



Millet Chalisa

Finger millet



Finger millet

(*Eleusine coracana* L.)

Common name: *Ragi*, *Mandika*, *Marwah* (Hindi), *Nagli*, *Nachni* (Marathi), *Ragi* (Kannada), *Ragulu*, *Chodi* (Telugu), *Keppai*, *Kelvaragu* (Tamil), *Marwa* (Bengali), *Nagli*, *Bavto* (Gujrati), *Mandia* (Oriya), *Mandhuka*, *Mandhal* (Panjabi)



Finger millet is 3rd most important millet next to pearl millet and sorghum grown for food and fodder. Grain of finger millet are rich in calcium (250-350 mg/kg) and also known for rich dietary fiber and quality protein. In India, finger millet is cultivated in an area of 1.18 million ha and productivity of 1600 kg/ha with production of 1.8 million tons. Karnataka occupies about 60% of the area and production of finger millet followed by, Tamil Nadu, Maharashtra and Uttarakhand. Finger millet can be grown up well in subtropical climate and can be cultivated up to an altitude of 2100 m. The minimum temperature required is 8-10 °C. A mean temperature range of 26-30 °C during the growth is the best for proper development and good crop yield. Finger millet contains 7.2% protein, 66.8% carbohydrates, 11.2% dietary fiber and 2.5-3.5% minerals. It has the highest calcium content among all cereals and millets (344 mg/100 g). The major phenolics found in finger millet are ferulic acid and p-coumaric acid, and the bound phenolic fraction accounts for 64-96% and 50-99% of total ferulic acid and p-coumaric acid contents of millet grains, respectively. High calcium content of finger millet is useful for growing children, old people and lactating women. Building strong bones in childhood was found to associate with maintaining bone strength in elderly especially after menopause. Regular consumption of high calcium diet was also found to reduce the chance of kidney stone formation from dietary oxalates. Calcium binds with oxalic acid in intestines and prevents absorption of oxalates by the body.

Improved varieties

A number of high yielding varieties were evolved and released for cultivation in different states. The list of latest and popular varieties recommended for different states are given below:

Name	Adaptation	Crop duration in days	Yield q/ha
CFMV-1 (Indravathi)	AP, Karnataka, Tamil Nadu, Puducherry and Odisha	110-115	30-32
CFMV-2	AP, Chhattisgarh, Gujarat, Maharashtra and Odisha	119-121	29-31
VL-378	Rainfed organic conditions of Uttarakhand hills	110-114	22-24
VL-382	Rainfed organic conditions of Uttarakhand hills	106-108	11-13
Chhattisgarh Ragi 3 (FMV-1102) (BR-14-3)	Northern Zone (Assam, Bihar, Chhattisgarh, Jharkhand, Uttarakhand and MP)	110-115	33
ATL-1 (TNEc 1285)	Tamil Nadu	105-110	30
Dapoli 3 (DPLN-2)	Konkan region of Maharashtra	125	20-22
Birsa Marua 3	Jharkhand	110-112	26.9
Gossaigaon Marua Dhan (AAU-GSG-Marua Dhan-1) (FMV 1156)	Assam	125-130	30.51
Phule Kasari (KOPN 942)	Maharashtra	100-110	22.44
CFMV 4 (FMV 1166)	Andhra Pradesh, Maharashtra & Tamil Nadu	113	GY: 28.66 FY: 60.29
VL Mandua 400 (CFMV5) (FMV1162)	MP, Kamataka, Chhattisgarh, Bihar, Jharkhand, Gujarat and Andhra Pradesh	102	GY: 34.77 FY: 84.80
Gosthani (VR 1099)	Andhra Pradesh	110-115	GY: 38-39
Siri (KMR-316)	Zone 5 & 6 of Karnataka	105-110	30-35
Shreeratra (OUAT Kalinga Finger Millet-1) (OEB 601)	Odisha	117	23.5

