अनुसंधान की मुख्य विशेषताएं
Research Highlights
2022

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ICAR

Diamond Jubilee
60 Years
ICAR-CTCRI

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CTCRI

भाकृअनुप-केन्द्रीय कंद फसल अनुसंधान संस्थान
(भारतीय कृषि अनुसंधान परिषद)
श्रीकार्यम, तिरुवनंतपुरम 695 017, केरल, भारत

ICAR-CENTRAL TUBER CROPS RESEARCH INSTITUTE
(Indian Council of Agricultural Research)
Sreekariyam, Thiruvananthapuram 695 017, Kerala, India

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Diamond Jubilee of ICAR-CTCRI

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Contents

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From The Director

The population of India is expected to grow to 1.62 billion and the demand for food grains is estimated to increase to 360 million tons by 2050. The likely gap in demand-supply would be partially bridged by tropical tuber crops like cassava and sweet potato, which are cheap energy sources. Moreover, when climate change continues to disrupt agricultural production, challenging our ability to feed a growing population, tuber crops come in handy, bestowed with resilience to global warming and prospects for better returns under adverse edaphic and climatic conditions. Tropical tuber crops are versatile crops with transforming roles from providing a substantial part of the world's food-cum-feed supply to diverse industrial applications and nutritional attributes. In the context of ICAR-CTCRI celebrating its 60 years of service, I take stock of the research accomplishments, technologies and developmental programmes for the year 2022 featured in the form of Research Highlights.

The germplasm was enriched with 79 new collections and overall, 5588 accessions are being conserved for valued traits. Two cassava genotypes with better-fried chips quality and five genotypes for N and K use efficiency; two sweet potato genotypes with high carotenoids and anthocyanin and five genotypes suitable for processing; three high yielding bushy white yam clones; five non-acrid elephant foot yam hybrid lines; two promising arrowroot lines and two yam bean lines for high yield and quality were identified.

In order to face the complex climate change challenges, the agrifood systems involving tuber crops are getting strengthened with productive, profitable and biologically efficient intercropping system of taro with vegetable cowpea; nature-based solutions like organic packages for intercropping system of elephant foot yam with cucumber/amaranthus and cassava-groundnut system; reduction of chemical fertilizers by zone-specific site specific nutrient management (SSNM) involving customized fertilizers, which resulted in 17-23% increase in yield, environmental protection and reduction in global warming potential and INM involving nutrient use efficient cassava variety, Sree Pavithra enabling 75% saving of NPK fertilizers. The fertigation schedule developed in taro with 25% saving of N and K nutrients and 83% higher cormel yield would intensely facilitate 'Per Drop More Crop', the mission-mode programme of Govt. of India.

Biorational management of cassava mealybug, identification of phytochemical constituents from the root extract of *Ipomoea mauritiana* with insecticidal activity against sweet potato weevil, management of collar rot in elephant foot yam and taro leaf blight using new generation fungicides, confirmation of pathogenicity of cassava root rot were some of the other significant findings. Production of thermoplastic starch sheets from cassava, development of cassava starch phosphate carbamate with high water absorption capacity, commercialization and patent filing of power operated size based Chinese potato grader, development of a prototype tractor operated Chinese potato harvester, a modified continuous type cassava peeler and frozen yogurt from biofortified sweet potato would make faster and longer strides for value chain to elevate the status of these crops.

A mobile app *'Krishi Krithya'* for e-Crop based smart fertigation system for tuber crops, women empowerment index in Chinese potato, a workflow for the analysis of whole genome sequence data of cassava were also developed. To better align on-station research for development, service and delivery to its stakeholders, ICAR-CTCRI continued its efforts by conducting out-reach programmes like NEH, SCSP and TSP, besides 476 OFTs/FLDs. Sustained focus was given to the two flagship programmes of Govt. of India, *'Mera Gaon Mera Gaurav'* and 'Swachh Bharat Abhiyan Mission', which could create tremendous impact in the society.

I am very happy to inform that ICAR-CTCRI bagged the 14th Rank among 93 ICAR Institutes for the combined years 2019-20 and 2020-21.The scientific credibility and quality of the research outcomes are evidenced from 248 publications, including 54 research papers in high impact international and national journals. The legacy and impact of R&D programmes of tropical tuber crops will continue for many years! Thanks to the collaborative functional linkages with CGIAR institutes like CIP, CIAT; Govt. of India organizations/schemes like CDB, RKVY, DST, DBT, NAIF, DAE, PPV&FRA, NABARD; ICAR Institutes, AICRP on Tuber Crops Centres, KVKs; Govt. of Kerala organizations like KSCSTE, KSPB and State Department of Agriculture & Farmers' Welfare.

I extend my sincere and profound thanks to Dr. Himanshu Pathak, Secretary (DARE) & Director General (ICAR); Dr. Anand Kumar Singh, DDG (Hort. Sci.), ICAR and Dr. Sudhakar Pandey, ADG (FVS & MP), ICAR, for their valuable guidance and support. I profusely thank Dr. M.N. Sheela, Former Director (A), ICAR-CTCRI for her able leadership during the period.

I thank all the staff for serving this national Institute with diligence and commitment to make this year scientifically momentous. I appreciate the efforts made by the Chief Editor and Editors in documenting this Research Highlights in high standard.

G. Byju
Director

10 May 2023

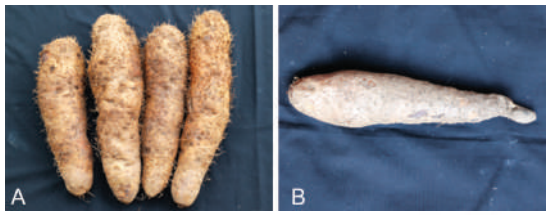
Research Achievements

The genetic wealth conserved with newer collections, varieties released, processes, protocols, technologies, methods, high value compounds and post-harvest machinery developed under 42 Institute projects as well as 27 externally aided projects are given below.

Crop Improvement

1. A total of 5588 accessions, comprising 1216 cassava, 1110 sweet potato, 1121 yams, 683 edible aroids, 207 minor tuber crops and 1251 collections from Regional Station were maintained and conserved in the field gene bank. Seventy nine new collections of tuber crops, cassava (8), sweet potato (7), yams (13), edible aroids (46) and minor tuber crops (5) were added to the germplasm.

Cassava germplasm field view



New collections: A: Lesser yam; B: Greater yam

2. Cassava lines having the following desirable traits were identified (i) CMD symptom-free exotic accessions (25) (ii) lines having better-fried chips quality (16-5 and landrace, *Manna*) (iii) high yield (KBH-2006/18 with 60.48 t ha^{-1} and 8S-501-2 with 48.42 t ha^{-1}) and (iv) nutrient use efficient lines (KBH18 and 15S-409 for N use efficiency; 8S-501-2, 15S-409 and KBH18 for K use efficiency).

3. Sweet potato lines having the following desirable traits were identified (i) good culinary quality (38/46) (ii) high carotenoids and anthocyanin (110/28 with 9.5 mg 100 g^{-1} FW total carotenoids and 60 mg 100 g^{-1} FW anthocyanin and 38/15 with 14.5 mg 100 g^{-1} FW total carotenoids and 8 mg 100 g^{-1} FW anthocyanin) (iii) high yield (SPH-60, white flesh hybrid with 31.20 t ha^{-1}; SPH-21, orange flesh hybrid with 26.29 t ha^{-1} and SPH-31, purple flesh hybrid with 27.45 t ha^{-1}) and (iv) suitable for processing (S-27, Palakkad local, S-1401, Sree Arun, Indira Madhur and EC321693).

Selected promising hybrids of sweet potato

4. Greater yam lines with high tuber yield (DaH-10-130 with 46.91 t ha^{-1} and DaH-10-41 with 40.24 t ha^{-1}); high yielding white yam line (DRS-1047 with 59.30 t ha^{-1}) and high yielding bushy white yam clones (DrD-1095 with 38.27 t ha^{-1}, DrD-1038 with 35.80 t ha^{-1} and DrD-1112 with 35.16 t ha^{-1}) were identified.

5. Five non-acrid elephant foot yam hybrid lines were identified (H-102-2015, H-107-2015, H-843/2-2017, H-6-7-2017 and H-6-34-2017). A high yielding arrowroot line (M-3 with 42.26 t ha^{-1}) and another line with high dry matter content (M-2 with 33.25%) were identified. A high yielding yam bean line (3 x 8 with 38.64 t ha^{-1}) and a line with highest readily usable carbohydrate (48.14%) and protein (2.27 mg) (DPH-10) contents were identified.

Promising genotypes identified in arrowroot for A: Rhizome yield; B: Dry matter

6. Two varieties of tannia i. IGSGTN-1 (TTn14-1) for central release for the states of Chhattisgarh, Manipur and Kerala; ii. XaMTS Local (TTn14-5) for release in Kerala and three varieties of stolon taro (*Colocasia esculenta* var. *stoloniferum* (L.) Schott.) i. CAUST-2 for release in Manipur; ii. BCST-14 for central release for the states of West Bengal, Assam and Manipur; iii. AAUST-2 for release in Assam were recommended by AICRP TC.

