The 3 A's of ICAR-CTCRI...
Achievements, Aspirations & Action Plan

Diamond Jubilee 60 Years ICAR-CTCRI

भाकृअनुप-केन्द्रीय कन्द फसल अनुसंधान संस्थान

(भारतीय कृषि अनुसंधान परिषद्)

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ICAR-Central Tuber Crops Research Institute

(Indian Council of Agricultural Research)

SREEKARIYAM, THIRUVANANTHAPURAM 695 017, KERALA, INDIA

भा कृअनु प ICAR

केकफअसं CTCRI

Diamond Jubilee of ICAR-CTCRI

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From the Director

Dr. G. BYJU
Director

Tropical tuber crops are the third most important food crops after cereals and pulses and are either a staple or secondary staple for one in every five of the world population. Cassava and sweet potato rank among the top 10 food crops produced in developing countries that contribute about 6% of the world's dietary calories, and are also important sources of animal feed and raw material for industrial products. Most of these crops are bestowed with resilience to climate change and have potential for better returns under adverse soil and weather conditions.

ICAR-CTCRI has made significant contributions during the last six decades of service to the nation which led to the development of 68 improved varieties, crop production practices including organic farming and good agricultural practices, protocols for quality planting material production, pest and disease management packages, value added food and industrial products and ICT tools including crop growth models and decision support systems.

Large scale demonstrations of newly released varieties, production technologies, SSNM, cropping system models, integrated pest and disease management strategies, post-harvest processing and value addition were undertaken across different states of India under the centrally sponsored and development schemes like NEH, TSP, RKVY and SCSP. The agribusiness incubator and techno-incubation centres at headquarters and regional station promote entrepreneurship among the stakeholders. The All India Coordinated Research Project on Tuber Crops (AICRP TC) with 21 centres across 18 states and one union territory cater to the needs of ecoregional testing of varieties and technologies.

I am happy to inform that ICAR-CTCRI has bagged the 14th position in the ranking among 93 ICAR Institutes during 2022 which was possible through the dedication and commitment of our staff members. This coffee table book covers significant achievements, aspirations and action plan of ICAR-CTCRI, which will be useful to all our stakeholders for strengthening tuber crops sector in the country.

27 March 2023
Sreekariyam

G. BYJU
Director

Prologue

The tropical tuber crops consist of cassava/tapioca, sweet potato, yams, elephant foot yam, taro, tannia and a few other minor tuber crops. Tropical tuber crops are the third most important food crops after cereals and pulses and are either a staple or secondary staple for one in every five of the world population. Cassava and sweet potato rank among the top 10 food crops produced in developing countries that contribute about 6% of the world's dietary calories, and are also an important source of animal feed and raw materials for food and other industrial products.

Tropical tuber crops are cultivated in an area of about 0.40 million ha with a total production of about 8.74 million tons contributing to 4.64% of the total vegetable production in India. Many of the poorest farmers and most undernourished households in India depend on these crops as a contributing, if not principal source of food and nutrition. Such farm households value these crops because they produce large quantities of dietary energy and have stable yields under conditions such as marginal soils and limited inputs where other crops may fail to perform. Most of the root and tuber crops are rich in minerals, vitamins, antioxidants, omega-3 fatty acid, dietary fibre and resistant starch and have many medicinal properties. They can play an important role in mitigating hidden hunger through diet diversification.

Our Goals and Intentions

ICAR-CTCRI,Thiruvananthapuram, Kerala, was established in July 1963 and its Regional Centre at Bhubaneswar, Odisha was established in September 1976. It also houses the headquarters of All India Coordinated Research Project on Tuber Crops (AICRP TC) functioning since April 1968 and Indian Society for Root Crops (ISRC) established in 1971, which publishes the Journal of Root Crops.

Vision

Root and tubers for ensuring better health, wealth generation and inclusive growth.

Mission

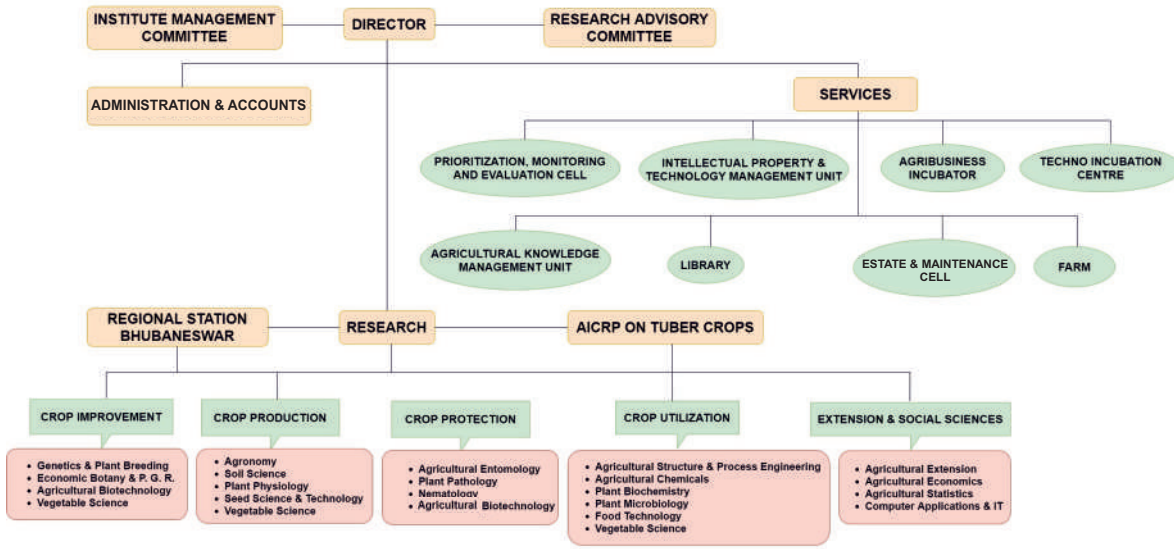
To integrate root and tuber crops as sustainable farming system components to ensure food and nutritional security of the nation and livelihood improvement of rural population.

