The 3 A's of the Division of Crop Improvement…

Achievements, Aspirations & Action Plan

भाकृअनुप– केंद्रीय कंद फसल अनुसंधान संस्थान

श्रीकार्यम, तिरुवनंतपुरम 695017, केरल, भारत

ICAR-Central Tuber Crops Research Institute

(Indian Council of Agricultural Research)

SREEKARIYAM, THIRUVANANTHAPURAM 695 017, KERALA, INDIA

The 3 A's of the Division of Crop Improvement

Achievements, Aspirations and Action Plan

भाकृअनुप– केंद्रीय कंद फसल अनुसंधान संस्थान
श्रीकार्यम, तिरुवनंतपुरम 695017, केरल, भारत
ICAR-Central Tuber Crops Research Institute
(Indian Council of Agricultural Research)
SREEKARIYAM, THIRUVANANTHAPURAM 695 017, KERALA, INDIA

ICAR-Central Tuber Crops Research Institute
Sreekariyam, Thiruvananthapuram 695 017, Kerala, India
Tel: (91) (471) 2598551 to 2598554
E-mail: director.ctcri@icar.gov.in
Website: https://www.ctcri.org

Published by
Dr. G. Byju
Director

Compiled and Edited by
Manas Ranjan Sahoo
M.N. Sheela
A. Asha Devi
N. Krishna Radhika
C. Visalakshi Chandra
P. Murugesan
K.I. Asha
C. Mohan
Shirly Raichal Anil
L.K. Bharathi
K.M. Senthilkumar
T.P. Sujatha
S.N. Rahana

December 2024

Correct Citation

ICAR-CTCRI. 2024. The 3 A's of Division of Crop Improvement. Achievements, Aspirations and Action Plan, ICAR-Central Tuber Crops Research Institute, Sreekariyam, Thiruvananthapuram, Kerala, India, 28 p.

From the Director

Dr. G. Byju

Improving the tropical tuber crops through breeding and biotechnology holds significant promise for enhancing crop productivity, resilience, and nutritional quality. Tuber crops like cassava, sweet potato, yam, taro, and others are vital staples for millions of people, particularly in the tropical regions where they serve as a major source of carbohydrates. starch content of tubers is to be explored to bring out the immense scope of these crops to be recognised as an economically valuable industrial crop.

The Division of Crop Improvement focuses on the conservation of tropical tuber crops, curating over 5000 accessions, as ICAR-CTCRI is recognised as the National Active Germplasm Site (NAGS) for tropical tuber crops. The Division of Crop Improvement has as its mandate the traditional breeding methods involving selection as well as hybridization, which involves introgression of desirable traits to plants of interest, viz., high yield, disease resistance, tolerance to biotic and abiotic stresses, and improved nutritional content. This approach requires extensive field trials and several years to develop new varieties. The Division has released 71 high-yielding improved varieties, including climate-resilient, short-duration and bio-fortified varieties. The Division has recently ventured into modern speed breeding techniques integrating the Omics approaches, starting from genomics to phonemics, making use of Artificial Intelligence.

A total of nine bio-fortified varieties were released by the Division indicating the persistent efforts of the Division to improve the nutritional quality of tuber crops. Further research has been initiated for enriching these crops with vitamins, minerals, and other micronutrients to address malnutrition and improve public health in regions where tubers are dietary staples. Post-harvest losses due to spoilage are a significant concern, particularly in regions with inadequate storage facilities. The Division also focuses on the development of varieties tolerant to Postharvest Physiological Deterioration (PPD) in cassava.

Apart from the traditional methods, Biotechnology intervenes as an additional tool for crop improvement. Genetic engineering techniques like gene editing allow precise modification of plant genomes to introduce desirable traits or eliminate undesirable ones. Starch is the prime source of economic value in tuber crops, especially cassava. A new initiative has been made to genetically modify starch in cassava using CRISPR Cas9-mediated gene editing approaches.

Overall, the integration of breeding and biotechnology offers a powerful approach to enhancing tropical tuber crops, ensuring food security, and promoting sustainable agriculture in tropical regions. However, it's crucial to address regulatory, socio-economic, and ethical considerations to ensure that these technologies benefit farmers and consumers equitably while minimizing potential risks to human health and the environment.

This compendium stands as a beacon of inspiration and testament to the significant achievements, future aspirations, and strategic action plans of the Division of Crop Improvement. The division is working towards improving the tuber crops sector, which enriches lives, sustains livelihoods, and nourishes communities across the world.

G. Byju
Director

31 December 2024

Our Mission

1. To conserve the germplasm of tropical tuber crops both *ex situ* and under *in vitro* conditions.
2. To develop improved varieties for high yield, high starch, high dry matter, bio-fortified with vitamins, minerals and antioxidants, enhanced resistance to biotic and abiotic stresses, climate resilience, nutrient use efficiency, eco-regional suitability and adaptability to different cropping systems to cater to the industries as well as the food and fodder sector.
3. To intervene in the improvement of tuber crops through novel breeding approaches combining omics, both genomics and phenomics as well as other molecular biology tools.

Our Team

Scientific staff (15)

Sl.No.	Name	Designation
1.	Manas Ranjan Sahoo	Principal Scientist & Head
2.	P. Murugesan	Principal Scientist
3.	K.I. Asha	Principal Scientist
4.	C. Mohan	Principal Scientist
5.	A. Asha Devi	Principal Scientist
6.	Shirly Raichal Anil	Principal Scientist
7.	L. K. Bharathi	Principal Scientist
8.	Kalidas Pati	Senior Scientist
9.	N. Krishna Radhika	Senior Scientist
10.	C.Visalakshi Chandra	Senior Scientist
11.	K.M. Senthilkumar	Senior Scientist
12.	V.B.S. Chauhan	Senior Scientist
13.	K. Hanume Gowda	Scientist
14.	T.P. Sujatha	Scientist
15.	S.N.Rahana	Scientist

Technical (4) and SSS (1)

Sl.No.	Name	Designation
1.	G. Suresh	Technical Officer
2.	B.S. Prakash Krishnan	Technical Officer
3.	P.S. Shameer	Technical Assistant
4.	K. Chandran	Technician
5.	S.L. Jyothi	Skilled Support Staff

Ph.D. Scholars (5)

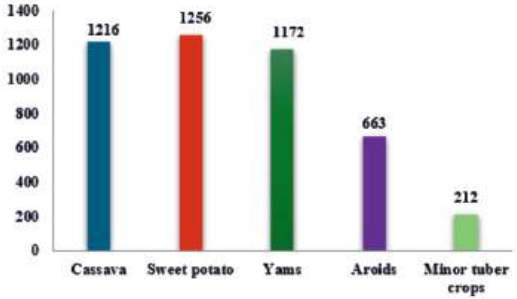
1.	U. Adarsh Krishnan	Ph.D. Scholar
2.	Reshma Maria Joseph	Ph.D. Scholar
3.	C. Nandini	Ph.D. Scholar
4.	M. Vismaya	Ph.D. Scholar
5.	Maria Treesa Joyas	Ph.D. Scholar

	Young Professional II	5
	Project Assistant	2
	Skilled Contract Staff	5
	Apprentice trainee	2

Our Achievements in Brief

1. Germplasm wealth

1. ICAR-CTCRI is the National Active Germplasm Site (NAGS) for tropical tuber crops conserving 5542 accessions comprising important tuber crops like cassava, sweet potato, yams, edible aroids and minor tuber crops. These include around 50 species.
2. The Field Gene bank (FGB) includes landraces collected from different states of India as well as exotic accessions from Africa, Latin America, China, the Pacific Islands, etc
3. Pre-breeding lines (inbreds, inter-specific backcross) of tuber crops and crop wild relatives (CWR) are conserved in the FGB/ net houses.



Status of germplasm maintained at ICAR-CTCRI

2. Conventional breeding for genetic improvement of tropical tuber crops

The Division of Crop Improvement has released 71 high-yielding improved varieties of tropical tuber crops, comprising 20 cassava, 21 sweet potato, 16 yams (9 *D. alata*, 5 *D. rotundata,* and 2 *D. esculenta*), 10 taro, 2 elephant foot yam and 1 Chinese potato. The varieties were developed to cater to the following categories –industrial, food and fodder.

