



Little millet: A climate resilient crop for sustainable millet production in Odisha

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Abstract

Little millet (*Panicum sumatrense* L.) is one of the minor millets known for its nutritional value and contribution to sustainable food system. It belongs to the family *poaceae*, subfamily *panicoideae* and tribe *paniceae*. India is considered as one of the centres of origin of little millet. In India little millet is cultivated in an area of 2.34 lakh ha with annual production of 1.27 lakh tones with productivity of 544 kg/ha during 2015-16. Cultivation of little millet in India is confined to Madhya Pradesh, Chhattisgarh, Andhra Pradesh, Odisha, Karnataka, Tamil Nadu, Gujarat, Jharkhand, Maharashtra and Uttar Pradesh. In Odisha popularly known as *suani* is second most small millet crop next to finger millet grown in Koraput, Nuapada, Gajapati, Ganjam, Mayurbhanj, Rayagada, Balangir, Sundargarh and Kalahandi districts mostly in uplands and hilly regions.

Soil and Climatic requirement

Little millet is grown in tropical and subtropical climates, and it is well known for its drought tolerance, least water requirement, suitable for delayed sowing and rainfed condition, multiple and contingent cropping system. Its cultivation is restricted to hilly regions up to an altitude of 2000 m. little millet matures in 70 to 110 days

depending on varieties and ecologies. The crop is grown in areas having rainfall of 250 to 600 mm but it also cultivated in areas having rainfall up to 1500 mm. The optimum temperature for proper growth and yield of little millet is 25-30°C. But it cannot withstand temperatures below 10°C. Little millet can be grown on a wide range of soils including waterlogged soils. Deep, loamy, fertile soils rich in organic matter are preferred for satisfactory growth. It can withstand salinity and alkalinity to some extent.

Nutritional value

Little millet is highly nutritious and good source of balanced food for human beings. Each 100 g of grain enriched with 65.5 g carbohydrate, 10.1 g protein, 3.89 g fat, 346 Kcal energy, 7.7 g dietary fibre, 16.1 mg calcium, 130 mg phosphorus, 91 mg magnesium, 1.8 mg zinc, 1.2 mg iron, 0.26 mg thiamine, 0.05 mg riboflavin, 1.3 mg niacin and 362 µg folic acid on dry weight basis (Bhat *et al.*, 2018). The protein has balanced amino acid profile and good source of methionine, cystine and lysine.

Uses

Little millet is a quick growing coarse-cereal grain crop consumed in the form of rice. It can be processed into various food products, including porridge, rice substitutes and flour for making flat breads and other dishes. The stover of little millet are very good source of animal feed.

Health benefits

The demand for little millet is increasing now-a-days due to its high nutritional profile with low glycemic index. Recent study revealed that hypoglycemic effect of little millet is due to its higher proportion of dietary fiber (Itagi *et al.*, 2013). It has a significant role in providing substantial amounts of antioxidants and phytochemicals in the diet (Pradeep and Guha, 2011). Its



high fibre content aids in the reduction of fat deposits in the body. Besides, it also exhibits hypoglycaemic, hypolipidemic effects and faecal bulking effects (Itagi *et al.*, 2013).

Climate Resilience

Little millet is quick growing short duration crop which can withstand both drought and waterlogging. By virtue of short duration, it can be grown as catch crop under rainfed ecology. It can tolerate salinity and alkalinity. Little millet is typically grown in hill tops, hill slopes as well as in hill bases during kharif season (Barik, 2007). These crops have a comparative advantage in marginal lands where they have been selected to withstand stress conditions and contribute to sustainable production with low inputs. The crop is popular under dry land farming due to its tolerance to moisture stress condition and flexibility with sowing time.

Causes of low productivity of little millet

- Little millets are mostly grown under marginal and submarginal soils under rainfed ecology thus suffers from terminal drought frequently.
- Non availability of location specific and farmers friendly high yielding varieties and hybrids.
- Non availability of disease-free quality seeds at right time.
- Broadcasting method of sowing mostly leading to poor crop establishment.
- Poor weed management at critical period of crop-weed competition.
- Lack of suitable Integrated Pest Management technologies for little millet production system.
- Lack of knowledge on water management options under little millet production system.