Mandate

The Institute has a broad mandate of generating information on research of tropical tuber crops that will help to enhance productivity and improve the utilization potential.

- Basic, strategic and applied research on genetic resource management, crop improvement, sustainable production and utilization of tropical tuber crops.
- Coordinate research and validation of technologies through AICRP on Tuber Crops.

Organogram



Cadre Strength

Category	Sanctioned	In position	Vacant
Research Management Post	01	01	00
Scientific Staff	44	42	02
Technical Staff	47	31	16
Administrative Staff	30	22	08
Skilled Support Staff	38	19	19
Total	**160**	**115**	**45**

Mandate Crops (15)

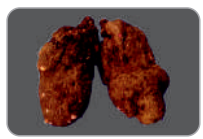

Cassava


Tannia

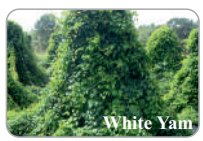

Sweet Potato


Giant taro


Greater Yam



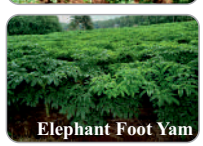

Swamp taro

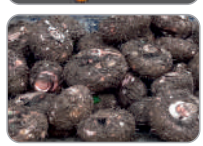

White Yam


Chinese Potato


Lesser Yam

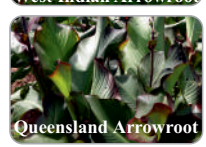

Yam bean

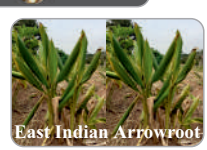

Elephant Foot Yam

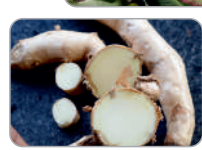



West Indian Arrowroot


Taro


Queensland Arrowroot


East Indian Arrowroot



SWOT

Strengths

- Food, nutritional and livelihood security crops.
- Cassava and yams are resilient to drought & high temperature.
- High production potential per unit area.
- Vegetative propagation enables maintenance of true-to-type genotypes, breeding populations and varieties.
- Adaptability to wide range of edapho-climatic conditions.
- High yielding varieties with nutritional quality and biotic & abiotic stress resistance /tolerance.
- Generate income and employment opportunities.
- Source of raw materials in sago/starch, biofuel, animal feed, textile and pharmaceutical industries.
- Strong research base with qualified human resource.
- Strong network and linkages with 21 centres of AICRP on Tuber Crops.

Weaknesses

- High volume and low value crops.
- Heterozygosity, sterility, asynchrony and poor seed set make breeding difficult.
- Low availability of genetic variation in elephant foot yam and other minor tuber crops.
- Post-harvest physiological deterioration in cassava and photosensitivity of sweet potato & Chinese potato.
- Low multiplication ratio of planting materials.
- Lack of Government policy for promotion of tuber crops.
- Lack of reliable database especially for yams, aroids and minor tuber crops.
- Declining area due to competition from other crops and changes in consumer preferences.
- Lack of value addition and product diversification in yams, aroids and minor tuber crops.

SWOT

Opportunities

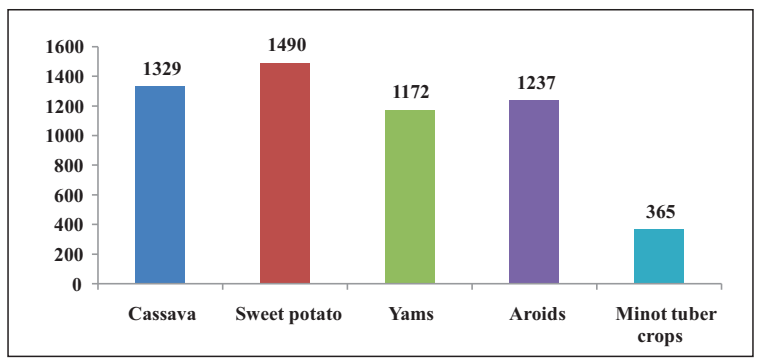
- Good scope for area expansion in non-traditional areas as high calorie, low fat foods.
- Suitability in agro-ecology based sustainable production intensification including cropping /farming systems, integrated farming systems and organic/natural farming.
- Scope for increased product diversification and value addition.
- Potential for developing environment friendly biodegradable plastics and allied materials like biofilms, packaging materials etc.
- Govt. of India has declared 'biofuel policy' by including cassava as one of the potential crops for industrial level biofuel production.
- Government schemes for promoting tuber crops in traditional and non-traditional areas.
- Extraction of anthocyanins from greater yam and sweet potato as natural colouring agent.
- Exploitation of medicinal properties of yams, aroids and minor tuber crops like arrowroot and Chinese potato.

Threats

- Spread of viral diseases in tuber crops due to vegetative propagation.
- Mechanical mixing during harvest may affect genetic purity.
- Rapid shrinkage of area due to competition from other crops.
- Declining trend in demand due to change in consumer preferences and diet.
- Competition from other starchy sources for food, feed and industrial applications.
- Increasing import of starch from other countries, where cost of production is cheaper.
- Increase in incidence of pests and diseases due to climate change and other factors of production.
- Bulky and perishable nature of the tubers limits the scope for export of raw materials.
- Wide price fluctuation may discourage farmers and other stakeholders for taking up tuber crops cultivation.

Genetic Wealth

- National Active Germplasm Site for Tropical Tuber Crops at ICAR-CTCRI conserves 5593 accessions comprising 50 species.
- Field gene bank includes landraces collected from different states of India and also exotic accessions from Africa, Latin America, Pacific Islands, etc.
- Pre-breeding lines (inbreds, interspecific backcross) of tuber crops are also conserved in the field gene bank. Wild species collected from forests are also conserved in net houses.



