



**Guli/Guni/Netti Method:  
A boon to Finger millet cultivation  
in virgin fertile soils**



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## **GULI/GUNI/NETTI METHOD: A BOON TO FINGER MILLET CULTIVATION IN VIRGIN FERTILE SOILS**

Finger millet is a staple food to the millions of the populace in the arid and semiarid regions of the world. Finger millet secures sixth position in India among major cereal grains (Devi *et al.* 2014). India contributes more than 50 per cent of the world production with an area of 1.2 million ha and a production of 1.75 million tonnes and productivity of 1.7 tonnes ha<sup>-1</sup>, respectively. In India its area is mainly concentrated in southern states particularly in Karnataka, Tamil Nadu, Andhra Pradesh and Kerala. It is rich in calcium (0.34%), dietary fibre (18%), phytates (0.48%), protein (6–13%) minerals (2.5–3.5%), and phenolics (0.3–3%) and other essential amino acids making it a powerhouse of health benefiting nutrients (Chandra *et al.* 2016). Finger millet also known for its climate resilience such as adaptation to wide range of climatic conditions, minimum vulnerability to abiotic and biotic stresses, low input requirement, high water use efficiency, etc. Finger millet seeds can resist storage pests for as long as 10 years, ensuring round the year food supply or even during a crop failure, has earned it the name ‘famine crop’ (Mgonjaet *al.* 2007).

Being a staple food crop for tribals and lower income classes, it suffers from low yields. Productivity limit in finger millet is attributed to resource-poor soils of rainfed areas, low affordability of the marginal and poor farmers, faulty methods of cultivation, poor management practices due to lack of awareness, unwillingness towards adoption of improved agro techniques, poor recycling of crop residues, etc. Among the modern management practices, crop establishment method is an important factor to achieve higher productivity. When compared to other cereal crops, small millets are generally low yielders due to smaller grain size and less tiller number. Increase in seed size may not be advantageous to increase the yield but increase in productive tillers and number of ear heads per plant

will significantly increase the yields. Hence, crop management practices should aim at increasing the productive tillers per unit area which in turn increase the yields.

Crop geometry is one such management practice which is essential for obtaining optimum plant stand in the field, as the yield of a crop depends on the final plant density with effective utilization of growth resources. Under conventional method, use of higher or lower seed rate per square metre causes below or above optimum level of plant population, which results in under or over utilization of growth resources, thus decreasing the productivity. Therefore, there is every need for adoption of intensive agricultural practices in order to increase the productivity for ensuring food security of the people.

System of Finger millet Intensification has tremendous effect on tiller number due to optimum spacing availed by each individual plant. Optimum row to row and plant to plant spacing in SRI system, allows the plants to produce increased number of tillers with better girth than those plants cultivated under traditional methods (broadcasting or random transplanting). Further, wider spacing also facilitates inter row and intra row weed control, enabling farmers to use simple weeding tools to incorporate the weeds to increase the soil fertility. However, crop geometry of any crop for that matter depends on several factors *viz.*, **soil fertility, season, age of seedlings and plant type.**

Influenced by the SRI principles, farmers of Haveri district of Karnataka have developed Guli/Netti/Guni method of finger millet cultivation in order to increase the productive tillers per plant. This method involves practices like wide spacing, pit planting, manure application in pits, early transplanting of seedlings, planking, inter-cultivation with ox-drawn wooden implements, etc. This practice resulted in yield increase up to 5-10q/ha through significant increase

in tiller number per plant. A large number of Non-Governmental Organizations have widely popularized this method in different parts of the country especially in tribal areas, where the finger millet is a major food crop. In Andhra Pradesh, this Guli method of finger millet cultivation is being clubbed with ZBNF principles of Subhas Palekar and getting good yields in tribal areas. Farmers in Haveri district of Karnataka used to harvest only 1.25 to 3.5 t/ha of finger millet under conventional method, however, in guli method, yield has increased upto 4.5-5 t/ha.

The system of Guli involves two very interesting bullock-drawn implements that farmers are adopting for following purposes.



**Koradu/Wooden log/wooden plank**



**Passing of wooden log over crop**

**i. Koradu / Wooden log/wooden plank:**

It is a hallowed out wooden log, about 6-7 feet long and 15-18 inch width attached by ropes to the yoke of a team of bullock. It is pulled across the field several times in different directions between 15 and 45 DAT, to bend over the young plants without breaking them off. When other growing conditions are favourable, the dragging of *koradu* stimulates profused tillering and adventitious root system enabling the plants to absorb more nutrients and water, which ultimately resulting in higher yield.

