Improved Production Technologies to Enhance Yield and Productivity of Finger Millet (*Eleusine Coracana* Gaertn.)

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Among various small millets crops, Ragi or Finger millet crop (*Eleusine coracana* L. Gaertn.) occupies premier position in area and productivity. In India it is an important crop of Karnataka, Tamilnadu, Maharashtra, Andhra Pradesh, Orissa, Bihar, Himachal Pradesh and Uttarkhand states. It is grown for grain and fodder purpose especially in dry regions. In recent past the area gradually declined due to several reasons like urbanization, limitation in processing drudgery involved in preparation of millets food etc. in view of the rich nutritive value Ragi consumption is increasing again. In Andhra Pradesh ragi is grown in an area of 50000 ha with a production of 52000 t and productivity is 1189 kg/ha. In 21st century climatic changes, water scarcity, increasing world population, rising food prices and nutritional security for the poorest people who lives in arid region millets especially ragi crop provides opportunity to overcome the above said problems. As cultivable area under this crop declines it is necessary to increase productivity with good production technology. The production technology of Ragi crop suitable for the state of Andhra Pradesh is given in detail along with high yielding varieties.

Season/climate: It can be grown in all seasons mainly in tropics. It requires well distributed rainfall (annual rainfall 600-800 mm) with absence of prolonged droughts.

Kharif	:	June – July
Rabi	:	September – October
Summer	:	January- February

Soils: Red sandy loam soils are preferred. Soils should be well drained as ragi crop cannot tolerate water logging.

Soil preparation: One deep ploughing with mould board plough followed by ploughing with wooden plough twice during summer months is necessary. Before sowing secondary tillage with cultivator and multiple tooth hoe has to be done to get smooth tilth. Minor land smoothening before sowing helps in better insitu moisture conservation

Seeds: The quantity of seed required for sowing depends on the method of sowing. For direct sowing by broad casting / line sowing seed rate is 8-10 kg /ha. For transplanting 5-6 kg seed is sufficient.

Seed treatment: Seed should be treated with Thiram / Carbendazim / Mancozeb @ 2g/kg seed 24 hours before sowing to avoid the seed borne diseases.

Sowing and spacing

a) Direct sowing

1. **Broad casting:** Seed can be mixed with sand and can be broad casted on the prepared field.
2. **Line sowing:** Seed drill with country plough with a spacing of 15-20 x 7.5-10 cm

b) Transplanting: In this method ragi is grown by raising nursery and transplanting the raised seedlings in main field. About 400 sq. m nursery bed is enough to raise nursery and transplant the seedlings in one hectare land. Nursery beds should have the proper drainage. For transplanting 20-25 days age seedlings at 22.5 cm distance between rows and 10 cm between the plants are ideal for getting optimum yields. Transplanting provides uniform plant population which results in higher production. It also increases the tiller number and avoids the crop lodging.

Manures and fertilizers

5 tons of farm yard manure is required for one hectare field. For rainfed areas 40 kg nitrogen, 20 kg phosphorous and 20 kg potassium is required for one hectare field. For irrigated areas 60 kg nitrogen, 40 kg phosphorous and 30 kg potassium is required for one hectare field. Entire phosphorous and potassium fertilizers should be applied as basal at the time of sowing. Nitrogen fertilizer can be given in two or three splits depending on the moisture availability in assured rain fall areas. Half dose of nitrogen should be applied at the time of sowing or transplanting and remaining can be given at 25 -30 days after sowing or transplanting

Biofertilizers: Treat the seeds with *Azospirillum brasillense* (N fixing bacteria) and Aspergillus *awamori* (P solubilizing fungus) @ 25 g/kg seed is beneficial.

Table 1. Popular Ragi varieties in Andhra Pradesh

Variety/ Culture No.	Duration (days)	Yield (q/ha)	Salient features
Godavari (PR 202)	115-120	30-40	Drought and blast tolerant, widely adaptable for Kharif, Rabi & Summer in all areas of the state.
Ratnagiri (PR 1044)	110-115	30-40	Blast tolerant, suitable for all the three seasons in all the areas in the state
Padmavati (PPR 2350)	100-105	28-40	Suitable for all ragi areas in the state
Saptagiri (PPR 2614)	100-105	25-40	Suitable for early planting situations, non-lodging; tolerant to water logging as well as drought situations.
Champavati (VR 708)	80-85	20-25	Drought tolerant, Suitable for intercropping with Red gram
Maruthi (RR 230)	85-90	25-30	Early maturing, drought tolerant, tolerant to blast in all stages.
Bharathi (VR 862)	105-110	35-40	Moderately tolerant to blast, suitable for all seasons and all ragi growing areas of the state.
Sri Chaitanya (VR 847)	105-110	35-45	Moderately tolerant to blast, suitable for early and late Kharif situations and irrigated Rabi situations in all ragi growing areas of the state
Vakula (PPR 2700)	100-105	35-40	Tolerant to leaf blast, semi dwarf and medium duration variety suitable for irrigated and rainfed situation.
Hima (VR (W) 936)	110-115	25-30	White grain ragi variety, blast tolerant, suitable for rabi season.
Tirumala	115-120	35-40	Tolerant to all types of blast, superior grain quality and higher straw yield.
Vegavathi	110-115	35-40	Tolerant to leaf blast and lodging resistant
Suwarnamukhi	105-110	35-40	Suitable to grow in paddy fields, blast tolerant and withstand to drought condition in later stages.
Gouthami	115-120	35-40	Tolerant to leaf blast and lodging resistant
Indravathi	115-120	35-40	Tolerant to all types of blast and higher content of calcium, iron and zinc in seed.

