

System

of finger millet intensification

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Finger millet can tolerate harsh conditions and provides higher nutritional cereal than rice and wheat. It can grow in areas having water scarcity or in regions with a certain risk of failure of conventional crops. Finger millet cultivation has the potential to bridge the demand and supply of food grains in resource-poor areas and therefore, its production needs to be increased by various means such as the system of finger millet intensification (SFMI). SFMI follows the principles of system of rice intensification (SRI) and is traditionally practiced with different names like Guli ragi method in Karnataka. Although the research is very less in this regard, this method has already proved its potential to ensure vigorous growth and sustainable yield utilizing less/cost-effective resources. Still, its adoption by farmers is poor and needs strong policy, subsidies and other support from public, private organizations as well as strong extension services for the technology dissemination.

Keywords: Finger millet, Guli ragi, Sustainable yield, System of finger millet intensification

FINGER millet (*Eleusine coracana* L.) or ragi is an important cereal crop grown in low-rainfall, resource poor conditions as food for poor people. India is a major producer of this crop. Finger millet is nutritionally richer than the common cereal crops like rice, wheat etc. This crop can grow in wide range of agro-climatic conditions exhibiting highest productivity among other millets. However, as compared to its potential, finger millet productivity is less due to poor and harsh environmental conditions for its growth, less use of inputs by resource poor farmers, attention towards major food crops and stereotypic mentality of consumers. However, it can serve as good alternative of major cereal crops especially under the risk of crop failure due to several reasons like water scarcity, poor soil fertility status, adverse agro-climatic conditions, etc. Considering the need of the food from ever increasing population, production of this crop needs be elevated by different means especially through modification of

agronomic approaches. Among the new approaches, system of crop intensification as developed in 1980s has received high attention in recent times. This method is already successful in rice and is now being tried for many crops like wheat, mustard, sugarcane, vegetables, etc. This method has the potential to elevate finger millet yield in both

rainfed and irrigated areas under climate change scenario.

Requirement of crop intensification system

The present-day crop cultivation is not sustainable and is receiving major setback as soil productivity is greatly hampered due to continuous use of chemical fertilizers and



Finger millet ear

Source: <https://news.trust.org/item/20180928095848-ed6f/>

pesticides. These chemicals leave toxic foot print in the environment and impose detrimental impact on soil health resulting in poor crop growth and yield. Demand and supply for food is increasing tremendously and it requires jump in crop productivity by any means to ensure food security. In this context, system of crop intensification (popularly known as system of rice intensification) can hold good promise in improving crop productivity especially in dry land areas as it follows alternate wetting and drying approach.

System of finger millet intensification

Millets especially finger millet is mostly sown by broadcasting/random transplanting in dry tracts and less care is paid to it resulting in higher competition for resources and thereby, poor productivity. If millets are cultivated according to system of crop intensification, the competition among plants and weeds for resources can be minimised leading to high growth and yield of crop. The idea of system of finger millet intensification (SFMI) is not new. It has been practiced with different names (Guli/Guni/Netti) since last 40 years by the farmers of Haveri district of Karnataka with some location-wise modifications and variations.

Principles and aim

The concept of SFMI has emerged from the increased success and popularity of system of rice intensification (SRI) and now this concept is being tried in other crops as well. In doing so, the traditional Guli ragi method (SFMI) is receiving the attention. There are two basic principles of SFMI:

- Principle of root development (proper nourishment and sufficient space around the plant for better root growth and uptake of nutrients and moisture)
- Principle of intensive care (careful management of soil, agronomic practices in each stage of plant growth)

