

and lesser yam and *Azospirillum* @ 3 kg ha<sup>-1</sup> and mycorrhiza @ 5 kg ha<sup>-1</sup> for dwarf white yam at the time of planting

- Inter-sow green manure cowpea (seed rate @ 20 kg ha<sup>-1</sup>) between yam mounds and incorporate green matter at 45-60 days. The green matter addition from the green manure will be @ 15-20 t ha<sup>-1</sup>
- Apply ash @ 1.5 t ha<sup>-1</sup> (120 g per plant) at the time of incorporation of green manure
- It is advisable to plant greater yam anthracnose disease resistant varieties like Sree Keerthi, Sree Swathy or tolerant varieties like Sree Nidhi and Sree Karthika



#### Taro

- Use organically produced planting material
- Treat cormels of 20-25 g with slurry containing cowdung, neem cake and *Pseudomonas fluorescens* (5 g per kg seed) and dry under shade before planting
- Apply FYM @ 15 t ha<sup>-1</sup> (400 g per pit) in pits at the time of planting
- Apply neem cake @ 1 t ha<sup>-1</sup> (25-30 g per pit) in pits at the time of planting
- Apply biofertilizers, *Azospirillum* @ 3 kg ha<sup>-1</sup>, mycorrhiza @ 5 kg ha<sup>-1</sup> and phosphobacteria @ 3 kg ha<sup>-1</sup> at the time of planting
- Inter-sow green manure cowpea (seed rate @ 20 kg ha<sup>-1</sup>) between pits and incorporate green matter at 45-60 days. The green matter addition from the green manure will be @ 15-20 t ha<sup>-1</sup>
- Apply ash @ 2 t ha<sup>-1</sup> (60 g per plant) at the time of incorporation of green manure cowpea
- To manage taro leaf blight (TLB), plant TLB resistant variety Muktakeshi, treat the cormels in cowdung slurry enriched with *Trichoderma asperellum* (5 g per kg of seed) and apply vermi compost @ 100 g per plant
- As a prophylactic measure against TLB, spray vermi wash @ 100 ml per litre of water and repeat at fortnightly intervals, especially during rainy season (or) Akomin @ 3 ml per litre from one month after planting at fortnightly intervals up to 4 months



#### Tannia

- Plant organically produced whole cormels of size 50-80 g or mother corm pieces of 150-200 g
- Apply FYM @ 20 t ha<sup>-1</sup> (1.6 kg per pit) in pits at the time of planting
- Apply neem cake @ 1 t ha<sup>-1</sup> (80-85 g per pit) in pits at the time of planting
- Inter-sow green manure cowpea (seed rate @ 20 kg t ha<sup>-1</sup>) between pits and incorporate green matter at 45-60 days. The green matter addition from the green manure will be @ 15-20 t ha<sup>-1</sup>
- Apply ash @ 2 t ha<sup>-1</sup> (160-165 g per plant) at the time of incorporation of green manure cowpea



#### Chinese potato

- Raise green manure cowpea (seed rate @ 20 kg ha<sup>-1</sup>) prior to Chinese potato and incorporate green matter at 45-60 days (green matter @ 10-15 t ha<sup>-1</sup>)
- Plant organically produced vines of 10-15 cm
- Apply FYM @ 10 t ha<sup>-1</sup> at the time of planting
- Apply neem cake @ 1 t ha<sup>-1</sup> in the ridges at the time of planting
- Apply biofertilizers (*Azospirillum*, P solubilizer and K solubilizer @ 3 kg ha<sup>-1</sup> each) at the time of planting



#### Arrowroot

- Raise green manure cowpea (seed rate @ 20 kg ha<sup>-1</sup>) prior to arrowroot and incorporate green matter at 45-60 days (green matter @ 10-15 t ha<sup>-1</sup>)
- Plant organically produced rhizome pieces of 20-25 g
- Apply FYM @ 10 t ha<sup>-1</sup> at the time of planting
- Apply biofertilizers (*Azospirillum*, P solubilizer and K solubilizer @ 3 kg ha<sup>-1</sup> each) at the time of planting



#### References

- FiBL and IFOAM. 2021. *The World of Organic Agriculture: Statistics and Emerging Trends 2021*. Research Institute of Organic Agriculture, Frick, Switzerland, International Federation of Organic Agriculture Movements, Bonn, Germany. 336 p.
- APEDA, 2020. Agricultural & Processed Food Products Export Development Authority, Ministry of Commerce and Industry, Government of India (<https://apeda.gov.in>)

