

FOXTAIL MILLET

A NATIVE SALUBRIOUS GRAIN

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INTRODUCTION:

Millets are nutritionally superior to cereals and holds a good position in the diet of people throughout the world. Yet, their consumption as a food is restricted to traditional consumers and people from lower strata of society. Environmental threats like sudden climatic changes, water scarcity draught, cyclones and global problems like ever increasing population and demand on food to these people brings in an unavoidable situation for nutritionists to search for healthy alternate food sources to rescue the human population from hunger, poverty, malnutrition and inevitable deaths. During the green revolution of 1950's and early 1960s, wheat and rice garnered huge attention as staple food crops with all modernization and crop improvement techniques directed towards them helped developed high yield varieties to overcome food poverty. This kind of focused treatments for wheat and rice crippled the cultivation of all millets. Otherwise these millets especially foxtail millet would have sustained the extreme conditions to yield high produce in dry lands with adequate nutritional composition for combating nutritional deficiencies and maintain good health. Therefore, future of foxtail millet in our daily diet can be foreseen, as agrarian and nutritional challenges can be solved by cultivating foxtail millet in dry lands going waste with minimal farming inputs as it is rich in therapeutically important components like antioxidants, photochemical, essential free fatty acids, vitamins and minerals.

History of foxtail millets

More than 100 varieties of *Setaria* were cultivated. *Setaria italica* (foxtail millet) only gained worldwide acceptance playing an important role in Chinese civilization and continued to exist as a staple crop in arid and semi-arid regions of the world in the present era also. The green foxtail which was the ancestor of present-day foxtail millet was cultivated approximately around 16000 YBP and gained popularity in the Northern China between 5000-6000 YBP followed by the remaining parts of the world as per archaeology findings.

Foxtail millets were believed to be native of China as it was domesticated in that country around 8700 years ago and was named foxtail because of its bushy, tail-like appearance and immature panicles. It is commonly called as Italian millet, German millet, Chinese millet, Hungarian millet, Dwarf setaria, Giant setaria, Liberty millet and Siberian millet.



Foxtail millet in Indian languages Kangni (Hindi), Tenai (Tamil), Korralu (Telugu), Navane (Kannada), Kanghu, Kora (Oriya), Shol (Kashmir), Thina (Malayalam), Rala (Marathi), Kaon dana (Bengali) and kang (Gujarati).

Taxonomy and genomic size of foxtail millets

Foxtail millet possesses short generation time dependent on accession which is usually 5-8 weeks for flowering from planting and 8-15 weeks for seed maturity from planting. The inflorescence of the plant can be dense, cylindrical and bristly panicle whereas, it can produce hundreds of seeds from each inflorescence which were not dormant and hence were possible to cultivate in a glass house at densities of about 100 plants/m² or in fields of temperate or tropical climates. The seed is covered by different colours like white, yellow, orange or other shades of green and purple.

Foxtail millet is enclosed within a thin, papery hull that can be dehulled easily by threshing. They are small and measured around 2 mm in diameter with varying colours and thousand seeds weighing about 2.0 g. The notable characteristics of foxtail millets included small genomic size along with short life cycle and were genetically related to other cereals, millets and bioenergy grasses. Due to its potentiality to withstand various biotic and abiotic stresses, this millet can be a novel model system to perform C4 photosynthesis, stress biology and biofuel traits. Many of the foxtail millet accessions were tolerant to abiotic stresses, especially drought and salinity.



Agricultural aspects of foxtail millet

Foxtail millet is an annual warm season crop which can be grown in arid and semi-arid regions of the country. It thrives well in poor and dry soils. Foxtail millet farming requires clean and weed free land and must be brought to fine tith stage which can be achieved by deep ploughings.

The seed rate depends on the type of farming method and variety. An average of 8 to 10 kg/ha seed rate is required in case of sowing whereas 15 kg/ha seed rate is required in case of broad casting method. The ideal time of sowing is June to August for rain-fed crop and for January for summer irrigated crop. However, every state in India has its own ideal conditions for sowing. A spacing of 25cm × 10cm and sowing depth of 2 to 3cm was found suitable.