SFMI aims at establishment of young and healthy seedlings for



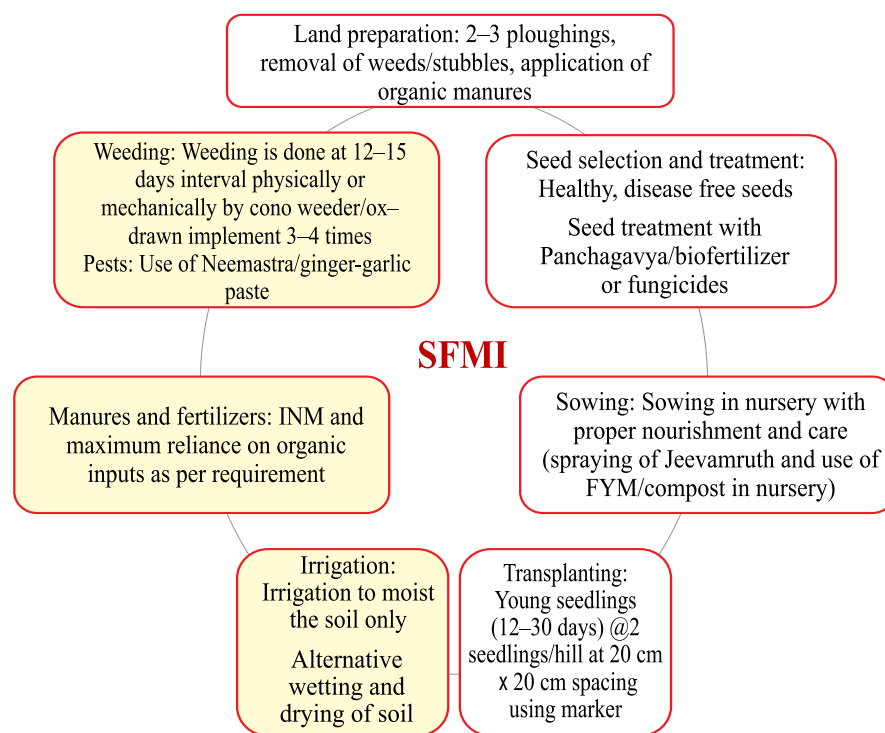
System of finger millet intensification
Source: <http://genecampaign.org/wp-content/uploads/2015/03/Annexure-13.-System-of-Millet-Intensification.pdf>

optimum root and shoot growth, reduction in crop population by wider sowing/transplanting for effective utilization of space, light, nutrients and water, etc., improvement of soil health through enriching organic matter, aeration as well as biological environment, use of water for moistening the soil without creating hypoxic condition. All these agronomic practices can improve crop yield and quality.

Scenario

In south India, SFMI is popular as Guli ragi (hole-planted finger millet) method where 12 days old young finger millet seedlings are transplanted @2 seedlings/hill at

45 cm × 45 cm. Adequate compost/manure is applied to each hole prior to transplanting. After 15–45 days after transplanting, light weight board (Koradu/wooden plank) is dragged over them in different directions for bending (stressing) the plants resulting in more growth of roots and tillers from meristematic tissues, resulting in high crop growth. Additionally, ox-drawn implement (Yade Kunte and/or hand operated cycle weeder) is used to loosen or aerate the soil several times and to cut the weed roots within 3–5 cm soil depth as well as organic manure is applied for higher tillering, growth and productivity. This Guli ragi method has produced relatively higher yield (4.5–5 t/ha) over conventional method (1.25–2.5 t/ha, maximum 3.75 t/ha). In Andhra Pradesh, this method has been introduced by Agricultural Technology Management Agency (ATMA), Andhra Pradesh and Govt. of Agriculture, India and is now clubbed with zero budget natural farming principles (use of desi ragi cultivars, use of Ghanajeevamruth during land preparation, transplanting of 18–25 days old seedlings after treating with Beejamruth, application of NSKE/Agniastara as plant protection



Package of practices of SFMI



Comparative growth of ragi under SFMI (left) and conventional method (right) in Jharkhand
Source: Abraham *et al.* 2014

measure etc.) and is also being implemented in tribal areas.

