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Millets Production for Food Security and Livelihood

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Introduction

Following India's suggestion to the Food and Agriculture Organization, which was accepted at the 160th session of the FAO Council in December 2018, the year 2023 will be recognised as the International Year of Millets. Through decades, the country has enjoyed a rich association with millets, though the Green Revolution favored rice and wheat. Millets survived because of many cultural traditions, but they were later referred to as "coarse grains." Millets are now being reintroduced to farms and industry as a result of actions taken at the federal and state levels. Farmers are favoring millets because they are drought-resistant, climate-smart crops that thrive in regions with little rainfall and infertile soil (Padulosi et al, 2015).

The first crops to be farmed were millets, which are small-seeded annual plants in the Poaceae family. Millets are separated into major and minor varieties according to the size of their seeds and the degree of cultivation. These grains are now referred to as nutritious grains or nutri cereals due to their high nutritional value. In the dry and semi-arid tropics, millets make up a sizable portion of the rainfed cropping system. One of the world's top producers of millet is India (Riley et al, 2015). They are frequently cultivated in a range of soils, environments, and challenging circumstances. Since they consistently produce more than many other crops, they have been significant food and feed crops (Shanthakumar et al, 2010).

Due to the development of new, high producing varieties, the overall yearly planting area for millets in India is between 23 and 24 million hectares, yielding 20 to 22 million tonnes. The cultivated area of millets has, nevertheless, gradually increased over the previous five decades due to the attention paid to these crops. Millets are frequently grown in a range of soil types, extreme environments, and climatic circumstances. Additionally, the cultivation is done with the barest of resources. By performing minimal interventions, yields can be increased dramatically. In millet farming, the provision of top-notch seeds is a crucial

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intervention. Finger millet, foxtail millet, kodo millet, proso millet, small millet, brown top millet, and barnyard millet are among the significant minor millets.

Significance:

Millets are significant crops in semiarid tropics of Asia and Africa, particularly in India, Mali, and Nigeria. Developing nations produce 97% of the world's millet (Annual Progress Report, ICAR-AICRP on Small Millets, 2019-20). The crop is preferred because of its quick growth in hot, dry circumstances and excellent output. Millets may have been consumed by people for 7,000 years and may have had a "key role" in the evolution of settled farming civilizations and multi-crop agriculture.

Millets only need 350–400 mm of annual rainfall to thrive in arid areas. Low input cultivars of pearl millet may endure temperatures as high as 46 degrees Celsius. Millets are a less extractive crop, therefore growing them will help to keep the soil healthy. They add a lot of organic matter and are excellent water reservoirs, both of which improve the health of the soil (MSSRF, 2001).

The area under millets has decreased in India over the last six decades. However, due to the adoption of high-yielding varieties and improved production technologies, these crops' productivity (yield in kg/ha) has increased.Among the states, Rajasthan had the most millets planted in 2017-18, followed by Maharashtra and Karnataka.

Botanical Descriptions of different millets:

Crop	**Scientific name**	**Common name in Kannada**	**Chromosome number**	**Origin**	**Maturity Duration in days**
Finger millet	*Eleusinecoracana* (L.)	Ragi	36 (4X)	East Africa	90-120
Foxtail millet	*SetariaItalica* (L.)	Navane	18 (2X)	Central Asia	60-90
Proso millet	*Panicummiliaceum*(L.)	Baragu	36 (4X)	Central Asia	60-90
Barnyard millet	*Echinochloafrumentacea*(L.)	Oodalu	54 (6X)	India	60-90
Kodo millet	*Paspalumscrobiculatum*(L.)	Haraka	40 (4X)	India	60-90
Little millet	*Panicumsumatrense*(L.)	Saame	36 (4X)	India	60-90
Brown top millet	*Brachiariaramosa (L.)*	Korale		Southeast Asia	100-110

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Nutritional benefits

Millet is a starchy grain and rich in carbohydrates, vitamins and minerals. Notably, it also packs several vitamins and minerals (Sarita&Singh, 2016). One cup (174 grams) of cooked millet packs contains calories: 207, carbohydrates: 41 grams, fiber: 2.2 grams, Protein: 6 grams, Fat: 1.7 grams, Phosphorus: 25% of the Daily Value (DV), Magnesium: 19% of the DV, Folate: 8% of the DV and Iron: 6% of the DV (w ww. u n d e r u t i l i z e d - s p e c i e s . o r g).

Climate &Soil requirement:

Millets thrive in tropical and subtropical climates and can be grown at elevations of up to 2100 metres. During the growth season, temperatures between 26 and 30 degrees Celsius are excellent for proper development and crop yield. Millets can be cultivated in a wide range of soil conditions (Chapke et al 2020).

Land preparation

Ploughing at the correct time helps to save moisture. In April or May, one deep ploughing with a mould-board plough is advised. To ensure a smooth seed bed, secondary tillage with a cultivator and a multiple tooth hoe is required before sowing. Minor land smoothing prior to sowing helps to conserve moisture in situ. The seeds are tiny and germinate in 5-7 days. As a result, quality seeds and land preparation contribute to enhanced germination, weed control, and soil moisture conservation (Chapke et al 2020).

