System of Ragi intensification (SRI)

Introduction:

Finger Millet is a highly nutritious cereal crop that can be grown throughout India, especially in the southwest monsoon season, and in summer under irrigated conditions. Presently, it is a major crop only in a few southern states and Himalayan region.

Finger Millet or Ragi (as it is known in south India) has superior nutritional value compared to major cereals like Rice and Wheat because of the higher content of Calcium and Iron in addition to calories. This nutritional benefit is particularly important for women and children.

Finger Millet (Ragi) is better adapted to both low rainfall and high rainfall conditions and has high genetic variability to suit a host of conditions. It can be grown productively in poor soils with less clay content and soil depth. It can easily be integrated into multi-cropping systems involving pulse and oil seeds. Intensive application of organic inputs can increase Finger Millet productivity to the average levels achieved for rice and wheat in India in the respective areas. Thus this neglected crop can be an easy local solution to counter the agricultural problems posed by climate change. It can also effectively remedy malnutrition in Indian population, which is so grave in many women and children.

GULLI RAGI or GULI VIDHANA is a traditional agronomic practice of growing Finger Millet in some parts of the Southern states. This received the revived attention of farmers when the System of Rice Intensification (SRI) started getting popular and demonstrated in farmers' fields. SRI is based on agro-ecological principles of harvesting sunlight through higher bio-mass production; and by facilitating more root-volume growth and microbial population in the root zone through aeration and more organic inputs. Like SRI, the traditional Indigenous organic system of Guli-Ragi also follows almost similar agronomic practices of wide spacing, early transplanting of seedling and inter-cultivation to create more aerated soil.

"The word gulli means intersection or node, so Gulli Ragi is 'intersection millet,' implying widely-spaced millet".

Main principles

- Only young seedlings should be planted

- Plant to plant and row to row distance must be equal.
- In order to get more tillers, the young plants should be pressed with a stick.
- In order for the hills to grow into a bush, they should be left space between the plants and plants should get adequate sunlight and wind.
- In order for the roots to go deep into the bush, the soil should be mulched frequently by intercropping.
- Alternate wetting should be given if necessary
- The botanicals may be used for plant protection if necessary

The introduction of sowing in lines to permit inter-cultivation (weeding) between rows was an innovation that probably came with colonial agricultural extension. However, it was not clear when transplanting in a square pattern was started, rather than rows, permitting inter-cultivation in perpendicular directions.

Gulli ragi require more input of labor, at 60 days of age, the roots of ragi plants that were transplanted at 10 or 15 days old seedlings become much larger than those of seedlings transplanted when 21 days old. soil aeration it achieves, especially when used in perpendicular directions with square-planted seedlings.

This course grain is the staple food for millions of Indian households, especially poor ones. It is grown as a rainfed crop, enhanced with supplementary irrigation where possible. Yields are usually in the range of 5-10 quintals per acre (1.25-2.5 tons/ha). A yield of 15 quintals is considered a very good yield (3.75 tons/ha).

The cultivation system practiced here in called guli ragi, has many resemblances to SRI for rice. It achieves yields of 18-20 quintals per acre (4.5-5 t/ha) and as much as 25 quintals per acre (6.25 t/ha) without use of chemical fertilizers. Also, 20 to 25 cartloads of ragi fodder are also.

Comparison between conventional method and Gulli ragi method

	conventional method	**Gulli ragi**
Seed rate	10kg/Acre	1kg/Acre
Yield	8 to 10 Quintal/Acre	18 to 20 Quintal/Acre
Distance	¾ feet between rows	1 ½ feet between rows
Spread of Disease	Attack of disease is more	Attack of disease is low
Method of sowing	Seed drill or Broadcasting	Transplanting
tillers	Tillers 4 to 6 and less no of ear heads	40-80 tillers and more heads
Cultural operations	Leveling is no done	Leveller is used

“Transplanting of rainfed finger millet in ‘gulli’ method at 45 cm × 45 cm spacing led to enhanced yield, nutrient uptake and improved economics.”