Crop wise database of varieties released by ICAR CTCRI

Sl. No.	Crop/Variety	Main Developer	Release and notification	Important traits
	Cassava			
1.	H-97	M.L. Magoon, R. Krishnan, S.G. Appan and R.C. Mandal	1971	Yield: 25-35 t ha^{-1}. Industrial variety, tubers have 27-31% starch, 180-200 ppm cyanogen and good cooking quality, moderately resistant to *Cercospora* leaf spot, spider mite and scale insect.
2.	H-165	M.L. Magoon, R. Krishnan, S.G. Appan and R.C. Mandal	1971	Yield: 33-38 t ha^{-1}. Industrial variety, tubers have 23-25% starch, 150-165 ppm cyanogen and good cooking quality, field tolerant to spider mite and scale insect.
3.	H-226	M.L. Magoon, R. Krishnan, S.G. Appan and R.C. Mandal	1971	Yield: 30-35 t ha^{-1}. Industrial variety, tubers have 28-30% starch, 180-200 ppm cyanogens and good cooking quality, susceptible to CMD and *Cercospora* leaf spot, field tolerant to spider mite and scale insect.
4.	Sree Visakham	J.S. Jos, N. Hrishi and R.G. Nair	1977	Yield: 35-38 t ha^{-1}. Tubers with 25-27% starch, 466 IU/100g carotene, 35-40 ppm cyanogen having good cooking quality. Field tolerant to *Cercospora* leaf spot.
5.	Sree Sahya	J.S. Jos, N. Hrishi and R.G. Nair	1977	Yield: 35-40 t ha^{-1}. Long necked (4.5-6.5 cm) medium long cylindrical tubers with starch 29-31%, cyanogens 75-85 ppm, good cooking quality and moderately resistant to *Cercospora* leaf spot.
6.	Sree Prakash	R.B. Nair, P.G. Rajendran and G.G. Nayar	1987	Yield: 30-35 t ha^{-1}. Cylindrical, short necked, shallow bulking radially arranged tubers with 29-31% starch, 30-50 ppm cyanogen having good cooking quality and highly tolerant to *Cercospora* leaf spot.
7.	Sree Harsha	J.S. Jos, M.T. Sreekumari, S.G. Nair and C.R. Mohan Kumar	1996	Yield: 35-40 t ha^{-1}. Triploid industrial variety, tubers with 38-41% starch, 40-55 ppm cyanogen having good cooking quality, field tolerant to *Cercospora* leaf spot, spider mite and scale insect, drought tolerant variety.
8.	Sree Jaya	S.G. Nair, M. Unnikrishnan, C.R. Mohan Kumar, M. Anantharaman and M. Thankappan	1998	Yield: 26-30 t ha^{-1}. Early maturing variety (6-7 months) with 40-50 ppm cyanogen having excellent cooking quality. Field resistant to scale insect.
9.	Sree Vijaya	S.G. Nair, M. Unnikrishnan, C.R. Mohan Kumar, M. Anantharaman and M. Thankappan	1998	Yield: 25-28 t ha^{-1}. Early maturing variety (6-7 months) with 40-60 ppm cyanogen having excellent cooking quality. Field tolerant to *Cercospora* leaf spot.

10.	Sree Rekha	C.S. Easwari Amma, M.N. Sheela, K. Abraham, M. Unnikrishnan, S.G. Nair, K.R. Lakshmi and C.R. Mohankumar	2000	Yield: 45-48 t ha^{-1}. Tubers have 28-30% starch, 49-60 ppm cyanogen having excellent cooking quality and field tolerant to *Cercospora* leaf spot.
11.	Sree Prabha	C.S. Easwari Amma, M.N. Sheela, K. Abraham, M. Unnikrishnan, S.G. Nair, K.R. Lakshmi and C.R. Mohankumar	2000	Yield: 40-45 t ha^{-1}. Tuber neck is absent. Tubers have 26-29% starch, 50-85 ppm cyanogen having good cooking quality good, field tolerant to *Cercospora* leaf spot, spider mite and scale insect.
12.	Sree Padmanabha	M. Unnikrishnan, S.G. Nair, M.N. Sheela, C.S. Easwari Amma, S. Edison, SanthaV. Pillai, M.T. Sreekumari, S. Ramanathan, C. Mohan, and M.Anantharaman	2006	Yield: 38.0 t ha^{-1}. First CMD resistant cassava variety. Tubers have 25.8% starch, 38.2 µg/100g cyanogen with excellent cooking quality. Shows cupping of leaves under drought conditions. Tubers are long cylindrical with silvery white skin colour, tuber rind and flesh colour white, tuber neck absent.
13.	Sree Athulya	M.T. Sreekumari, M. Unnikrishnan, S. Ramanathan, K. Abraham, S. Edison and R.R. Nair	2014 (Central release)	Yield: 35-40 t ha^{-1}. Industrial high starch triploid variety with long cylindrical tubers with brown skin, cream rind and white flesh, tuber neck absent. Extractable starch high (30.2%), cooking quality fair, ideal for cassava-based industries. Field tolerant to *Cercospora* leaf spot, spider mite and scale insect.
14.	Sree Apoorva	M.T. Sreekumari, M.N. Sheela, M. Unnikrishnan, S. Ramanathan, James George. M. Anantharaman, C. Mohan, K. Abraham, T. Makeshkumar, R.R. Nair, S. Edison, S.K. Naskar and S.K. Chakrabarti	2014 (Central release)	Yield: 35-40 t ha^{-1}. Industrial high starch triploid variety with long cylindrical tubers with brown skin, cream rind and white flesh. Extractable starch high (29.9%), cooking quality fair, ideal for cassava-based industries. Field tolerant to *Cercospora* leaf spot, spider mite and scale insect.
15.	Sree Swarna	M.N. Sheela, Santha V. Pillai, James George, T. Makeshkumar, M.S. Sajeev, K.I. Asha, C. Mohan, A. Asha Devi, Shirly Raichal Anil, N. Krishna Radhika, S. Sunitha and S.K. Chakrabarti	2015	Yield: 35-40 t ha^{-1}. Clonal Selection from landrace Arumasa Kappa with early bulking (7 months), good culinary quality, yellow flesh colour and tolerance to cassava mosaic disease, suitable for Kerala.

16.	Sree Pavithra	M.N. Sheela, K. Susan John, G. Suja, S. Edison, S.K. Naskar and S.K. Chakrabarti	2015	Yield: 35-45 t ha^{-1}. Clonal selection from indigenous germplasm with 9-10 months duration with excellent cooking quality, high K efficiency (243.65 kg tuber/kg K absorbed), suitable for cultivation in Kerala soils which are inherently low to marginal in soil exchangeable K.
17.	Sree Reksha	M.N. Sheela, T. Makeshkumar, James George, S. Sunitha, G. Byju, C. Visalakshi Chandra, N. Krishna Radhika, K.I. Asha, K.M. Senthilkumar, A.V.V. Koundinya, B.S. Prakash Krishnan and K. Velayudhan	2017	Yield: 45-50 t ha^{-1}. It is completely resistant to cassava mosaic disease caused by both Indian cassava mosaic virus and Sri Lankan cassava mosaic virus. It is also tolerant to postharvest physiological deterioration. It has medium starch (27-31%) and low sugar (1.10%) content. Suitable for planting in rainfed and irrigated conditions.
18.	Sree Sakthi	M.N. Sheela, M. Velmurugan, P. Ashok, N.V. Mhaskar, M. Janaki, James George, S. Sunitha, T. Makeshkumar, N. Krishna Radhika, B.S. Prakash Krishnan and K. Velayudhan	2018 (Central)	Yield: 45-50 t ha^{-1}. It is completely resistant to cassava mosaic disease caused by both Indian cassava mosaic virus and Sri Lankan cassava mosaic virus. It is also tolerant to post harvest physiological deterioration. It has high starch content of 29% (range: 26-32%) and is an industrial variety.
19.	Sree Suvarna	M.N. Sheela, M. Velmurugan, P. Ashok, M. Janaki, James George, S. Sunitha, T. Makeshkumar, N. Krishna Radhika and B.S. Prakash Krishnan	2018 (Central)	Yield: 45-50 t ha^{-1}. It has medium starch, 25-27% (range: 24-29.8%) and is completely resistant to cassava mosaic disease caused by both Indian cassava mosaic virus and Sri Lankan cassava mosaic virus.
20.	Sree Kaveri	M.N. Sheela, T. Makeshkumar, S. Sunitha, K. Susan John, N. Krishna Radhika, K.I. Asha, A.V.V. Koundinya, C. Visalakshi Chandra, K.M. Senthilkumar, B.G. Sangeetha and B.S. Prakash Krishnan	2023 (Central)	Yield: 50 t ha^{-1}. Inbred developed from pre breeding line, completely resistant to cassava mosaic disease, drought tolerant, N and K efficient variety, suitable for the States of states of Kerala, Tamil Nadu and Andhra Pradesh for industrial use.