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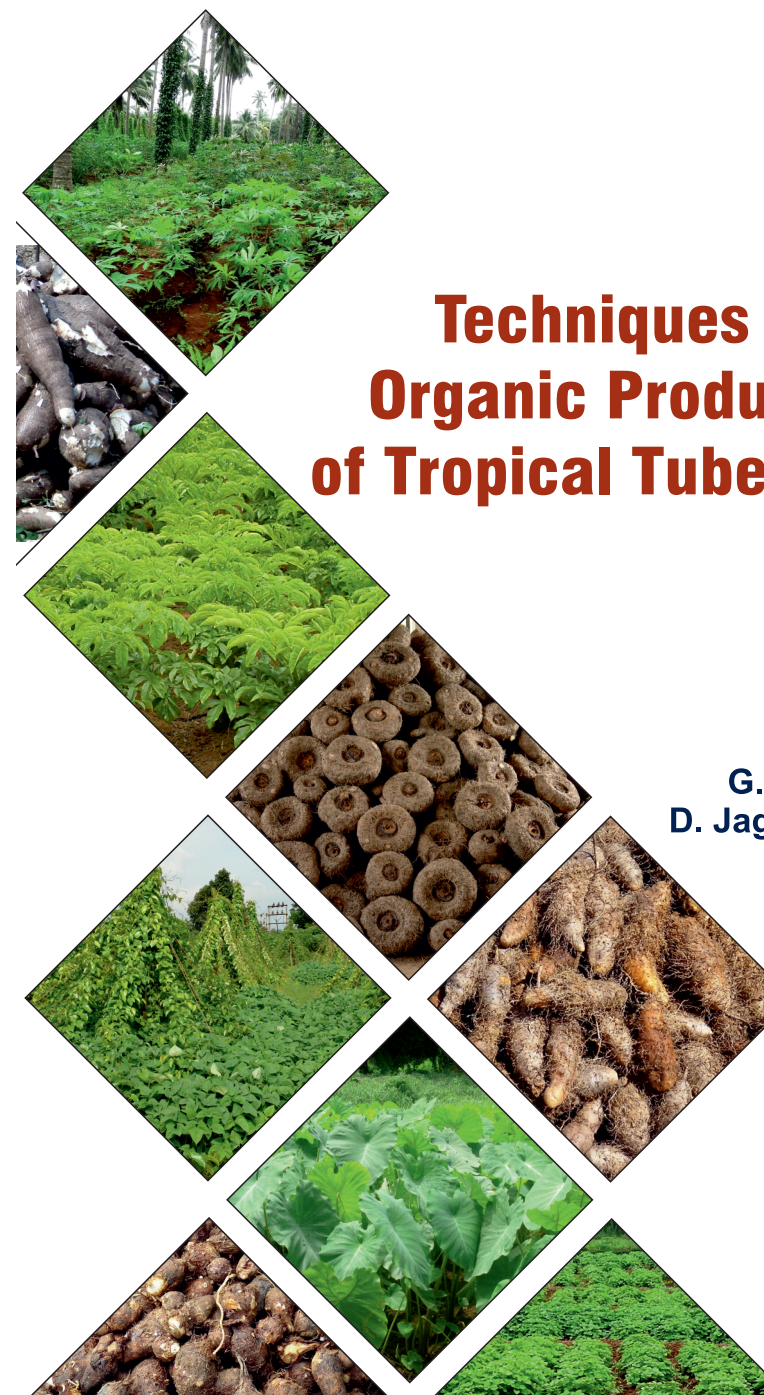
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## Techniques for Organic Production of Tropical Tuber Crops

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Growing awareness about environmental preservation, resource conservation, safe and healthy food has triggered the growth of alternative sustainable agriculture systems like organic farming. Organic agriculture is an alternative strategy that aims at sustainable and safe food production, while at the same time maintaining soil health and environmental protection by avoiding the use of synthetic chemicals, reduced use of purchased inputs and with maximum use of on-farm resources. Production of safe-to-eat, high quality and nutritious food, improved soil health, reduced energy use and CO<sub>2</sub> emission, employment generation, waste recycling and export promotion are the merits of organic farming.

### Key data on organic agriculture

#### World scenario

Organic agriculture is developing rapidly and statistical information is now available from 187 countries. As per the estimates in the year 2019, total area under organic farming was 72.3 m ha globally, including conversion areas, managed by more than 3.1 million producers, including small holders. The global sales of organic food and drink reached almost 106.4 billion euros in 2019. A growth rate of more than 10% was recorded in the most advanced markets for organic products (FiBL and IFOAM, 2021).