7. High quality draft genome assembly of two inbred cassava lines (8S-501 and 9S-127) through whole-genome re-sequencing revealed the presence of 7,789,154 and 7,130,986 SNPs as well as 943,104 and 1,104,776 In Dels in 8S-501 and 9S-127, respectively. Genome based synteny and collinearity analysis revealed that the *MeMADS* box genes in cassava were evolved through gene duplication and divergence. Twenty three *MeMADS* box genes were found to be potential targets of 53 *miRNAs*.

Crop Production

1. Package of practices for intercropping taro with vegetable cowpea (1:1) was developed, which was productive, profitable and biologically efficient. Organic package of practices for intercropping elephant foot yam with vegetables such as cucumber and amaranthus were developed. The corm equivalent yield of elephant foot yam was highest when intercropped with cucumber under 75% organic + 25% inorganic (28.28 t ha^{-1}) in the first year and with amaranthus under 100% organic (33.29 t ha^{-1}) in the second year.

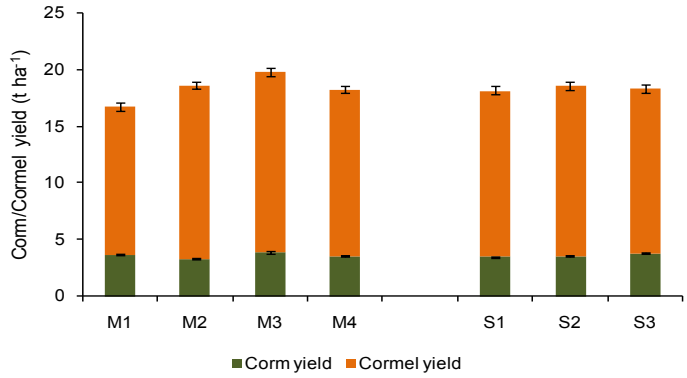
Elephant foot yam + amaranthus | Elephant foot yam + okra | Elephant foot yam + cucumber | A single harvest of vegetables

Organic farming of elephant foot yam + vegetables (second season)

2. Weed control ground cover perforated mat proved to be an effective weed management technique in taro with significantly lower weed population, significantly higher yield stability index (0.78) and higher B:C ratio (2.76). In taro, planting density of 74,000 plants ha^{-1} along with paddy straw mulching resulted in lower weed dry weight (9.90 g m^{-2}), higher yield (25.84 t ha^{-1}) and B:C ratio (3.05).

3. Developed fertigation schedule in taro. Application of 60:25:75 kg ha^{-1} of N, P_2O_5 and K_2O @ 50% within 90 DAP, 25% during 90-120 DAP and the rest 25% during 120-150 DAP was optimum and economical for fertigation in taro with 25% saving of N and K nutrients and 83% higher cormel yield over soil application.

Taro under drip fertigation



Yield of taro under different fertigation treatments

4. Fertilizer Best Management Practices by SSNM proved to be significantly superior in cassava, elephant foot yam, greater yam, white yam and sweet potato by enhancing yield to the extent of 17-23% over present recommendation.

5. Planting Bhu Krishna vines on 45 cm ridge height and at 90 cm row to row spacing resulted in significantly higher marketable tuber yield (14.09 t ha^{-1}), gross (₹ 2,81,700 ha^{-1}) and net (₹ 2,02,100 ha^{-1}) returns as well as B:C ratio (3.54).

6. Customized fertilizer with a composition of N:P_2O_5: K_2O:Mg:Zn:B @ 8:11:21:3.84:0.84:0.315 ratio applied @ 500 kg ha^{-1} produced significantly highest tuber yield (39.25 t ha^{-1}) in cassava. Among the NUE genotypes/variety, Sree Pavithra at 25% NPK resulted in a tuber yield (32.50 t ha^{-1}) on par with H-1687 under PoP (35.05 t ha^{-1}).

7. Developed protray method for accelerated multiplication of yams through container growing system. Greater yam var. Sree Nidhi performed consistently better in grow bag with yield ranging from 0.51 to 1.2 kg per plant using minisett of 20 g raised protray plants. Among the five media evaluated, soil + coir pith + vermicompost in 1:1:1 ratio produced the highest mean

Preparation of greater yam minisett

Different stages of development of greater yam nursery plant

Nursery plants of greater yam var. Sree Neelima ready for planting

Field view of established plants

tuber yield. Two node vine cuttings of greater yam showed significantly highest sprouting (89.97%). The mean number of roots produced was the highest in IBA treatment followed by PGPR Mix-1.

8. Twenty five seed villages were established for quality planting material production of cassava, sweet potato, elephant foot yam and Chinese potato in Kerala, Tamil Nadu, Odisha and Andhra Pradesh covering an area of 80 acres. Eighty six farmers from Kerala, Tamil Nadu, Andhra Pradesh and Odisha (covering 84.60 acres) have been registered as decentralized seed multipliers for quality planting material production of tuber crops.

9. Quality planting material of 1,33,000 stems of cassava, 31 tons of elephant foot yam, 32.5 tons of greater yam, 3 tons of white yam, 3.5 tons of lesser yam, 2.5 tons of taro, 14,60,000 vine cuttings of sweet potato, 50,000 vine cuttings of Chinese potato and 200 kg of yam bean were produced.

Quality planting material production of tuber crops during 2022

Sl. No.	Name of the crop	Unit	Varieties	Quantity of planting materials produced
1.	Cassava	Number of stems	Sree Vijaya	35000
			Sree Jaya	28000
			Sree Reksha	60000
			Sree Suvarna	5000
			Sree Sakthi	5000
			Total	**133000**
2.	Sweet potato	Number of vine cuttings	Bhu Sona	550000
			Bhu Krishna	504000
			Kishan	400000
			Sree Arun	2000
			Sree Kanaka	2000
			Gouri	2000
			Total	**1460000**

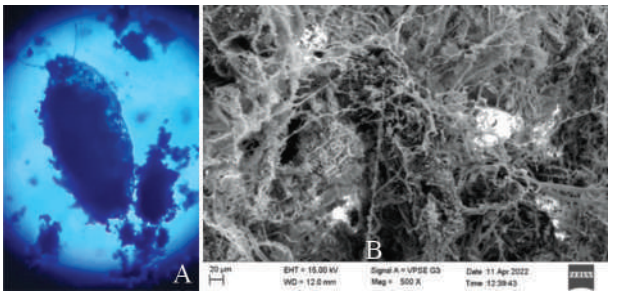
3.	Elephant foot yam	Ton	Gajendra	20.50
			Sree Padma	10.50
			Total	**31.00**
4.	Greater yam	Ton	Sree Shilpa	8.50
			Sree Roopa	6.50
			Sree Keerthi	5.50
			Sree Karthika	6.50
			Sree Nidhi	5.50
	White yam	Ton	Sree Priya	2.00
			Sree Dhanya	1.00
	Lesser yam	Ton	Sree Latha	3.50
			Total	**39.00**
5.	Taro	Ton	Muktakeshi	1.50
			Telia	1.00
			Total	**2.50**
6.	Chinese potato	Number of stem cuttings	Sree Dhara	50000
7.	Yam bean seeds	kg	RM-1	200

10. Planting material of 8000 kg of greater yam, 8500 kg of elephant foot yam, 7000 kg of taro, 150 kg of yam bean, 9,00,000 vine cuttings of sweet potato and 5000 stems of cassava were distributed to 450 tribal farmers from five districts of Odisha under ICAR-CTCRI-TSP programme.

11. Under SCSP programme, 140 demonstrations on improved varieties of cassava, greater yam and elephant foot yam were carried out in Parakode block of Kerala and Mangalur block of Tamil Nadu. Planting materials of improved varieties of tuber crops, inputs, farm tools and implements were distributed to 124 farmers. Twenty one outreach programmes were conducted for the benefit of 1246 farmers and other stakeholders.

Crop Protection

1. Developed biorational management of cassava mealybug (*Phenacoccus manihoti*) involving *Shreya* at 0.8% followed by *Nanma* at 1% after 5 days and also with entomopathogenic fungi (EPF), *Purpureocillium lilacinum* @ 20 g l^{-1} (1 x 10^8 CFU).

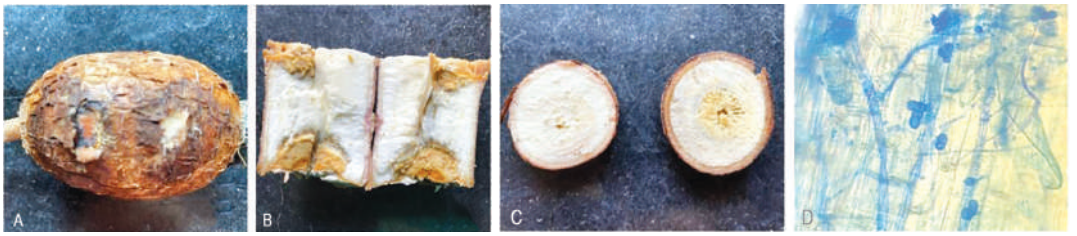


A: *P. lilacinum* growth on treated mealybug; B: SEM image of fungal growth on mealybug

2. Identified different phytochemical constituents from the methanolic root extract of *Ipomoea mauritiana, I. batatas* and *I. palmata* using GCMS. Quinic acid present in *I. mauritiana* was identified as one of the major components with insecticidal activity against sweet potato weevil.