**ii. YadeKunte / Intercultivation implement:**

It is a blade mounted on the end of a long handle pulled along the wide space (45cm) between rows and between plants, in order to eliminate weed competition and also to aerate the soil.



**Cycle weeder**

However, due to non-availability of draught animals, hand operated cycle weeders are getting popularized for inter-cultural operations. These weeders perform the same functions as that of Yadekunte. It clears the weed population in the inter-row spaces, incorporates the uprooted weeds to improve soil fertility. It also helps in earthing up of the plants, which were disturbed during the rolling of wooden log. It aerates the root zone soil and helps in production of more adventitious roots.

## Methodology of Guli:

1. In Guli method, 15-20 day old seedlings will be used for transplanting as they put forth more number of tillers than over aged seedlings.



**Sowing in  
nursery bed**



**Removal of seedlings along  
with roots**

2. Plant spacing will depend upon soil fertility and soil type. In well fertile soils, 45cm x 45cm or 60cm x 60cm spacing could be practiced. Wide spacing between the plants allows plants to produce more number of tillers per plant. However, in low fertile shallow soils, closer spacing of 20cm x 20cm, 25cm x 25cm or 30cm x 30cm spacing is the best method in order to get maximum tiller number from unit area.
3. With the help of marker, vertical and horizontal lines have to be drawn. Following this, small pits have to be dug at each intersection point with the help of hand hoes or spades.





### **Formation of Gunis or pits & filling of FYM**

4. Guli method includes putting a handful of well decomposed manure into each pit/guli along with the seedlings to boost soil fertility.
5. Two saplings will be planted at each inter section point. As only two saplings are placed in one pit/guli, they absorb maximum nutrients.



### **Planting of seedlings in pits**

6. Between 15 and 45 DAT, the Koradu will be dragged 3-6 times across the field in different directions.
7. The inter cultivation equipment Yedukunteor cycle weeder will be used for weeding. It breaks, lifts and aerate the surface soil as it cuts through the roots of weeds, burying them in the soils.



## Cycle weeder

### Differences between Conventional and Guli method of finger millet cultivation:

S.No.	Conventional method	Guli method
1.	Seed requirement is 5-6 kg/acre	Seed requirement is 1-2 kg/acre
2.	Yield : 800-1000 kg/ac	Yield : 1800-2000 kg/ac
3.	No spacing will be maintained in broadcasting and random transplanting.	Spacing is 45 x 45 cm or 60 x60cm
4.	Pest and disease attacks are more due to high plant density.	Pest and disease attacks are less due to wide spacing.
5.	FYM requirement is 5 Cartloads /acre	FYM requirement is 10 Cartloads of / acre
6.	Chemical fertilizers will be used along with FYM. In tribal areas, proper nutrient management practices are not being followed.	Only organic manures will be used or can be integrated with inorganic fertilizers.
7.	Tillers/hill varies between 2-6	Tillers/hill varies between 10-30
8.	No use of Koradu or Yadukunte. Inter cultivation will be done manually or chemically.	Koradu will be used between 15-45 DAT. For inter cultivation, Yedukunte or cycle weeder will be used.

#### Advantages of Guli method:

1. Seed requirement is less (2 kg/acre) when compared to conventional method (5-7 kg/ac) of sowing.

2. Presence of Farm Yard manure in pits increases water holding capacity and nutrient holding capacity.
3. In this system, individual plant produces more tillers and more number of ear heads. Tiller number varies from 40-50 /hill in high fertile soils and 10-14 /hill in low fertile soils.
4. Bending of the plants with Koradu, traumatizes their stems at ground level, which might accelerate the plant's meristematic tissues to produce new tillers and roots.
5. Inter cultivation with Yedukunte or cycle weeder not only helps in weed control but also aerates the root zone soil and helps in production of more adventitious roots. More aeration in the root zone also helps in increased availability of nutrients and reduced incidence of soil borne diseases.
6. The larger root system helps in increased absorption of nutrients by plants which in turn helps in better filling of grains.



### More tillers due to passing of wooden log over crop

7. Due to application of huge quantities of farm yard manure, soil health will be improved in the long run.
8. Lodging problem is less due to deeper root system, increased stem girth and earthing up in gull method.
9. Pest and disease problems are less due to wide spacing.

### Disadvantages of Guli method:

1. Guli method is cumbersome process, requires more input of labour for marking lines, making pits at intersection points and filling of pits with FYM, pulling of Koradu and Yedukunte.
2. It requires huge quantities of well decomposed FYM, which is very costly and its transportation and application in pits adds more financial burden on the farmer.
3. Adequate care must be taken while handling the young seedlings in guli method.
4. Weed problem is more due to wider spacing. Hence it requires repeated running of intercultivation equipment.
5. Adequate care must be taken with regard to method of pulling of Koradu and stage of the crop.
6. Maturity of all ear heads on the plant is not uniform. Hence, it requires multiple harvests, which further increases cost of cultivation.