This method has also been tried in Jharkhand, Orissa and Chhattisgarh. In Jharkhand, due to the initiative taken by non-governmental organization named Professional Assistance for Development Action (NGO PRADAN), farmers are practicing SFMI since 2005 and have obtained 3 times yield than conventional broadcasting and obtained 60% increase in economic profitability due to enhanced soil health and root system of finger millet leading to more and more adoption by around 2000 farmers in these eastern states. In North India (Uttarakhand), NGO named People's Science Institute tried field trial in five farmers' plots in 2007 and obtained 33% yield increase over conventional method. Later, 43 farmers of Uttarakhand tested

this method on 0.8 ha in 2008 and observed 60% yield increase (from 1.5–2.4 t/ha) leading to more and more adoption by around 1000 farmers with some local modifications (use of 15–20 days old seedlings, spacing of 20 cm × 20 cm etc.). In Orissa, SFMI began in Koraput district in 2010 by NGO Pragati and initial yield was 2.1–2.25 t/ha over 1–1.1 t/ha in conventional method. Gradually, adoption of SFMI in Orissa has been increased and 4.5–4.7 t/ha yield from improved varieties (maximum 6 t/ha) has been noticed in 2016 along with climate resilience specially against cyclone. One popular local modification of Guli ragi method is Jamuna method of ragi cultivation in which instead of seedlings, seeds are sown in hole due to issues of high rainfall/water and other practices remain same.

VS	
Conventional method	SFMI method
✓ Seed requirement 12-15 kg/ha	✓ Seed requirement 2.5-5 kg/ha
✓ Broadcasting and random transplanting method of sowing	✓ Transplanting at wider and squared spacing
✓ High pest and disease attacks	✓ Low pest and disease attacks
✓ High use of chemical fertilizers	✓ High use of organic manures
✓ Tillers/ha 2-6	✓ Tillers/ha 10-30
✓ Chemical or manual weed control	✓ Koradu and YadeKunte for intercultural operations
✓ Yield: 2-2.5 t/ha	✓ Yield: 4.5-5 t/ha

Comparison between conventional method and SFMI

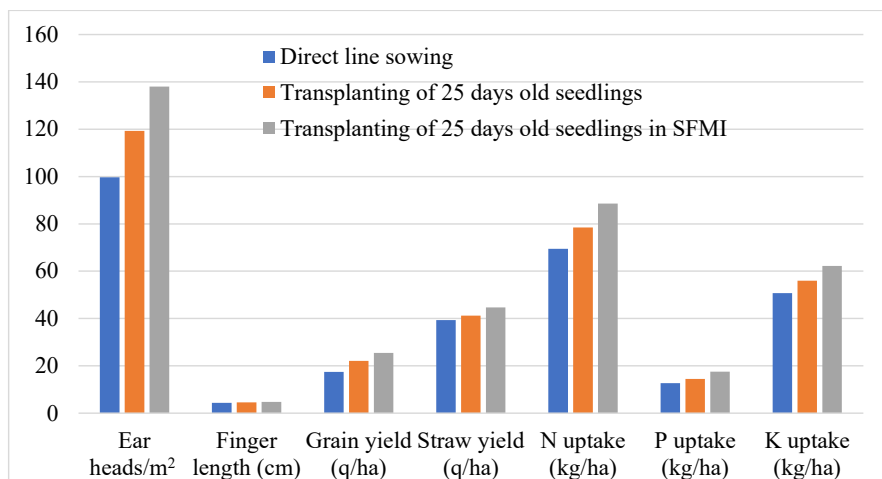
Globally, SFMI is practiced in Ethiopia, Nepal, Malawi, etc. In Tigray province of Ethiopia, an elderly woman farmer (Mama Yehansu) first adopted SFMI in 2003 by growing 30 days old seedling at 25–30 cm spacing and obtained 7.8 t/ha yield over 1.4–2.8 t/ha yield under conventional broadcasting method in rainfed condition leading to higher adoption by other farmers. In Ethiopia, they call this method as planting with space method and obtain 4–5 t/ha mean yield of finger millet. In Rampur, Nepal, SFMI (transplanting of 15 days old seedlings) has ensured 82% and 25% higher yields than direct sowing and conventional transplanting (30 days old seedlings). Since, 2015, farmers of Malawi have also started practicing SFMI.