Tips to enhance production, productivity and profitability of little millet

- Selection of improved location and season specific local varieties, development of high yielding varieties and high breeds suitable to farmers with consumer preference and market values.
- Ensure the availability of quality seeds at appropriate time and reasonable cost by development of location specific seed villages.
- Timely sowing of little millets particularly under rainfed ecology.
- Optimum crop establishment by using seed drill in direct seeded crop
- Crop intensification by suitable intercrops, cropping sequences and utilisation of rice fallows
- Adoption of integrated nutrient management with emphasises on consumptive use of organic and inorganic fertilisers
- Mechanisation of inter-cultivation operations and weed management at critical period of crop weed competition by integrated manner with the inclusion of suitable early post emergent herbicides in weed control.
- Adoption of advanced water management options in rainfed as well as irrigated little millet.
- Development and popularization of post-harvest management like processing, value addition and marketing of millets.

Growing seasons

Little millet is mainly cultivated during *kharif* season. Second fort night of June to first fort night of July is optimum time for sowing of rainfed kharif crop. But it can also be grown during summer season under assured irrigation. Second fort night of



January to first fortnight of February is suitable sowing time of summer crop. The crop is ideally suited to rice-fallow under irrigated ecology.

Varieties of little millet

Selection of appropriate variety as per the location specific growing period and consumers preference is the one of low-cost technology which influences yield and profitability of the crop. Some of the recommended varieties for various agro-climatic zones of Odisha are tabulated in Table 1.

Table 1: Recommended varieties of little millet for Odisha

Name	Duration	Average Yield(Q/ha)	Special Character	Year of release
OLM-208	100-105	12-15	Moderately resistance to shoofly	2009
OLM-217	105-110	15-16	Resistance to rust, grain smut	2009
BL-6	90-95	12-14	Recommended for upland, Rich in Zn & Fe	2016
DHLM-36-3	95-100	14-16		2016
DHLM-14-1	97-99	16		2017
OLM-203 (Tarini)	105-110	10-11	Resistance to rust, grain smut	2001
OLM-20	75-80	11-12	Drought tolerant	2003
OLM-36 (Kolab)	95-100	10-11	Resistance to brown smut	2001

Seed rate and seed treatment

For line sowing seed rate of 8-10 kg/ha is ideal whereas for broadcasting 12-15 kg/ha is required for obtaining optimum population. Seed treatment with biopriming substances, biocontrol agents and bio-fertilizer are recommended for little millet to induce hardiness against moisture stress, to control seed and soil borne diseases and to enhance availability of plant nutrients at different

crop growth stages for realising the potential yield. Seeds treatment with carbendazim @ 2 g/kg of seeds or *Trichoderma* dust formulation 5 g/kg of seeds before sowing helps in control of soil and seed borne diseases. Treating seeds with *Azospirillum brasiliense* and *Aspergillus awamori* @ 25 g/kg of seeds is beneficial and reduces requirement of chemical fertilisers by 25%. Treat the seeds with seed treating chemicals first and then go for biofertilizers.

Crop Establishment methods and optimum crop geometry

Sowing at the optimum time, and maintenance of adequate plant stand are basic requirements for sustainable grain yield of millets (Sapthagiri *et al.*, 2020). Broadcasting of dry seeds in dry soil is the most prevalent crop establishment methods of millets. Line sowing behind the country plough has significantly improved little millet yield. Sowing by seed cum fertiliser drill at a spacing of 22.5-25 cm apart and 10 cm between the rows ensures optimum crop stand and resulting higher grain and straw yield. The seed should not be sown less than 2-3 cm deep.

Nutrient management

Little millets are traditionally grown under organically managed nutrition with less dependence on synthetic chemical fertilisers. Biofertilizers, vermicompost and growth promoters can be used to grow millets under rainfed ecology. But under irrigated ecology integration of organic manures with soil test-based inorganic fertilizers enhances farm productivity and profitability. Results of several field experiments revealed that little millet responds well to nutrient management. For Odisha general blanket recommendation is 40:20:20 kg of NPK/ha. Application of Compost or farmyard manure @ 5 tones /ha before sowing at the time of land preparation is beneficial for realising optimum yield.



Apply entire quantity of P_2O_5 and K_2O and half of nitrogen at the time of sowing and remaining half of Nitrogen after first interculture at 20-25 DAS.

Weed management

Millets grow slowly thus less competitive with weeds during early stage of crop growth. Little millet like other small millets should be kept weed free during the first 3-4 weeks after germination. It was observed that weed association during cropping greatly influenced the compartmental caloric contents of the crop (Barik 2007). The yield loss due to weeds in little millet is up to 59.6%. Generally, weeding is done manually at 15- 20 days after emergence of seedling and 2nd weeding at 15-20 days after 1st weeding. Pre-emergence application of Isoproturon 1.0 kg /ha or post emergence spraying of 2, 4 D Na salt 80% @ 1.0 kg/ha at 20-25 days after sowing (DAS) results broad spectrum weed control in little millet.

