

## Proso Millet: Crop of Low Rain Fall Area and Rich in Nutrition

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Proso millet (*Panicum miliaceum*), is also commonly known as broomcorn millet, common millet, hog millet, kashfi millet, red millet and white millet. In India, it is known as chena (Hindi), baragu (Kannada), panivaragu (Tamil), variga (Telugu) etc. Archaeobotanical studies indicate that proso millet was domesticated in China as early as 10000 years ago. As the human settled during Neolithic era, proso millet was cultivated. It is a warm climate crop with high water and nitrogen use efficiency. It matures in 60–75 days and has shallow root system which makes it suitable for any cropping system and intercropping. Proso millet produces 3–4 tillers, its

plant type can be erect, decumbent or prostrate. The plant height reaches up to 100–120 cm. There are three types of panicles, viz. lateral, vertical-loose, and dense panicle. It produces small round seeds covered by a smooth and glossy hull. Its seeds may be cream, yellow, orange-red, or brown in colour. These traits help in identification of varieties of proso millet. Farmers can remember the growth habitat and inflorescence characters to identify the varieties.

According to cytological investigators, proso millet is an allotetraploid cereal ( $2n=4x=36$ ). Its genome progenitors are not clear, although phylogenetic data suggest *P. capillare* L. or a close relative as the maternal ancestor, with the other genome shared with *P. repens* L. It has been reported that the variation among these proso millet accessions is low when studied by isozyme and microsatellite molecular markers which likely reflect the double bottleneck of polyploidation and domestication. Phylogenetic analysis revealed two sets of homologous chromosomes that may have merged ~5.6 million years ago, both of which exhibit strong synteny with other grass species. Broomcorn millet contains 55,930 protein-coding genes and 339 microRNA genes. Paniceae-specific expansion in several subfamilies of the BTB (broad complex/tramtrack/bric-a-brac) subunit of ubiquitin E3 ligases, suggesting enhanced regulation of protein dynamics may have contributed to the evolution of broomcorn millet.

### Environmental requirement

Proso millet is highly drought-resistant, which makes it of interest to regions with low water availability and longer periods without rain. Proso millet also grows under non-irrigated conditions in arid lands with as little as 200–500 mm of average annual precipitation. and can produce grain with only 330–350 mm of annual rainfall. As a warm season crop, proso millet is sensitive to frost and requires warm temperatures for seed germination and development. Optimal soil temperatures for seed germination range from 20–30°C. Proso millet has very low transcription ratio, which may be attributed in part to the C4 photosynthetic mechanism. Proso millet avoids drought sensitivity by reaching maturity rapidly. In addition, at temperatures above 30° C, proso millet stops vegetative growth, ceases to flower, and maintains its primary stem at a shorter height to better resist drought conditions. Proso millet can be grown on sandy loam, slightly acidic, saline and low fertility soils.

However, this crop grows poorly on water logged soils. Proso millet thrives in low pH soils and most of its seeds germinate well on soil pH of 5.5 to 6.5. However, plants grown on soils with pH above 7.8 show symptoms of iron chlorosis. Substantial salinity tolerance has been reported in proso millet but with significant varietal diversity with some especially tolerant varieties reported. A higher sodium concentration in roots compared to shoots has been suggested as a biomarker for future breeding efforts.

### Nutritional profile

Proso millet is rich in protein (13–17%) and carbohydrates (60–75%). In China, waxy type proso millet (100% amylopectin) is grown for making sticky rice and other cuisine. The recent study at ICAR-IIMR suggests that protein content in proso millet could be as high as 21% or even higher. It is a rich source of plant-based protein and can be used for formulating new energy foods for sport-person etc. Proso millet is free from gluten which suits the patients with celiac diseases. The biological value of proso millet protein varies between 42–56, similar to bean and wheat flour.

Proso millet contains 156–230 mg phosphorus, 78–140 mg magnesium, 8.20 mg calcium, 0.80–5.20 mg iron and 1.40–2.60 mg zinc per 100 g of dehulled proso millet. It is also a rich source of trace elements, dietary fibre and vitamins. Proso millet grains contain components with healing benefits, which decrease the level of low-density lipoprotein cholesterol in the blood. The phenolic compounds like antioxidants and beta-glucans present in proso millet have many health benefits.

### Conclusion

Proso millet cultivation can help farmers in arid and semi-arid regions of India. It can be cultivated as a sole crop or intercrop. Most of the fallow lands in summer can be brought into proso millet cultivation with limited irrigation, which will generate additional income if grown as an intercrop. Proso millet is a good source of plant-based protein and its value addition can enhance acceptance among consumers. The demand for millets has increased many folds, the market linkages are in incipient stage but sooner the market will face scarcity of raw material for making value added products.

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