

# Agrotechnology of Monk Fruit (*Siraitia grosvenorii*): A Natural Zero-Calorie Sweetener



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Monk fruit (*Siraitia grosvenorii*) is a unique herbaceous perennial plant belongs to the Cucurbitaceae family. It is native to the southern parts of China, prevalent in the mountainous areas of Yongfu, Longsheng and Lingui Counties in northern Guangxi province. In China, monk fruit is commonly known as *Luo Han Guo*, *Arhat fruit* and *Buddha fruit*. Monk fruit is known throughout the world for its intense sweet taste. The sweet taste of monk fruit results primarily from the content of a group of cucurbitane-type triterpene glycosides known as mogrosides. The extracted mixture of mogrosides is about 300 times sweeter than sucrose or cane sugar. Among them, mogroside-V is extremely sweet.



The global market for monk fruit is estimated to generate US\$ 379.4 million revenue by the end of 2026. In spite of high demand for non-caloric sweeteners from natural sources, monk fruit accounts for a small share of the alternative sweetener market, remaining at about 2.2%. The market share of monk fruit is small because of the limited supply. This plant is not commercially cultivated in large scale even in China due to lack of proper agrotechnology, suitable cultivar and scientific knowledge.

## **Botanical Description**

Family : Cucurbitaceae  
Botanical Name : *Siraitia grosvenorii* (Swingle) C.Jeffrey ex A.M.Lu & Zhi Y.Zhang  
Synonym : *Momordica grosvenorii* (Swingle); *Thladiantha grosvenorii* (Swingle) C.Jeffrey

Monk fruit is an herbaceous perennial vine having tendrils for climbing. The vine attains up to a length of 15 meters. Stem is weak, angular, and green in color. Leaves are heart-shaped, and up to a 32 cm long and 25 cm wide. Phyllotaxy is alternate. Root is branched-tap root. Fruit is pepo type with 5- 7 cm in diameter.

## Uses of Monk Fruit

Monk fruit has been used for centuries in Traditional Chinese Medicines for the treatment of cough, sore throat, and minor stomach and intestinal troubles. The extracts of monk fruit also have specific biological properties, including anti-tumor, antidiabetic, anti-inflammatory and anti-oxidative. Now, monk fruit is known throughout the world for its intense sweet taste, and it has been widely used as a non-caloric natural sweetener in some countries. Its use in industrial food and beverage has gradually increased.

## Introduction in India

Keeping in mind importance and essentiality of non-nutritive natural sweetener, and diverse agro-climatic conditions in India, CSIR-Institute of Himalayan Bioresource Technology, Palampur has introduced seed of monk fruit from China through ICAR- National Bureau of Plant Genetic Resources, New Delhi on March 2018 with bearing import permit No. 168/2017. This plant has been introduced probably first time in India by CSIR-IHBT.

## Major Challenges

To date, there is no evidence of the species being domesticated and cultivated in other countries than China. The main reasons for its failure are inherent heterozygosity among the seed-raised plants, dioecious nature, natural pollination is difficult due to the specific male and female flower structure, sticky pollen grains, short flowering time and pollen viability is affected over time.

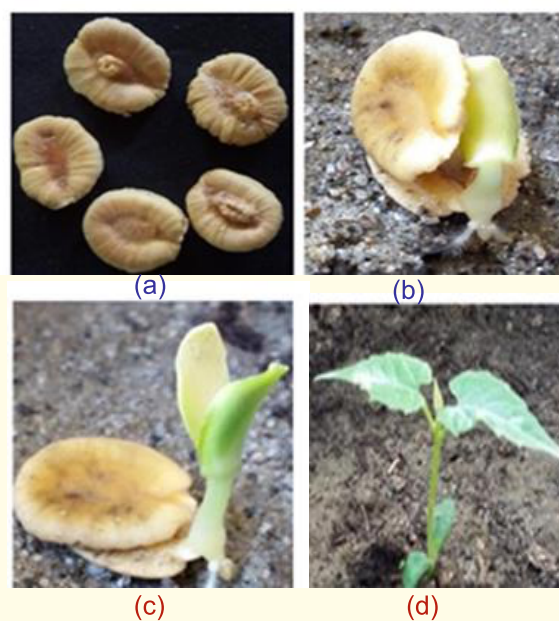
## Propagation

For its commercial cultivation, both seeds and asexual reproduction such as stem cuttings can be used. However, stem cuttings method is very slow and time-consuming, and usually associated with various problems, such as limitation of stock plant, sensitive to disease infections and prolonged nursery stage. On the other hand, since the seed coat of monk fruit is very hard and tough, germination of seeds is slow and may take several months. Nevertheless, CSIR-IHBT has developed unique technique to increase the germination rate as well as to reduce the time. The ideal conditions for germination are 25-30 °C and more than 75% relative humidity. Germination of seeds takes place in 14-21 days. Light irrigation should be provided regularly. For raising the planting material through stem cuttings, a separate mother nursery should be maintained.