**Guli /Pit method  
(45 cmX 45 cm)**

**Recommended spacing  
(30cmx 10cm)**

7. Total crop duration will be extended when compared to conventional method. Hence it will limit the crop intensification.
8. In light soils, adoption of 45cm x 45cm or 60cm x 60 cm is not advantageous as the tiller number/hill does not exceed fifteen. Hence it is unable to compensate the yield loss caused by reduced plant density.

## Case studies of Guli method across the country

### Validation of Guli method in Andhra Pradesh:

In Andhra Pradesh, guli method of finger millet cultivation is widely popularized among tribal farming community by Non-Governmental Organizations, Agricultural Technology management Agency (ATMA) and Dept. of Agriculture. Demonstrations in farmer's fields on guli method of finger millet cultivation are being taken up in the tribal areas of the districts like Srikakulam, Vizianagaram, Visakhapatnam, EastGodavari, Ananthapur, Chittoor and Kurnool districts. Adoption of spacing and performance of guli method depend upon soil fertility and soil type. In low fertile soils, 25cm x 25cm is giving good results and in highly fertile soils, 30 cm x 30 cm or 45cm x 45 cm are giving good result.

For the first time, Agricultural Research Station, Vizianagaram has initiated validation of guli method in Andhra Pradesh during *rabi* 2018-19 on red sandy loam soils. This validation has been continued at ARS, Vizianagaram and RARS, Nandhyal with little modifications in the treatments under AICRP on Small millet during 2019-20 and 2020-21. The soil of the experimental sites at Vizianagaram and Nandhyal were sandy loam and deep vertisols respectively with low organic carbon content ranging from 0.30% to 0.50%. Soil available nitrogen was low, higher in soil available phosphorus and medium to high in soil available potassium. Experiments were taken up with three spacings, planking with wooden log and different FYM levels along with 100% RDF.

Experimental results revealed that general recommended spacing of 30 cm x 10 cm gave 15.6% and 18.9 % higher yields over 45 cm x 45 cm guli planting and normal planting respectively during *rabi* 2018-19.

Further, no significant difference was observed between pit method and normal method of planting at 45 cm x 45 cm spacing. During *khariif* 2019-20 and 2020-21, again 30 cm x 10 cm spacing recorded highest grain yield at both locations when compared to 30 cm x 30 cm or 45 cm x 45 cm spacing of guli method. 30 cm x 30 cm spacing was next best spacing. Tillers/plant was significantly high in square planting, whereas the number of productive tillers per m<sup>2</sup> was significantly high in 30cm x 10cm spacing. Considering the economics of both methods B:C ratio was also significantly higher in 30cm x 10cm. However, pulling of Koradu over the crop and application of FYM have positive impact on yield attributes and yield of finger millet.



**Grain yield (kg/ha) at different spacings under Guli method of finger millet cultivation:**

Treatments	ARS, Vizianagaram			RARS, Nandhyal		
	2019-20	2020-21	Mean	2019-20	2020-21	Mean
30cmX10cm	2910	2843	2877	2963	<b>3247</b>	3105
30cmX30cm	2732	2295	2514	2218	2899	2559
45cmX45cm	2437	1899	2168	1930	2808	2369

### Soil fertility status at both locations:

	ARS, Vizianagaram	RARS, Nandhyal
Soil	Sandy loams	Deep vertisols
Bulk Density	-	1.28
PH	7.4	8.2
EC (ds/m)	0.18	0.22
Organic carbon (%)	0.41	0.34
Available N (kg/ha)	245	180
Available P <sub>2</sub> O <sub>5</sub> (kg/ha)	68	48.2
Available K <sub>2</sub> O (kg/ha)	224	366

### Validation of Guli method of planting in Eastern dry zone of Karnataka

A field experiment was conducted at Zonal Agricultural Research Station, UAS, GKVK, Bengaluru by Prakasha *et al.*, 2015 on sandy loam soil during 2015. Treatments consisted of two spacings (45 x 45cm and 60 x 60cm) with three levels of NPK (0%, 75% and 100% RDF) compared with farmer's method of guli planting (60 x 60cm with only farm yard manure). The remaining package of practices were common. Significantly higher grain and straw yield (41.60 q/ha and 60.80 q/ha respectively) were recorded with spacing of 60cm x 60cm with 100% RDF followed by 60cm x 60cm with 75% RDF. Higher grain yield was attributed to more number of productive tillers per hill, more dry matter production and grain yield per hill and higher 1000 grain weight. Higher net return (Rs. 44789/-) and B:C ratio (2.2) were recorded in 60cm x 60cm spacing with 75% RDF due to on par grain and straw yields and also saving in cost of fertilizers.