3. Application of difenoconazole (0.1%) and combination fungicide, famoxadone + cymoxanil, as prophylactic spray and later on three sprays at 15 days interval as soon as the disease is noticed are recommended for the management of collar rot in elephant foot yam and taro leaf blight respectively.

4. Association of *Fusarium falciforme* with cassava root rot was confirmed by sequencing second largest subunit of RNA polymerase (RPB2) and the translation elongation factor (*TEF-1α*) gene of the isolates.



A: Infected tuber (Outer view); B: Infected tuber (Inner view); C: Infection in tuber slices; D: Microscopic view of chlamydospores inside inoculated roots

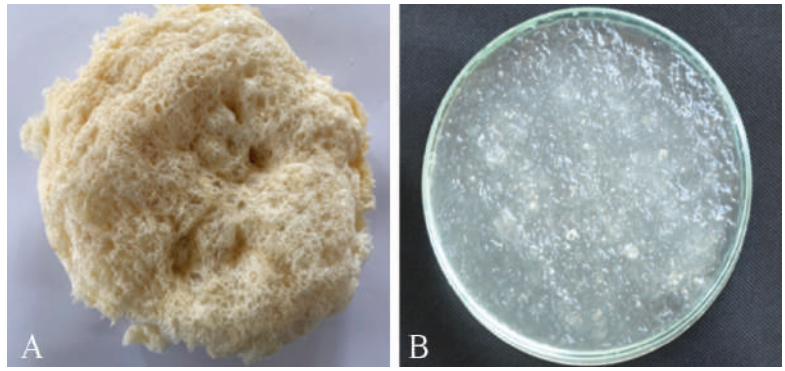
5. Treatment of cassava setts at 55.30°C for 15 min could eliminate the cassava mosaic virus in infected cuttings. Treatment with *Trichoderma* isolates showed reduction in virus load as evident from Cq value of 34.41 as against 12.66 in control. The Cq value is inversely proportional to virus concentration.

6. An isolate of an entomopathogenic nematode, *Heterorhabditis* sp. was identified from a soil sample in Thiruvananthapuram, Kerala.

Crop Utilization

1. Optimized process conditions for production of thermoplastic starch sheets from cassava starch and bagasse/banana fibre composites.

2. Developed process to synthesize cassava starch phosphate carbamate with high water absorption capacity (91-94 g g^{-1}) for water remediation and other hydrogel applications.



A: High water absorbing cassava starch phosphate carbamate;
B: Microgel after water absorption

3. Patent application filed for power operated size based Chinese potato grader and it was commercialized to M/s Stonehat Technologies, Coimbatore, Tamil Nadu.

4. Developed a prototype tractor operated Chinese potato harvester and a modified continuous type cassava peeler for small scale processing.

5. Developed frozen yogurt from carotene and anthocyanin rich sweet potatoes, which combines probiotic as well as prebiotic properties to improve human gut health.

Extension and Social Sciences

1. FLDs conducted in Salem district revealed that the yield of cassava variety Sree Athulya was 14.19% higher than the local varieties with a B:C ratio of 2.23 and in Pudukottai district the yield of Sree Athulya was 9.65% higher than the local varieties with a B:C ratio of 1.94. Demonstrations on CMD resistant variety Sree Reksha in East Godavari district of Andhra Pradesh revealed that the yield was 12.50% higher (with a B:C ratio of 2.7) under irrigated conditions and 14.81% higher (with a B:C ratio of 2.20) under rainfed conditions than the local varieties. OFTs on SSNM in Chinese potato conducted in ten farmers' fields in Tenkasi district showed that the yield of SSNM treated plot of Sree Dhara gave 14.61% higher yield with a B:C ratio of 2.96 than the farmers' practice.

2. Thirteen on-farm trials (Attapadi-8; Kallakurichi-5) involving five biofortified and high yielding varieties of sweet potato were conducted to assess its performance. Sensory acceptability of cassava pasta by students, indicated that wheat pasta scored significantly higher for general appearance (M=7.04), colour (M=6.89) and texture (M=6.73), while cassava pasta for its aroma (M=6.06).

3. Overall empowerment index in sweet potato was 0.76 for men and 0.57 for women in Ganjam district of Odisha. Impact assessment on improved variety of Chinese potato conducted among 200 farmers in Tamil Nadu revealed that 38% of the farmers adopted 'Sree Dhara' which gave an additional yield and income of 25%.

4. Validated e-Crop based smart fertigation technology in sweet potato. Developed a workflow for the analysis of whole genome sequence data of cassava.

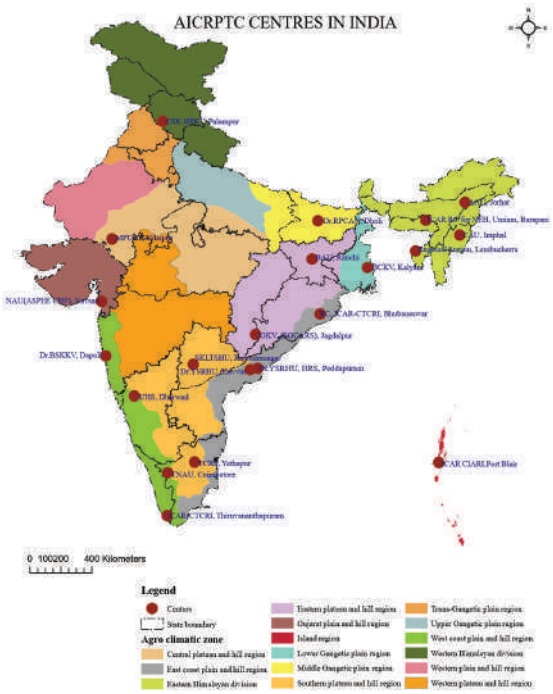
Flow chart of the pipeline developed for the bioinformatics analysis of whole genome data of cassava

5. e-Crop based smart farming system generated the advisories for farmers to practice at regular intervals. Sweet potato tuber yield under smart farming (SF) was 218% over traditional farming (TF) practices and for cassava, elephant foot yam and banana the yields under SF were 187, 218 and 152% over the corresponding TF yields respectively.

6. Two technologies on fried snack foods and fried chips from cassava were licensed to two firms in Kerala.

All India Coordinated Research Project on Tuber Crops (AICRP TC)

The AICRP on Tuber Crops, is the national network of tropical root and tuber crops covering 18 states and one union territory with 21 centres, affiliated to 12 State Agricultural Universities, three ICAR Institutes and two Central Agricultural Universities.



Map of AICRP TC

Varieties recommended for release

Two varieties of tannia (*Xanthosoma sagittifolium* (L.) Schott.) and three varieties of stolon taro (*Colocasia esculenta* var. *stoloniferum* (L.) Schott.) were recommended for release in different states due to higher economic yield.

Tannia

IGSGTN-1 (TTn14-1): Tannia from IGKV, Jagdalpur centre, with more than 30% tuber yield compared to check variety was recommended for central release, for the states of Chhattisgarh, Manipur and Kerala.

IGSGTN-1 (TTn14-1)

XaMTS Local (TTn14-5)

XaMTS Local (TTn14-5): Tannia from ICAR-CTCRI, Thiruvananthapuram, which performed second at the national level and highest in Kerala was recommended for state release in Kerala.

Taro

CAUST-2: A stolon taro, which produced the maximum caudex yield in Manipur was recommended for state release in Manipur. BCST 14: A stolon taro, which was found to produce the maximum stolon yield and caudex yield was recommended for central release for the states of West Bengal, Assam and Manipur. AAUST-2: Stolon taro, which produced the maximum caudex yield in Assam was recommended for state release in Assam.

CAUST-2

BCST 14

AAUST-2

Salient achievements and technologies recommended

- Mulching with porous ground cover weed mat was best for weed management in taro in agro-climatic zones of West coast plains and hills, southern plateau and hills, eastern plateau hills and in west Himalayan zones. However, hand weeding thrice-30, 60 and 90 DAP was more economical in central plateau and hills and middle gangetic plains.
- In a trial on fertilizer best management practices in sweet potato, application of customized fertilizers developed by ICAR-CTCRI @ 300 kg ha^{-1}as basal dose and one month after

planting, followed by foliar application of micronol @ 5 ml l^{-1} thrice on 15, 30 and 45 days after planting was the best for higher tuber yield compared to the present PoP and was recommended for eastern plateau and hills, lower Gangetic plains, middle Gangetic plains, southern plateau and hills, and Gujarat plains and hills.

- Standardized the nutrient requirement of swamp taro for eastern Himalayan, and western Himalayan zones as application of FYM @ 15 t ha^{-1}+ $N:P_2O_5:K_2O$ @120:60:90 kg ha^{-1} to produce good growth, stolons and caudex yield.
- For the management of taro leaf blight disease, spraying with mancozeb + metalaxyl M @ 0.1% was the best to reduce the disease incidence and enhance cormel yield, which is recommended for the zones of eastern Himalayan, western Himalayan, middle Gangetic plains, eastern plateau and hills, lower Gangetic plains, southern plateau and hills, and in Islands.
- Dipping of cormels in *Trichoderma* amended (@ 5 g kg^{-1}) cow dung slurry + soil application of *Trichoderma* amended vermicompost @100 g $plant^{-1}$ at the time of planting and later at the time of intercultural operations is recommended as technology for bio-intensive management of taro leaf blight in states declared as organic.