	Sweet Potato			
21.	H-41	M.L. Magoon, S.G. Nair, R. Krishnan and R.C. Mandal	1971	Yield: 20-25 t ha^{-1}. Hybrid which matures in 120 days, with excellent cooking quality, low in fibre content, susceptible to sweet potato weevil (*Cylas formicarius*) and suitable for Kerala, Tamil Nadu and Karnataka
22.	H- 42	M.L. Magoon, S.G. Nair, R. Krishnan and R.C. Mandal	1971	Yield: 22-25 t ha^{-1}. Hybrid with 120 days duration, with excellent cooking quality, susceptible to sweet potato weevil (*Cylas formicarius*) and suitable for Kerala, Tamil Nadu and Karnataka
23.	Varsha	A.R. Karnik, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra and S.G. Nair, Central Tuber Crops Research Institute	1983	Yield: 17-22 t ha^{-1}. A double cross hybrid with 120 days duration, with good cooking quality, susceptible to sweet potato weevil (*Cylas formicarius*), drought tolerant and suitable for Konkan region of Maharashtra.
24.	Sree Nandini	P. Kamalam, G.G. Nayar and R.B. Nair	1987	Yield: 20-25 t ha^{-1}. Selection from open pollinated progeny with 100-105 days duration, with excellent cooking quality which cooks well and tastes sweet, susceptible to sweet potato weevil (*Cylas formicarius*), drought tolerant, suitable for paddy fallows as a catch crop and adopted to Kerala.
25.	Sree Vardhini	P. Kamalam, G.G. Nayar and R.B. Nair	1987	Yield: 20-25 t ha^{-1}. Selection from open pollinated progeny of duration 100-105 days which cooks well, susceptible to sweet potato weevil (*Cylas formicarius*), early maturing dual-purpose variety (tubers for human consumption and foliage for animal feed) and suitable for Kerala.
26.	Sree Rethna	B. Vimala	1996	Yield: 20-22 t ha^{-1}. Hybrid having 90-105 days duration with excellent cooking quality and susceptible to sweet potato weevil (*Cylas formicarius*), suitable for Kerala.
27.	Sree Bhadra	P.G. Rajendran and B. Vimala	1996	Yield: 20-22 t ha^{-1}. Seedling selection from seeds introduced from Nigeria in 1984 with 90 days duration, excellent cooking quality, susceptible to sweet potato weevil (*Cylas formicarius*), useful as a trap crop for root knot nematode (*Meloidogyne incognita*), suitable for Kerala, Maharashtra, Bihar and Madhya Pradesh.
28.	Gouri	S.K. Naskar, D.P. Singh and S.P. Varma	1998	Yield: 19 t ha^{-1}. A hybrid having 110-120 days maturity, with fair, non-mealy cooking quality, susceptible to sweet potato weevil (*Cylas formicarius*), with carotene content, can tolerate mid-season moisture stress, suitable for *kharif* and *rabi* seasons in the State of Odisha.
29.	Sankar	S.K. Naskar and D.P. Singh	1998	Yield: 13.7 t ha^{-1}. Hybrid which matures in 120 days, with excellent cooking quality, susceptible to sweet potato weevil (*Cylas formicarius*), suitable for Odisha.

30.	Sree Arun	B. Vimala, S. Ramanathan, G.M. Nair and C.A. Jayaprakas	2002	Yield: 20-28 t ha^{-1}. Seedling from recurrent selection of seeds of polycross having 90 days maturity, with good cooking quality, early maturity and suitable for Kerala (uplands).
31.	Sree Varun	B. Vimala, S. Ramanathan, G.M. Nair and C.A.Jayaprakas	2002	Yield: 20-28 t ha^{-1}. Seedling selection from seeds from CIP, Peru having 90 days maturity, good cooking quality, early maturity and suitable for Kerala (uplands).
32.	Kalinga	S.K. Naskar, M. Nedunchezhiyan and Archana Mukherjee	2004	Yield: 17.2 t ha^{-1}. Selection from open pollinated seed with 105-110 days maturity, excellent cooking quality, susceptible to sweet potato weevil (*Cylas formicarius*), medium duration variety with high starch, suitable for Orissa, Bihar, Jharkhand and West Bengal. Can be used as food, fodder and for starch extraction.
33.	Sree Kanaka	B. Vimala, G.M. Nair and Archana Mukherjee	2004	Yield: 10-15 t ha^{-1}. Hybrid with 75-85 days duration, having good cooking quality with a soft texture, with 8.8-10.0 mg/100g fresh weight of β-carotene, having early maturity and suitable for Kerala.
34.	Goutam	S.K. Naskar and Archana Mukherjee	2005	Yield: 18.9 t ha^{-1}. Hybrid generated from a polycross with Dhenkanal local, a popular land race as the female parent with a duration of 105-110 days, with very good cooking quality, soft, mealy and very sweet, Tolerant to weevil (*Cylas formicarius*), suitable for both *kharif* and *rabi* season, well accepted by the farmers of hilly and coastal areas of Odisha.
35.	Sourin	S.K. Naskar and Archana Mukherjee	2005	Yield: 16.2 t ha^{-1}. Hybrid generated from a polycross with accession No. 1162 as the female parent with 105-110 days duration, good cooking quality, slight hard, sweet and intermediate to moist in texture, Tolerant to weevil (*Cylas formicarius*), suitable for both rainfed and irrigated conditions, can withstand mid-season drought and can perform better in sandy loam soils, adapted to the state of Odisha.
36.	Kishan	S.K. Naskar and Archana Mukherjee	2005	Yield: 17 t ha^{-1}. Hybrid generated from a polycross with accession 1016 as the female parent having 110-120 days duration, with good cooking quality, sweet and mealy, Tolerant to weevil (*Cylas formicarius*), high yielding, with 18.2% extractable starch, suitable for food, fodder and starch, can withstand mid-season drought, perform better in sandy loam and black sandy soils, adapted to Orissa (coastal, plains and hilly areas) under both *kharif* and *rabi* season.
37.	Bhu Sona	S.K. Naskar and Archana Mukherjee	2017	Yield: 20-24 t ha^{-1}. Clonal selection of open pollinated seedling progenies of exotic source with a duration of 105-110 days, orange fleshed with good cooking quality, dry matter: 27-29%, total starch: 18.8-19.7%, total sugar: 2-2.4%, β-carotene: 13.2- 14.4 mg/100g, suitable for Odisha.

