

Innovative approaches for quality planting material production in tropical tuber crops

Tropical tuber crops such as cassava, sweet potato, yams, taro, and elephant foot yam are vital food security crops, especially in marginal and adverse environments. However, their vegetative mode of propagation and low multiplication rates hinder the rapid dissemination of improved varieties. This paper highlights innovative approaches for quality planting material production to overcome these challenges. Techniques such as the minisett method and tissue culture-based meristem propagation have significantly enhanced multiplication ratios and ensured disease-free planting material. Decentralized models like Seed Villages and Decentralized Seed Multipliers (DSM) have empowered farmers with access to timely, high-quality seed. Additional innovations such as poly tunnel nurseries, vertical farming, and contract farming are also being integrated to scale up production and expand cultivation to non-traditional areas. These farmer-centric strategies have shown promising results in improving productivity, profitability, and self-reliance, contributing to the larger vision of ensuring food and nutritional security under the 'Viksit Bharat' initiative.

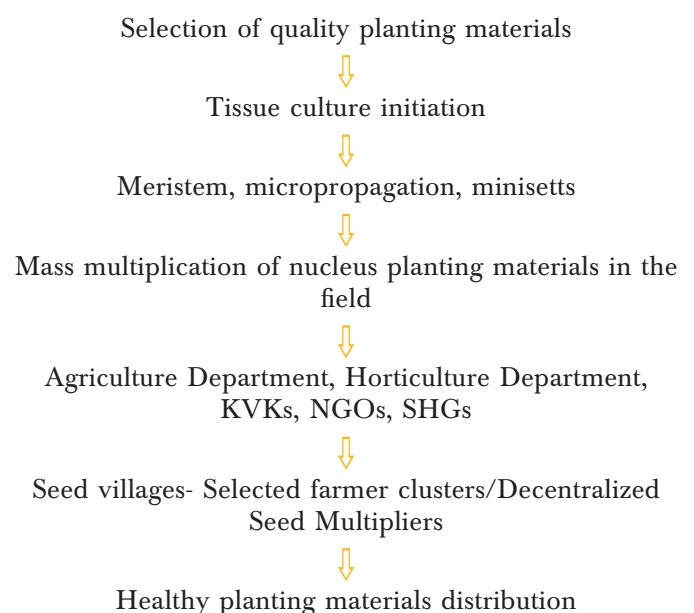
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TUBER crops are often referred to as 'crops for adversity' because of their vital role in sustaining life during natural disasters and famines. They can be cultivated even on marginal lands, without the need for prime farmland. These crops can be grown on marginal farms. They have resilience to adverse climatic conditions and never let down the farmers, as they provide them with a reasonable harvest even when other crops fail. Tropical tuber crops include cassava, sweet potato, elephant foot yam, taro, tannia, yams, yam bean, arrowroot, etc. This group consists of plants that develop modified roots or stems functioning as starchy storage organs, which are harvested from the soil. Following cereals and grain legumes, they occupy the third position among major food crops, valued for their substantial dry matter production and adaptability under changing climates. These crops can be grown under the warm, humid conditions of tropical as well as sub-tropical agro-ecosystems. They played a key role in the human diet before the evolution of settled agriculture. By acting as staple or secondary food sources, these crops contribute to the food security of millions across tropical and subtropical regions, feeding roughly one-fifth of humanity. These crops are vegetatively propagated with a low multiplication ratio. In tropical tuber crops, the seed requirements are mainly met through traditional seed systems, where farmers keep a portion of their produce as seed for the next season. As a result of the continuous use of the same planting

material year after year, the quality of seed/planting materials deteriorates due to degeneration and a lack of proper knowledge among farmers about seed production and storage techniques.

Seed production system in tropical tuber crops

The ideal seed production system followed in tropical tuber crops for large scale adoption of varieties by the farmers and other stakeholders is given below.



QUALITY PLANTING MATERIAL PRODUCTION

Minisett technique

The lack of quality planting material during the planting season is a major hindrance in the cultivation of cassava. High yielding varieties released by research institutes take several years to reach the end users because of the extremely low multiplication rate. It is imperative to explore the possibilities to step up the multiplication ratio of these crops by adopting novel techniques. ICAR-CTCRI has developed a novel minisett technique for quality planting materials production. Minisett technique developed at the institute has the potential to enhance the multiplication ratio in cassava from 1:10 to 1:60, elephant foot yam from 1:4 to 1:15, yams from 1:6 to 1:24, and taro from 1:20 to 1:120. Clean and disease free planting materials could be generated by this technique and farmers can adopt this technique easily.



Cutting of minisett



Minisett



Nursery bed



Planting of minisetts



Minisett nursery



Minisett for transplanting



Transplanting in main field



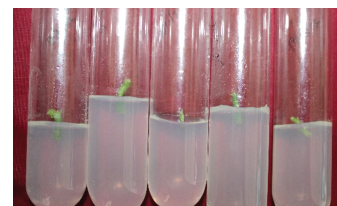
Main field

Steps in minisett technique in cassava

Tissue culture

Meristem culture

ICAR-CTCRI has developed diagnostic techniques for elimination of virus through different techniques like TAS-ELISA, TBIA and PCR. Through these techniques, virus-free mericlones of all major cassava varieties have been successfully developed. These healthy mericlones are further multiplied in the field to produce large quantities of planting material. Meristem culture has proven to be an effective approach for eliminating systemic infections such as viruses from vegetatively propagated crops. The method involves micro-dissection of the meristem from shoot buds, followed by culturing on media supplemented with specific concentrations of growth regulators. Typically, the medium used for meristem culture contains 0.1 μM NAA and 0.1 μM GA, along with organic and inorganic salts, vitamins, and sucrose dissolved in distilled water. Hardened plants could be micropropagated. On establishment of roots and shoot, the plantlets are carefully removed from the culture medium, washed, and transferred into plastic cups (8 cm diameter) containing a medium such as vermiculite to maintain a high-humidity environment. These cups are then placed on trays filled with moist soil and covered with a bell jar to ensure adequate humidity for acclimatization. After 2–3 weeks, when the plantlets attain a height of about 10–15 cm, they can be transplanted to the field for establishment.