Conservation of germplasm in field gene bank at ICAR-CTCRI

Field gene bank of cassava

Field gene bank of white yam

Elite Varieties for Agri-Food Systems

Elite varieties of tropical tuber crops: 68

Cassava (19)	:	H-97, H-165, H-226, Sree Sahya, Sree Visakham, Sree Prakash, Sree Harsha, Sree Jaya, Sree Vijaya, Sree Rekha, Sree Prabha, Sree Padmanabha, Sree Athulya, Sree Apoorva, Sree Pavithra, Sree Swarna, Sree Reksha, Sree Sakthi, Sree Suvarna
Sweet Potato (21)	:	H-41, H-42, Varsha, Sree Nandini, Sree Vardhini, Sree Rethna, Sree Bhadra, Gouri, Sankar, Sree Arun, Sree Varun, Sree Kanaka, Kalinga, Goutam, Kishan, Sourin, Bhu Sona, Bhu Kanti, Bhu Krishna, Bhu Ja, Bhu Swami
Greater Yam (10)	:	Sree Keerthi, Sree Roopa, Sree Shilpa, Sree Karthika, Orissa Elite, Sree Neelima, Sree Swathy, Bhu Swar, Sree Nidhi, Sree Hima
White Yam (5)	:	Sree Subhra, Sree Priya, Sree Haritha, Sree Dhanya (dwarf), Sree Swetha (dwarf)
Lesser Yam (2)	:	Sree Latha, Sree Kala
Elephant Foot Yam (2)	:	Sree Padma, Sree Athira
Taro (8)	:	Sree Rashmi, Sree Pallavi, Muktakeshi, Sree Kiran, Pani Saru-1, Pani Saru-2, Bhu Kripa, Bhu Sree
Chinese Potato (1)	:	Sree Dhara

Cassava Mosaic Disease (CMD) resistant varieties of cassava

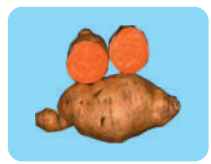
Sree Reksha

Sree Sakthi

Sree Suvarna

β-carotene rich varieties of sweet potato

Sree Kanaka
(β-carotene: 10 mg 100g^{-1})



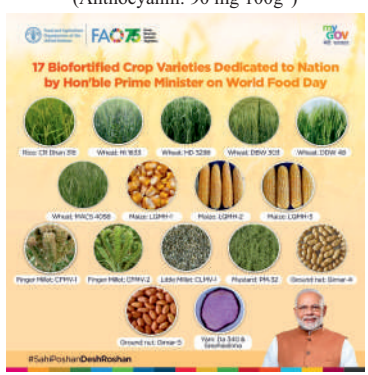
Bhu Sona
(β-carotene: 14.4 mg 100g^{-1})

Bhu Kanti
(β-carotene: 7.8 mg 100g^{-1})

Bhu Ja
(β-carotene: 6.4 mg 100g^{-1})

Anthocyanin rich variety of sweet potato

Bhu Krishna
(Anthocyanin: 90 mg 100g^{-1})



Biofortified greater yam varieties, Sree Neelima and Da-340, dedicated to Nation by Hon'ble Prime Minister of India on 16 October 2020

Improved varieties of greater yam

Sree Neelima
(Anthocyanin: 50 mg 100 g^{-1})

Da-340
(Anthocyanin:141.4 mg100 g^{-1})

Bhu Swar
(Yield: 20-25 t ha^{-1})

Sree Nidhi
(Yield: 35 t ha^{-1})

Improved varieties of white yam

Sree Haritha
(Yield: 46 t ha^{-1})

Sree Swetha
(Dwarf, Yield: 30 t ha^{-1})

Improved varieties of taro

Bhu Kripa
(Yield: 15-20 t ha^{-1})

Bhu Sree
(Yield: 15-20 t ha^{-1})

Production Technologies

- Ecoregional agrotechniques to reduce costs and maximize production.
- Protocols for the massive production and rapid multiplication of quality planting materials.
- Productive and profitable cropping systems and integrated farming system (IFS) models.
- Organic production packages for crops and cropping systems.
- Integrated nutrient management (INM) and low input technologies.
- Nutrient Use Efficient (NUE) genotypes of cassava.
- Sustainable soil fertility management for continuous cassava cultivation.
- Fertilizer best management practices (FBMP) by site specific nutrient management (SSNM), customized fertilizers and micronutrient formulations.
- Precision nutrient and water management and water saving techniques.

Seed production system in tuber crops

Selection of quality planting materials

↓

Tissue culture initiation

↓

Meristem, micropropagation, minisetts

↓

Mass multiplication of healthy planting materials in the field

↓

Agriculture & Horticulture departments, KVKs, NGOs, SHGs, FPCs

↓

Seed villages - Decentralized Seed Multipliers

↓

Healthy planting materials distribution

Quality planting material production in tuber crops

Minisett technique in cassava

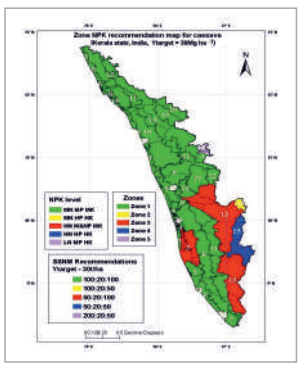
Minisett technique in elephant foot yam

Decentralized Seed Multipliers

Site Specific Nutrient Management

- FBMP for different agro-eco-zones using 4R nutrient stewardship.
- Tailor-made nutrient management for individual farms with customized plant nutrient and micronutrient formulations.
- Technology for preparation of customized plant nutrient formulations and micronutrient formulations.

Five crop specific micronutrient formulations commercialized



Zone wise NPK recommendations

SSNM in cassava

SSNM in elephant foot yam

Nutrient Use Efficient Genotypes: Released the first K efficient cassava variety, Sree Pavithra and identified two N use efficient genotypes (CR 43-8, W-19) and three NPK efficient genotypes (7 III E3-5, CI-905 and CI-906) in cassava.

Sree Pavithra

7III E3-5

CI - 905

CI - 906

Water and nutrient saving techniques: Drip fertigation schedules for cassava, elephant foot yam and taro were standardized and demonstrated in major tuber crops growing states of India.