GY = Grain yield, FY = Fodder yield

Nutri-rich varieties

Name	Adaptation	Special features
CFMV-2	Andhra Pradesh, Chhattisgarh, Gujarat, Maharashtra and Odisha	Resistant to leaf blast, foot rot, brown spot, grain mold and moderately resistant to neck blast, finger blast and banded blight
CFMV-1 (Indravathi)	Andhra Pradesh, Karnataka, Tamil Nadu, Puducherry and Odisha	Resistant to Finger blast, Neck blast, Banded blight and Foot rot, Shoot aphids, stem borer and grass hoppers; rich in calcium (428.3 mg/100 g), iron (58.3 mg/kg), zinc (44.5 mg/kg)

Soil and Climate

Finger millet is grown in all cropping seasons except winter, however 90% of the area is under *kharif* rainfed conditions. The crop is widely adaptable to range of environmental conditions and is grown in attitudes ranging from mean sea level to foot hills of Himalayas. The crop can tolerate a certain degree of alkalinity. The best soil is alluvial, loamy and sandy soil with good drainage. The minimum temperature for germination is 8 to 10 °C and mean temperature of 28-32 °C is ideal for good crop development.

Land preparation

In the month of April or May, one deep ploughing with mould-board-plough helps in retaining more soil moisture

followed by, harrowing twice is necessary. Before sowing, secondary tillage with cultivator using multiple-tooth hoe to prepare smooth seed bed is necessary. Minor land smoothening before sowing helps in better in-situ moisture conservation. Seeds are very small and take 5-7 days to germinate. Hence, good seeds, land preparation helps in better germination, minimize weeds problem and effective soil moisture conservation. In Uttaranchal where frequent ploughing operations are difficult to carry out, effective digging and turning of soil, removing perennial weeds, land smoothening, providing inward slope with a shallow drain helps in taking out excess rain water.

Soil and moisture conservation practices

To increase soil quality, summer ploughing or ploughing after the harvest of previous crop can be done across the slope. Preparation of small section bunds at an interval of 10-12 m depending on the slope and levelling helps in better management for operations. Opening a dead furrow at 3.3 to 4.0 m interval is beneficial.

Seed rate

Use 8-10 kg/ha (3 to 4 kg/acre) for line sowing is advised and 4-5 kg/ha (1.5 to 2.0 kg/acre) for transplanting. A seed rate of 10 kg/ha is found to be optimum for drill sowing and 5 kg/ha for raising seedlings for transplanted condition.

Seed treatment

Seed should be treated with *Thiram* or *bavistin* @ 2.5 g/kg of seed to prevent diseases. Treating seeds with *Azospirillum brasilense* (N fixing bacterium) and *Aspergillus awamori* (P Solubilizing fungus) @ 25 g/kg seed is beneficial. In case seeds are to be treated with seed dressing chemicals, treat the seeds first with seed dressing chemicals and then with bio-fertilizers at the time of sowing. Bio-fertilizer culture specific to the crop is to be used @ 25 g/kg of seed. Sticker solution is necessary for effective seed inoculation. This can be prepared by dissolving 25 g jaggery or sugar in 250 ml water and boiling for 5 minutes. The solution thus prepared is cooled. Smear the seeds well using the required quantity of sticker solution. Then add culture to the seeds and mix thoroughly so as to get a fine coating of culture on the seed. The culture-coated seed is to be dried well in shade to avoid clumping of seeds. Use of the inoculated seeds for sowing can be done.

Sowing time

Suitable time for sowing is for *kharif*- June to July, for *rabi*- September to October. In certain regions, it is grown in summer under irrigated land condition.

Method of sowing

Line sowing and transplanting

Line sowing is beneficial, helps in inter cultivation and control of weeds effectively. Maintenance of optimum plant population of 4-5 lakh plants/ha and this is attained by line sowing using seed drill with spacing of 22.5-30.0 cm between rows and 7.5-10.0 cm between plants. Transplanting is done in irrigated condition.

Nursery preparation

An area of 150-200 m² is required to raise seedlings to suffice 1.0 ha of main land. Apply 2-3 baskets of well decomposed farm yard manure (FYM) along with 1.0 kg super phosphate, half kg muriate of potash and half kg ammonium phosphate and 750 g zinc sulphate per bed. Sow the seeds by opening rows at every 3 inch uniformly. Cover the seed with well decomposed FYM and soil/sand/water every bed. Top dressing with urea 500 g/bed when the seedlings are 12-14 days old is necessary. Seedlings of 21-25 days old are ideal for transplanting in rows of 22.5-25 cm with 2 seedlings/hill with 10 cm between hills.