Inoculation of meristematic bud



In vitro hardening



Hardening in net house



Sub cultured plantlet



Main field



Planting in net house

Steps for quality planting material production by tissue culture techniques

Decentralized innovative approaches

Quality planting material production of tuber crops is being carried out through establishment of seed villages and Decentralised Seed Multiplier (DSM).

Establishment of seed villages

The timely availability of quality planting material (seed) plays a decisive role in crop growth and contributes to enhanced productivity. Replacement of the local varieties with the good quality planting materials of recently released improved varieties is one of the important mandates of the Institute to increase the yield by 15-20%. Small and marginal farmers are often at disadvantageous position in adopting the improved varieties. Though the organized sectors are producing enough quantity of planting materials, the supply chain is unable to meet the huge demand for planting materials across the country.

Seed village is a village which consists of trained group of farmers who are involved in planting materials production of tuber crops and meet the needs of their households, fellow farmers in the village, as well as those in neighbouring villages, at the right time and at an affordable cost. Seed village programme provides an alternative to this problem and helps farmers to become self-reliant and meet timely supply of planting materials among the villagers. The productivity of tuber crops can further be enhanced by the adoption of high yielding varieties through the supply of good quality planting

materials. In this regard, seed village programme is one of the flagship programmes of the Institute to meet the demand of planting materials. ICAR-CTCRI has been successfully implementing seed village programme for the high yielding varieties of cassava, sweet potato, Chinese potato and elephant foot yam in major growing states since 2014 in Tamil Nadu, Kerala, Andhra Pradesh, Manipur, Arunachal Pradesh and Meghalaya. During the crop season from 2014-2015 to 2024-2025, a total of 164 seed villages were established in the states of Kerala, Tamil Nadu and Odisha covering an area of 704 acre for planting material production of tuber crops, cassava, sweet potato, greater yam, Chinese potato and elephant foot yam.

Decentralised Seed Multiplier

The objective is to establish the tuber crop farmers' network for production of quality planting materials of tuber crops under the guidance of ICAR-CTCRI. The beneficiary farmers of the various schemes of ICAR-CTCRI who cultivate tuber crop varieties in less than 1 ha area are approved as Decentralised Seed Multipliers. A team of scientists monitor the planting material production on regular basis and provide agro-advisories as per the standard seed guidelines and ensure the quality of the planting material. During the crop season from 2021-2022 to 2024-25, a total of 256 farmers were registered as Decentralized Seed Multipliers (DSM) from the states of Kerala, Tamil Nadu and Odisha covering an area of 146 acre for planting material production of tuber crops viz.,



Seed village programme in cassava

cassava, sweet potato, greater yam, elephant foot yam, Chinese potato and yam bean.

Promotion of tuber crops in non traditional areas

Under this, the Institute initiated programmes with an objective to promote and popularize tropical tuber crops in non traditional areas. Quality planting materials of improved variety of cassava Sree Reksha were distributed to non traditional areas Viz., Jodhpur, Rajasthan; Kutch, Gujarat and Lakshadweep Islands.

Contract farming

Contract farming involves planting material production of tuber crops being carried out on the basis of an agreement between the buyer and producers. In some cases the buyer specify the quantity required and the price, with the farmer and the farmers agree to meet his requirement at a future date.

Poly tunnel nursery

The adoption of poly tunnel technology facilitates year-round production of vegetable nurseries for supply to farmers. Seedlings raised under poly tunnels exhibit ideal vegetative growth, reduced incidence of pests and diseases, and improved field germination. Unlike in open-field conditions, nurseries can be successfully established in any season, even under adverse climatic situations, without major difficulties. Establishment of poly tunnel technology aims to raise planting material of tuber crops through minisetts nursery establishment across all seasons with distribution support from various development departments.

Vertical farming

Vertical farming refers to the cultivation of crops

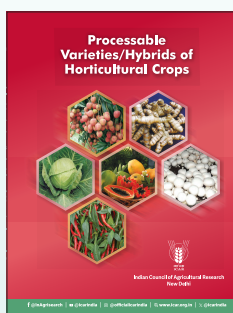
in vertically stacked layers, usually within a controlled environment that optimizes plant growth. It often relies on soilless systems such as hydroponics, aquaponics, or aeroponics. The key advantage of this approach is the ability to achieve higher crop yields while requiring significantly less land area.

CONCLUSION

Non-availability of quality planting material is the important constraint in production of tropical tuber crops. The demand can be met by adopting minisetts techniques, whereby the multiplication ratio could be enhanced compared to conventional system. The seed village programme and decentralized seed multiplier concepts are novel and a feasible practice that should be encouraged to support local production and timely supply of quality seeds of improved tuber crops, strengthening self-sufficiency at the village level. Results of these programmes have shown that productivity and profitability of tuber crops could be increased by technological interventions with active participation of farmers and other stakeholders. There is an urgent need to have concerted efforts by various research and developmental organizations for ensuring availability of sufficient quantities of quality planting materials as well as to ensure farm income to meet the target set by Government of India which includes the vision of 'Viksit Bharat'.

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TECHNICAL ASPECTS

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