Organic farming in tuber crops

Cropping system/Integrated farming system models

Coconut + Cassava

Coconut + Greater yam

Coconut + Lesser yam

Coconut + Elephant foot yam (EFY)

Coconut + Arrowroot

Banana + EFY

Mango + Cassava

Banana + Yam

Greengram + EFY

Maize + Greater yam

Sequential cropping system with rice

Rice followed by cassava

Integrated farming system model at ICAR-CTCRI

Plant Health Management

Pest Management

- Integrated pest management (IPM) for sweet potato weevil.
- IPM for mealybug, white fly, scale insects, mites, spiraling white fly and storage pests of tuber crops.
- Bioactive molecules from cassava crop residues.

Bioformulation extraction plant

Biofumigant plant

Bioactive molecules

Patent for extraction plant (Patent No. 368943)

Bioactive molecules viz., *Nanma, Menma* & *Shreya* are effective against pseudo-stem weevil in banana & sucking pests in vegetables, 5-20% yield increase was recorded.

Disease Management

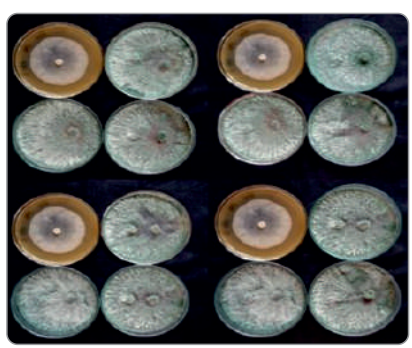
- Integrated disease management (IDM) for cassava tuber rot, elephant foot yam collar rot, elephant foot yam post harvest rot, taro leaf blight and greater yam anthracnose.
- Organic management of collar rot of elephant foot yam and leaf blight of taro.
- Diagnostic tools for 10 viruses: *Indian cassava mosaic virus, Sri Lankan cassava mosaic virus, sweet potato feathery mottle virus, sweet potato leaf curl virus, dasheen mosaic virus (Elephant foot yam & taro), taro bacilliform virus, yam mild mosaic virus, yam mosaic virus and yam chlorotic necrosis virus.*
- Production of planting material free of 4 viruses: *Cassava mosaic virus, sweet potato feathery mottle virus, dasheen mosaic virus and yam mild mosaic virus.*
- LAMP technique to diagnose 5 pathogens: *Dasheen mosaic virus, Sri Lankan cassava mosaic virus*, *Sclerotium rolfsii*, *Phytophthora colocasiae* and *Colletotrichum gloeosporioides.*

- Lateral flow technique to diagnose *Dasheen mosaic virus* and *Sweet potato leaf curl virus*.

Dipsticks for DsMV detection

Diagnostic kit (DsMV ELISA KIT) against *Dasheen mosaic virus*

- Biocontrol agents: Nitrogen fixing, Phosphorous and Potassium solubilizing bacteria; Two *Trichoderma asperellum* isolates viz., CTCRI-Tr9 and CTCRI-Tr15 for elephant foot yam and greater yam; Four *Trichoderma asperellum* isolates effective against all major fungal pathogens of tropical tuber crops viz., *Sclerotium rolfsii*, *Phytophthora colocasiae*, *Colletotrichum gloeosporioides* and *Fusarium* spp. were identified; Potential endophytes against taro leaf blight and greater yam anthracnose with growth promoting characters were identified.
- Cassava tuber based medium was standardized for the multiplication of *Trichoderma* isolates. The multiplication procedure ensures a population $>10^{20}$ cfu g^{-1} substrate with all isolates.



***Trichoderma asperellum* isolates**

Cassava tuber based medium

Mechanization

Cassava chipping machines

Hand operated
Output: 35-120 kg h^{-1} for chip thickness 2.3-6.9 mm

Pedal operated
Output: 80-750 kg h^{-1} for chip thickness 0.9 -6.9 mm

Motorized
Output: 300-1100 kg h^{-1} for chip thickness 2.5-10 mm

Mobile starch extraction unit

Output: 200 kg h^{-1}

Cassava raspers

Output: 350-1500 kg h^{-1}

Centrifugal granulator for cassava based feed

Output: 20 kg h^{-1}

Pilot plant for liquid adhesive from cassava starch

Output: 100 litres

Chinese potato grader

(Patent Application No. 202241043900)

Capacity: 1000 kg h^{-1}

Value Addition

Food Products

- Fried chips and snack foods from cassava and sweet potato; Functional foods enriched with fibre and protein viz., gluten free spaghetti, pasta and noodles from fortified sweet potato and cassava flour; Vacuum fried chips from biofortified sweet potato; Nutribars; Extruded products from cassava and sweet potato; Bakery products-Protein and fiber enriched cookies from biofortified sweet potato, sweet potato muffins & cakes and gluten free cookies from taro; Food mixes and nutrijelly from sweet potato; Ready to fry products-Papads, nutri-shreds and pop-ups; Rice analogues from cassava and sweet potato based composite flour.


Functional pasta from cassava


Gluten free pasta


Low glycaemic spaghetti

Industrial Products/Processes

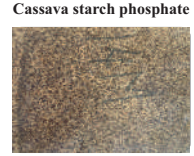
- High quality cassava flour; Quick cooking dehydrated cassava tubers and elephant foot yam corms; Sago from reconstituted cassava based dry starch; Functional sago from wet and reconstituted cassava dry starch; Wax coating technology for fresh cassava tubers; Food grade modified starches of cassava as thickening agent, gelling agent, binding agent; RS4 (Modified starch) and RS5 (Starch-lipid complex) type resistant starches of cassava and sweet potato; Cassava starch based nanocomposite films for food wrapping application; Cassava starch-Konjac Glucomannan blend for liquid coating of fruits and vegetables; Encapsulated sweet potato and purple yam anthocyanins, anthocyanin capsules with nutrient supplement.