Weed free environment is essential for any successful crop farming. Crop rotation ensures soil fertility and good yield. Foxtail millet can be rotated with legume crops like green gram, soybean, horse gram, black gram or peanuts. Some of the common diseases in foxtail millets are lead and head blast caused by *Magnaporthe grisea*, green ear caused by *Sclerospora graminicola* and smut disease caused by *Ustilago crameri*.

Foxtail millet is self-pollinated and produces seeds in 85 to 95 days in case of grain/seed production. Hand or machine harvesting can be carried out. Post harvesting includes threshing the crop and grading the seeds. Yield of the foxtail millet depends on variety, soil type, climate and other agricultural or horticultural management practices.

Foxtail millet is mainly affected by environmental factors like precipitation, diurnal temperature range, latitude, sunshine hour and $\geq 20^{\circ}\text{C}$ accumulate temperature. The altitude and precipitation had direct positive effect while $\geq 20^{\circ}\text{C}$ accumulate temperature showed negative effect on foxtail millets grain quality.

The maturity of foxtail millet ranges from 61 – 104 and 60 – 103 days, with plant height of 69 – 138 and 120 – 177cm, number of productive tiller being 5 – 15 and 16 – 41, panicle length 7 – 28 and 14 – 33cm, panicle breadth 4 – 9 and 5 – 8cm, panicle weight per plant 55 – 132g and 11 – 75g during rainy and summer season respectively. The panicle weight per plant decreases during summer season due to water scarcity whereas other components are not much affected

Foxtail millets for nutrition security

The continued existence of nutrition insecurity has been an utmost challenge to world's population that relied on cereal grains. Foxtail millet grains are non-allergic, easily digestible packed with exceptionally rich macronutrients like proteins, essential fatty acids, micronutrients such as vitamins, minerals and phytonutrients such as flavonoids and polyphenols are the need of the hour to be included in regular diets. Therefore, it can be used to fight protein energy and micronutrient malnutrition by biofortification of staple crops. The ability of this millet to adapt to abiotic stress and its nutritional benefits are of importance in developing breeding strategies that facilitate the increasing demand for high quality grain which better satisfies consumers.

Foxtail millet can be consumed as food based nutraceuticals for its minerals, flavonoids and amino acids. Calcium and magnesium are two of the most important minerals required for maintaining healthy bones, cellular function and good health. Calcium deficiencies are much common among young children, elderly, pregnant and lactating women and as millets are rich in calcium and magnesium can help maintain calcium homeostasis in the body.

Foxtail millets for economic security

Foxtail millet is an important food source for people living in dry, hot and humid areas. Their cultivation is not too demanding, it requires less agricultural inputs and can grow in difficult terrains. They tolerate extreme climatic conditions like droughts, high salinity and low fertility of soils without or limited fertilizer application making them highly recommended crops for dry land farmers resulting the cost of cultivation withstanding climate vagaries. Foxtail millets are more drought tolerant than many other known grain crops with adaptability to extreme weather conditions. It was found that the cereals required about 45.0% of their seed weight of water for successful germination whereas foxtail millets need only 26.0% of its seed weight. The amount of water required by this millet for production of one unit of biomass called as water use efficiency is higher than any other food crops as it requires about 257.0 g of water to produce one unit of biomass, whereas maize and wheat requires 47.0 and 510.0 g of water respectively.

CONCLUSION

The reduced cost of cultivation in the present-day pandemic situation with erratic climate can benefit farmers to a greater extent. Processing of foxtail millet as value-added foods by food processing techniques like fermentation, malting, roasting, suji preparation, flour and baking can also contribute significantly to economic development of primary producers through small scale industries as a source of additional income. Hence, consumption of millets in our daily diet contributes to food, nutritional, economic and livelihood security.

