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Finger Millet: A Nutritious Crop with Resilience and Versatility

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Abstract

Finger millet (*Eleusine coracana*), an ancient and climate-resilient millet, is a staple in semi-arid and hilly regions, particularly in India and Africa. Thriving in diverse soil types and withstanding drought conditions, it plays a crucial role in food security and sustainable agriculture. The crop is self-pollinated, highly adaptable, and can be cultivated up to 2100 meters above sea level. With improved varieties and agronomic practices, productivity has increased despite a stable cultivation area. Finger millet requires minimal inputs, responding well to biofertilizers and strategic nutrient management. Effective weed and pest control, along with timely irrigation, further enhance yields. It is commonly grown as a sole crop, intercropped with sorghum and pulses, or rotated with crops like rice and sugarcane. Beyond its agronomic advantages, finger millet's superior nutritional profile rich in calcium, iron, and fiber makes it a valuable crop for combating malnutrition. Its promotion can support rural livelihoods and climate-resilient farming systems.

1. Introduction

Finger millet (*Eleusine coracana*), commonly known as ragi in India, is an ancient and highly nutritious grain that has been a staple food for centuries, particularly in Africa and South Asia. This resilient crop is known for its exceptional adaptability to diverse agro-climatic conditions, making it an essential component of food security and sustainable agriculture. It thrives in semi-arid, hilly and marginal soils where many other crops struggle to grow, making it a lifeline for smallholder farmers in regions prone to drought and soil degradation. Rich in essential nutrients such as calcium, iron, dietary fiber and amino acids, finger millet plays a crucial role in addressing malnutrition (Anitha et al., 2019) and promoting health-conscious diets. Its low glycaemic index and high fiber content make it particularly beneficial for managing diabetes, obesity and cardiovascular health (Devi et al., 2014). Additionally, finger millet

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is naturally gluten-free, making it an excellent dietary option for individuals with gluten intolerance or celiac disease.

Beyond its nutritional benefits, finger millet contributes to sustainable agriculture due to its low water requirement, minimal dependence on synthetic fertilizers and pesticides and its ability to improve soil health. The crop's deep root system enhances soil structure and prevents erosion, while its resistance to pests and diseases reduces the need for chemical inputs, supporting eco-friendly farming practices.

Despite its historical significance, finger millet has often been overshadowed by high-yielding crops such as rice and wheat. However, with the growing emphasis on climate-resilient and nutritious crops, there is renewed interest in promoting its cultivation, value addition and consumption (Belton & Taylor, 2004). Research and policy interventions are increasingly focused on enhancing productivity, developing improved varieties and integrating finger millet into mainstream food systems through fortification, processing innovations and market linkages (Devi et al., 2014).

By recognizing the potential of finger millet in ensuring food security, improving nutrition and fostering sustainable farming systems, its cultivation and utilization can be expanded, benefiting both farmers and consumers alike.

2. Origins and Growth Characteristics

Finger millet has a long and fascinating history. Vedic literature suggests that India is its center of origin, while Russian agronomist Nikolai Vavilov proposed Abyssinia (modern-day Ethiopia) as the point of domestication. Over centuries, this millet has evolved to adapt to different agro-climatic conditions, making it a vital component of food security in South Asia and Africa. It is an erect annual plant that profusely tillers, characterized by a compressed, elliptic stem and linear leaves with a distinct mid-rib. The leaf sheath fully envelops the stem and leaves are alternately arranged. The plant bears panicles with distinct shapes, including curved, incurved, open and fisty forms. Each finger-like spikelet consists of 4-6 flowers and the crop is predominantly self-pollinated, ensuring genetic stability across generations.

3. Importance and Cultivation in India

Finger millet holds a prominent place in the southern parts of India, including Karnataka, Tamil Nadu, Andhra Pradesh, Telangana, Odisha and parts of Maharashtra. It is cultivated for both grain and fodder, supporting food security and livestock nutrition. Although the total cultivated area has remained relatively constant over the years, improvements in high-yielding varieties, better agronomic practices and nutrient management have significantly increased productivity. It is one of the few cereals grown at high altitudes, up to 2100 meters above sea level, making it a staple for communities in hilly regions such as Uttarakhand and Himachal Pradesh. The resilience of finger millet ensures stable yields even under adverse climatic conditions, making it a preferred choice for sustainable agriculture.

4. Climate Adaptability

Finger millet thrives in tropical and subtropical regions and is well adapted to a wide range of climatic conditions. The ideal temperature for its growth is between 26-29°C. However, if temperatures drop below 20°C, the yield is significantly affected.