Super absorbent polymer


Sweet potato anthocyanin capsules

- Cassava starch factory effluent treatment plant; Cassava bioethanol production technology; Cassava starch based biodegradable plastics; Biodegradable films from cassava starch; Cassava starch based adhesives; Cassava stem based thermoplastic starch sheets and particle boards; Cassava starch based eco-friendly disposable articles; Modified cassava starch for textile, paper and adhesive industries; Non-food grade modified starches-Crosslinked starch, oxidized starch, starch phosphate; Semisynthetic superabsorbent polymer (SAP) based on cassava starch; Lab scale process for urea coated with cassava starch-graft-copolymer; Process for cassava starch-graft copolymers in textile sizing, flocculant; Production technology for biochar.


Cassava starch phosphate


Cassava stem based particle board

Reaching the Unreached

- Farmer participatory technology development and transfer.
- Entrepreneurship development programmes.
- Sustainable livelihood assessment of tuber crops growers.
- Rainbow diet campaign and upscaling technologies for food and nutritional security.
- Documentation and validation of farmers innovations/ITKs.
- Gender mainstreaming in tuber crops.


Method demonstration


Frontline demonstration


Mera Gaon Mera Gaurav


International training


EDP programme for students

Rainbow diet campaign


Video conferencing


Exhibition


EDP programme for farmers

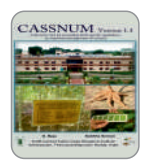
ICT and Statistical Tools

ICT Tools

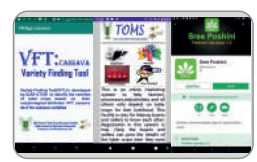
- IoT device: Electronic Crop (e-Crop) is an AI enabled IoT device that simulates crop growth in response to weather and soil parameters and generates agro-advisory that is sent to the farmer's mobile by SMS.
- Crop growth simulation models: EFYSIM- an elephant foot yam growth model, SPOTCOMS- sweet potato growth model; SIMCAS-a cassava growth model; MADHURAM-the world's first sweet potato growth model.
- Decision Support System: Sree Visakham cassava expert system; Tuber crops online marketing system, OUSHADHAM for disease and pest diagnostic system for tuber crops, Cassava protector, Tuber Information Cafe, CASSNUM 1.1 for nutrient management of cassava.
- Mobile Apps: Krishi Krithya for e-Crop based smart farming; Variety Finding Tool (VFT) cassava and VFT taro; TuberGuru App for information of tropical tuber crops; Sree Poshini.
- Database/Information system: TUBERTECH on the CTCRI technologies; TUBERHELP on information system of tuber crops.

e-Crop

Cassava expert system



Nutrient decision support system



Mobile Apps

Statistical Tools

- Database: Germplasm of tuber crops; EST database of cassava and SSR identification tool; SNPs and miRNAs in cassava and elephant foot yam.
- R Programmes: A web based interactive tool for tuber crops statistics using R and Shiny; An interactive web-based gene network development tool; RIntGeneNet to facilitate the construction of gene regulatory networks; R packages for box plot, cluster and principal component analysis, Soil Quality Index (SQI) by integrating ANOVA and computation of SQI.
- Statistical methodologies: Mapping QTL analysis of non-normal traits using MCMC technique and linkage map construction under polyploidy. Bayesian method of QTL mapping was applied for mapping of SSR markers for cassava mosaic disease.
- Machine learning tool: Plant-*Phytophthora* protein-protein interaction using protein features from sequences and integrated into an interactive web application.
- Bioinformatics: Comparative and functional genomics analysis of starch biosynthesis and carotenoid biosynthesis pathways in cassava; Whole genome sequence analysis in cassava; Next Generation sequencing data (RNA Seq) analysis for tuber color in sweet potato.

Developmental Programmes

SCSP Programme: Institute technologies viz., improved varieties, nutrient use efficient varieties, site specific nutrient management, integrated nutrient management, pest and disease management, post-harvest processing and value addition were used for the empowerment of more than 3000 farmers and other stakeholders in Kerala, Tamil Nadu and Andhra Pradesh.


Demonstration


Supply of critical inputs


Mechanization in Chinese potato


Capacity building in value addition

TSP Programme: Technological interventions for improving livelihood security of the tribal people in Odisha, Jharkhand and Chhattisgarh.


Demonstration


Training


Harvest fest


Seed village of sweet potato

NEH Programme: NEH programme is implemented in Manipur, Meghalaya, Nagaland, Tripura and Arunachal Pradesh to enhance the food, nutritional security and livelihood improvement of the tribal people. Village incubation centre was created at Riha village, Ukhrul district of Manipur in 2016.


Seed village on cassava


Ethnic food festival


Village incubation centre


Raibow diet campaign

Commercialization and Agribusiness Incubation

Technology Commercialization

The Institute Technology Management Unit & Professional Services Cell (ITMU & PSC) under the guidance of the Institute Technology Management Committee (ITMC) has carried out the following technology transfer, contract research and consultancy services of the Institute.

- Total commercializable technologies: 33
- IPR protection and commercialization of technologies: 5
- Commercialization of technologies without IPR: 28
- Technology licensing: 24
- Contract manufacturing: 9
- Contract research: 5
- Total number of licenses granted including contract research: 82
- Consultancy services: 2



Technology commercialization

Agribusiness Incubation (ABI) Centre

- Provides technology, skill upgradation and incubation for sustainable entrepreneurship using technological advancements in tropical tuber crops in the areas of production of quality planting materials, eco-friendly farming, smart farming and nutrition & health.
- Imparts training and capacity building to prospective entrepreneurs in agribusiness ecosystem.
- Participants: Agripreneurs, Entrepreneurs, Students, Startups, FPCs, SHGs, MSME and large companies.

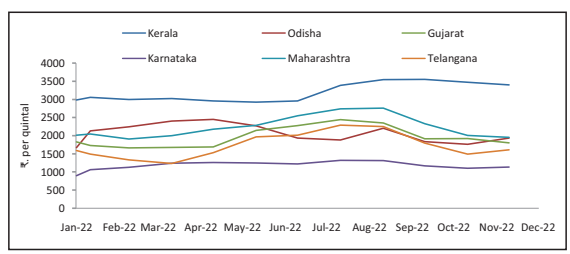


Agribusiness Incubation

Economics and Impact Assessment of Technologies

Price forecasting of tuber crops, value chain assessment of tuber crops, market intelligence for tuber crops, techno-economic feasibility reports are done besides impact assessment of tuber crops technologies.