Weed control

- In broad cast crop, two hand weedings are required. In line sown crop, 2-3 inter cultivations with one hand weeding is required to get weed free crop.
- In transplanting crop one hand weeding at 21 days after transplanting is enough to get weed free field.

Herbicides: In assured rainfall areas where moisture is sufficient spray pendimethalin 30 @ 3 ml/lit as pre emergence application. For broad leaved weeds spray 2, 4-D Sodium salt @ 2 g/lit as post emergence application around 20-25 days after planting.

Irrigation

- This crop is generally grown under rainfed conditions. Adequate moisture is necessary at sensitive stages like germination, tillering, flowering and grain filling stages.
- For irrigated crop, form beds by raising ridges and furrows before transplanting for irrigating the crop. Irrigate once in 7-8 days in light soils, 13-15 days in heavy soils.

Insect Pests:

1. Army worms and Cut worms:

- Dust Malathion 5% or Phosalone 5% or Quinolphos 1.5% @ 20-25 kg/ha.

- Spray chloripyriphos @ 2.5 ml/lit or quinolphos 2 ml/l

2. Leaf aphid

- Spray Dimethoate 2 ml/l or monocrotophos @ 1.6 ml/l

3. Stem borers

- Spray Dimethoate 2 ml/l or Phosphamidon 2 ml/l or Monocrotophos 1.6 ml/l

4. Ear head caterpillars

- Dust Malathion 5% or Phosalone 5% or Quinolphos 1.5% @ 20-25 kg/ha. Spray chloropyriphas @ 2ml/l

Diseases

1. Blast

- Treat the seed with Carbendazim @ 2g / kg seed
- If necessary spray the nursery with Carbendazim 1g/l, or Tricyclazone @ 0.5 g/l or Saaf 2.5 g/l
- Spray any of the above fungicides at 50% flowering and repeat 10 days later to control neck/ finger blast.

2. Brown leaf spot

- Damage could be severe if the crop is subjected to drought or nutrition deficiency. The disease can be effectively managed by proper nutrition and water management.
- Need based spray of Mancozeb or Saaf 2.5 g/l

3. Leaf blight

- Seed treatment with captan or thiram @ 3g/l
- Spray mancozeb @ 2.5 g/l

Inter cropping

Ragi under rainfed conditions is grown with Jowar, Bajra, oil seed crops and pulses. In hills it is grown with soya bean. Ragi can be grown with red gram or field bean in ratio of 8:1 (Ragi : 8 rows & Red gram / Field bean : 1 row).

Harvesting: When the grain colour turns to brown and becomes hard, harvesting can be done. The time of harvesting varies depending the duration of the varieties grown. In Ragi crop mother tiller matures first when compared to the side tillers, so depending upon the maturity 2-3 pickings are necessary for harvesting the entire produce.

Threshing and storage

The harvested crop is stacked for about 1-2 days and dry the ear heads under sunlight before threshing. The threshed grain should be winnowed, cleaned and dried properly before storage. The grain is free from any serious pest damage during storage and it keeps well for several years provided it is kept dry. Dry straw can also be stored for long time and used as fodder.

Nutritional value of Ragi

Ragi grain is rich in carbohydrates (76 %) and gives a very slow release of sugar to the body and thus it is considered as an ideal food for patients suffering from diabetes. The Ragi is rich in protein (9-14 %) and minerals also whish serves as a medicated food for infants and pregnant women. Rich in fiber (3.6 %) prevents constipation, high cholesterol formation and intestinal cancer. It also helps in lowering the incidence of cardio vascular diseases, duodenal ulcer and hyperglycemia (Diabetes). It provides rich nutritional supplementation to the deprived diabetic patients, being the richest natural source of carbohydrate, iron, calcium and energy, without increasing blood sugar level as it is absorbed into the blood stream at a very slow rate. Ragi reduces the esterified cholesterol deposit on blood vessel walls in turn increasing the radii of blood vessels resulting in the reduction of blood pressure. The grains are also rich in several vitamins such as thiamine, riboflavin and niacin. Ragi is especially valuable as it contains the amino acid methionine, which is lacking in the diets of hundreds of millions of the poor who live on starchy staples such as cassava, plantain, polished rice, or maize meal.

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