Input requirements:

Quality seed sowing combined with good agronomic practices will result in a better crop harvest. The following are the inputs needed for various millets.

Crop	Seed Rate	Sowing time	Spacing &Fertlizer
Finger millet	8-10 kg/ha (line sowing): 4-5 kg/ha (transplanting); 10 kg/ha for drill sowing and 5 kg/ha for raising seedlings for transplanted condition.	Kharif- June to July Rabi- September to October	Between rows should be 22.5 to 30 cm, plant to plant 7.5 cm to 10cm. 60:30:30 NPK per ha under irrigation and 40:20:20 NPK per ha under rainfed conditions.
Foxtail	6-8 kg/ha for line sowing and	Kharif- June to July	Row to row 25-30 cm, plant

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millet	for broadcasting 15 kg/ha is recommended	Rabi- September to October	to plant 8-10 cm. 40:20:20 NPK per ha
Little millet	6-8 kg/ha for line sowing and for broadcasting 10-12 kg/ha	Kharif-June to July; Rabi-September to October	Row to row is 22.5 cm, plant to plant is 8-10 cm 40:20:20 NPK per ha
Proso millet	6-8 kg/ha for line sowing and for 15 kg/ha for broad casting	Kharif-June to July; Rabi-September to October	Row to row is 22.5 cm, plant to plant is 8-10 cm 40:30:20 NPK per ha
Barnyard millet	6-8 kg/ha in line sowing and 15 kg/ha for broadcasting	Kharif-June to July; Rabi-September to October	Row to row 25 cm, plant to plant 10 cm 40:20:20 NPK per ha
Kodo millet	6-8 kg/ha for line sowing and for 15 kg/ha for broad casting	Kharif - June to July	Row to row is 22.5 cm, plant to plant is 8-10 cm 40:20:20 NPK per ha
Brown-top Millet	5 kg/ha for line sowing	Planted from mid April until mid August in most locations.	

Seed Production: Seed multiplication chain in India includes the seed multiplication in four stage generation system:

- Nucleus seed (NS)
- Breeder seed (BS)
- Foundation seed (FS)
- Certified seed (CS)

According to the Seeds Act of 1966, seed certification is voluntary and only applies to notified varieties. Only registered kinds of varieties that prove DUS and VCU are eligible to be permitted under the seed trade and voluntary certification system, according to the Draft Seeds Bill, 2002.

a) Nucleus seed: The handful of initial seed obtained from selected individual plants of a particular variety produced by the originating breeder or the institute constitutes the nucleus seed. It is not covered under the purview of certification, is produced in small quantities on

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experiment stations by the breeder under his direct supervision, and forms the basis for further multiplication.

b) Breeder seed: It is the progeny of nucleus seed. It bears a golden yellow tag issued by the producing breeder. Its production is organized by the ICAR through the ICAR institutes, Agricultural Universities and seed corporations in certain crops on the basis of indents received from Department of Agriculture, Ministry of Agriculture, Government of India.

c) Foundation seed: It is the progeny of breeder seed. It is genetically and physically pure, satisfying the minimum Indian Seed Certification standards. Foundation seed is produced by National Seed Corporation, State Seed Corporations, State Farms Corporation of India, State Agricultural Universities and designated public and private sector agencies. Foundation seed bears white tag on certification.

d) Certified seed: The foundation seed shall be the source for production of certified seed. It is the progeny of foundation seed. It should satisfy the prescribed minimum Indian Seed Certification standards.

In general best season for seed production is June - July and February – March. The pollination should not coincide with rains for quality and effective seed setting. All these millets are self-pollinated crops. However seed crop should be raised in isolation. The isolation distance maintained between the varieties is 3 metres for both foundation and certified seed production to maintain the varietal purity. The percentage of minimum physical purity of certified and foundation seeds should be 97% with a minimum of 75% of germination capacity and 12% of moisture content. The presence of inert matter should not exceed 2.0%.

Rouging:

Rouging should be done frequently to avoid genetic contamination by removing off-types, volunteer plants, and diseased plants from the seed production field. Rouging should be done prior to the flowering stage. Maximum percentage of off type permitted at the final inspection is 0.05% for foundation and 0.10% for certified seed production.

Field inspection:

A minimum of two inspections should be done between flowering and maturity stages by the Seed Certification Officer. The first inspection is done at the time of flowering to

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check the isolation and off-types and the second done during the maturity stage prior to harvest to check the off-types and to estimate the yield.

Harvesting and processing:

Harvest is done once the ear heads are physiologically mature. Physiologically mature ear heads will turn from brown to green colour. Plants are cut close to the ground level, bundled and stacked for a week before threshing. The ear heads are threshed by trampling under the feet of bullocks. The threshed grains are further cleaned by winnowing.

Drying and storage:

The cleaned seeds should be sun dried to attain a safe moisture level of 10-12%. Care should be taken while drying to avoid mechanical injury to the seeds and contamination. Seeds can be stored up to18 months under proper storage conditions.

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