38.	Bhu Kanti	Archana Mukherjee and S.K. Naskar	2017	Yield: 22-24 t ha^{-1}. Clonal selection from exotic lines from CIP which matures in 105-110 days, orange fleshed with good cooking quality, dry matter: 24-26.6%, total starch: 16-18.8%, total sugar: 1.9-2.2%, β-carotene: 6.2-7.8mg/100g, suitable for Odisha.
39.	Bhu Ja	Archana Mukherjee, S.K. Naskar, James George, S.K. Chakrabarti, R.S. Misra, M. Nedunchezhian and K.R. Rao	2017	Yield: 20-22 t ha^{-1}. Clonal selection of introduced CIP line with 100-110 days maturity, orange fleshed with good cooking quality, dry matter: 23.2-24.8%, total starch: 16.6-17.2%, total sugar: 2.4-3%, β-carotene: 5.5-6.4mg/100g, suitable for Odisha.
40.	Bhu Krishna	S.K. Naskar, Archana Mukherjee and K.R. Rao	2017	Yield: 18-22 t ha^{-1}. Clonal selection of open pollinated seedling progenies of exotic source with a maturity of 110-120 days, purple fleshed with fair cooking quality, dry matter: 24-25.5%, total starch: 19.5%, total sugar: 1.9-2.2%, anthocyanin 85-90mg/100g, suitable for Odisha.
41.	Bhu Swami	S.K. Naskar and Archana Mukherjee	2017	Yield: 20 t ha^{-1}. Open pollination and clonal selection from exotic lines with 105-110 days maturity, white fleshed variety with excellent cooking quality, dry matter: 27.4-29.7%, total starch: 20.8-21.2%, total sugar: 3-3.7%, suitable for Odisha.
	Yams			
42.	Sree Keerthi	C.S. Easwari Amma, K. Abraham and S.G. Nair	1987	Yield: 25-30 t ha^{-1}. Clonal selection from germplasm with 9-10 months duration, good cooking quality, susceptible to anthracnose (*Colletotrichum gloeosporioides*) and leaf spot (*Cercospora* sp.), tolerant to scale insect in storage, high yielding, large sized tubers, suitable for intercropping in mature coconut gardens as well as with banana, adapted to coastal and interior plains of Kerala.
43.	Sree Roopa	C.S. Easwari Amma, K. Abraham and S.G. Nair	1987	Yield: 25-30 t ha^{-1}. Clonal selection from germplasm with 9-10 months duration, with excellent cooking quality, susceptible to anthracnose (*Colletotrichum gloeosporioides*) and leaf spot (*Cercospora* sp.), resistant to scale insect in storage, suitable for coastal and interior plains of Kerala.
44.	Sree Shilpa	K. Abraham, S.G. Nair, M.T. Sreekumari and M. Unnikrishnan	1998	Yield: 28 t ha^{-1}. World's first greater yam hybrid with compact medium sized oval tubers with easy harvestability having 8 months duration, good cooking quality, Susceptible to anthracnose (*Colletotrichum gloeosporioides*), suitable for coastal and interior plains of Kerala.

45.	Sree Karthika	M.N. Sheela, K. Abraham, S. Edison, S. Ramanathan, G. Padmaja and James George	2004	Yield: 30 t ha^{-1}. Clonal selection with 9 months duration, having excellent cooking quality, no virus or anthracnose symptoms observed, suitable for Kerala.
46.	Orissa Elite	R.S. Misra, M. Nedunchezhiyan, S.K. Naskar, S. Panda and S. Edison	2005	Yield: 25 t ha^{-1}. Clonal selection with 6-7 months duration having excellent cooking quality, soft, non-sticky, field tolerant to yam viruses and *Cercospora* leaf spot, field tolerant to scale insects and mealy bugs, suitable for Odisha.
47.	Sree Swathy	M.N. Sheela, S. Ramanathan, James George, G. Padmaja, M.L. Jeeva, Shirly Raichal Anil, Vivek Hegde and S.K. Chakrabarti	2014	Yield: 30 t ha^{-1}. Variety has 9-10 months duration, tubers having good culinary and nutritive quality and moderately tolerant to anthracnose disease, withstands drought, suitable for Kerala.
48.	Sree Neelima	M.N. Sheela, A.N. Jyothi, S. Ramanathan, G. Padmaja, Lila Babu, N. Krishna Radhika and S.K. Chakrabarti	2014	Yield: 35 t ha^{-1}. Variety has 9-10 months duration, tubers have good culinary and nutritive quality (high protein and micronutrients) and flesh colour is light purple, suitable for Kerala.
49.	Sree Nidhi	M.N. Sheela, S. Ramanathan, M. Nedunchezhian, James George, Archana Mukherjee, M.L. Jeeva and R.S. Mishra	2017	Yield: 35 t ha^{-1}. Clonal selection from germplasm with 8-9 months duration, with good tuber shape, field tolerance to anthracnose disease, suitable for Kerala and Odisha.
50.	Bhu Swar	S.K. Naskar, Archana Mukherjee, S.K. Chakrabarti, James George, R.S. Misra, M. Neduchezhian and K.R. Rao	2017	Yield: 20-25 t ha^{-1}. Clonal selection from germplasm with 6-7 months duration with excellent cooking quality, dry matter: 32-33%, total starch: 18-20%, total sugar: 1-1.5%, suitable for Odisha.
51.	Sree Hima	M.N. Sheela, K. Abraham, N. Krishna Radhika, K.I. Asha, M.L. Jeeva, G. Suja, C. Visalakshi Chandra, S. Natarajan and K. Velayudhan	2020	High yielding variety having 9-10 months duration, rich in crude protein (5.28%), excellent cooking quality, suitable for Kerala.
52.	Sree Priya	S.G. Nair, K. Abraham and G.G. Nayar	1987	Yield: 35 t ha^{-1}. Seeding selection from the African variety "Umidika", with 9-10 months duration having excellent cooking quality, no virus or anthracnose symptoms observed, drought tolerant, has a novel flavour, suitable for intercropping in mature coconut gardens as well as with banana, suitable for coastal and interior plains of Kerala.

53.	Sree Subhra	S.G. Nair, K. Abraham and G.G. Nayar	1987	Yield: 35 t ha^{-1}. Seedling selection from the African variety "lwo" having 9-10 months duration with excellent cooking quality, no virus or anthracnose symptoms observed, drought tolerant, having novel flavour, suitable for coastal and interior plains of Kerala.
54.	Sree Dhanya	S.G. Nair, K. Abraham, M.T. Sreekumari and James George	1993	Yield: 20 t ha^{-1}. Seedling selection (Half – sib) with 9 months duration having good cooking quality, the World's first dwarf bushy variety that does not require staking, no virus or anthracnose symptoms observed, suitable for coastal and interior plains of Kerala.
55.	Sree Swetha	M.N. Sheela, James George, K. Abraham, G. Suja, K.I. Asha, A. Asha Devi, Shirly Raichal Anil, N. Krishna Radhika, S. Natarajan and B.S. Prakash Krishnan	2017	Yield: 30 t ha^{-1}. Dwarf hybrid variety with 7-8 months duration, with cylindrical tuber having brown skin and white flesh colour, does not require staking and can be accommodated in closer spacing (60cm x 60cm), released for the state of Kerala.
56.	Sree Haritha	M.N. Sheela, James George, K. Abraham, K.I. Asha, A. Asha Devi, N. Krishna Radhika, S. Sunitha, S. Natarajan and B.S. Prakash Krishnan	2020	Yield: 46 t ha^{-1}. Hybrid with 9-10 months maturity with excellent cooking quality and good flavour with medium size compact cylindrical tubers with smooth texture, brown skin and white flesh colour, suitable for Kerala.
57.	Sree Latha	N. Hrishi, C.S. Easwari Amma and K. Abraham	1983	Yield: 25 t ha^{-1}. Selection from germplasm with 8 months duration having good cooking quality, field tolerant to mosaic disease, with wide adaptability in the States of Kerala, Bihar, Maharashtra, Andhra Pradesh, Assam and West Bengal.
58.	Sree Kala	K. Abraham, S.G Nair and M. Unnikrishnan	1993	Yield: 20 t ha^{-1}. Selection from exotic germplasm Kombi with 7.5 months duration having excellent cooking quality, field tolerant to yam mosaic disease, having oval tuber shape, suitable for coastal and interior plains of Kerala.
	Edible Ariods			
59.	Sree Padma	M. Unnikrishnan, P.K. Thankamma Pillai and C.R. Mohan Kumar	1998	Yield: 42 t ha^{-1}. Selection from germplasm collection from Wyanad (Kerala) with 8-9 months duration having very good cooking quality, fairly tolerant to mosaic disease (virus), field tolerant to collar rot (*Sclerotium rolfsii*), suitable for Kerala.
60.	Sree Athira	M.T. Sreekumari, K. Abraham, M.N. Sheela and G. Padmaja	2006	Yield: 40.5 t ha^{-1}. This is the first genetically improved variety with 9-10 months duration having good cooking quality, tolerant to collar rot (*Sclerotium rolfsii*) and mosaic disease, suitable for Kerala.