## **Validation of System of Millet Intensification in Uttarakhand:**

In a demonstration on application of SRI principles to finger millet conducted by an NGO People's Science Institute (PSI) during 2007 revealed that, transplanting of 15 days old seedlings at 20cm x 20cm spacing increased the yield by 33% over the conventional method of finger millet planting. In the subsequent year, even under unfavorable weather conditions, square planting (20cm x 20cm) method gave 60% higher yield (2.4 t/ha) when compared to conventional method (1.5t/ha).

## **FIELD SURVEY OF FINGER MILLET IN TRIBAL AREAS OF VIZIANAGARAM AND VISAKHAPATNAM DISTRICT:**

During field survey it was observed that the finger millet is the major millet crop grown in both the districts. In Visakhapatnam, normal area under finger millet is around 18,000 ha area mostly grown as rainfed during kharif season. Very little irrigation facilities are available to save the crop during prolonged dry spells. Complete organic farming is inherent practice and use of chemical fertilizers and pesticides are very meagre especially in the tribal belt. Direct sowing by broadcasting is a common practice adopted by the farmers. Based on the availability of family labour, one or two intercultivations will be taken up during initial crop growing period. Average yield obtained in this method is around 1000-1200 kg/ha.





### **Major yield limiting factors observed:**

1. High seed rate
2. Below or above the optimum plant population
3. Lack of proper nutrient management
4. Lack of timely intercultivation to reduce competition from weeds
5. Uncertainties in monsoon rains
6. Lack of assured irrigation facilities
7. Insufficient labour force
8. Poor resources of farmers
9. Lack of awareness on critical management practices
10. Limited availability of high yielding cultivars

In order to improve the finger millet yields in tribal areas, Dept. of Agriculture and certain NGOs are jointly conducting demonstrations on improved production technologies. Guli method is one such technique, imported from Haveri district of Karnataka is being popularized among the farmers. Numbers of farmers are being attracted by this method because of its yield advantage compared to the existing broadcasting practice. Most of the farmers are adopting 30cm x 30cm spacing. Productivity of finger millet has increased upto 1800-2400kg/ha, which is 80-100% improvement over broadcasting method.

Added to this, Andhra Pradesh Community Natural Farming (APCNF) Wing of Department of Agriculture is clubbing the principles of Zero Budget Natural Farming Principles with Guli method of finger millet cultivation. As the finger millet cultivation is inherently under organic farming in this area, ZBNF principles could be readily accepted by the tribal farmers. Under ZBNF, certain practices in guli method were slightly modified. Here, in this method, pit planting is not a practice. Ghanajeevamruth will be applied at the time of last ploughing and thoroughly incorporated into the soil.



### **ZBNF principles in Guli method:**

1. Only local or desi cultivars of finger millet will be used in this method.
2. The field will be supplied with 1000 kg/ ha Ghanajeevamruth at the time of last ploughing as a basal dose prior to transplanting (Alternative to basal dose)
3. 18-25 days old seedlings will be used for planting after treating with Beejamruth (Alternative to seed treatment).
4. Further nutrient requirement of crop will be met through Dravajeevamruth, which will be applied 3-4 times immediately after receiving rainfall or along with irrigation water (Alternative to top dose fertilizer).
5. Need based plant protection measures will be followed by spraying of Agnasthram or neem seed kernel extract (NSKE) (Alternative to plant protection chemicals)

## Key requirements for successful cultivation of finger millet through guli method:

- 1. Seedling age:** Younger seedlings have the greater potential to put forth higher number of tillers. Hence, based on the duration of a variety, seedling age of finger millet must be between 18-25 days old. If the seedling age exceeds due to non receipt of rains, the tillering potential of the seedlings will be drastically reduced.
- 2. Assured rainfall or irrigation:** Irrigation is necessary at the time of planting. Under rainfed conditions, always it is not possible to transplant the seedlings at the optimum age due to aberrations in the monsoon rains. After completion of every round of dragging of Koradu, the traumatized plants should be supplied with enough moisture and nutrition to boost their tillering capacity. Otherwise, the plants will be adversely affected. At least 2-3 irrigations are necessary as the koradu will be dragged for 2-3 times over the crop in different directions.
- 3. Plant geometry:** Inherent soil fertility and nutrient supplementation through different sources play an important role in deciding the plant to plant and row to row spacing. As most of the soils in tribal areas are virgin soils with high organic carbon content, adoption of 30cm x 30cm spacing would be beneficial in reaping better harvest.
- 4. Adequate labour force:** Actual method of guli is highly labour intensive as it requires digging of small pits at intersection points of vertical and horizontal lines, filling of pits with well decomposed manure, careful planting of young seedlings, dragging of Koradu (2-4 times), running cycle weeder or Yadekunte (2-3 times). Further, the crop will not show uniform maturity due to production of earheads on secondary and tertiary tillers. Hence it needs to harvest 2-3 times. All these operations require more number of labour.