Direct seeds sowing practice is not recommended due to poor germination rate. Thus, seeds are sown in raised nursery beds having a good mixture of sand, soil and organic manure. The seeds are sown at 3-4 cm deep in the soil. Under controlled conditions, seeds can be sown throughout the year. For the first 15 days after sowing, light irrigation should be provided regularly to maintain the ideal moisture level. Direct seed-sowing in polythene sleeve or nursery bag is the best method.

## Soil and Environment

The planting areas of monk fruit are generally distributed at an altitude of 200- 800 amsl with a slopes gradient greater than 15°. Monk fruit grows well in area having annual average temperature about 16 - 20 °C and annual average precipitation 1500- 2002 mm. However, this plant can survive with a



Different germination stages from seed



Raising of nursery in polythene sleeve under controlled conditions



temperature range of -5 to 40 °C. For proper fruiting the annual average sunshine time requirement is about 1237- 1626 hours. The difference between day and night temperature is also important for flowering. Monk fruit grows well in the red, black and brown limestone soil developing from the carbonate rocks with rich in humus and pH range of 4.5- 6.7.

### Land Preparation and Transplanting

For getting the good yield, the well-drained fields or sloppy land should be selected for its cultivation. 2-3 rounds of ploughing are required to get a good tilth. Deep-rooted weeds should be uprooted thoroughly. During the land preparation, farmyard manure @ 15 t/ha should be mixed with the soil. About two-month-old seedlings at 5-7 leaves stage are suitable for transplanting in the main field. Seedlings are transplanted during the month of April- May. However, the date of transplanting should be adjusted as per the local weather conditions.



Nursery plant under controlled conditions



Field view of monk fruit plantation at active growth stage

Transplanting during extreme temperature should be avoided. Since this plant can not tolerate water logging, transplanting is done in ridge at a row to row spacing of 1.5 m and plant to plant within row 1 m. Approximately, 6500 seedlings are required for plantation of 1ha land under sole cropping system. Monk fruit is dioecious in nature and male and female flowers are appeared in separate plants. Thus, the ratio of male and female plan should be 1:5 in the field.



Female plant at flowering stage



Male plant at flowering stage

### Irrigation and Drainage

Moderate amount of water is required for its growth. Depending upon the slope and water holding capacity of the soil, irrigation interval may vary. During plantation to establishment stage frequent irrigation is required. However, no irrigation is required during the monsoons. Water logging conditions should be avoided for the better growth and to avoid from fungal diseases.

### Pollination and Fruiting Technique

Due to dioecious nature of plant, specific male and female flower structures, sticky nature of pollen grains and lack of natural pollinators, natural pollination is difficult in monk fruit. Moreover, flowering time is short and intense, and pollen viability is affected over time. Thus, manual pollination is essential by means of hand pollination (mechanical pollination) for successful fruiting.

### Harvesting and Yield

Monk fruit is harvested in the form of a green fruit, which becomes brown after drying. The major compound of monk fruit is mogroside-V, which accumulates after certain time. Generally, 80 days from date of pollination is required for accumulation of mogroside-V in fruits. Thus, the quality of fruits is largely dependent on age of the fruits. So that, fruits should be harvested after 80 days for maintaining the quality of fruits. On an average fresh fruit yield of monk fruit ranges from 2.25- 2.50 tonnes/ha/year.



Plant at early fruiting stage



Plant at fruit harvesting stage

### Post-harvest Practices

Generally, monk fruit is not used in its fresh form, as it is difficult to store. Thus, the fruits are slowly dried in hot-air over at particular temperature before further use and for storage. During drying process, the undesired flavours are removed from the fresh fruit, which are associated with volatile components.



Harvested fresh fruits at CSIR-IHBT, Palampur



After post-harvest management

### Economics of Cultivation

The estimated input cost is about Rs. 1.50 lakh/ha/ year. The expected market value of fresh fruits ranges from Rs. 200- 225 per kg. The net profit from the cultivation of monk fruit is about 3.00- 3.50 lakh/ha/year. The average net income from monk fruit cultivation has been observed to be 2- 3 times higher than traditional crops.

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