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Conservation of Landraces of Millets for Overcoming Malnutrition Problems and Nutritional Food Security

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Abstract

Malnutrition problems and nutritional insecurity is a major threat to the world's population including India. Millets include maize (*Zea mays* L.), sorghum *(Sorghum bicolor* L.*)*, pearl millet [*Pennisetum glaucum* (L.) R. Br.], finger millet [*Eleusine coracana* (L.) Gaertn], foxtail millet [*Setaria italica* (L.) Beauv], proso millet (*Panicum miliaceum* L.), barnyard millet (*Echinochloa* spp.), kodo millet (*Paspalum scrobiculatum*) and little millet (*Panicum sumatrense*). Millets are the primary sources of energy of Asia and Africa because of presence of high amount of essential amino acids, minerals, vitamins and protein. So, these cereals, rich in nutrients content can help to eradicate the nutritional deficiency diseases. To feed increasing population of India, climate change scenario and exploitation to maximum of agricultural lands with irrigation facility, it is need to focus on dry lands also to produce sufficient grain. Millets are better option in comparison to other crops due to their climate change compliant nature. So, millets conservation and cultivation can also keep dry lands productive and ensure nutritional food security. Therefore it is urgent need to conserve land races of these underutilized crops for food security and sustaining the agro-diversity.

Keywords: Millets; Landraces, Conservation, Nutritional, Security

Abbreviation: PGRs: Plant Genetic Resources.

Introduction

Among the 7.8 billion global populations, 820 million people experience chronic hunger, and these include 135 million people surviving in acute food insecurity zones across 55 countries [1,2]. Developing countries like India, Bhutan, Sri Lanka, Sudan, Ethiopia, Yemen and Somalia where >31% of children under 5 years of age are stunted and 15% are too thin for their height, will be worst affected owing to the combined effects of disease and hunger [3]. After attack of COVID-19 pandemic disease, situations have more difficult due to interruption in supply chain of grain, increase of prices in food commodities and increase of prices in agricultural food stuffs. Plant based diet is main source to improve the health status of the world's population including India for overcome malnutrition problems and nutritional security. Changing climatic conditions in which include unpredictable rainfall, low and high temperature, drought conditions, increased attack of insect pests have created more complex situation of malnutrition problems and food insecurity by affecting the cultivation of vegetable, cereals, oilseeds, pulses. So, it is urgent need to take action to address malnutrition problems and food security of people's worldwide. Consumption and cultivation in non-cultivated and rain fed areas of millets may be a solution of these problems. Because, these are nutrient rich, gluten free, low irrigation and low fertilizer requirement, short duration, low cost of cultivation, more capacity to well survive and tolerate to high temperature and drought conditions in comparison to others cereals [4,5].

Millets includes sorghum (*Sorghum bicolor* L.), maize (*Zea mays* L.) pearl millet (*Pennisetum typhoides* L.), finger millet (*Eleusine coracana* L.), foxtail millet (*Setaria italic* L.), proso millet (*Panicum miliaceum* L.), barnyard millet (*Echinochloa crus-galli* L.), kodo millet (*Paspalum scrobiculatum* L.), little millet (*Panicum sumatrense* L.), teff (*Eragrostis tef* L.), fonio (*Digitaria exilis* L.), Job's tears (*Coix lacryma-jobi* L.), guinea millet (*Brachiaria deflexa* L.), and browntop millet (*Urochloa ramosa* L.).

Strategies for enhancing nutri-cereals supply without interruption is collection, conservation of landraces, development of high yielding and high nutritive rich varieties by using land races as parents as a parent in plant breeding program and increase quality seed production of these varieties with public, private, NGO partnership and establishment of seed villages.

Breeding Objectives of Millets

The major breeding objectives in millets are development of high yielding cultivars with high nutritive value, reduced blodging and shattering, reduced bristles, spines in shoots, and leaves in miner millets, breeding for larger seeds would help minimize post-harvest losses, improving the color, fodder yield, flour quality and reduced antinutritional traits [1,6,7].