- Impact assessment on improved varieties of cassava and Chinese potato conducted in Tamil Nadu revealed that improved varieties of cassava viz., H-165, H-226, Sree Jaya, Sree Athulya, Sree Reksha and 8S-501 were adopted by 39% of the farmers and the Chinese potato variety 'Sree Dhara' was adopted by 38% of the farmers.
- Value chain analysis of sweet potato was conducted in Karnataka and Odisha states with a sample size of 509 covering 422 farmers and consumers, 35 commission agents of APMC market and aggregators, 17 wholesalers and 35 retailers.
- Price forecasting of sweet potato was done for six selected states in India using time series monthly market price, collected from AGMARKNET price portal from January 2010 to December 2022.
- Partial budgeting method and economic surplus approach were used for monetization of technologies of tuber crops. Research investment on tropical tuber crops resulted in generating direct benefits to producers and consumers with net present value of ₹ 11057 crores with a benefit-cost ratio of 9.75 and an internal rate of return of 54%.



Price forecast of sweet potato in selected states of India using SARIMA

Impact assessment of technologies

Value chain analysis

Facilities and Infrastructure

Experimental farm: Research is conducted in an area of 48 ha at headquarters and 20 ha area at Bhubaneswar. Maintenance of germplasm collections and released varieties of tuber crops, experiments on tuber crops and quality planting material production are done at the farm.

Experiment on Integrated organic farming system

AAS laboratory

Laboratory: The Institute has state-of-the art laboratories for DNA sequencing, molecular study, transgenics, gene editing, tissue culture, bioinformatics, soil fertility and plant nutrition, soil physics, geoinformatics, plant pathology, virus diagnostics, agricultural entomology & nematology, biomolecules from crop residues, food processing, value addition and starch biochemistry.

Library: Provides necessary information support for Institute research programmes. Library has a collection of 17400 volumes, subscription of 42 journals, theses, annual reports and other technical publications.

Library

Techno-incubation centre

Provides hands-on training, technical assistance and incubator facilities to prospective entrepreneurs, SHGs and FPCs for the production of value added products from tuber crops.

Facilities and Infrastructure

Museum: Showcases the tuber crops technologies, products, and publications for the benefit of farmers and other stakeholders.

Museum

Dairy Unit

Dairy Unit: As a component of Integrated Organic Farming System Model and to undertake experiments on organic farming & natural farming for sustainability of tuber crops farming and for clean milk production.

Agricultural Knowledge Management Unit: Nodal point of National Knowledge Network of India (NKN) for effective sharing of scientific resources. A high speed 200Mbps fiber optic connectivity was established for internet communication and can be accessed through the Local Area Network. ICAR-CTCRI home page can be accessed at https://www.ctcri.org.

Agricultural Knowledge Management Unit

Guest House

Residential Complex and Guest Houses: There are staff quarters (5 nos.), play ground and indoor stadium at headquarters. CTCRI has two guest houses with well furnished 3 AC suite rooms, 16 AC double bed rooms and dormitories.

Awards and Recognitions

National Awards

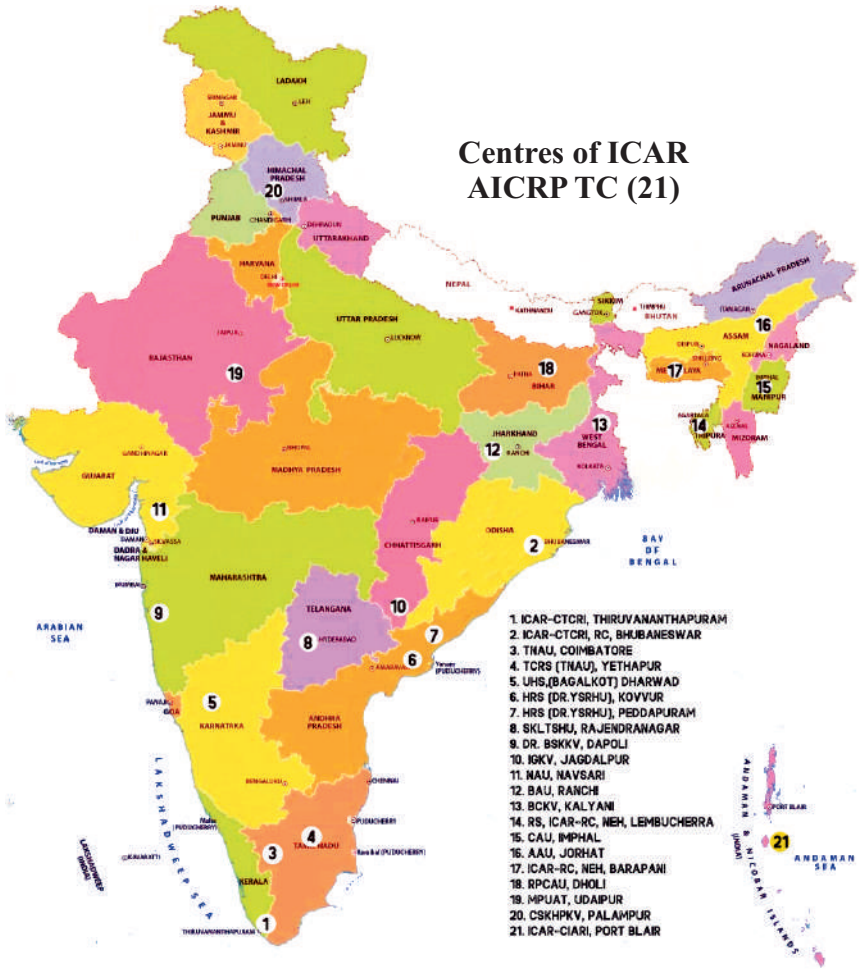
- Sardar Patel Outstanding Institution Award of ICAR (2005).
- 14th Rank among 93 ICAR Institutes (2022).