The regions with the largest areas of organic agricultural land are Oceania (35.9 m ha, 50% of the world's organic agricultural land) and Europe (16.5 m ha, 23%). Latin America has 8.3 m ha (11%), followed by Asia (5.9 m ha, 8%), North America (3.6 m ha, 5%) and Africa (2 m ha, 3%). The countries with the most organic agricultural land are Australia (35.7 m ha), Argentina (3.7 m ha) and Spain (2.4 m ha).

#### Indian scenario

In India, systematic and institutional framework started in May 2000 with the launch of the National Programme for Organic Production (NPOP) with the objective of promoting organic farming. Since then, Indian agriculture is showing rapid progress in organic sector. National Steering Committee comprising of Ministry of Commerce, Ministry of Agriculture and Farmers Welfare, Agricultural and Processed Food Products Export Development Authority (APEDA), commodity boards, ICAR Institutes and various other government and private organizations associated with the organic movement are monitoring the overall organic activities in the country. APEDA is the coordinating agency for organic production and export under the brand name "India Organic".

India ranks 5<sup>th</sup> in terms of World's Organic Agricultural land and 1<sup>st</sup> in terms of total number of producers as per 2019 data (Source: FiBL & IFOAM Year Book, 2021). According to APEDA (2020), the total area under organic certification in India is 3.67 million ha (13.66 lakh certified organic producers) during 2019-20, which includes 2.30 million ha under cultivable area and 1.37 million ha under wild harvest collection area. India produced around 2.75 m t of certified organic products including all varieties of food products. The major organic products which are produced in India are oilseeds followed by sugar crops, cereals & millets, tea & coffee, fiber crops, fodder, pulses, medicinal/herbal & aromatic plants and spices & condiments. Among all the states, Madhya Pradesh has the largest area under organic certification, followed by Rajasthan, Maharashtra and Uttar Pradesh. The total volume of export of organic products during 2019-20 was 6.389 lakh MT with export realization of ₹ 4,686 crores (689 million USD). Organic products are exported to USA, European Union, Canada, Switzerland, Australia, Japan, Israel, UAE, New Zealand, Vietnam etc.

### Status of research on organic farming of tropical tuber crops at ICAR-CTCRI

Tuber crops in general and aroids in particular, like elephant foot yam do respond well to organic manures and there is considerable scope for organic production in these crops. Further the tropical tuber crops are well adapted to low input

agriculture. They are less prone to pest and disease infestations. Moreover presently there is a great demand for organically produced ethnic vegetables, particularly aroids and yams, among affluent Asians and Africans living in developed nations (Europe, United States of America and Middle East).

Organic farming experiments were conducted at ICAR-CTCRI, Thiruvananthapuram, for more than one and a half decade (2004-2020) to compare organic vs conventional farming in cassava, elephant foot yam, taro, yams, Chinese potato and arrowroot in an acid Ultisol (pH: 4.3-5.0) through institute activity and five external funded projects. The on-station developed organic farming technologies for cassava, elephant foot yam, yams and taro were on-farm validated. Varietal response, tuber yield, economics, tuber quality, soil physico-chemical and biological properties were evaluated.

### Techniques for organic production of tropical tuber crops

#### The general package

Use of organically produced planting material, seed treatment in cowdung, neem cake, bio-inoculant slurry, farmyard manure incubated with bio-inoculants, green manuring, use of neem cake, bio-fertilizers and ash form the strategies for organic production (Fig. 1). The organic farming package for elephant foot yam is included in the Package of Practices (PoP) Recommendations for crops by Kerala Agricultural University (KAU, 2011) and for yams and taro included in PoP Crops (2016) of KAU. The package of practices for organic production of tuber crops developed based on 14 on-station experiments and 54 on-farm validation trials are briefed below crop wise:

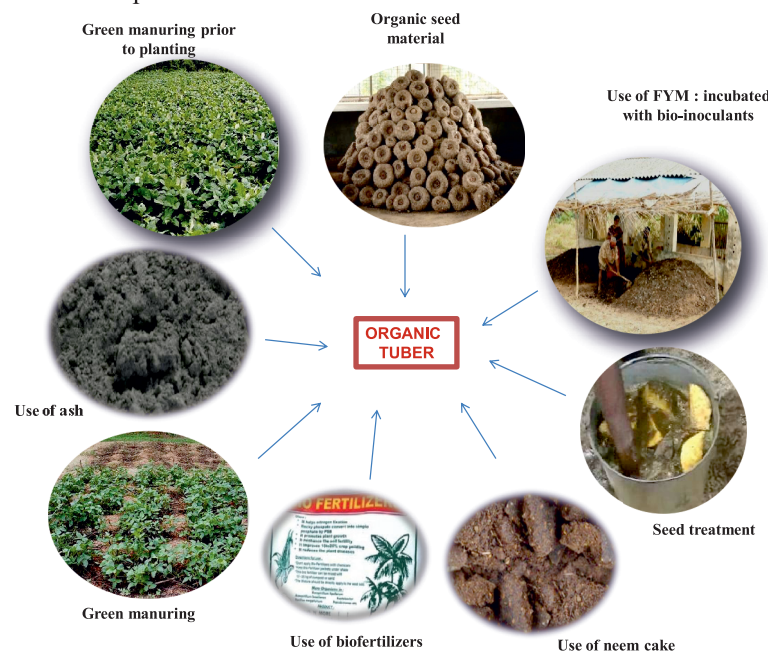


Fig. 1. Essential components of organic tuber production

#### Cassava

- Incorporate crop residue of the previous season crop (generates dry biomass @ 3 t ha<sup>-1</sup>)
- Plant setts of 15-20 cm from organically produced stems of cassava
- Apply farmyard manure (FYM) @ 12.5 t ha<sup>-1</sup> (1 kg per plant) at the time of planting
- Apply *Azospirillum* @ 3 kg ha<sup>-1</sup>, phosphobacteria @ 3 kg ha<sup>-1</sup> and K solubilizer @ 3 kg ha<sup>-1</sup> at the time of planting
- Inter-sow green manure cowpea (seed rate @ 20 kg ha<sup>-1</sup>) between mounds and incorporate green matter at 45-60 days. The green matter addition from the green manure will be @ 10-15 t ha<sup>-1</sup>

- Use of pest and disease free healthy planting materials, use of CMD resistant varieties viz., Sree Reksha, Sree Sakthi and Sree Suvarna
- A few best cropping systems involving cassava are: Intercropping of cassava with perennials viz., coconut + cassava; arecanut + cassava; rubber + cassava and mango + cassava in major cassava growing areas of Kerala, Tamil Nadu, Andhra Pradesh and north eastern states
- Sequential cropping with rice-pulse (black gram/green gram)-short duration cassava (var. Sree Vijaya, Vellayani Hraswa); rice-short-duration cassava+pulse (black gram)



#### Elephant foot yam

- Raise green manure cowpea (seed rate @ 20 kg ha<sup>-1</sup>) prior to elephant foot yam and incorporate green matter at 45-60 days
- Use organically produced planting material
- Treat corm pieces of 500-750 g with slurry containing cowdung, neem cake and *Trichoderma harzianum* (5 g per kg seed) and dry under shade before planting
- Apply *Trichoderma harzianum* enriched FYM @ 36 t ha<sup>-1</sup> (3 kg per pit) in pits at the time of planting (FYM: neem cake mixture (10:1) inoculated with *Trichoderma harzianum* @ 2.5 kg per tonne of FYM neem cake mixture. *Trichoderma* can be multiplied in FYM alone but it will take 15 days to form sufficient inoculum as against 7-8 days if neem cake is also used along with FYM). This is effective against collar rot caused by *Sclerotium rolfsii*
- Apply neem cake @ 1 t ha<sup>-1</sup> (80-85 g per pit) in pits at the time of planting
- Inter-sow green manure cowpea (seed rate @ 20 kg ha<sup>-1</sup>) between elephant foot yam pits and incorporate green matter in pits at 45-60 days. The green matter addition from the two green manure crops should be 20-25 t ha<sup>-1</sup>
- Apply ash @ 3 t ha<sup>-1</sup> (250 g per pit) at the time of incorporation of green manure in pits
- Apply *Trichoderma* enriched vermicompost @ 150 g per plant twice after weeding and interculturing as a precaution to avoid collar rot infection
- Remove the collar rot infected plants and apply *Trichoderma* enriched vermicompost @ 150 g per plant in the collar region of the adjoining healthy plants



#### Yams

- Plant organically produced tuber pieces of 250-300 g for white yam and greater yam and medium sized tuber of 100-150 g for lesser yam
- Apply FYM @ 15 t ha<sup>-1</sup> (1.2 kg per plant) in pits at the time of planting
- Apply neem cake @ 1 t ha<sup>-1</sup> (80-85 g per pit) in pits at the time of planting
- Apply biofertilizers, *Azospirillum* @ 3 kg ha<sup>-1</sup>, mycorrhiza @ 5 kg ha<sup>-1</sup> and phosphobacteria @ 3 kg ha<sup>-1</sup> for trailing genotypes of white yam, greater yam