Procedure:

Field Preparation:

Farmers clear their field as usual for crop production, and then they create a grid similar to that with SRI. Furrows 18 inches (45 cm) apart are incised on the soil using a simple ox-drawn plow, pulled across the field in perpendicular directions. Approximately 500Kg / acre of Ghanajeevamrutham should be applied before ploughing. The soil should not be mixed.

Seed Selection and Seed treatment:

- 300 to 400 grams per acre of quality seeds should be selected. These Seeds should be treated with Bheejamrutham before sowing.

Seedling preparation

- A 40 sq. Ft. (4 x 10 ft. Size) nursery bed should be made by mixing clay, sand, and type2 compost in equal layers, or four nursery beds can be made to measure 4 x 4 × 1 feet.
- It provides enough seedlings per acre. Care should be taken to keep the nursery in the shade. The seeds can be laid in thin rows.
- After sowing, thin mulching should be applied. Spray drava jeevamrutham on the raised beds during the growing stages.

Molding

- Molds with ropes or markers so that there is a distance of 1 foot between rows and between plant to plant Should be planted (some can be planted 9 x 9 inches or even 10 x 10 inches apart).
- The seedling should be planted where the two lines meet. This equal distance on both sides makes it easier for inter-cultivation or lifting the bicycle weeder.

Transplanting

- Planting of 12-21 days(never more than 30 days old), are planted gives good results. 2 each at each intersection.The seedlings in the seed bed should be removed with a little clay without damaging roots.
- Dry and spray 400 kg Ghana jeevaamrutham per acre in the field before planting. The fibre should be cleaned once again with sterilizer. Make a small hole at the junction of the two lines and add a little solid biodegradable seedling (two bulbs) and then bury the hole. Or you can tie ropes on both sides and plant them with your finger where they meet (although the soil should be soft).
- Half a ton of Ghana jeevamrutham should be applied 30 days after planting.

- Then young seedlings, 20-25 days old

Intercultural operations:

The most innovative part of guli ragi is what is done to the growing crop.

- While the young plants are still supple, between 15 and 45 days after transplanting, when their stems will not break when bent over, farmers draw a simple ox-drawn implement a **wooden implement called a "koradu"** across the field in different directions.
- Bending the plants over traumatizes their stems at ground level, where root and shoot meet and where the plants meristematic tissue which produces new tillers and roots is located.
- Dragging a koradu across the field 3 and 6 times during this period of early plant growth (during the third to sixth week) stimulates profuse growth of adventitious roots and also much more tillering above-ground.
- The koradu is essentially a hollowed-out log, about 6-7 feet long and 15-18 inches wide, attached by ropes to the yoke of a team of oxen. A farmer stands on the koradu to add weight to it as he guides the team and the koradu over the field.

RESULTS

Yield attributes

- The yield attributes like number of ear heads per square meter, weight of ear head, and length of finger were significantly influenced by establishment method and crop geometry while number of fingers per ear head and test weight varied only due to crop geometry. The number of ear heads per unit area increased significantly with transplanting 25 days over direct line sowing and in guni method again over transplanting method. Highest number of ear heads were produced at 30 x 10 cm spacing compared to all the other wider spacing. But the mean weight of single ear head was more than doubled at each successive wider spacing compared to the previous one. Highest weight (13.1g) was recorded at 60 × 60 cm. Further, it was also significantly superior in guni method compared to direct sowing. Similarly, the mean finger length was enhanced significantly in transplanting method over direct sowing and further with guni method. Crop geometry also influenced the finger length which was enhanced significantly at 60 × 60 cm over 30 × 30 cm and 30 × 10 cm. the finger millet crop established by transplanting at 20 cm × 15 cm spacing produced higher ear weight and grain weight per ear.
  Crop Nutrient Uptake Nutrient uptake is the process of nutrient movement from an external environment into plant. It is one of the fundamental processes of plant's life which involves qualitative change where an abiotic material becomes a component of a cell, capable of further assimilation

Farmer experience

Despite resorting to high yielding varieties and application of fertilizers and chemicals, the farmers get at the most 15 quintals of finger millet (ragi) grain yield per acre. But the farmers in the Kurabalakota and Valmikipuram adopted unique method of cultivating ragi called as GULI VIDHANA – square planting.

Field preparation and sowing