CTCRI/QSF/RP/424

अनुसंधान की मुख्य विशेषताएँ
Research Highlights
2014 - 2015

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

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

CTCRI/QSF/RP/424

अनुसंधान की मुख्य विशेषताएँ
Research Highlights
2014-2015

भाकृअनुप-केन्द्रीय कन्द फसल अनुसंधान संस्थान
(भारतीय कृषि अनुसंधान परिषद्)
श्रीकार्यम तिरुवनन्तपुरम 695 017 केरल भारत

ICAR-CENTRAL TUBER CROPS RESEARCH INSTITUTE
An ISO 9001-2008 Certified Institute
SREEKARIYAM THIRUVANANTHAPURAM 695 017 KERALA INDIA

ICAR-Central Tuber Crops Research Institute
Sreekariyam, Thiruvananthapuram 695 017
Kerala, India

Tel. No. : (91) (471) 2598551 to 2598554
Fax: (91) (471) 2590063
e-mail: director.ctcri@icar.gov.in
website: http://www.ctcri.org

Published by
Dr. S. K. Chakrabarti
Director

Compiled and Edited by
Dr. G. Suja
Dr. A. Asha Devi
Dr. V. Ramesh
Dr. M.L. Jeeva
Dr. Rajasekhara Rao Korada
Dr. Sheela Immanuel
Mrs. Namrata Ankush Giri
Dr. S. Shanavas
Shri. Davis Joseph
Shri. R. Bharathan
Smt. T.K. Sudhalatha
Shri. A.S. Manikuttan Nair

Correct Citation
ICAR-CTCRI 2015, Research Highlights 2014 - 2015,
ICAR-Central Tuber Crops Research Institute
Thiruvananthapuram, Kerala, India, 47p.

Design & Printing
Akshara Offset, Thiruvananthapuram

Cover Illustration
Front : Cassava (*Manihot esculenta*) canopy, Female flower of cassava (*Manihot esculenta*), Flowering taro plant (*Colocasia esculenta*), Sweet potato (*Ipomoea batatas*) vine
Back : *Dioscorea alata* (Greater yam), Farmer in Ranchi, Jharkhand with elephant foot yam harvest, Farmer in Joida Taluk, Uttar Kannada with dasheen type taro tubers

15 July 2015

Contents

Preface

The ICAR-Central Tuber Crops Research Institute established in 1963 with its headquarters at Thiruvananthapuram and its Regional Centre at Bhubaneswar has grown over the years into a premier research organization of international repute doing exclusive research on tropical tuber crops. The Institute in collaboration with the sister Institutions of ICAR, SAUs, NGOs etc. accomplished significant achievements in development and dissemination of tropical tuber crops technologies during 2014-2015. As a public institution, it is our paramount responsibility to keep informed our clientele farmers, entrepreneurs, industrialists, extension personnel, and policy makers about our latest achievements. To fulfill that commitment, a concise document on research progress and achievements made on other related activities of the institute during last year is presented here.

Two new varieties of cassava (Sree Swarna and Sree Pavithra) and two of greater yam (Sree Swathy and Sree Neelima) were released for cultivation in Kerala. Profitable production technologies, viz., drip fertigation for elephant foot yam, cropping system consisting of rice-black gram-short-duration cassava, site specific nutrient management schedules based on nutrient zonation map, customized fertilizers and INM for yam bean have been developed. Similarly, bio-intensive management schedules for taro leaf blight and collar rot of elephant foot yam have been perfected. Full genome sequence of Dasheen Mosaic Virus was determined that facilitated development of robust detection protocol for the virus. Technologies for production of lacto-pickle from elephant foot yam, low-moist gelatinised dough for cassava papad, cassava-rice based extruded products, functional sago with high protein and calcium content, cereal grain type pasta including cassava-maida and cassava-rice blends were developed. An electronic device (E-Crop) for giving real-time agro-advisory was developed. It collects real-time weather data at 15 minutes interval and generates agro-advisories that are delivered to the farmers as SMS. Concerted efforts were made to extend profitable production technologies to the farmers of Chhattisgarh, Jharkhand, Odisha, Karnataka as well as NEH region. For detailed description of all the technologies readers may go through the Annual Report 2014-2015 available in our website (http://www.ctcri.org).