61.	Sree Rashmi	M. Unnikrishnan, G.G. Nayar, P.K. Thankamma Pillai, K. Vasudevan, J.S. Jose, T. Venkateswarlu, M. Thankappan and K.R. Lakshmi	1987	Yield: 18 t ha^{-1}. Selection from indigenous germplasm with 7 months duration having very good cooking quality, moderately susceptible to leaf blight (*Phytophthora colocasiae*), field tolerant to dasheen mosaic virus, having edible leaves, corms and cormels which are acrid free, can give economic yield under low input levels also, suitable for Kerala.
62.	Sree Pallavi	M. Unnikrishnan, G.G. Nayar, P.K. Thankamma Pillai, K. Vasudevan, J.S. Jose, T. Venkateswarlu, M. Thankappan and K.R. Lakshmi	1987	Yield: 16 t ha^{-1}. Selection from germplasm collection from Meghalaya having 7 months duration with very good cooking quality, field tolerant to leaf blight (*Phytophthora colocasiae*) and Dasheen mosaic virus, a tall variety with large number of small sized tubers, suitable for Kerala.
63.	Muktakeshi	R.S. Misra, P.G. Rajendran, S.K. Naskar, S. Sriram and Archana Mukherjee	2002	Yield: 20 t ha^{-1}. Clonal selection from Cuttack, Odisha with 150-180 days maturity having excellent cooking quality, non-acrid tubers, resistant to taro leaf blight under field condition, field tolerant to dasheen mosaic, aphids, cut worm and scale insects, suitable for uplands and lowlands during summer and rainy season in the States of Odisha, Chhattisgarh and Jharkhand.
64.	Sree Kiran	M.T. Sreekumari, K. Abraham, G. Padmaja and James George	2004	Yield: 17.5 t ha^{-1}. Hybrid with 190-210 days maturity having very good cooking quality, moderately susceptible to taro leaf blight, long keeping quality (60 days), suitable for Kerala.
65.	Pani Saru - 1	S.K. Naskar, Archana Mukherjee and M. Nedunchezhiyan	2005	Yield: 15.7 t ha^{-1}. Selection from local land race from Kantilo with 6-7 months duration having good cooking quality, field tolerant to leaf blight, can be grown in upland and low / submerged condition, having long shelf life of cormels (3 months), suitable for Odisha.
66.	Pani Saru - 2	S.K. Naskar, Archana Mukherjee and M. Nedunchezhiyan	2005	Yield: 13 t ha^{-1}. Selection from local land race from Begunia with 6-7 months duration having good cooking quality, field tolerant to leaf blight, can be grown in upland and low land / water logged / swampy conditions, suitable for Odisha.
67.	Bhu Kripa	S.K. Naskar and Archana Mukherjee	2017	Yield: 15-20 t ha^{-1}. Selection from local landrace Jhankri with 6-7 months duration having excellent cooking quality, dry matter: 23.5-24.6%, total starch: 12.3-14.2%, total sugar: 1.3-1.7%, biotic and abiotic stress tolerant, suitable for Odisha.
68.	Bhu Sree	S.K. Naskar and Archana Mukherjee	2017	Yield: 15-20 t ha^{-1}. Selection from local landrace Sonajuli with a duration of 6-7 months having excellent cooking quality, dry matter: 23-24.8%, total starch: 15.6-17.3%, total sugar: 1.2-1.5%, biotic and abiotic stress tolerance, suitable for Odisha.

69.	Sree Telia	M. Nedunchezhian and Kalidas Pati (lead developers), V.B.S. Chauhan, K. Laxminarayana, R.S. Misra and M.N. Sheela	2024	Yield: 10-12 t ha^{-1}. Clonal selection with a short duration of 120 days, cormels have good palatability, are mealy and have aroma, it has low acridity (calcium oxalate 12.6 mg 100 g^{-1}), suitable for cultivation under rainfed conditions during *kharif* in Odisha.
70.	Sree Hira	M. Nedunchezhian and Kalidas Pati (lead developers), V.B.S. Chauhan, K. Laxminarayana and M.N. Sheela	2024	Yield: 16-20 t ha^{-1}. Clonal selection having a during of 180 days, tolerant to leaf blight disease, it bears 12-16 cormels per plant which are long elliptical with brown skin and white flesh colour, the average weight of each cormel is 60-100 g, has low acridity (calcium oxalate 9.2 mg 100 g^{-1}), suitable for the rainfed upland and irrigated, medium and low land conditions of Odisha.
	Minor tuber crops			
71.	Sree Dhara	Dr. B. Vimala	1993	Yield: 25 t ha^{-1}. Clonal selection from indigenous germplasm with 5 months duration having good cooking quality, the first variety of Chinese potato released in Kerala and in India, susceptible to root knot nematode (*Meloidogyne incognita*).

The developed varieties cater to the following categories: industrial, food, and fodder. They were developed with high yield, high starch, and high dry matter, bio-fortified with vitamins, minerals, and antioxidants, enhanced resistance to biotic and abiotic stresses, climate resilience, nutrient use efficiency, eco-regional suitability, and adaptability to different cropping systems. These include;

a. World's first greater yam hybrid- Sree Shilpa

b. World's first dwarf white yam- Sree Dhanya

The other major highlights are;

a. India's first cassava mosaic disease-resistant variety- Sree Padmanabha

b. First hybrid elephant foot yam developed for Kerala- Sree Athira

c. First hybrid taro developed for Kerala- Sree Kiran

Sree Shilpa

Sree Dhanya

Sree Padmanabha

Sree Athira

Sree Kiran

Cassava Mosaic Disease (CMD) is a major setback for the otherwise prospective cassava industry. To address this issue, many cassava mosaic-resistant varieties were also developed by the Division, which has been a boon to the farming community as well as the Industries.


Sree Padmanabha


Sree Reksha


Sree Shakthi


Sree Suvarna

Climate resilience is an important trait to target under unpredictable and changing climatic conditions. The Division has successfully developed many climate-resilient varieties of cassava (5), sweet potato (10), greater yam (2), white yam (3), and taro (5).


H-97

Sree Harsha

Sree Sahya


Sree Pavithra


Sree Reksha

Climate-resilient cassava varieties


Varsha


Sourin


Kishan


Gouri


Sree Nandini


Bhu Kanthi


Bhu Sona


Bhu Krishna


Bhu Swami


Bhu Ja

Climate-resilient sweet potato varieties


Sree Keerthi


Sree Swathy


Sree Shubra


Sree Haritha

Climate-resilient greater yam varieties

Climate-resilient white yam varieties


Panisaru 1


Panisaru 2


Sree Rashmi


Bhu Kripa


Bhu Sree

Climate-resilient taro varieties

Biofortification is of utmost interest as it naturally fortifies important vitamins, minerals, etc. Biofortified crops fetch a better price in the market and ensure the nutritional security of the nation. The Division developed many naturally biofortified tuber crop varieties, including cassava (3), sweet potato (6), and greater yam (1).


Sree Visakham

Sree Vijaya


Sree Swarna


Sree Neelima

Naturally biofortified cassava and greater yam varieties


Sree Kanaka


Gouri


Bhu Sona


Bhu Kanti


Bhu Ja


Bhu Krishna

Naturally biofortified sweet potato varieties

On the eve of the 75th Anniversary of the Food and Agriculture Organization (FAO), our Hon'ble PM dedicated 17 biofortified varieties of 8 crops to the nation, two of which were our biofortified yam genotypes.