Spacing and fertilizers

In direct sowing, spacing between rows should be 22.5 to 30 cm, plant to plant 7.5 cm and depth 3-4 cm. Application of addition quantities of organic matter in soil is considered beneficial, since it helps to improve physical condition of soil which helps soil to retain moisture for a longer period of time. Apply 5-10 t/ha FYM about a month before sowing. The crop responds well to fertilizer application. The general recommendation for finger millet is 60 kg nitrogen, 30 kg P and 30 kg K per hectare under irrigation and 40 kg nitrogen, 20 kg P and 20 kg K per hectare is for rainfed conditions. Entire P and K fertilizers are to be applied at sowing, whereas nitrogen is to be applied in two or three split doses depending upon moisture availability.

In areas of good rainfall and moisture availability: 50% of recommended nitrogen is to be applied at sowing and the remaining 50% in two equal splits at 25-30 and 40-45 days after sowing.

In areas of uncertain rainfall: 50% N at sowing and the remaining 50% around 35 days after sowing is recommended.

Irrigation management

Finger millet is generally grown during *kharif* under rain-fed conditions. If there is any longer dry spell, then irrigation would be required. Depending on soil type, weather condition and duration of variety; for light soils irrigate the crop once in 6-8 days, and for heavy soils once in 12-15 days

under limited irrigation. The crop may be irrigated at critical growth stages like tillering, flowering and grain filling.

Important weeds

Grassy weeds: *Echinochloa colonum*, *Echinochloa crusgalli* (sawan), *Dactyloctenium aegypticum* (makra), *Elusine indica* (kodo), *Setaria glauca* (banra), *Cynodon dactylon* (doob), *Phragmites karka* (narkul), *Cyperus rotundus* (motha), *Sorghum halepense* (banchari) are common weeds.

Broad-leaved weeds: *Celosia argentia* (chilimil), *Commelina benghalensis* (kankoua), *Phyllanthus niruri* (hulhul), *Solanum nigrum* (makoi) and *Amaranthus viridis* (chaulai) are common weeds.

Weed Control

The field should be kept weed free up to 25-30 days after sowing. It is essential to control weeds in the initial stage of plant growth and development. The inter-cultivation and weeding should be done with hand hoe at 25 days after sowing (DAS). Weeds problem in ragi crop can be effectively managed by cultural and mechanical operations. In line sowing, 2-3 inter cultivations and one hand weeding is suggested. For Broadcast crop, 2 hand weedings will minimize weeds. In assured rainfall and irrigated areas, pre-emergence weedicide spray with *Isoproturon* @ 0.5 kg a.i./ha needs to be done. Rainfed areas, spray of *Oxyfluorfen* @ 0.1 lt a.i. /ha (irrigated areas) can be done. For post-emergence spray 2, 4-D sodium salt @ 0.75 kg a.i./ha should be done at around 20-25 days after sowing to control these weeds.

Intercropping

State	Crop system
Karnataka,	Finger millet + Pigeon pea 8-10:2
Tamil Nadu and Andhra Pradesh	Finger millet +Field bean 8:1 Finger millet + Soybean 4:1
Bihar	Finger millet + Pigeon pea 6:2
Uttaranchal	Finger millet and soybean mixed together in 90:10 per cent proportion by weight basis
North hilly areas	Finger millet + Soybean in <i>kharif</i> and oats in <i>rabi</i> is an ideal remunerative sequence
Maharashtra (Kolhapur)	Finger millet + black gram / moong bean 6-8 : 1 (Sub montane regions)

Crop rotation year-wise

Northern states: Rotation with legumes like green gram/black gram/rice bean/soybean is done.

Southern states: In southern states horse gram, pigeon pea, field bean or groundnut are good for crop rotation. This practice will minimize inorganic fertilizer application and also sustain higher yields. Finger millet-finger millet rotation must be discouraged as it affects soil fertility as well as crop yield.