Technologies Assessed, Transferred, Consultancy and Patent Services

Technologies transferred

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 and contract activities during 2022.

Technology commercialization

- Fried snack foods and fried chips from tapioca were commercialized through licensing to two firms in Kerala (Kerala State Co-operative Federation for Fisheries Development Ltd, Matsyafed, Kamaleswaram, Manacaud P.O., Thiruvananthapuram 695009, Kerala on 14 January 2022 for an amount of ₹ 25000 and Chipro Karshaka Swayam Sahaya Sangham, Ponkunnam P.O., Kottayam 686506, Kerala on 02 March 2022 for an amount of ₹ 25000).
- Power operated size based Chinese potato grader was commercialized through licensing to M/s Stonehat Technologies, 26/262, Madasamy Kovil Street, Rajapalayam, Coimbatore, Tamil Nadu on 10 October 2022 for an amount of ₹ 10000.

Patent obtained/filed

- Filed patent application for power operated size based Chinese potato grader and methods of grading (Inventors: Krishnakumar, T., Sajeev, M.S., Pradeepika, C., Muthuraj, R. and Jaganathan, D.; Patent Application No: 202241043900) on 01 August 2022 and the response to the First Examination Report was submitted on 12 November 2022. The revenue generated through various activities at the Institutional level is indicated below.

Revenue generated through technology commercialization and other professional service functions

Sl. No.	Activity	Revenue generated (₹)
1.	Technology licensing	65000
2.	Sale of technological products, machineries and value added products	25000
3.	Professional training (ABI and TIC)	146000
4.	Students' fees	621860
5.	ICAR-CTCRI Incubatee enrolment fee	10000
	Total	**867860**

Technologies developed

Varieties/Technologies for crop improvement

- Two varieties of tannia i. IGSGTN-1 (TTn14-1); ii. XaMTS Local (TTn14-5) and three varieties of stolon taro (*Colocasia esculenta* var. *stoloniferum* (L.) Schott.) i. CAUST-2; ii. BCST 14; iii. AAUST-2 having high yield were recommended by AICRP TC for release in different states.
- Identified two early bulking cassava varieties, D-48 and 15S-409 that yielded significantly higher than the control variety, Vellayani Hraswa.
- Identified white yam variety, SD-15 with high yield (44.72 t ha^{-1}) and good culinary quality for release in Kerala.
- Identified two cassava clones, 8S-501 and CR43-7 as highly drought tolerant based on their mean performance and stability. Developed 618 cassava hybrids by crossing between drought tolerant and susceptible genotypes. Generated the information regarding the changes in leaf morphology and leaf biochemical traits under drought stress conditions.
- Developed 620 F_1 hybrid progenies in two different mapping populations. From this population, CMD resistant, high starch lines will be identified based on phenotypic screening and molecular marker work.
- Developed 867 cassava F_1 hybrids, segregating for PPD tolerance and other traits.
- Standardized Trizol-based RNA isolation protocol for isolation of the high-quality RNA from the tuberous tissues of sweet potato.

- Three high yielding orange-fleshed sweet potato hybrids, H-473/8, H-562/32 and H-43/83 are submitted for AICRP TC trials.
- Identified six sweet potato genotypes suitable for processing based on evaluation for important traits.
- Identified sweet potato genotypes, DB/21/57 (17.00 t ha^{-1}), RS-III-3 (16.60 t ha^{-1}), B × 7 (15.44 t ha^{-1}), SP-123 (13.37 t ha^{-1}) and S-162 (12.88 t ha^{-1}) as drought tolerant lines on the basis of field and *in vitro* screening for yield.
- Developed *in vitro* plant regeneration protocol of elephant foot yam var. Gajendra.
- Standardized breeder seed standards for RM1 variety of yam bean including breeder seed health test methodologies.
- Elucidated *gbss* gene sequence from the whole genome sequence data of cassava 9S-127 and cassava 8S-501.
- Identified *Curcuma angustifolia* accession IC number 641835, on par with Tikhur 1 variety in antimicrobial effects. The methanolic extract of this accession showed antibacterial effects towards *Staphylococcus aureus, Klebsiella pneumoniae, Mycobacterium smegmatis, Vibro cholerae, Salmonella typhi* and also antifungal effects towards *Candida albicans*.

Technologies for higher yield and sustainability

- Productive, profitable and energy efficient cropping system model, rice-short duration cassava-cluster bean.
- Organic package for cassava-groundnut cropping system.
- Organic package for cassava submitted to KAU for inclusion in PoP of KAU.
- Soil and foliar nutrition of cassava with essential nutrients for cassava mosaic disease (CMD) management under continuous cultivation.
- Polyhalites/polysulphates containing K_2O, CaO, MgO and S @13.5, 16.6, 5.5 and 18.5% as best soil amendment for cassava in the acid laterite (Ultisols) of Kerala.
- Water saving technique in taro.
- Irrigation schedule in sweet potato.

- Fertigation schedule in taro.
- Seed villages for quality planting material production of cassava and Chinese potato.
- Perforated weed control ground cover mat @120 gsm for high yield and less weed incidence in taro.

Technologies for plant health management

- Standardized the combination dose of bio-pesticide and chemical insecticide against sweet potato weevil.
- Diagnostic PCR technique for the presence of bacterial endosymbionts in whiteflies using specific bacterial primers.
- *Bacillus licheniformis*, an endophyte from the leaf of Aloe vera against *Colletotrichum gloeosporioides* causing anthracnose in greater yam.
- Organic management of collar rot and corm rot in elephant foot yam.
- Organic management of taro leaf blight.

Mechanization

- Power operated size based Chinese potato grader.
- Wet processing for extracting starch from cassava stem of different varieties.

Value addition

- Standardized a laboratory scale process to synthesize high viscosity cross-linked cassava starch phosphates with high water absorption capacity for possible application as thickener in convenient foods.
- Optimized the process parameters for making thermoplastic starch sheets of cassava starch, bagasse/banana fibre composites.
- A bench scale process to produce a highly water absorbing cassava starch phosphate carbamate.
- Cassava and wheat composite flour based rusk.

Methodologies/ICT tools/Statistical tools/Models

- Seasonal ARIMA and Time delay Neural Network model for forecasting of price in sweet potato.

- Women empowerment index in Chinese potato.
- Methodology for assessing the impact of adoption of improved variety 'Sree Dhara' on yield and income using IPWRA.
- e-Crop based smart fertigation system for tuber crops.
- Mobile app '*Krishi Krithya*' for e-Crop based smart farming.
- A workflow for the analysis of whole genome sequence data of cassava.
- R tool for identifying optimal number of clusters, clustering using K means, hierarchical clustering, computing intra and inter cluster distances at optimal number of clusters.
- Certified Agritech Startup Professional (CAgtSP) System: A professional student certification system of ICAR-CTCRI ABI, KAU and Kerala Startup Mission.
- Satellite Incubation Center (SIC): A collaborative value-chain based entrepreneurship development model for startups, FPOs, agripreneurs and other entrepreneurs.

General Information

Education and Training

Education

ICAR-CTCRI is the approved Research Centre of University of Kerala and Kannur University, Kerala; Manonmaniam Sundaranar University, Tamil Nadu; Utkal University and Odisha University of Agriculture and Technology, Odisha and Jawaharlal Nehru Krishi Viswavidyalaya, Jabalpur, Madhya Pradesh, for undertaking Ph.D. programmes on tuber crops. During the period, the Institute has offered exposure trainings to students and imparted technical guidance to Ph.D. programmes and project work of M.Sc. students. Besides, the scientists of ICAR-CTCRI have handled courses at College of Agriculture, Vellayani for the students of B.Sc.-M.Sc. (Integrated) Biotechnology.

Sl. No.	Particulars of the programme	Number of students/scholars
1.	B.Sc./B.Tech project work	101
2.	M.Sc. project work	13
3.	B.Sc.-M.Sc. (Integrated) Biotechnology	01
4.	Ph.D.	22

Training Programmes

A total of 749 farmers, 727 officials and 315 students from different parts of the country had undergone training at ICAR-CTCRI. They were trained on the recent technologies of tuber crops for enhancing productivity and profitability in farming.