Da 340 and Sree Neelima dedicated to the Nation by the Hon'ble PM, Sri. Narendra Modi

Apart from these varieties, few other lines are in the pipeline, which will be proposed to be released soon.

a. First varieties in arrowroot, one for the State of Kerala and two for Central release
b. First varieties in tannia, one for the State of Kerala and another for Central release
c. A non-trailing high yielding white yam variety for the state of Kerala.
d. A variety of yam bean, the first from ICAR-CTCRI.
e. Two bio-fortified sweet potato varieties

Arrowroot M3

Tannia
Xa-MTS local

Biofortified sweet potato
Sree Arunima

Yam bean
Sree Chandrika

Non-trailing white yam SD-15

3. Biotechnological interventions for the improvement of tropical tuber crops

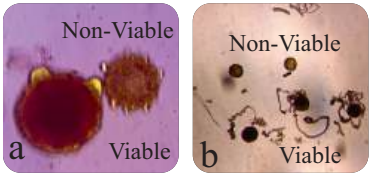
Various biotechnological tools were adopted for the conservation and improvement of tuber crops, *viz.,*

1. *In vitro* Active Germplasm (IVAG) for conservation
2. Standardization of *in vitro* protocols.
3. Standardization of cryopreservationprotocols.
4. DNA fingerprinting of released varieties using different markers

5. Standardization ofbioprospecting in different germplasm of tuber crops
6. Oomics approaches for the development of improved varieties.
7. Transgenic approaches for quality improvement in cassava.
8. Genetic modification through gene editing
9. Transcriptome sequencing
10. Bioinformatics for gene mining

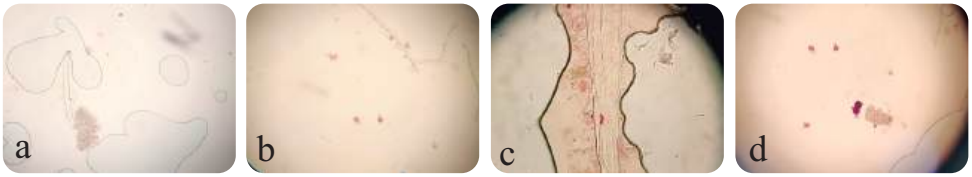
The major achievementsthrough biotechnological means

1. *In vitro* conservation was used to maintain and conserve the important accessions and varieties in the *in vitro* active germplasm (IVAG) at the HQ and the Regional Station.
2. *In vitro* protocols were standardized for all the major tuber crops, such as cassava, sweet potato, yams, aroids, and minor tuber crops, for conservation under IVAG.
3. Protocols were also standardized for cryopreservation in cassava, yams, and taro using pollen. The viability of cryopreserved pollen from cassava and yams was validated.The cryopreserved pollen was successfully used for hybridization in cassava and taro.



(a)Viability of stored cassava pollen assessed by acetocarmine test and (b) *in vitro* germination test

Fruit set in cassava using the cryo-stored pollen

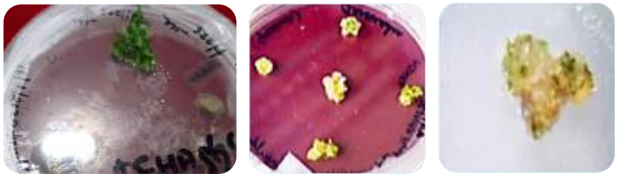


a. *D. alata* pollen fresh; b. *D. alata* pollen under cryo-storage after 45 days, 20X, c. at 40X; d. *D. rotundata* fresh pollen

4. Bioprospecting studies were performed on different germplasm of tuber crops to identify novel traits with industrial/pharmacological values.
5. DNA fingerprinting of tuber crop varieties using SSR markers was done.

6. Standardised synthetic seed production for cassava

7.Standardized transformation and regeneration protocols in Indian cassava varieties



8. Genetic modification through gene editing approaches are also been attempted especially for the development of waxy cassava.
9. Transcriptome sequencing of cassava for drought and PPD as well as TLB in taro was done.
10. Whole genome re-sequencing of cassava elite breeding lines 8S-501 and 9S-127 was successfully completed.

a. Analysis of 8S-501 and 9S-127 draft genome sequences revealed the presence of 7,789,154 and 7,130,986 SNPs in 8S-501 and 9S-127, respectively. Comparative analysis showed the presence of 1,104,776 and 943,104 InDels in 9S-127 and 8S-501, respectively

b. The SNPs and InDels identified in this study will be utilized for the identification and development of molecular markers linked to important agronomic traits including high starch, profuse flowering and CMD resistance. The high-quality draft assembly would be helpful for mining SSRs and the development of molecular markers for marker-assisted backcross breeding in cassava.

Facilities and infrastructure

Laboratories

Tissue Culture Lab
Cytogenetics Lab
Molecular Cloning Lab
Molecular Biology Lab
Biotechnology Lab
Genome Editing Lab
Genomics Lab

The Division has a well-equipped *In vitro* Active Genebank, a tissue culture facility, Cytogenetics Lab, molecular biology lab, a molecular cloning lab, a microbial culturing facility and a new facility for gene editing. The molecular biology lab has facilities for conducting hands-on training for skill development in molecular techniques, cytology, bioprospecting, and *in vitro* studies and cryo-preservation. The major equipment in the laboratories is listed below.

Major equipments

In vitro facility

- Laminar air flow
- Autoclave
- Dishwasher
- Microscope
- Refrigerator
- Incubator
- Automated temperature and light controlled racks for *in vitro* storage

Molecular biology lab

- Genetic analyser
- Gel documentation system
- Electrophoresis units and power pack
- Nanodrop spectrophotometer
- Refrigerated incubator shaker
- Hot air oven
- Deep freezer, -20 degree Celsius
- Ultra freezer -80 degree Celsius
- Water purification unit
- Thermal cycler
- Ice flaking machine
- Autoclave
- Microwave
- Microscope
- Stereomicroscopes
- Water bath
- Minifuges
- Hot plate with stirrer


Molecular biology lab


Tissue culture room


In vitro facility at HQ


Incubator shaker


PCR machine


Water purification unit


Laminar air flow


Gel documentation system


Nanodrop spectrophotometer

ICAR certified technologies 2022

- Concept on drought tolerance index scale for cassava.
- Methodology for measurement of pith density of cassava stem for assessment of drought tolerance.

Recent publications

Number of research papers			
Sl. No.	**NAAS Score**	**Nos.**	**Percent**
1.	6<	48	41
2.	>6	71	60
Total			**119**

Other publications		
Sl. No.	**Number of publications**	**Nos.**
1.	Symposia	45
2.	Books	21
3.	Book chapters	76
4.	Technical bulletins	19
5.	Technical folders	21
6.	Technical leaflets	6
7.	Popular articles	60
	Total	**248**

Peer recognition

Students guidance

Ph.D.: 6
M.Sc.: 134
Integrated M.Sc.: 23
Total: 163

Ph. D. Guides

Sl. No.	Name and designation	Suject	University affiliated
1.	Dr. K. Abraham, Principal Scientist	Botany	University of Kerala
2.	Dr. Santha V. Pillai, Principal Scientist	Botany	University of Kerala
3.	Dr. M.T. Sreekumari, Principal Scientist	Botany	University of Kerala
4.	Dr. Archana Mukherjee, Principal Scientist	Botany/ Biotechnology	Odisha University of Agriculture & Technology, Bhubaneswar & Utkal University, Bhubaneswar
5.	Dr. Manas Ranjan Sahoo, Principal Scientist	Horticulture/ Vegetable Science	Odisha University of Agriculture & Technology, Bhubaneswar
6.	Dr. C. Mohan, Principal Scientist	Biotechnology	Manonmaniam Sundaranar University, Tirunelveli & University of Kerala
7.	Dr. K.I. Asha, Principal Scientist	Botany	University of Kerala
8.	Dr. A. Asha Devi, Principal Scientist	Botany	University of Kerala
9.	Dr. Shirly Raichal Anil, Principal Scientist	Botany	University of Kerala
10.	Dr. N. Krishna Radhika, Senior Scientist	Biotechnology	University of Kerala
11.	Dr. K.M. Senthilkumar, Senior Scientist	Biotechnology	Digital University, Kerala