Crop sequence

Northern Bihar: Potato-paddy-finger millet crop sequence is highly remunerative than other cropping sequences.

Southern Karnataka or Deccan plateau: Finger millet-potato-maize or finger millet-onion-finger millet is highly remunerative cropping sequence.

Assured rainfall areas: Raising crop of cowpea or green gram or Sesamum followed by, sowing / transplanting of early duration finger millet can be practiced.

Insect-pests and their management

Finger millet attracts a few pests, army worm, cutworm, stem borer, leaf aphid, grasshoppers, grey weevil, shoot fly and ear caterpillars which are major.

Army worms and cut worms

They appear during the early stages and continue up to harvest. The caterpillars cut seedlings at the base during early stage, which appears as it grazed by domestic animal. They are active during night and hide under stones and clods during the day. In later stages of plant growth, these insects act as defoliators. They are cyclic in nature.

Control measures: Apply poison baits, comprising 10 kg rice bran + 1 kg Jaggery + 1 liter *Quinolphos* (25% EC). Prepare small balls and broadcast in the fields preferably in the evening times. Spraying *Chloroantraniliprole* 18.5 SC @ 0.4 ml/litre water can also control armyworms/cutworms.

Leaf aphid

It occurs throughout the crop growing period. The nymphs and adults suck the sap from tender leaves and stem. They can cause serious damage at the seedling stage up to 30 days.

Control measures: Spraying of *Quinolphos* (0.05%) or *Imidacloprid* 17.8 SL @ 0.25 ml/litre give effective control.

Pink stem borer

The larva bores into the stem, resulting in dead heart.

Control measure: Spraying the crop with *Chloroantraniliprole* 18.5 EC @ 0.4 ml/litre helps in control of borer.

Ear-head caterpillars

Ear head caterpillars appear at dough stage on ear-heads and persist till harvest. The caterpillars bite the maturing seeds and make a fine web out of their casting and half eaten grains. This further attracts saprophytic fungi.

Control measures: Dust *Chloroantraniliprole* 18.5 EC @ 0.4 ml/litre or *Quinolphos* 1.5% @ 24 kg/ha.

Diseases and their management

Blast (*Piricularia fungi* /*Pyricularia grisea*)

Diamond shaped lesions with gray center and dark margin appear on the leaf. Any part of plant including leaves, peduncle and fingers can be infected. Infected fingers become brown to black in color with poor or no seed setting in the infected parts. Grains on blast affected fingers become shriveled, discoloured and light in weight.

Control measures: It can be controlled by growing resistant varieties. Treating seeds with fungicides like *Carbendazim* @ 2 g/kg a day before sowing. If necessary, spraying the nursery with *Kitazin* or *Tricyclazole* @ 0.1% a.i 10-12 days after sowing is recommended depending on disease incidence. Spray the fungicide at 50% flowering stage and repeat 10 days later for controlling neck and finger blast.



Blast

Brown spot

Many small to medium size brown to dark brown spots appear on the leaf, leaf sheath and other plant parts. Damage could be severe if the crop is subjected to drought or nutrition deficiency.

Control measures: The disease can be effectively managed by proper nutrition and water management. Need-based spraying of *Mancozeb* (0.2%) can be taken up.

Harvesting

The crop matures in about 95 to 110 days for early varieties and 115 to 125 days for medium to late duration varieties depending on the crop season. The panicles are harvested with ordinary sickles and straw is cut close to ground. At some places under rain-fed condition, the whole plant with panicles are cut, heaped, sun dry and then threshed.

Yield

Average grain yield of 2.0-3.0 t/ha and 3.0-4.0 t/ha under well managed conditions and 6.0-9.0 t/ha fodder. The straw of finger millet makes nutritious fodder and it is preferred over paddy straw. It can be conserved by putting up in well-built stakes.



This view of on-farm assessment trials of high yielding finger millet varieties (HYVs) organised in tribal area of Koraput district in Odisha state of India. Being resource-poor agro-ecology, millets were major source of their food and nutrition of local community which is dominated mainly by tribals

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