Collection and Conservation of Millets Germplasm for Nutritional Traits Rich Varietal Development

Collection and conservation of germplasm including land races is first requirement for make strategies to development of varieties for face upcoming future constraints including development of nutrient reach varieties for overcome malnutrition problems and food insecurity. Conservation of plant genetic resources (PGRs) provides a continuous supply of raw material for crop improvement. Collection means tapping of genetic diversity of millets from farmer's field, centers of its origin, seed companies, different institutes and conservation means assembling of germplasm at one place for protection and further use in crop improvement. Germplasm is conserved in two way, Ex-situ means offsite conservation, conservation of millets away from their natural habitat like seed gene bank and In-situ conservation means on-site conservation, conservation of germplasm of millets away from their natural habitat like Agro gene sanctuaries. These gene sanctuaries conserve traditional landraces within their native agro-ecosystems.

Globally, total number of cultivable germplasm of major millets *viz*. sorghum (1,68,500), pearl millet (20, 844), and finger millets (36,873) whereas minor millets are foxtail millet (44,761), proso millet (29, 308), barnyard millet (7923), shama millet (707), kodo millet (4780) and little millet (3064) accessions respectively. Worwide, 1,33,849 cultivated germplasm of small millets are conserved in gene banks and majority of genotypes are conserved 64.4% in Asia, followed by 13.8% in Africa and 13.5% in Europe [8].

In India, ICRISAT, contains the largest collection of millet germplasm representing 27.4% of total crop accessions in the genebank. Of this, pearl millet constitutes the vast majority of germplasm represented by 23,092 accessions including landraces, cultivars, genetic stocks, breeding lines, and wild relatives [9]. Finger millet germplasm consisting of 6,084 accessions is grouped under two subspecies, africana and coracana on the basis of morphology of inflorescence [10]. Foxtail millet is a self-fertilizing species including 1,542 accessions from 23 different countries. Foxtail millet accessions are classified into three races, namely indica, maxima, and moharia and 10 subraces [9]. Barnyard millet germplasm comprises of 749 accessions mainly from Japan and India [9]. The major collections of kodo millet from India and USA account for 665 accessions [9]. India is the prime contributor of little millet germplasm with 473 accessions [9]. By germplasm characterization from the millet genomic resources like in pearl millet [11], finger millet [12] foxtail millet [13] and in other small millets [9] for nutritional quality traits and other traits, new varieties may be evolved [14].

Only by the start of the 21st century, millet germplasm received scientific attention for nutrition traits. Evaluation of pearl millet, foxtail millet, and finger millet genotypes for grain nutrients revealed sufficient genetic variability. Multi-location on farm trials identified nutritionally superior lines with farmer preferred traits such as earliness to flowering and grain yield, adapted to local environments [2]. This process accelerates the pace of breeding in millets by studying the inheritance pattern and genotype– environment interaction for grain nutrients. Crossing between diverse lines will generate mapping populations for DNA marker-assisted tagging of genomic regions linked to grain nutrients and may be use in plant breeding program for development of high nutrient rich variety. In changing climate situations besides from being nutritionally superior to major cereal crops, millets are inherently tolerant to abiotic stresses like drought, high temperature, cold, poor soil fertility, and salinity [3,15] and are physiologically sustainable under adverse environmental conditions owing to their excellent and efficient water and nitrogen use [16,17].

Strategy for Nutritional Security by Using Millets

Productivity of millets is low because farmers give priority to grow millets in adverse climatic conditions and rainfed areas as cover crops without using of quality seeds to conserve arable lands in harsh conditions [18]. So, availability of quality sees of high yielding and nutritive rich variety may boost the productivity of millets. For fulfill needs of consumer demand, expansion of cultivable are is required. Till date, consumer prefers to take major cereals in their diet which are less nutritive values in compare to millets. So, food diversification by utilization of millets among peoples is required. Food diversification of consumers means in crop diversification and the potential to reintroduce lost and underutilized millets. Value added product must be developed through millets so that more consumers may be attracting for uptake of millets in their diet. Market consumers must be familiarized with diversifying their food habits for a sustainable life [19].

Conclusion

This review highlights the importance of millets in our health and importance of conservation of landraces for upcoming future threats of production and breeding strategies for food and nutritional insecurity. By development of values added products of millets and awareness of consumers about nutritive value of these, consumer should be promoted for use of them in their diet. To fulfill market demand area of cultivation and production for millets must extend by using quality seeds of high yielding and high nutritious varieties. Because, the landraces of millets have treasures of nutritional and climate resilience traits which are used for development of high nutritive value and high yield potential varieties as parents. Therefore, conservation of landraces (on-farm, gene sanctuaries conservation and seed gene bank) of wild and traditional landraces of millets is essential. Millets are climate-resilient crops that can meet the need for food and fodder and act as nutritional supplements in future also.

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