List of Ph. D. Awarded

Sl. No.	Name	Title of the thesis	Year of award
1.	Dr. Nusaifa Beevi	Biosystematic studies in taro (*Colocasia esculenta* (L.) Schott) under the guidance of Dr. M.T. Sreekumari	2009
2.	Dr. Sreeja Thankappan	A comparative study of tuber characters, reproductive biology and *in vitro* response of minor edible yams (*Dioscorea* species) under the guidance of Dr. K. Abraham	2013
3.	Dr. Vidya P.	Identification of candidate genes responsible for CMD resistance in cassava and mapping the CMD resistance using SSR markers under the guidance of Dr. C. Mohan	2017
4.	Dr. Aswathy G. H. Nair	Studying the genetics of flesh colour variation in sweet potato using molecular markers under the guidance of Dr. C. Mohan	2017
5.	Dr. Darshan	Introgression of cassava mosaic disease resistance in popular short duration cassava varieties of Kerala through marker assisted selection under the guidance of Dr. M. N. Sheela (Co-guide)	2018
6.	Dr. Swathy Sivan	Genetic diversity analysis for nutrient efficiency and identification of nutrient responsive genes in cassava under the guidance of Dr. M. N. Sheela (Co-guide)	2023
7.	Mr. Adarsh Krishnan U.	Genetic diversity analysis of cassava germplasm using morphological descriptors and molecular markers with emphasis on resistance to cassava mosaic disease under the guidance of Dr. K. I. Asha	Ongoing
8.	Ms. Reshma Maria Joseph	Micro tuber production and prospecting for photoresponsive tuberization genes in *Ipomea batatas* (L.) Lam under the guidance of Dr. Shirly Raichal Anil	Ongoing
9.	Ms. Nandini, C.	Deciphering the nature of cassava mosaic disease (CMD) resistance and validation of CMD associated SSR, SNP markers in cassava under the guidance of Dr. C. Mohan	Ongoing
10.	Ms. Vismaya M.	Assessment of diversity of elephant foot yam (*Amorphophallus paeoniifolius* Dennst. Nicolson) and deciphering the taxonomic position of cv. Karunaikizhangu under the guidance of Dr. Asha Devi A.	Ongoing
11.	Ms. Maria Treesa Joyas	Comparative morphological characterization and gene prospecting for early tuberization in *Ipomea batatas* (L.) Lam under the guidance of Dr. Shirly Raichal Anil	Ongoing

Awards and Recognition

Sl.No.	Award	Year
1.	Pat Coursey award	2000, 2006
2.	Brazilian Government Award for Best Breeder	2004
3.	Best Oral Presentation Awards	2006, 2008, 2013 (2), 2016
4.	Best Poster Award	2011, 2013, 2016, 2019, 2021, 2022, 2023
5.	Young Scientist Award from ISRC	2016, 2023
6.	Young Researcher Award	2022
7.	Young Scientist Excellence Award	2023
8.	UGC Junior Research Fellow	1995
9.	ISPC Fellow2014	2014
10.	ISST Fellow	2019
11.	Selection for Indo-U.S. Genome Engineering/Editing Technology Initiative (GETin) Overseas Fellowship (IUSSTF) (cancelled during Covid time)	2019
12.	IAHF Fellow	2021
13.	SOPPRAV Fellow	2022
14.	Fellow of the Indian Academy of Horticultural Sciences	2023
15.	Fellow of Royal Society of Oil Seed Research	2023

Human Resource Development

Recent visits abroad during the last six years

Dr. M.N. Sheela attended the meeting in connection with the launching of the project entitled 'Establishing Sustainable Solution to Cassava Diseases in the Mainland Southeast Asia' as an Expert on 12-14 September 2019.

Dr. M.N. Sheela participated and presented the deputation reports on the Indo Swiss Cassava Network Review meeting at HAFL, Zollikoffen, Switzerland during 3-4 September 2019.

Dr. Shirly Raichal Anil and Dr. Visalakshi Chandra C. attended the training on "Advanced Breeding Tools for the Development of Biofortified Varieties and Marker-assisted Selection and Related Molecular Breeding Tools" at International Potato Centre (CIP), Av. La Molina, Lima, Peru from 15-20 October, 2023.



Trainings organized during the last seven years

21-day Hands-on Training Programme on 'Advances in Plant Biotechnology and Molecular Biology for Crop Improvement' was organized at ICAR CTCRI during 2 -22 January 2024.

Workshop on 'Cherishing Scientific minds for Nourishing Human Health' [Under SERB Scientific on Social Responsibility Policy (SSR)] was organized at ICAR CTCRI during 20-21 December 2022.

Winter school on 'Sustainable Exploitation of Genetic Resources of Neglected and Underutilised Tuber Crops for Enhancing Climate Resilience and Nutritional Security' during 29 November to 19 December 2022.

National Webinar on 'Genetic Resources of Underutilized Tuber Crops for Nutritional Security' on 27 August 2022.

ICAR sponsored short course on 'Exploitation of Genetic Resources of Underutilized Tuber Crops' from 2-11 February 2022.

Webinar on 'Biofortification Strategies in Tropical Tuber Crops' organized by the Division of Crop Improvement as part of *Azadi ka Amrut Mahotsav* on 29 October 2021.

Webinar on 'The Tribal Way of Sustainable Living: Lessons from Tuhet Farms of Nicobar Islands' organized by the Division of Crop Improvement as part of *Azadi ka Amrut Mahotsav* on 17 August 2021.

IAFS India Africa Summit (III) Forum International training on 'Genetic Improvement of Tropical Tuber Crops Through Conventional and Biotechnological Approach on the Cloning and Transformation Techniques' from 1-15 March 2018.


Glimpses of 21-day hands-on training program


Glimpses of SERB training

International trainees

Three C. V. Raman International Fellows from CRIN, Nigeria, University of Yaounde I, Cameroon, and University of Ibadan, Nigeria, are pursuing their research in the division.

Dr. Balogun Shamsudeen Tomiwa

Dr. Lile Christere Nguemnang Mabou

Mr. Akinsanmi Oluwatosin Fowowe

Student guidance

Ph.D. guideship is available in the following disciplines and Universities:

a. Botany, Biotechnology (University of Kerala)

b. Bioinformatics (Digital University of Kerala)

M.Sc. guideship is available in the disciplines –

a. Biotechnology b. Botany c. Bioinformatics & d. Molecular Biology and Biotechnology (IARI Mega University)

Internship training to B.Sc., B.Tech and M.Sc. students are organized on a continuous basis in the Division of Crop Improvement on molecular biology, tissue culture, transgenics and bioinformatics aspects.

Linkages and Collaborations

External funded projects

1. No. of external funded projects completed: 16
2. No. of external funded projects (ongoing): 8
3. ICAR funded project on Genome Editing:1

What are our expectations?

1. Agrobiodiversity conservation and evaluation
2. Accelerated genetic gain through modern breeding tools
3. Gene identification through integrated omics-based approaches & gene editing
4. Biofortified (vitamins, minerals & antioxidants), climate resilient and input use efficient varieties

How will we rise to the expectations?

Agrobiodiversity conservation and evaluation

- The National Active Germplasm Site (NAGS) for tuber crops existing at the Institute will be strengthened through the introduction/collection of trait specific genetic resources from various sources both withinand outside the country for use in improvement programs.
- Collection trips to unexplored areas and areas of diversity will be undertaken to collect trait-specific germplasm/ landraces/ crop wild relatives of various tuber crops.
- Conservation of the germplasm under both *ex situ* (field gene bank) and *in vitro* (*in vitro* active gene bank) conditions will be strengthened. For sweet potato, bench conservation will also be adopted.
- Morphological (standard descriptor based), molecular (markers like ISSR, SSR, SNPs, etc) and biochemical (proximate analysis) evaluation will be done exhaustively for evaluation of the vast germplasm collection, identification of elite lines and registration of these for important traits. Bio-prospecting studies of different tuber crops germplasm will be undertaken to identify traits of importance for the pharma industries.