Benefits

- It creates vigorous crop growth with 4–5 times increase in tillers.
- Branching of culm is also higher in SFMI over conventional process.
- It improves panicle length, number of fingers as well as test weight of finger millet grains.
- Soil health is improved through organic manuring, tillage and weed control.
- It ensures better weed control due to wider spacing of crop. Interculture operations help in improvement of root system.
- It increases root volume and biomass for facilitation of nutrients and water uptake, resulting in yield improvement.
- It prolongs the crop maturity leading to high vegetative growth and reproductive organ development.
- It makes the crop to resist lodging, pest and disease attacks and to cope up with climate change.

Limitations

- Mechanical and financial support, policies and subsidies, availability of organic manures as well as technical know-how and adequate research works are lacking to limit adoption of SFMI especially from small-scale farmers.



Influence of SFMI on growth, yield and nutrient uptake of finger millet

Source: Padesur et al. 2022

- High weed problem, more requirement of labours, bulk use of organic manure, staggered harvesting, etc. are some problems associated with its limited adoption.
- Irrigation water management (wetting and drying) is very difficult in predominant rainfed cultivation of finger millet.
- SFMI has mostly remained as a mere technological intervention rather than practical

implementation due to poor extension service.

- Stereotypic mentality of farmers towards cultivation of ragi in conventional process as well as lack of skilled farmers is also a constraint behind its adoption.

Way forward

So far, SFMI has shown its good prospects in finger millet cultivation for resource poor farmers. However, this method is very less known and confined to particular pockets of globe and in India. As it requires labour and moderate irrigation water, repeated weeding and bulk organic manures, availability and arrangement of these resources can play important role in its adoption and further success. Timely and proper supply of nutrients and other resources are also needed along with it. There is also the need for development of improved finger millet varieties for SFMI. The package of practices of SFMI show great variations, which need to be

standardised properly. Further, multi-locational research trials as well as strong extension works are highly needed for utilization of benefits of SFMI in a long run for successful finger millet cultivation.

SUMMARY

Finger millet/ragi is one of the majorly grown millet in India. Due to its potential in surviving harsh environments and providing nutritionally rich millet grains, the cultivation of finger millet can be a good alternative of traditional food grain crops, specifically under the situation of crop failure. However, its cultivation practices need to be modified/adjusted as per the situations. System of finger millet intensification holds good prospect in uplifting the productivity of finger millet by 2–3 times over conventional in poor village and tribal areas where millet is often cultivated for subsistence purpose with less care and inputs due to harsh soil and climatic conditions hindering crop cultivation. Finger millet is nutritionally rich and its market demand is growing not only in village but also in urban areas and therefore, production increase through SFMI can be a win-win option as this eco-friendly option revives soil health as well as ensures vigorous crop growth and yield. However, its poor adoption and confinement to limited areas further requires organizational/individual support as well as strong extension/awareness programmes.



Comparison between SFMI and non-SFMI panicle

Source: <http://genecampaign.org/wp-content/uploads/2015/03/Annexure-13.-System-of-Millet-Intensification.pdf>

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Water

Even though households are relatively low consumers of water, population growth and expanded water use have outweighed the effect of water saving technology and behavior.

- Less than 3% of the world's water is fresh (drinkable), of which 2.5% is frozen in the Antarctica, Arctic and glaciers. Humanity must therefore rely on 0.5% for all of man's ecosystem's and fresh water needs.
- Man is polluting water faster than nature can recycle and purify water in rivers and lakes. More than one billion people still do not have access to fresh water.
- Excessive use of water contributes to the global water stress. Water is free from nature but the infrastructure needed to deliver it is expensive.

- See more at: <http://www.unep.org/wed/theme/water.asp#sthash.ki5vg3lB.dpuf>

Courtesy: United Nations Environment Programme website - <http://www.unep.org/wed>