On-campus training programmes

Sl. No.	Particulars of training	Date	Details of participants
1.	ICAR sponsored short course on Exploitation of genetic resources of underutilized tuber crops	02-11 February 2022	27 participants from different states of India

2.	ICAR sponsored short course on Novel processing and value addition technologies for augmenting entrepreneurial opportunities in tuber crops	15-24 February 2022	36 participants from different states of India
3.	Training on Improved technologies of tuber crops	26 April 2022	50 progressive farmers from Madurai under ATMA, Govt. of Tamil Nadu
4.	Online training programme on Extension strategies for scaling up of biofortified crops sponsored by MANAGE, Hyderabad, Telangana	23-27 May 2022	60 participants from different states of India
5.	Training on Smart farming using Electronic Crop *(e-Crop)* (TOSFUE-2022)	16 June 2022	200 farmers of Thiruvananthapuram
6.	Internship training programme on Improved technologies of tuber crops	23 June 2022 to 09 July 2022	7 B.Sc. (Ag.) students from VIT, Vellore, Tamil Nadu
7.	National awareness campaign on Organic farming (All India Network Programme on Organic Farming (AINP-OF))	04 August 2022	74 delegates, including farmers, students and academicians from Kerala
8.	Training on Improved processing technologies of tropical tuber crops	20-22 September 2022	15 officers from Department of Horticulture, Salem district, Tamil Nadu
9.	Certified Agritech Start-up Professional (CAgtSP) Programme in collaboration with KAU and Kerala Start-up Mission	10-12 October 2022	155 students from College of Agriculture, Vellayani, Thiruvananthapuram
10.	Internship training on Improved technologies of tropical tuber crops	07-12 November 2022	15 B.Sc. (Agriculture) students from Karunya Institute of Technology and Sciences, Coimbatore

11.	ICAR sponsored winter school on Sustainable exploitation of genetic resources of neglected and underutilized tuber crops for enhancing climate resilience and nutritional security	29 November to 19 December 2022	21 participants from different states of India
12.	National workshop on Smart management of agricultural resources to transform Indian farms (Smart IF)	15-17 December 2022	210 participants from different states of India

Trainings at Regional Station, ICAR-CTCRI, Bhubaneswar

Sl. No.	Particulars of training	Date	Details of participants
1.	Tuber crops technologies	18 May 2022	65 B.Sc. (Ag.) students from Agricultural College, Naira, Srikakulam of Acharya NG Ranga Agricultural University, Andhra Pradesh
2.	Tuber crops technologies and on-going programmes	27 October 2022	30 B.Sc. (Ag.) students from SOA Deemed to be University, Sri University, Cuttack and Jagannath University, Rajasthan
3.	Tuber crops technologies	28 October 2022	18 students of B.Sc. (Ag.) from SOA Deemed to be University as a part of RAWE internship training programme
4.	Agro-techniques and value addition in tropical tuber crops	03 November 2022	28 Agricultural Officers, VAWs, and ATMs representing Puri, Kendrapada, Khorda, Nayagarh, Cuttack, Jagatsingpur, Jajpur districts of Odisha organized by State Institute of Training & Extension, Bhubaneswar
5.	Agro-techniques and value addition in tropical tuber crops	13 December 2022	72 Agricultural Officers, VAWs, and ATMs representing all the 30 districts of Odisha organized by State Institute of Training & Extension, Bhubaneswar

On-campus training programmes by Techno Incubation Centre

Sl. No.	Particulars of training	Date	Details of participants
1.	Value addition and entrepreneurship development in tuber crops	12 January 2022	13 VFPCK farmers from Kollam, Kerala
		25 February 2022	21 VFPCK farmers from Chathannoor, Kollam, Kerala
		08 March 2022	20 Women from Rotary Club, Thiruvananthapuram, Kerala
		15 March 2022	29 farmers from Krishi Bhavan, Elakamon, Thiruvananthapuram, Kerala
		24 March 2022	12 farmers from Krishi Bhavan, Perinthalmanna, Malappuram, Kerala
		31 March 2022	20 farmers from different districts of Kerala
		04 May 2022	26 farmers from Attappadi, Kudumbasree, Muvattupuzha FPO, Kerala
		19 May 2022	17 farmers from VFPCK Kollam, Kerala
		06 June 2022	14 officials from FPO under NMDCS Ltd, Wayanad, Kerala
		08 June 2022	21 farmers from ATMA, Malappuram, Kerala
		09 June 2022	10 farmers from ATMA, Palluruthy Block, Ernakulam, Kerala
		17 June 2022	41 farmers from ATMA, Sasthamkotta, Kollam, Kerala
		02 August 2022	37 farmers from ATMA, Chathannoor, Kollam, Kerala

2.	Value added products for farmer centric entrepreneurship	09 August 2022	20 officials from NABARD, Thiruvananthapuram, Kerala
		23 August 2022	33 farmers from Kerala
		24 August 2022	22 participants from SAMETI, Anayara, Thiruvananthapuram, Kerala
		15 September 2022	20 participants from Thiruvithamkore Farmers Producers Organisation, Vazhoor, Kottayam, Kerala
		23 September 2022	12 farmers from KVK, Kanyakumari, Tamil Nadu
		24 September 2022	22 participants from FPO Kannur and Cooperative Bank, Malappuram, Kerala
		11-17 October 2022	13 farmers and officials from Manipur, AICRP TC NEH programme
		18-19 October 2022	04 officials from Chirakadav Cooperative Bank, Kottayam, Kerala
		04 November 2022	48 participants from DIC, Thiruvananthapuram, Kerala
		15 November 2022	27 farmers from Peermade Development Society FPOs, Idukki, Kerala
		17 November 2022	27 participants from Women Welfare Association, Vaduvanchal, Wayand, Kerala
		18 November 2022	14 trainees from SAMETI, Anayara, Thiruvananthapuram, Kerala
3.	Quick cooking tubers	22 November 2022	03 MoU signees, APCOS, Muvattupuzha, Ernakulam, Kerala
4.	Value addition and entrepreneurship development in tuber crops	07-08 December 2022	37 officials from Cooperative Banks, Kerala
		12 December 2022	30 officers and farmers from BIO mountain FPO, Thalassery, Kannur, Kerala
		13 December 2022	25 CFRD students, Konni, Pathanamthitta, Kerala
		20 December 2022	15 participants from DIC Kollam, Kerala
		21 December 2022	26 participants from Teachers Training Programme under DST project
		22-23 December 2022	03 MoU signees from Mythri FPO, Uzhavoor, Kottayam, Kerala
		27 December 2022	26 farmers from Krishi Bhavan, Vaikkom, Kottayam, Kerala

Resource person in training programmes

More than 250 classes on varieties, quality planting materials, production, organic farming, natural farming, protection, mechanization, processing, value addition, smart farming, entrepreneurship etc. were handled through online and offline mode by the scientists of various divisions/ sections and regional station, Bhubaneswar under different programmes within and outside the Institute beneficial to department officials, subject matter specialists, students and farmers all over the country.

Exposure visit cum training programme

One day exposure visit cum training on 'Improved technologies of tuber crops' was organized for the benefit of 563 farmers, 1720 students and 173 officials across the nation at ICAR-Central Tuber Crops Research Institute, Sreekariyam, Thiruvananthapuram. A total of 823 farmers and other stakeholders were trained at ICAR-CTCRI, Regional Station, Bhubaneswar.

Trainings attended by ICAR-CTCRI Staff

Scientific staff

Sl. No.	Name of scientist	Particulars of the training	Period
1.	Dr. C. Visalakshi Chandra	Advanced statistical techniques for data analysis using R at ICAR-Indian Rice Research Institute, Hyderabad, Telangana	03-15 January 2022
2.	Dr. C. Pradeepika	Short course on Exploitation of genetic resources of underutilized tuber crops at ICAR-CTCRI, Thiruvananthapuram, Kerala	02-11 February 2022
3.	Dr. Sheela Immanuel	Competency enhancement programme for effective implementation of training functions by HRD Nodal officers of ICAR organized by ICAR-NAARM, Hyderabad, Telangana (Online mode)	21-23 February 2022
4.	Dr. K.M. Senthilkumar	Short course on *Phytophthora*: From isolation to functional genomics at ICAR-IISR, Kozhikode, Kerala	02-11 March 2022

5.	All Scientists	Training programme on Intellectual property rights as part of awareness programme under national intellectual property awareness mission organized by Intellectual Property Office, New Delhi at ICAR-CTCRI, Thiruvananthapuram, Kerala	14 March 2022
6.	Dr. T. Krishnakumar	Advancement and challenges in food packing industry, organized by PHD Chamber of Commerce and Industry, New Delhi	23-24 March 2022
7.	Dr. H. Kesava Kumar	Capacity building workshop in Nematode taxonomy organized by Chaudhary Charan Singh University, Meerut, Uttar Pradesh	21-28 March 2022
8.	Dr. E.R. Harish	Trainer's training on mass production and release techniques of *Anagyrus lopezi* for the classical biological control of cassava mealybug in India at ICAR- NBAIR, Bengaluru, Karnataka	31 May 2022
9.	Dr. T. Krishnakumar	Statistical techniques for agriculturists organized by Indian Institute of Technology, Kanpur (Online mode)	16 June-26 July 2022
10.	Dr. K.M. Senthilkumar	National workshop-cum-webinar on Genome Editing, Glostem, Chandigarh	27 June-03 July 2022
11.	Dr. T. Krishnakumar	Training programme on Agripreneurship through banana based technologies-An avenue for Atma Nirbhar Bharat by MANAGE, Hyderabad, Telangana & ICAR-National Research Centre for Banana, Trichy, Tamil Nadu (Online mode)	15-17 July 2022

