

Micro-rhizomes technology for healthy planting material of ginger and turmeric

This article describes the methodology for disease free planting material production in ginger and turmeric. The propagation of two important medicinal plants- ginger and turmeric is through rhizomes which may harbour pests and disease-causing pathogens that affect crop establishment, growth and yield. Hence, use of good quality disease free seed rhizomes plays an important role in successful ginger and turmeric production. *In vitro* micro-rhizome technology can contribute substantially in increasing ginger and turmeric production in the country.

GINGER (*Zingiber officinale* Rosc.) and turmeric (*Curcuma longa* L.) are important spices and medicinally useful herbs, essential for day-to-day use in every home and cultivated almost in every state. Their propagation is through seed rhizomes that may harbour pests and disease-causing pathogens, which in turn affect crop establishment, growth and yield. Hence, use of good quality disease free seed rhizomes plays an important role in successful ginger and turmeric production.

There is no seed set in ginger while turmeric sets seed rarely. The crop improvement of these two crops is done by clonal selection, mutation breeding, induction of polyploidy and other biotechnological tools. The plantlets of ginger and turmeric that are regenerated by micro propagation methods take longer time to produce

normal size rhizome with good yield equal to conventional methods of propagation. Hence, a miniature form of rhizomes was induced in the regenerated plantlets of ginger and turmeric through micro-rhizome technology under aseptic conditions. These plantlets produced from micro-rhizomes are capable of giving yield as that of conventional method during first generation itself and also assure production of pathogen free planting materials in ginger and turmeric.

Micro-rhizome production

Micro-rhizomes of ginger and turmeric varieties were induced at Tissue Culture Lab of ICAR-Indian Institute of Spices Research, Kozhikode by following the procedures discussed below. The source of explants and



Micro-rhizomes of turmeric



Micro-rhizomes of ginger



Ginger plants derived from micro-rhizomes in grow bags



Yield obtained from single micro-rhizome



Field evaluation of micro-rhizome derived plantlets of ginger



Second generation rhizomes of ginger micro-rhizomes



Germination of rhizome buds, multiple shoot formation, established culture



View of the established cultures of turmeric variety Varna



Production of micro-rhizomes of ginger variety IISR Varada

its stage are the most important factors to be considered for establishing contamination free cultures with good *in vitro* response. The sprouted rhizome buds (2 cm in length) of ginger and turmeric served as explants for micro-rhizome production.

- Sufficient quantities of disease-free rhizomes of ginger and turmeric developed by ICAR-IISR and KAU (Kerala Agriculture University) were collected.
- The rhizome bits were planted in trays containing 4-5 inches of sand and kept in greenhouse under protected conditions and periodically moistened to ensure sprouting of rhizomes.
- Newly sprouted buds were selected and used as a source of explant for the culture.
- Sprouted buds excised from rhizomes have to be washed well with tap water to remove soil and other dust particles adhering to it, then treated with copper oxychloride and Tween 20 for 30 minutes and washed again.
- The external skin and remnant scale leaves were removed from the rhizomes with a knife.
- Sprouted buds along with attached portion of rhizome were cut, removed and treated with 0.1% Mercuric chloride (HgCl_2) for 3 minutes and washed with sterile distilled water 3-4 times.
- These explants were transferred to an aseptic environment in the laminar air flow chamber and treated with 0.1% HgCl_2 for 3 minutes and washed thoroughly with sterile distilled water to remove traces of HgCl_2 .
- These rhizome bits with viable buds were inoculated onto culture initiation medium (MS medium without growth regulators).

***In vitro* multiplication**

- After 30 days, established cultures were used for further multiplication.
- Cultures were inoculated onto multiplication media containing MS + BA (3 mg/L) + NAA (0.1 mg/L). Cultures were incubated at a temperature of 25°C and a photoperiod of 16 h light and 8 h darkness.
- After 30-40 days, these cultures were sub-cultured onto fresh media (MS + BA (3 mg/L) + NAA (0.1 mg/L).
- Further it was sub-cultured 3-4 times at an interval of 30-40 days.

Micro-rhizome induction

- Explants were taken from three-month-old

contamination free *in vitro* cultures.

- Roots as well as top part of the stem were trimmed off using sterile surgical blades and explants of about 2 cm were collected.
- These explants were inoculated in micro-rhizome induction medium containing MS with BA (3 mg/L) + NAA (1 mg/L) and 9% sucrose.
- A photoperiod of 16 h light and 8 h darkness was provided.
- Micro-rhizome development was noticed after 80-90 days of culture initiation and maturity was attained in 120 days.