One of the remarkable features of finger millet is its exceptional drought tolerance. The crop has a low transpiration coefficient nearly half to one-third of wheat enabling it to survive prolonged dry spells. Its deep-rooted system enhances soil water uptake, making it ideal for rainfed agriculture. The crop performs well in areas receiving 500-900 mm of rainfall annually. With proper irrigation, finger millet can achieve even higher yields, making it suitable for both rainfed and irrigated farming (Yadav & Yadav, 2020).

5. Soil

Finger millet exhibits remarkable adaptability to a variety of soil types, ranging from poor, degraded soils to highly fertile lands. It can tolerate salinity levels up to pH 11.0, a feature not common among major millets (Kumar et al., 2019). However, it performs best in well-drained alluvial, loamy and sandy soils with moderate fertility. Heavy clay soils with poor drainage are less suitable, as excessive water retention can adversely affect root development and yield.

6. Field Preparation and Sowing

A well-prepared field ensures good germination and healthy crop establishment. Deep ploughing followed by shallow harrowing creates a fine tilth, essential for optimal root penetration. In irrigated conditions, forming beds and proper irrigation channels at regular intervals

is crucial for moisture management.

7. Sowing Time

• **Rainfed conditions:** June-July, with the first fortnight of June being the most suitable.

• **Irrigated conditions:** Multiple sowing seasons in Karnataka, Andhra Pradesh and Tamil Nadu.

• **Hill regions (Uttarakhand, Himachal Pradesh):** April-May.

8. Seed Rate and Spacing

• **Direct seeding:** 6-8 kg ha^{-1}, with a row spacing of 20-25 cm. Studies indicate that a spacing of 22.5 cm is better than 15 cm.

• **Transplanting:** Requires 5 kg of seeds per nursery (12.5 cents), with seedlings transplanted at 15x15 cm spacing in Tamil Nadu and 30x7.5 cm in certain other areas.

9. Irrigation and Nutrient Management

Though finger millet is highly drought-tolerant, strategic irrigation at critical stages—tillering, flowering and grain-filling—can significantly boost yields (Upadhyaya et al., 2017). The crop responds well to fertilizers, with the general recommendation being 60:30:30 kg NPK per hectare. However, higher nitrogen application of up to 160 kg N and 50 kg P can further enhance growth and grain quality. Additionally, magnesium (50 kg ha^{-1}) and calcium (20 kg ha^{-1}) application support better plant development. Seed inoculation with biofertilizers like *Azospirillum brasilense* (for nitrogen fixation) and *Aspergillus awamori* (a phosphorus-solubilizing fungus) has proven advantageous in promoting vigorous growth (Saleh et al., 2013).

10. Weed and Pest Management

Weed competition is a major challenge in finger millet farming, particularly in the early growth stages. Hand weeding within the first 2-3 weeks is essential for effective control. For chemical control, butachlor (1.25 kg ha^{-1}) can be applied as a pre-emergence herbicide for transplanted crops, while 2,4 DEE or 2,4 D Na salt (0.5 kg ha^{-1}) is effective for post-emergence control in direct-seeded crops (Rao et al., 2011).

11. Major Pests and Diseases

• **Diseases:** Blast (the most severe), seedling blight, and downy mildew.

• **Insect pests:** Stem borer, grasshopper, and ear head-eating caterpillars.

12. Cropping Systems and Rotations

Under rainfed conditions, finger millet is often intercropped with sorghum, pearl millet, oilseeds, and pulses, ensuring better resource utilization (Yadav et al., 2020). In hilly regions, it is commonly mixed with soybean. In irrigated areas, finger millet fits well into crop rotations with:

• Tobacco, vegetables, turmeric, gram, linseed, mustard

• Sugarcane-finger millet system

• Finger millet-potato-maize rotation

• Finger millet-rice rotation

13. Harvest and Post-Harvest Processing

Harvesting is done either by cutting the ear heads alone or by staggered harvesting to collect differentially maturing heads. The harvested ears are dried and threshed manually or using machines. The remaining straw serves as a valuable fodder resource for livestock (Anitha et al., 2019)

14. Conclusion

With its impressive nutritional profile high calcium, iron, dietary fiber, and essential amino acids finger millet is often hailed as a super grain. Its resilience to climate variability, adaptability to poor soils and minimal input requirements make it an ideal crop for sustainable agriculture. Increasing its cultivation can enhance farmer livelihoods, promote nutritional security and contribute to climate-smart farming practices.

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