Insect pest management

Shoot fly is the major pest in little millet. The damage of this pests observed from sowing to six weeks of old crop. As a result of its feeding the central shoot starts drying and shows the typical symptoms of dead heart in the early stage. Damaged tillers may produce ear heads, but with no grains (white ears). Early sowing within 7 to 10 days of the onset of monsoon at higher seed rate and destroying the 'dead heart' seedlings without hampering the optimum plant stand is one of the practices to minimise yield loss. Seed treatment with Imidacloprid @ 10-12 ml/kg of seed or Thiamethoxam 70 WS @ 3g/kg of seed will be useful to keep the little millet free from shootfly attack at early stage of crop growth. Apply Carbofuran (Furadan 3G) or Phorate 10G at the time of sowing as soil application in the furrows @ 20 kg/ha in shoot fly endemic areas.

Disease management

Grain smut caused by *Macalpinomyces sharmae* is a common disease of little millet. The disease is overcolours and symptom appears at grain formation stage. Affected ovary is converted into smut sorus, but does not increase in size than the normal grain. Early varieties are more susceptible to grain smut. The disease can be controlled by adopting resistant cultivars (OLM 203), cultural practices like delayed sowing and seed treatment with Carbendazim @ 2 g per kg of seed.

Water management

Millet species need relatively less water than the other crops, because they have short growth season. During wet season little millet is mostly grown as rainfed and does not require any irrigation but if the dry spell prevails for longer period at least one irrigation should be given at the tillering stage to boost the yield. Chapke *et al.* (2018) suggested providing two irrigations, at 25-30 and 45-50 DAS during rainy season is critical. Summer crop requires 2 - 4 irrigations depending upon soil type and climatic conditions. During heavy rains the excess water from the field should be drained out.

Cropping System

Next to rice-based cropping systems, millets-based cropping systems have their own importance in tribal dominant regions of Odisha for food and nutritional security. little millet is cultivated in Odisha as a sole crop, inter crop, mixed crop and under different cropping sequence. Intensification of little millets with pulses and oil seeds has significant impact on land utilization, productivity and farm income. Some of the popular little millet-based cropping systems practised under different climatic zones of



Odisha are little millet + black gram (2:1 row ratio) and little millet + pigeon pea.

Harvesting and post-harvest care

Harvest is done once the ear-heads are physiologically mature. The cleaned seeds should be sun dried to attain a safe moisture level of 12%. Seeds can be stored up to 13 months under proper storage conditions. Gunny bags, nylon woven sacs or IRRI super bags can be used for safe storage.

Processing and Value addition

Little millet grains require primary and secondary processing to get its food and nutritional value. Destoning, dehulling, cleaning and drying are primary processing required for obtaining good market price. Secondary processing has significant effect on increasing its food and antioxidant value. Pradeep and Guha (2011) reported that roasting of little millet seeds improves nutraceutical and antioxidant properties of little millet. Normally little millet rice are used for cooking. Several value-added products like little millet flour and little millet flakes can prepared to meet the market demand

Seed production

It is a self-pollinated crop with a chromosome number of $2n=4x=36$. Seed production can be done during June-July and February-March. The pollination should not coincide with rains for quality and effective seed setting. Since it is a self-pollinated crop and should be raised in isolation. The isolation distances maintained between the varieties is 3 metres for both foundation and certified seed production to maintain the varietal purity.

Conclusions

Among the different millets little millet is short duration, low water requirement, wider adaptability, economically competitive, environmentally friendly, food and nutritional value and having market demand.

Availability of location specific farmers friendly high yielding varieties, quality seed materials and modern management practices with suitable processing technologies will ensure the wide adoption of little millet cultivation in both rainfed and irrigated ecologies under different agroclimatic zones of Odisha. Favourable government policies like implementation of millet mission, minimum support price, inclusion of little millets in public distribution system and revival of millet farming in tribal dominant districts of Odisha will play a crucial role in reduction of household vulnerability of small and marginal farmers under the present scenario of climate change. More involvement of women in little millet farming will create gender balance in agriculture production system. The millet based mixed farming has also helped in addressing the problem of malnutrition by taking the care of soil and environment. For sustainable millet production there is a need of development location specific integrated crop management practices particularly nutrient, weed and water management options for enhancing production, productivity as well as farmers profit.

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