Field transfer of micro-rhizomes through pro trays

- Matured micro-rhizomes were harvested.
- Roots and top portion of the shoots were trimmed off.
- The rhizomes were transferred to pro trays filled with potting mixture (coir pith + FYM + vermi compost @ 1:1:1 ratio).
- These were allowed to grow for 30-35 days under greenhouse conditions.
- Plantlets developed from micro-rhizomes in pro trays were transferred to polybags and maintained in green house for 40-50 days.
- The plantlets were then transferred to grow bags containing potting mixture (sand + soil + FYM at 1:1:1 ratio).
- Regular package of practices advocated by ICAR-IISR were adopted.

***Ex vitro* establishment of micro-rhizomes**

After six months, the plantlets of the ginger variety IISR Varada and turmeric variety Varna were taken out from the micro-rhizome induction media, cleaned, roots and shoots were trimmed off and observations were recorded. The mean number of micro-rhizomes produced in each bottle of ginger and turmeric was 8 and 10, respectively. The mean micro-rhizome weight of ginger and turmeric was 5.0 g and 3.40 g, respectively.

When the micro-rhizome derived plantlets of ginger variety IISR Varada was grown under poly house, the morphological and yield parameters were similar to that of the normal plants. It was found that when a micro-rhizome weighing 4 g was planted, it could yield about 500 g of fresh rhizome within 7-8 months after planting.

Normal rhizome vs Micro-rhizome

Micro-rhizomes resemble the normal rhizomes in all respect, except for their small size. The micro-rhizomes consist of 1 to 6 buds and 2 to 4 nodes. They have the aromatic flavour of ginger and resemble the normal rhizome in anatomical features with the presence of well-

developed oil cells, fibres, and starch grains. Generally, seed rhizome weight of micro rhizome was 4-8 g as against 20-30 g in case of conventionally propagated plants.

Table 1. Comparison of conventional field grown rhizome and *in vitro* produced micro-rhizomes

Character	Normal field grown rhizome	<i>In vitro</i> produced micro-rhizome
Weight of seed material	20-30 g	4-6 g
Shape	Cylindrical, elongated	Oval, round
Colour	Brown	Creamy yellow
Skin texture	Rough with scales	Smooth without scales
No. of nodes	6-10	2-4
No. of buds	1-2	1-6

Advantages of *in vitro* micro-rhizomes

- Micro-rhizomes can be produced throughout the year using *in vitro* methods.

- Micro-rhizomes have commercial potential for micro-propagation of ginger and turmeric.
- Micro-rhizome technique generates pathogen free seed rhizomes.
- Micro-rhizomes are easy to store and transport.
- Micro-rhizome technique can be employed for germplasm conservation.
- Micro-rhizome technique reduces quantity of seed materials required for field planting.

In vitro micro-rhizome technology is useful for scaling up the production of disease-free seed rhizomes in ginger and turmeric. High-tech intensive cultivation of micro-rhizomes is possible in poly house. It is concluded that the micro-rhizome technology can effectively contribute in disease free micro-rhizome production and helps enhance yield of ginger and turmeric.

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Post - harvest treatment machine for fruits and vegetables

Post-harvest treatments increase the shelf-life of the perishables. The machine can provide pre-cooling, washing, warm water treatment, anti-microbial treatment, anti-browning and pulsed light treatment to the freshly harvested fruits and vegetables. It also has an inspection conveyor to sort out the deformed and damaged products. This is an ergonomically designed single operator machine of size 4.4 × 1.0 × 1.6 m (length × width × height) and made of stainless (SS 304) steel. The capacity of the machine depends on the products being handled at a linear belt speed of 5 m/min. There is a provision to vary the operating speed of the machine which permits the required variations in the treatment time of commodity as per the established protocols. Water forms the medium of treatment and stored in a tank of 500 l capacity. Water jets operating at varying pressure wash the commodities. Treated and washed commodities travel on a roller conveyor where rotation/rolling and linear motion ensure adequate exposure (up to 3 s) to pulsed xenon light treatment.



Source: ICAR Annual Report 2022-23

Object-detection Model for Fruit Detection and Yield Estimation in Orchards

A study was carried out to develop an intelligent image processing methodology to count mandarin oranges on the tree and to estimate the yield. The focus was on detecting the harvest-ready and unripe fruits through Faster-RCNN and YOLOv4 object detection models, replicating human vision through convolutional neural networks. The data collection has been performed using unmanned aerial vehicle (UAV - DJI Phantom-4) from the mandarin orange orchards of Khamkheda village near Bhopal. The trees have been harvested manually, and the total yield per tree was measured to compare the performance of the developed system. The results indicated that the developed models work well in detecting both harvest-ready and unripe mandarin oranges. The mean average precision metric in detecting the mandarin oranges per tree by YOLOv4 and Faster RCNN is 80 and 76%, respectively. The manually counted and the YOLOv4 based detection resulted in a standard error (SE) of 12%.



Source: ICAR Annual Report 2022-23