12.	Dr. K.M. Senthilkumar	Genetically Engineered (GE) plants: Biosafety considerations, policies, challenges and detection strategies at ICAR-NBPGR, New Delhi (online mode)	19-25 July 2022
13.	Dr. T. Krishnakumar	National campaign workshop on Conservation of fish biodiversity & protection of farmer rights organized by Zonal Technology Management & Agribusiness Incubation (ZTM-ABI) Centre, ICAR-CIFT in association with KVK, CMFRI, Kochi, Kerala (Online mode)	25 July 2022
14.	Dr. T. Krishnakumar	Engineering interventions in post-harvest fisheries sector organized by ICAR-CIFT, Kochi, Kerala	29 July 2022
15.	Dr. M.N. Sheela	Training on IP awareness organized by Office of the Comptroller General of Patents, Designs and Trade Marks, Government of India (Online mode)	05 August 2022
16.	Dr. C. Pradeepika	Workshop on Response surface methodology organized by ICAR-NAARM, Hyderabad, Telangana (Online mode)	18-20 August 2022
17.	Dr. P. Sethuraman Sivakumar	Advanced certificate course on International trade & customs laws organised by The Confederation of Indian Industry (CII), Southern Region, Chennai, Tamil Nadu (Online mode)	14 October- 04 November 2022
18.	Dr. K.I. Asha Dr. A . Asha Devi Dr. Shirly Raichal Anil	Training workshop on Analysis of multi-environment trials organized by ICAR-NAARM, Hyderabad, Telangana (Online mode)	03-08 November 2022

19.	Dr. B.G. Sangeetha Dr. T.P. Sujatha	ICAR sponsored winter school on Sustainable exploitation of genetic resources of neglected and underutilised tuber crops for enhancing climate resilience and nutritional security at ICAR-CTCRI, Thiruvananthapuram, Kerala	29 November- 19 December 2022
20.	Dr. T. Krishnakumar	Workshop on Energy transition in agricultural sector organized by Energy Management Centre, Thiruvananthapuram, Kerala	28-29 December 2022

Technical staff

Sl. No.	Name of the staff	Particulars of the training	Period
1.	Smt. B.S. Deepa	Knowledge management for agricultural librarians and information professionals organized by MANAGE, Hyderabad (Online mode)	16-17 February 2022
2.	Smt. B.S. Deepa	Advanced training programme on D space software organized by Knowledge Centre, Digital University of Kerala	09-13 May 2022

Awards and Recognitions

1. ICAR-CTCRI bagged the 14th Rank among all ICAR Institutes in the combined list of Ranking of Institutes of Indian Council of Agricultural Research for the year 2019-20 and 2020-21 (Combined) as per the reference F.No. 13(37) /2017 /Cdn (Tech) dated 28 September 2022 from ICAR, New Delhi. (Editors of the ranking document during 2019-20: Drs. Byju, G., Jaganathan, D., Sanket J. More and Senthilkumar, K.M. and during 2020-2021: Drs. Murugesan, P., Koundinya, A.V.V. and Jaganathan, D.).
2. Dr. J. Suresh Kumar bagged the Young Scientist Award-2022 from the Society of Tropical Agriculture, New Delhi at the 14th International Conference on Agriculture, Horticulture and Food Sciences (ICAHFS) 2022, held during 17-18 December 2022 at New Delhi.
3. Dr. J. Suresh Kumar bagged the Best Paper Award-2022 from the Society of Tropical Agriculture, New Delhi at the 14th International Conference on Agriculture, Horticulture and Food Sciences (ICAHFS) 2022, held during 17-18 December 2022 at New Delhi.
4. Dr. C. Visalakshi Chandra bagged the Best Oral Presentation Award for the research paper titled 'Evaluation of cassava hybrids for postharvest physiological deterioration tolerance and other important traits for varied industrial uses' (Authors: Visalakshi Chandra, C., Sheela, M.N., Sreekumar, J. and Jyothi, A.N.) in the International Conference on Advances in Agriculture and Food Systems towards Sustainable Development Goals held during 22-24 August 2022 at University of Agricultural Sciences, Bengaluru.
5. Dr. Kalidas Pati bagged the Best Research Paper Award for Scientist (2021) as first author for the paper titled 'Element profiling of thirty genotypes of yam bean in eastern India by using proton induced X-ray emission (PIXE)', published in Journal of Food Composition and Analysis (NAAS score: 9.72) during ICAR-CTCRI Foundation Day Celebrations on 27 July 2022.
6. Dr. P. Murugesan received the Fellow of Society for Promotion of Oil Palm Research and Development for the year 2022 for his outstanding contributions to plantation crops-Oil palm.

7. Dr. S.S. Veena received the Fellow of Indian Phytopathological Society (FPSI 2021) from Indian Phytopathological Society, New Delhi.

8. Dr. M. Nedunchezhiyan bagged the Distinguished Horticultural Scientist Award-2020 for his significant contributions to Horticultural Sciences, on 27 April 2022 from the Society for Horticultural Research and Development, New Delhi.

9. Dr. V.B.S. Chauhan was awarded the Best Poster Award for the research paper titled 'Screening of taro (*Colocasia esculenta* L.) genotypes for salt tolerance under *in vitro* condition' (Authors: Chauhan, V.B.S., Reshmi Das, Kalidas Pati, Arutselvan, R. and Nedunchezhiyan, M.) in the International Conference on Agriculture for Sustainable Future (Agrivision 2022) held during 06-08 March 2022 at Ravenshaw University, Cuttack, Odisha.

10. Dr. Kalidas Pati was awarded the Best Oral Presentation Award for the research paper titled 'Molecular and biochemical characterization of tuberous legume crop yam bean [*Pachyrhizus erosus* (L.) Urban]' (Authors: Kalidas Pati, Jeen Linkan Meher, Biswajit Jena, Anant Kumar, Nedunchezhiyan, M., Chauhan, V.B.S. and Arutselvan, R.) in the International Conference on Agriculture for Sustainable Future (Agri Vision -2022) held during 06-08 March 2022 at Ravenshaw University, Cuttack, Odisha.

11. Ms. S.U. Shilpa received the Best Oral Presentation Award for the research paper titled 'Studies on endophytes isolated from taro having antagonistic activity against *Phytophthora colocasiae*' (Authors: Shilpa, S.U., Jeeva, M.L., Amrutha P.R. and Tom Cyriac) in National Webinar on Advances in Industrial Biotechnology held during 03-04 February 2022 at Department of Biotechnology, University of Kerala.

12. Dr. D. Jaganathan bagged ICAR-CPCRI Best Scientific Team Research Award 2022 on 05 January 2022 during Foundation Day Celebrations of ICAR-CPCRI, Kasaragod for the team research on EPN for the management of root grubs in arecanut and coconut gardens in Karnataka and Kerala.

Publications

Sl. No.	Publication	Number
1.	Research paper	54
2.	Research paper presentations in Seminar/ Conference/Symposia/Workshop	33
3.	Books	05
4.	Book Chapters	25
5.	Technical Bulletins	05
6.	Technical Folders/Leaflets/Pamphlets	31
7.	Popular Articles	58
8.	Training Manuals	03
9.	Chapters in Course/Training Manuals	19
10.	Institute Publications	04
11.	Radio Talks	03
12.	TV Programmes	08
	Total	**248**

Ongoing Projects

Institute projects : 42

Externally aided projects : 23

Developmental projects : 03

Visit Abroad

Name of the Scientist	Period	Place of visit	Purpose
Dr. G. Suja	13-15 October 2022	Goesan County, South Korea	Participated in the Fifth Organic Asia Congress on Transcending Borders and Generations for an Organic Asia and presented an invited lead lecture 'Organic management fosters yield, income, quality and soil health: Eighteen years of evidence in tropical tuber crops'.

Distinguished Visitors

1. Mr. V. Muraleedharan, Hon'ble Union Minister of State for External Affairs and Parliamentary Affairs, Government of India.
2. Smt. L.R. Aarathi, Mission Director, State Horticulture Mission, Government of Kerala.
3. Dr. N.K. Krishna Kumar, Former DDG (Hort. Sci.), Indian Council of Agricultural Research, New Delhi.
4. Dr. Vikramaditya Pandey, ADG (Hort. Sci.), Indian Council of Agricultural Research, New Delhi.
5. Dr. S.K. Pandey, Former Director, ICAR-Central Potato Research Institute, Shimla.
6. Dr. K. Umamaheswaran, Former Professor, College of Agriculture, Vellayani, Thiruvananthapuram.
7. Dr. Sanjaya Kumar Dash, Dean, College of Agricultural Engineering and Technology, Odisha University of Agriculture and Technology, Bhubaneswar.
8. Dr. P.M. Govindakrishnan, Former Project Coordinator, ICAR-Central Potato Research Institute, Shimla.
9. Dr. H. Philip, Former Director (Extension), Tamil Nadu Agricultural University, Coimbatore.
10. Dr. P. Pugazhendi IFS, Additional Principal Chief Conservator of Forests, Government of Kerala.
11. Dr. C. Anandharamakrishnan, Director, CSIR–National Institute for Interdisciplinary Science and Technology, Thiruvananthapuram.
12. Mr. Anoop P. Ambika, Chief Executive Officer, Kerala Start-up Mission.
13. Dr. Roy Stephen, Dean of Faculty, College of Agriculture, Vellayani, Thiruvananthapuram.