- Chaudhary Devi Lal Outstanding All India Coordinated Research Project (AICRP) Award (2007).
- Best Annual Report Award of ICAR (1997-98 & 2017-2018).
- Outstanding Grading by QRT 2014-2019 for ICAR-CTCRI and AICRP TC (2020)
- ICAR Team Research Awards (1985, 1994, 1998 & 2014).
- ICAR Award for Outstanding Interdisciplinary Team Research in Agricultural and Allied Sciences for Biennium 2011-12 (2012).
- Best Centre Award for All India Network Programme on Organic Farming (2020).
- Jawaharlal Nehru Award (1975, 1995, 1998, 2000 & 2003).

International Awards

- ICAR-CTCRI was rewarded at the First International Meeting on Cassava Plant Breeding, Biotechnology and Ecology organized at Brasilia, Brazil during 11-15 November 2006 in recognition for its contribution to cassava growers and consumers worldwide (2006).
- Pat Coursey Award (2000 & 2006).
- D.L. Plucknett Award for Tropical Root Crops (1991).

Our Networking



Collaborations/Linkages

International Institutes

1. International Potato Centre (CIP), Lima, Peru.
2. International Centre for Tropical Agriculture (CIAT), Cali, Columbia.
3. French Agricultural Research Centre for International Development (CIRAD), France.
4. Brazilian Agricultural Research Corporation (EMBRAPA), Brazil.
5. Swiss Agency for Development & Cooperation, Bern, Switzerland.

National Institutes/Organizations with MoUs

1. College of Agriculture, Kerala Agricultural University, Vellayani, Thiruvananthapuram, Kerala.
2. National Institute of Food Technology, Entrepreneurship and Management, Thanjavur, Tamil Nadu.
3. Jawaharlal Nehru Krishi Viswavidyalaya, Jabalpur, Madhya Pradesh.
4. Dr. YSR Horticultural University, West Godavari, Andhra Pradesh.
5. Coconut Development Board, Kochi, Ministry of Agriculture & Farmers' Welfare, Govt. of India.
6. Odisha University of Agriculture & Technology, Bhubaneswar, Odisha.
7. M/s SAGOSERVE, Salem, Tamil Nadu.
8. Tamil Nadu Veterinary and Animal Sciences University, Chennai, Tamil Nadu.
9. Kerala University of Digital Sciences, Innovation and Technology, Thiruvananthapuram, Kerala.
10. Mahatma Gandhi University, Kottayam, Kerala.

National Institutes/Organizations other than ICAR Institutes

1. Kerala Agricultural University, Thrissur, Kerala.
2. Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu.
3. Central Agricultural University, Imphal, Manipur.
4. North Eastern Hill University, Tura Campus, Meghalaya.
5. Indian Institute of Technology, Roorkee, Uttarakhand.
6. National Institute of Technology, Trichy, Tamil Nadu.

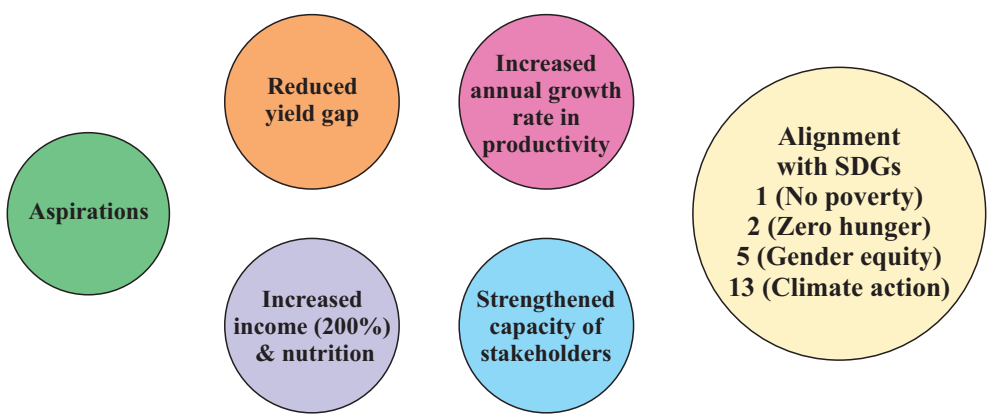
7. Institute of Petrochemicals Engineering & Technology, Kochi, Kerala.
8. National Institute of Agricultural Extension Management, Hyderabad, Telangana.
9. Department of Horticulture and Department of Agriculture, Government of Odisha.
10. Department of Horticulture, Government of Tamil Nadu, Andhra Pradesh & Telangana.
11. Kerala State Industrial Development Corporation (KSIDC), Government of Kerala.
12. Kerala Development and Innovation Strategic Council (KDISC), Government of Kerala.
13. Kerala Startup Mission, Government of Kerala.
14. Department of Horticulture & Meghalaya Basin Development Agency, West Garo Hills, Meghalaya.
15. Madurai Agribusiness Incubation Forum of NABARD, Madurai, Tamil Nadu.
16. Centre for Research on Innovation and Science Policy (CRISP), Hyderabad, Telangana.

External Funding Agencies

1. ICAR-National Agricultural Innovation Fund (NAIF), Government of India.
2. Protection of Plant Varieties & Farmers' Rights Authority (PPV&FRA), Government of India.
3. Department of Science and Technology, Government of India.
4. Department of Biotechnology, Government of India.
5. Bhabha Atomic Research Centre, Government of India.
6. Department of Atomic Energy, Government of India.
7. Potash Research Institute of India, Haryana.
8. National Bank for Agriculture and Rural Development (NABARD), Government of India.
9. Rashtriya Krishi Vikas Yojana (RKVY), Government of Odisha & Government of Kerala.
10. Department of Agriculture and Farmer's Welfare, Government of Kerala.
11. Kerala State Planning Board, Government of Kerala.
12. Small Farmers Agribusiness Consortium (SFAC), Government of Kerala.
13. Kerala State Council for Science, Technology and Environment (KSCSTE), Government of Kerala.
14. Kerala State Horticulture Mission, Government of Kerala.