- 5. High cost of cultivation :** All the above mentioned operations are labour intensive and require more capital from resource poor small and marginal farmers. Procurement and transportation of huge quantities of manure is also a cumbersome operation.

### **Jamuna method of finger millet cultivation:**

In order to overcome the shortcomings involved in guli method, “Jamuna method” of finger millet cultivation was evolved by one tribal woman named Jamuna and hence this method got popularized on her name.

Due to complete dependence on monsoon rains, planting of optimum age seedlings is not always possible in guli method and hence in Jamuna method, 2-3 finger millet seeds will be sown at intersection points of 30cm x 30cm spacing instead of seedlings with the onset of monsoon. Rest of the practices are same as that of guli method. Farmers are expressing that this method is equally effective as guli method and can be practiced under rainfed conditions.

### **Guli method adopted by the tribal farmer at Rastakuntubai of Vizianagaram district and Goppulavalasa of Visakhapatnam district:**

Data on crop and soil parameters were taken from the farmers fields, who adopted guli method following ZBNF principles at Rastakuntubai of Vizianagaram district and Goppulavalasa of Visakhapatnam district. Here at both locations, farmers are adopting ZBNF practices like use of desi cultivar (Peddachodi) coupled with application ghanajeevamruth, bijamruth, dravajeevamruth and agnasthram in order to supplement nutrition and for pest and disease management. Soil organic matter at Goppulavalasa was higher (> 1.0%) and at Rastakuntunai was medium in range (0.72%). Available nitrogen was medium, high in soil available phosphorus and medium in available potassium.

Data recorded at both locations revealed that the tiller number per square meter ranges between 70-80 with an average value of 75. The tiller number obtained at the Agricultural Research Station, Vizianagaram at 30cm x 30cm spacing was on par with tiller number in farmers fields. The grain yield obtained in Goppulavalasa was higher compared to Rastakuntubai. High organic matter content in soil might be the reason for higher grain yields at Goppulavalasa. Further addition of organic manures in guli method will further increase in organic carbon content in soil. There was no significant difference in straw yield was observed between both locations.

Location	Tillers/m <sup>2</sup>	Grain yield (kg/ha)	Straw yield (kg/ha)
Goppulavalasa	75	2240	5820
Rastakuntubai	76	1960	5915



**Opportunities for futher increase in finger millet yield under guli:**

The nutrients supplied through different amruthas (ghanajeevamruta, Bijamrutha and Dravajeevamruta) are far less than the actual requirement of finger millet. However, the grain yields of finger millet increased by 80-100% in guli method compared to conventional broadcasting method of sowing. There is a greater scope to increase the grain yields further in guli method in these areas with the following practices:

1. Finger millet crop requires 60-40-30kg NPK/ha. Hence, there is every need to supply the required quantities of nutrients through different sources of organic manures on nutrient equivalent basis. So that it is possible to achieve the full yield potential under this method.
2. Adoption of improved and high yielding varieties may further increase the yields.
3. In order to achieve full potential of this technology, guli method of cultivation should be taken up where ever supplemental irrigations are possible.
4. As it is highly labour intensive, it should be adopted in smaller areas. So that, it can be handled with the help of family labour.
5. Agricultural Research Station, Vizianagaram has recently released Zn and Fe rich biofortified variety “Indravathi”. Introduction of this variety in this method would be beneficial to improve the nutritional status of the tribal farmers.

**CFMV 1  
(Indravathi)**




16.10.2020



17 Biofortified Crop Varieties Dedicated to Nation  
by Hon'ble Prime Minister on World Food Day

Grain yield:  
32 – 35 q/ha

































Rich in Fe (58 mg/kg),  
Zn (44 mg/kg) &  
Ca(428 mg/100g)

PR 202 (C) : Fe (35 mg/kg),  
Zn (24 mg/kg) &  
Ca(357.0 mg/100g)

#SahiPoshanDeshRoshan