14. Shri. Rishi Raj Singh IPS, Retired Director General of Police, Government of Kerala.
15. Mr. A. Nizamudeen, Commissioner, Kerala State Land Use Board, Government of Kerala.
16. Dr. Jacob John, Director of Extension, Kerala Agricultural University, Vellanikkara, Thrissur.
17. Dr. G. Gopakumaran Nair, Chief General Manager, NABARD, Kerala and Lakshadweep region.
18. Dr. Manoj P. Samuel, Executive Director, Centre for Water Resources Development and Management, Kozhikode.
19. Prof. J. Adinarayana, Professor, Centre for Studies in Resources Engineering, Indian Institute of Technology, Bombay.
20. Prof. K.G. Satheesh Kumar, Visiting Professor, Digital University Kerala.
21. Prof. (Dr.) G.M. Nair, Director, Central Laboratory for Instrumentation and Facilitation Centre (CLIFF), University of Kerala.

Other Information

State Level Stakeholders Interface cum Farmers' Fair

The ICAR-Central Tuber Crops Research Institute organized the Nationwide Live Web Telecast of Hon'ble Prime Minister's address and State Level Stakeholders Interface cum Farmers' Fair on 31 May 2022. The programme was inaugurated by Mr. V. Muraleedharan, Hon'ble Union Minister of State for External Affairs and Parliamentary Affairs, Govt. of India. In his inaugural address, he highlighted about the growth and development of the country, by integrating economic growth with the welfare of the people under the eminent leadership of Honourable Prime Minister Shri. Narendra Modi during the last eight years. He emphasized about the latest developments in agriculture, especially the commercial production of liquid nano-urea. He congratulated the scientists of ICAR-CTCRI for developing technologies like bio-fuel from cassava. He released the PIB Report depicting the achievements of Govt. of India during the last eight years and felicitated four farmers. Dr. M.N. Sheela, Director (A), ICAR-CTCRI in her presidential address stressed the importance of technologies developed by ICAR-CTCRI for doubling farmer's income. Hon'ble Prime Minister Shri. Narendra Modi addressed the gathering through live web telecast. He said that more than 10 crore farmers of India were benefitted through direct beneficiary transfer scheme worth ₹ 21,000 crores. He emphasized the triple power of 'Jan Dhan account, Aadhaar card and Mobile linked bank accounts' in the formation of New India. Various schemes of Govt. of India are now easily accessible to the poor and economically weaker section with the adoption of technologies. With more than 45 crores Jan Dhan accounts, a total of ₹ 22 lakhs have been distributed so far since last eight years through various schemes. Technical sessions on centre and state government agricultural schemes and integrated farming systems were organized after PM's live web telecast. State Bank of India, NABARD and Indian Society for Root Crops were the collaborators. As a part of the event, exhibitions and field visits were also arranged for the farmers and other stakeholders. More than 2000 farmers from different parts of Kerala participated in this programme.

Participation in Exhibitions

ICAR-CTCRI participated in the following exhibitions for the benefit of farmers and other stakeholders. Large number of farmers, college and school students, industrialists and other general public acquired knowledge on improved technologies of tuber crops.

1. Exhibition in connection with Field day cum harvest festival on Improved variety of cassava 'Sree Athulya' and Distribution of critical inputs on 25 February 2022 at Goodamalai, Salem, Tamil Nadu.
2. Exhibition in connection with Training on Improved technologies of tuber crops for enhancing farm income on 04 March 2022 at Kovvur, West Godavari, Andhra Pradesh.
3. Exhibition in connection with Stakeholders interface on Improved technologies of tuber crops on 09 March 2022 at Mekkarai, Tenkasi, Tamil Nadu.
4. Exhibition in connection with Stakeholders interface on Improved technologies of tuber crops on 10 March 2022 at P. Pothukudi, Tirunelveli, Tamil Nadu.
5. Exhibition in connection with Stakeholders interface on Mechanization in Chinese potato on 23 March 2022 at Tirunelveli and Tenkasi districts of Tamil Nadu.
6. Exhibition in connection with 75th Anniversary celebrations of ICAR-CPCRI, Regional Station, Kayamkulam on 24 April 2022 at Kayamkulam, Alappuzha, Kerala.
7. Exhibition in connection with State level stakeholders interface cum farmers fair on 31 May 2022 at ICAR-CTCRI, Thiruvananthapuram, Kerala.
8. Exhibition on value added products on 22 August 2022 at Parakode, Kollam, Kerala.
9. Exhibition in connection with Gramolsavam of Chenkal panchayat during 05-10 September 2022 at Chenkal, Thiruvananthapuram, Kerala.
10. Exhibition in connection with Krishidarshan during 25-29 October 2022 at Mannuthy, Thrissur, Kerala.

Hindi Corner

During the year 2022, four meetings of the Official Language Implementation Committee (OLIC) was held on 16 March, 29 June, 23 September and 13 December 2022 to review the progress of work, under the Chairmanship of Dr. M.N. Sheela, Director (A) and Chairperson of the Official Language Implementation Committee, ICAR-CTCRI, Thiruvananthapuram. The Director reviewed the progress of the activities during the year and expressed her satisfaction. During the meetings, various points related to OLIC were raised, discussed and decisions were implemented. All quarterly

performance reports were sent to the Council for their compliances. Dr. A. Asha Devi, Principal Scientist and Liaison Officer and Shri. M. Padmakumar, Private Secretary & Member Secretary (OLIC) carried out the OL activities at the Institute. During the year the library purchased Hindi journals/magazines/ books etc. Necessary orders were given to the establishment section for making necessary entries in the service records of awardees of various Hindi competitions.

Hindi workshop was conducted on 25 March 2022 by Dr. Mahendra Sawant, Associate Professor and Head, Department of Yoga and Rajbhasha, LNCPE, Thiruvananthapuram on the topic, 'Official Language Policy and its Implementation in Central Government Offices' for the staff and students of the Institute. This was followed by the Valedictory function of the Hindi fortnight celebrations 2021 on 26 March 2022, where Dr. Mahendra Sawant was the Chief Guest. The Incentive Scheme Award 2022 was bagged by Shri. M. Padmakumar, for carrying out maximum official work in Hindi. Shri. Padmakumar also won accolades for doing original work in Hindi from the TOLIC-I. The Institute celebrated the Hindi fortnight during 14-28 September 2022 both at the headquarters and at the Regional Station of ICAR-CTCRI, Bhubaneswar, Odisha with various competitions for the staff and awareness was created for the use of Hindi language for official works. Officials from the OLIC, ICAR-CTCRI participated in the TOLIC-I meetings held on 21 February, 15 March and 16 September 2022.

Library

Library activities are mostly confined to necessary information support services for the research and training activities of the Institute and Regional Station, Bhubaneswar. One Ph.D. thesis, 17 M.Sc. theses, 2 B.Sc. theses and 45 books (7 Hindi books, 38 scientific books and one set of ICAR publication entitled 'Inventory of Indigenous Technical Knowledge in Agriculture' were added. In addition, the following services were also made available to the users of the library. A total of 176 books were issued to the users on loan; A total of 7382 hits were received through various CeRA services like Full text/Abstracts views, ILL request and table of contents browsing etc.; About 474 users availed the facility by using reference documents like International Symposium proceedings, Thesis, Dictionaries, very old and rare books related to International Symposium on tropical root and tuber crops. Library continued to provide photocopying service to the Institute staff and other library users on official/payment basis.

State of art of Mera Gaon Mera Gaurav

ICAR-CTCRI, Thiruvananthapuram and its Regional Station implemented the MGMG programme in collaboration with the other stakeholders' viz., Department of Agriculture and Horticulture,

Krishi Vigyan Kendra, grama panchayat, progressive farmers etc. Interface meetings, training programmes, demonstration of improved practices, farm advisory visits, mobile advisory services were organized in the selected villages for the benefit of farming community. A total of 42 scientists adopted 42 villages for the overall development of the villages through various programme as given below.

Activities undertaken

Sl. No.	Name of the activity	No. of activities conducted	No. of farmers participated & benefited
1.	Visit to village by teams	24	431
2.	Interface meetings/Gosthis	13	818
3.	Trainings organized	12	531
4.	Demonstrations conducted	6	74
5.	Mobile based advisories	111	135
6.	Literature support provided	13	1421
7.	Awareness created	10	430
	Total	**189**	**3840**

Mobile-based advisories (111 nos.), were given on improved varieties, tuber crop production, nutrient management, value addition, decision support tool for cassava nutrient management, pest and disease management in various crops, application of bio-pesticides for management of different pests and diseases, cassava marketing, vegetable cultivation and manuring in coconut. Training materials including publications and technical leaflets were supplied to 1421 farmers. Planting materials of cassava, sweet potato, yam, elephant foot yam and taro were given to 74 farmers. Soil health cards were distributed to the selected farmers in MGMG villages. Production technologies of cassava, sweet potato, yams and elephant foot yam and balanced application of fertilizers based on soil test data were advised to farmers.

Lack of awareness about biofortified and nutrient rich varieties in tuber crops, lack of awareness about valued added products in tuber crops, shortage of labour, price fluctuations, nematode and secondary fungal infection in elephant foot yam, cassava mosaic disease, root rot in cassava, red spider mite in cassava, sweet potato weevil, nonavailability of quality planting materials, banana pseudostem weevil, anthracnose in greater yam, fungal infection in elephant foot yam, nutritional deficiencies, wild animals attack and lack of storage facilities were the major problems faced in the MGMG villages.

