSIONS

Traditional values and medicinal importance of common bean landraces in the central region of

India increase their role in agriculture and in the farming systems. Socio-demographic characteristics may influence common bean production, with rich nutritious value, and use must be taken into consideration in future programs of conservation. However, an assessment of diversity and analysis of the distribution of the extent of common bean landraces in the study area is a necessity for the development of an efficient strategy for the conservation of this genetic resource. Conservation of this remarkable genetic diversity is recommended for future propagation, breeding, and the investigation of genetic relationships.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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