Accelerated genetic gain through modern breeding tools

- Apart from conventional and molecular breeding approaches, modern tools like speed breeding, genome editing, meta-genomics, phenomics, etc. will be employed for the development of high yielding, climate resilient, nutrient rich varieties of tuber crops.
- Distant hybridization will be attempted for introgression of traits of interest from crop wild relatives.
- Gene pyramiding will be attempted for the development of climate-resilient multi-trait varieties

through speed breeding approaches. Development of high yielding varieties resistant to biotic and abiotic stresses, short duration, enhanced shelf life and nutritional quality will be achieved through various means.

- Multi-trait varieties with short duration and photo insensitivity, varieties suitable for processing and export promotion having good quality tubers will be targeted for the industries. These will be developed using an integrated approach of all the modern breeding tools.

Gene identification through integrated omics-based approaches & gene editing

- Phenomics approaches will be used in different tuber crops for the identification of genes of interest like cassava mosaic disease resistance, physiological trait based breeding for drought and PPD tolerance in cassava. These will be integrated with AI for the development of multi-trait varieties with short duration and photo insensitivity, varieties suitable for processing and export promotion, high quality tubers with PPD resistance and resistance to biotic stresses.
- Identification of molecular markers associated with various biotic stresses like CMD and white fly in cassava, anthracnose in greater yam, nematodes in yams, taro leaf blight in taro, collar rot in elephant foot yam, root knot nematode in coleus, etc. and dwarfness in white yam.
- Functional characterization of abiotic stress-responsive genes in cassava and sweet potato and early-bulking responsive genes in cassava and tuberization-responsive genes in sweet potato and development of molecular markers for MAS.
- Developing waxy cassava varieties having resistant starches, by silencing the genes responsible for the enzymes in a starch metabolic pathway, for meeting industrial needs. Preparation of CRISPR-Cas 9 construct targeting *gbss* gene in cassava and transformation for developing waxy starch cassava variety and *sbeI* and *IIb* for developing high amylose starch in cassava suitable for various industrial applications, through gene editing.

Biofortified (vitamins, minerals & antioxidants), climate resilient and input use efficient varieties

- Strengthening the development of high yielding, climate resilient, nutritive, input-use efficient, biofortified varieties of various tuber crops through conventional and modern breeding methods.

- Studies on nutrigenomics in tuber crops through biotechnological approaches for studying the genes responsible for nutrient (protein) homeostasis.

The major breeding objectives identified for all the major crops are as follows:

A. Cassava

- In cassava, the major traits identified are - high yield; high dry matter content; high starch content; modified starch for industrial applications; good fried chips making quality; drought tolerance; early bulking nature for short duration varieties; low cyanide content for culinary purposes; cassava mosaic disease resistance; climate resilience and Post-harvest Physiological Deterioration (PPD) tolerance for increased shelf life.

B. Sweet potato

- In the case of sweet potato, the major traits identified are - high yield; high starch content; photosensitivity; bio-fortification; drought tolerance; sweet potato weevil resistance; quality traits and processing type varieties for the industries.

C. Yams

- Under yams, the major traits identified are - high tuber yield; high starch content; anthracnose resistance; bio-fortification; drought tolerance, dwarfness and quality traits

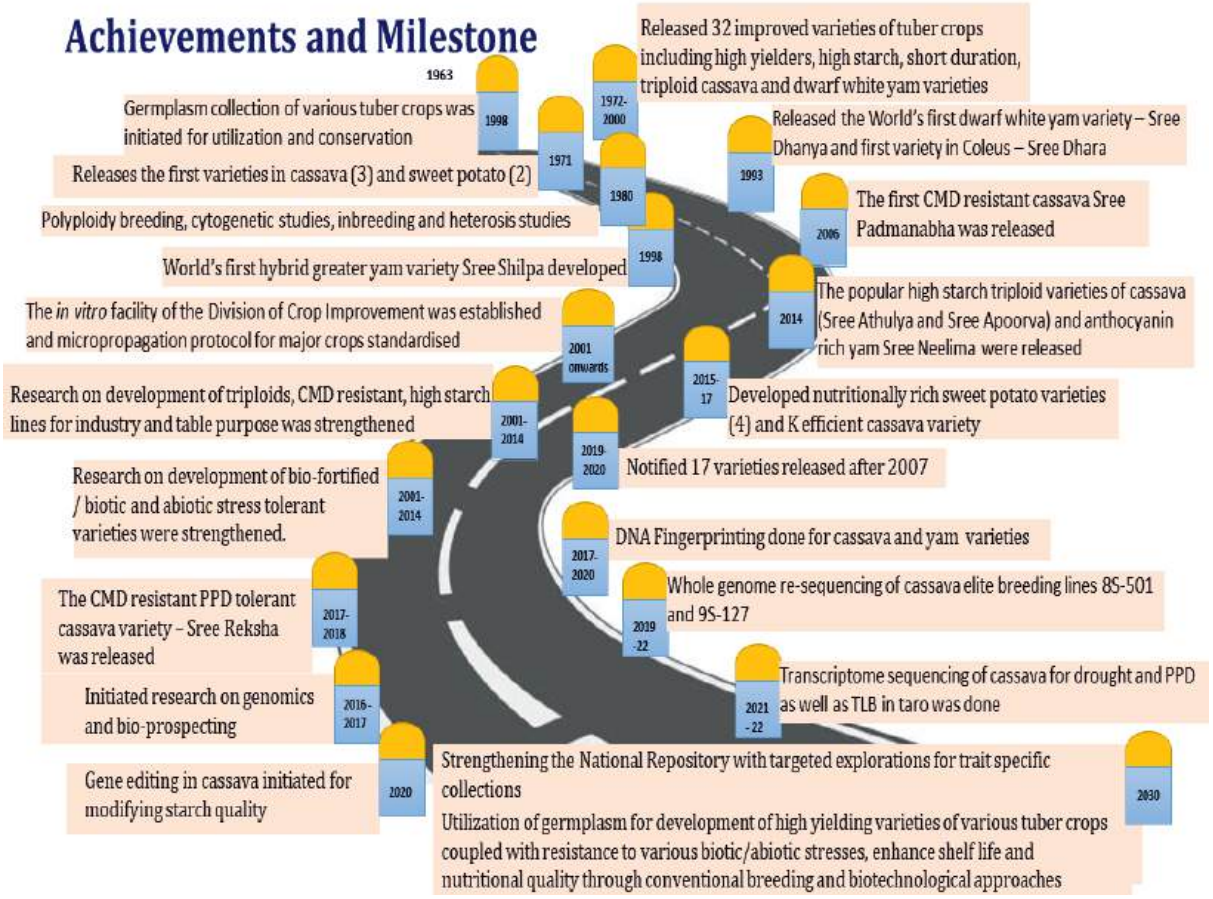
D. Edible aroids

- In edible aroids, the major traits identified are - high yield; high starch content; non-acridity; bio-fortification; earliness; disease resistance (taro leaf blight in taro and collar rot in elephant foot yam); salinity tolerance; climate resilience; nutritional enrichment; tuber quality traits.

E. Minor tuber crops

- In the case of minor tuber crops, the major traits of interests are - high tuber yield; high starch content; tuber quality traits; earliness; less fibre to help in starch extraction and resistance to important biotic stresses.

Achievements and Milestones



ICAR-Central Tuber Crops Research Institute

Sreekariyam, Thiruvananthapuram 695 017, Kerala, India
Phone: (91) (471) 2598551 to 2598554
E-mail: director.ctcri@icar.gov.in
Website: https://www.ctcri.org
Social Media
Facebook Twitter Whatsapp Instagram You Tube