Linkages were created with Parassala Block Panchayat; Krishi Bhavan, Venganoor; Venganoor Grama Panchayat; Krishi Bhavan, Pallichal; Mangalapuram Grama Panchayat in Kerala; Pubusahi Gram Panchayat, Khurda; Madhuban Gram Panchayat, Barang; Department of Agriculture and Horticulture, Khurda and Barang blocks in Odisha.

Swachh Bharat Abhiyan: Special Campaign 2.0 for Disposal of Pending Matters

The Swachhta Special Campaign 2.0 for the disposal of pending matters started on Gandhi Jayanthi 153rd birth anniversary of Mahatma Gandhi at ICAR-CTCRI, Thiruvananthapuram on 02 October 2022. Swacchhta Pledge (in Hindi and English) was taken and a human chain was formed by all staff in front of main building on 10 October 2022, followed by cleanliness drive at Block I, ICAR-CTCRI, Thiruvananthapuram.

The spots or places in office which need to be cleaned or cleared of scrap items were identified. During the various collective cleaning drives organized from 02-31 October 2022, plastic waste, papers, weeds, scrap items from the Institute and farm premises such as vehicle parking shed, canteen, sales counter, road sides near biopesticide lab, biotechnology lab and techno-incubation centre were removed. Old, broken and discarded furniture were removed from the corridors of staff canteen and potted plants were kept near the entrance. Old newspaper of about 324 kg were sold out from the library, ICAR-CTCRI generating a revenue of ₹ 9396. An essay competition in English and Malayalam on 'Startup for Swachh Bharat' was organised for final year B.Sc. (Ag.) students from College of Agriculture, Vellayani, Thiruvananthapuram. A poster competition and a slogan competition on Swachh Bharat were held for the staff of ICAR-CTCRI. Two outdoor campaigns at Government UPS School, Cheruvaikkal on 13 October 2022 and at Government Old Age home at Pulayanarkota, Thiruvananthapuram on 18 October 2022 were conducted as part of special campaign 2.0 on Swachhta at ICAR-CTCRI, Thiruvananthapuram led by Dr. M.N. Sheela, Director (A). All staff members collectively cleaned the school or old age home premises of trash, plastic bottles, waste papers, dried leaves, weeds etc. During the valedictory session held on 31 October 2022, the Chief Guest, Shri Shibu K. Nair, Organics Campaigner, GAIA (Global Alliance for Incinerator Alternatives) Asia Pacific, delivered a talk on 'Know your waste'. Prizes for various competitions such as slogan and poster competition, best lab, room/cabin and division of ICAR-CTCRI, Swachhta Soldier or Swachhta Sevak prize for 10 best participants for most active participation etc. were distributed. The house keeping staff of ICAR-CTCRI were also felicitated on the occasion.

The ICAR-CTCRI Regional Station, Bhubaneshwar also conducted two outdoor campaigns at Syez Mumtaz Ali Govt. High School, Dumuduma, Khandagiri, Bhubaneswar on 28 October 2022

and special swachhta campaign awareness programme at Pubusahi village, Khordha District, Bhubaneswar on 29 October 2022. Cleaning drives were also held from 25-31 October 2022 near sub road at Regional Station, Bhubaneswar.

Swachhta Pakwada

Swachhta pledge was taken in English and Hindi at the Millennium Hall, ICAR-CTCRI, Thiruvananthapuram on 16 December 2022. A tender notice for disposal or auction of old, condemned or obsolete equipments and machineries was published in ICAR-CTCRI, Thiruvananthapuram website on 19 December 2022. Cleaning drives and weeding were organised in the office premises, near techno-incubation centre of Block I, II and III of ICAR-CTCRI, Thiruvananthapuram. The trash was segregated into plastic waste, paper wastes and crop residues. After segregation, plastic wastes were removed from the sites and the paper wastes and crop residues were cleared. The nutrient enriched vermicompost '*Sree Amrutham*' made using organic wastes, crop residues, banana pseudostem, dried leaves etc. from the Integrated Organic Farming System (IOFS) unit of ICAR-CTCRI farm was released by Dr. S.K. Chaudhari, Deputy Director General (NRM), ICAR, as part of the All India Network Programme on Organic Farming (AINP-OF) on 28 December 2022. An outdoor swachhta campaign (cleaning drive) was organized at Government Taluk Homeo hospital/clinic, Karakulam village, Nedumangad block panchayat along with the *Mera Gaon Mera Gaurav* (MGMG) programme in the MGMG adopted village (Karakulam) led by Dr. M.N. Sheela, Director (A), ICAR-CTCRI.

The swachhta pakhwada programme at ICAR-CTCRI, Regional Station, Bhubaneswar was held during 16-31 December 2022, where all the staff participated in cleaning the Institute premises, main road and sub roads.

Important Events

Sl. No.	Name of the event	Date
1.	Institute Biosafety Committee Meeting (IBSC)	19 January 2022
2.	ICAR Sponsored Short Course on Exploitation of Genetic Resources of Underutilized Tuber Crops	02-11 February 2022
3.	9th Research Advisory Committee (RAC-IX) Meeting	18-19 March 2022
4.	Tuber Day at Regional Station, Bhubaneswar	22 March 2022
5.	48th Annual Institute Research Council Meeting	20-22 April 2022
6.	22nd Annual Group Meeting of the All India Coordinated Research Project on Tuber Crops at ICAR-RC for NEH region	11-13 May 2022
7.	Training on Scaling up of Biofortified Varieties	09-13 May 2022
8.	State Level Stakeholders Interface cum Farmers' Fair	31 May 2022
9.	Training on Smart farming using Electronic Crop (e-Crop) (TOSFUE-2022)	16 June 2022
10.	Awareness Campaign on Balanced Use of Fertilizers	21 June 2022
11.	RINK Demo Day on Tuber Crops Technologies	28 June 2022
12.	59th Foundation Day Celebrations	27 July 2022
13.	National Webinar on Genetic Resources of Underutilized Tuber Crops for Nutritional Security	27August 2022
14.	Institute Biosafety Committee Meeting (IBSC)	21 September 2022
15.	XXVI Meeting of ICAR Regional Committee-II at ICAR-National Rice Research Institute, Cuttack, Odisha	14 October 2022
16.	Rashtriya Mahila Kisan Diwas	15 October 2022

17.	PM Kisan Samman Sammelan 2022	17 October 2022
18.	MoU signed with TANUVAS for creating Satellite Incubation Centre (SIC)	19 October 2022
19.	Certified Agritech Startup Professional (CAgtSP) Programme	10-12 October 2022
20.	Vigilance Awareness Week Celebrations 2022	31 October 2022 to 06 November 2022
21.	ICAR Sponsored Winter School on Sustainable Exploitation of Genetic Resources of Neglected and Underutilized Tuber Crops for Enhancing Climate Resilience and Nutritional Security	29 November 2022 to 19 December 2022
22.	World Soil Day 2022	05 December 2022
23.	Inauguration of SIC and Cookathan Contest at KVK, Kallakurichi	13 December 2022
24.	National Workshop on Smart Management of Agricultural Resources to Transform Indian Farms (SmartIF)	15-17 December 2022
25.	DST-SERB Sponsored Workshop on Cherishing Scientific Minds for Nourishing Human Health	20-21 December 2022
26.	Tuber Crops Harvest Day at Regional Station, Bhubaneswar	22 December 2022
27.	Stakeholders Meeting for MoU on Nutrition-sensitive Agricultural Interventions	23 December 2022

Weather Data 2022

ICAR-CTCRI, Headquarters, Thiruvananthapuram, Kerala

Month	Temperature (°C)		Relative Humidity (%)		Rainfall (mm)	No. of rainy days
	Min.	Max.	FN	AN		
January	23.29	30.71	89.90	67.74	4.06	1
February	24.00	30.92	88.46	65.86	54.10	2
March	24.94	31.92	85.81	64.73	0.76	0
April	24.80	32.02	89.17	71.11	202.69	11
May	25.13	30.88	89.30	74.71	312.42	16
June	24.82	30.31	88.16	75.92	138.18	12
July	24.26	29.59	88.43	77.32	125.48	12
August	24.29	29.05	89.43	78.61	184.14	11
September	24.77	30.19	89.08	77.13	105.92	7
October	24.25	30.02	90.36	75.34	311.91	12
November	23.73	30.15	91.40	70.76	91.95	6
December	23.56	30.50	90.69	69.60	82.30	5

ICAR-CTCRI, Regional Station, Bhubaneswar, Odisha

Month	Temperature (°C)		Relative Humidity (%)		Rainfall (mm)	No. of rainy days
	Min.	Max.	FN	AN		
January	14.90	26.90	94	50	29.10	4
February	17.70	30.50	95	70	41.10	1
March	23.60	35.40	94	72	0.00	0
April	26.50	37.70	93	75	57.40	2
May	26.60	35.90	94	80	128.50	7
June	26.80	34.80	93	85	206.40	12
July	26.20	32.40	96	91	342.10	17
August	25.80	32.40	94	89	278.40	15
September	25.50	31.70	95	90	332.30	16
October	23.20	32.10	92	82	50.90	5
November	18.40	30.40	82	48	0.00	0
December	16.00	29.10	87	43	0.00	0

CTCRI/QSF/RP/400

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