Future Readiness and Aspirations

- Basic, strategic and applied research for the efficient management of genetic/genomic resources of tropical tuber crops and development of climate smart, nutrient dense varieties with stress resistance, enhanced shelf life, water and nutrient use efficiency, processing traits for food, nutrition, feed and allied industries suiting to different agro-ecological zones through conventional breeding and modern 'omics' approaches.
- Better agronomic practices, sustainable natural resource management and climate smart agriculture practices for increased yield, income and profitability as well as for development of seed systems.
- Integrated pest and disease management through eco-friendly strategies involving diagnosis, surveillance, decision support system and bio-intensive approaches to enhance returns of tropical tuber crops farmers.
- Adding value to tropical tuber crops through product diversification in food, feed and industrial sectors, handholding of incubatees for establishment of startups and entrepreneurship development and development of green energy.
- ICT based innovative extension approaches/models for sustainable livelihood of farming community through technology dissemination, commercialization and stakeholders' convergence for doubling farmers' income linking all actors in the value chain.



Action Plan

- Germplasm catalogues of tropical tuber crops, geotagged location maps of collected germplasm and targeted exploration and screening in unexplored regions. Screening germplasm for multiple biotic and abiotic stresses and their responsiveness to organic farming and nutrient use efficiency.
- Development of abiotic (drought, high temperature and salinity)/biotic stress tolerant/resistant varieties with high yield & starch, nutritional value and shorter duration. Identification and registration of farmers' varieties. Genomic and phenomic techniques for breeding.
- Popularization of location-specific varieties. Development of novel techniques for mass production of quality planting materials.
- Ecoregional smart farming of tropical tuber crops by enhancing input use efficiency using AI enabled IoT devices, models, sensors, UAVs etc.
- Agroecology based sustainable production intensification through organic farming, natural farming etc. for location specific tuber crop-based agrifood systems.
- Ecofriendly management of pests and diseases. Identification of novel biomolecules and rapid diagnostic techniques, endosymbionts, nanotechnology and pest/diseases forecast models.
- Refinement and upscaling of bioethanol production from cassava and development of biodegradable plastics. Development of sweet potato and millet based foods for school children, diabetics etc.
- Development of pre- and post-harvest machineries including pilot plants for value added products.
- Strengthening extension research and development of innovative extension programmes/ methodologies for tuber crops.

Outcomes

- Superior climate resilient varieties with multiple desired traits.
- Biofortified varieties for health, wellness and for industrial applications.
- Seed villages and decentralized seed chain to cover ICAR-CTCRI varieties in maximum area (>50%) for employment, income and livelihood improvement.
- Organic farming and natural farming technologies, vertical farming models, cropping system models, IFS models for enhancing resource use efficiency, farmers income and to provide year-round safe-to-eat and healthy food.
- Nature based solutions for sustainable production that will reduce depending on external inputs, improve livelihoods and reduce GHG emissions.
- Integrated and ecofriendly pest and disease management to mitigate pests and diseases, reduce yield loss and increase farm income.
- Fork to farm approach and develop locally suitable food systems through decentralized value addition technologies and facilities.
- Tuber crop based food, feed, pharmaceutical, cosmetic, biofuel and other sectors for boosting entrepreneurship and agribusiness.
- Research for development (R4D) outputs such as policy document and bankable projects. Innovative extension methodologies, ICT tools, economics and statistical tools for reaching the unreached and inclusive development.
- Capacity building of partners- farmers, entrepreneurs, startups, women SHGs, FPCs, students etc.
- Strengthening linkages with state, national and international organizations.

Reach Us

Headquarters: Thiruvananthapuram (Establishment: 1963)

Latitude : N 8° 59.673'; Longitude: E 76° 32.509'; 46 m MSL
Sreekariyam, Thiruvananthapuram 695 017, Kerala, India.
Phone: (91) (471) 2598551 to 2598554, E-mail: director.ctcri@icar.gov.in; Website: https://www.ctcri.org
Thampanoor central railway station: 10 km; Kochuveli railway station: 7 km
International airport (Terminal 2): 7 km; Domestic airport: 10 km (Terminal 1)

Mandate crops: Cassava, Sweet potato, Greater yam, White yam, Lesser yam, Elephant foot yam, Taro, Tannia, Chinese potato, West Indian arrowroot, Queensland arrowroot, East Indian arrowroot.

Important areas of research: Germplasm conservation, varietal development, biotechnology, molecular breeding, rapid quality planting material production, site specific nutrient management, integrated nutrient management, organic farming, natural farming, precision farming, cropping/farming systems, integrated pest and disease management, biomolecules from crop residues, diagnostic tools for pests and diseases, mechanization, value addition, home scale processing, extension, economics, statistics, bioinformatics and ICT applications.

Divisions: Crop Improvement, Crop Production and Crop Protection.

Sections: Crop Utilization and Extension & Social Sciences.

Regional Station: Bhubaneswar (Establishment: 1976)

Latitude: N 20° 14.154' ; Longitude: E 85° 47.3837'; 45m MSL
Dumduma P.O, Bhubaneswar 751019, Odisha, India.
Phone: (91) (674) 2470528; Fax: (91) (674) 2470528
E-mail: rcctcri@yahoo.co.in; Website: https://www.ctcri.org
Bhubaneswar railway station: 11 km; International airport: 10 km

Mandate crops: Sweet potato, Cassava, Greater yam, White yam, Lesser yam, Elephant foot yam, Taro, Giant taro, Swamp taro, Tannia, Yam bean.

Important areas of research: Germplasm conservation, varietal development, biotechnology, molecular breeding, rapid quality planting material production, integrated nutrient management, organic farming, precision farming, cropping/farming systems, integrated pest and disease management, diagnostic tools for pests and diseases.

Tuber Crops for ……..
Food, Health, Wealth and Prosperity

हर कदम, हर डगर
किसानों का हमसफर
भारतीय कृषि अनुसंधान परिषद
Agrisearch with a human touch

Azadi Ka Amrit Mahotsav

INTERNATIONAL YEAR OF MILLETS 2023

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