I am extremely grateful to Dr. S. Ayyappan, Secretary, DARE and Director General, ICAR for his constant support and guidance. I would also place on record my thanks to Dr. N. K. Krishna Kumar, DDG (Horticultural Science), Dr. S. K. Malhotra, former ADG (HS II), Dr. T. Janakiram, ADG (HS I), Dr. B.K. Pandey, PS (HS), Dr. Manish Das, PS (HS), Dr. Vikramaditya Pandey, PS (HS) for their suggestions and encouragement. I appreciate sincere efforts made by Drs. G. Suja (Chairperson), A. Asha Devi, V. Ramesh, M. L. Jeeva, R. R. Korada, Sheela Immanuel, Mrs. Namrata Ankush Giri, Shri. Davis Joseph, Shri. R. Bharathan, Smt. T.K. Sudhalatha, Dr. S. Shanavas and Shri. A.S. Manikuttan Nair in compiling this report.

15 July 2015

S. K. Chakrabarti
Director

Research Achievements

There were 17 ongoing projects and 24 externally aided projects during 2014-2015. The salient achievements of the projects are highlighted here. The scientific staff strength was 39 including Director during the reporting period.

CROP IMPROVEMENT

- A total of 5895 accessions of different tuber crops are being maintained in the National Repository for Tuber Crops at ICAR-Central Tuber Crops Research Institute (CTCRI), which comprises cassava 1383, sweet potato 1483, yams 1151, edible aroids 1350 and minor tuber crops 391 accessions along with 137 new accessions added during 2014-2015 from three targeted collection trips to Joida Taluk, Uttara Kannada, Karnataka; Arunachal Pradesh and northern parts of Kerala apart from few collections from Meghalaya, Karnataka, Kerala and Maharashtra.

Tuber variability available at Joida Taluk, Uttar Kannada, Karnataka

Arunachal Pradesh exploration group

Wild *Amorphophallus* spp. collected from Arunachal Pradesh

A view of the collection trip to North Kerala

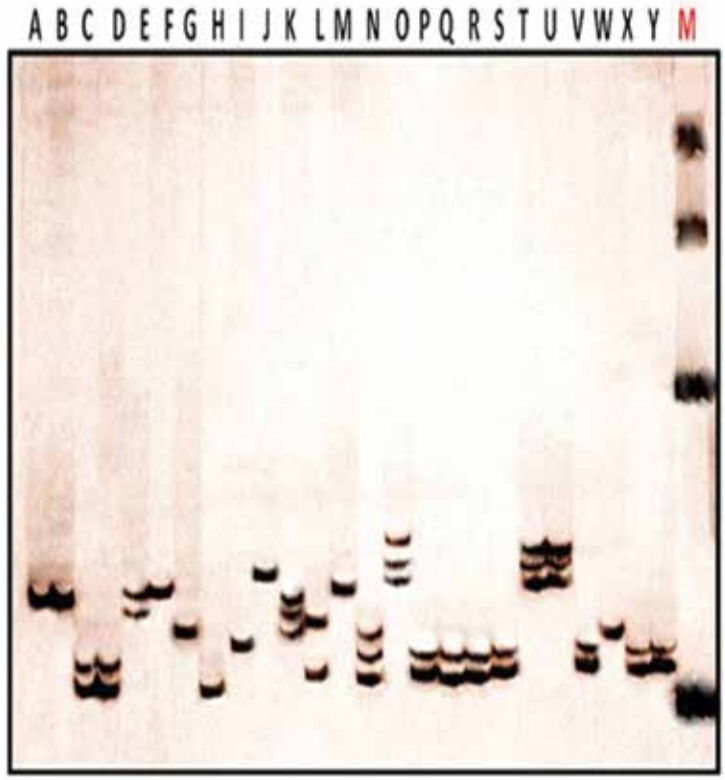
Tuber variability in yams collected from North Kerala

- Genetic diversity analysis of cassava (12 landraces); sweet potato (15 accessions) and elephant foot yam (12 accessions) was done using six SSR markers (cassava) and six ISSR markers (sweet potato and elephant foot yam). The results demonstrated uniqueness of all the accessions in cassava and elephant foot yam with similarity coefficient ranging from 0.35 to 0.88 and 0.50 to 0.93, respectively. In sweet potato, the ISSR markers could identify duplicates successfully. Two sets of duplicates could be identified here and the similarity coefficient ranged from 0.40 to 1.00.

- In white yam, few elite clones having desirable traits were identified which includes, 17 accessions (Dr-2, 24, 69, 73, 121, 128, 132, 142, 144, 161, 175, 240, 251, 318, 332, 334 and 342) having excellent coking quality; an accession (Dr-292) having high dry matter and starch content coupled with excellent cooking quality and eight accessions, Dr-2, 20, 40, 73, 140, 147, 287 and 292, with high dry matter content (>42%).

- The genetic diversity study based on SSR markers as well as morphological traits of 40 landraces of greater yam collected from different parts of India showed that among the landraces, the ones from Kerala (Da-331), Assam (Da-145) and Odisha (Da-327) were highly divergent as compared to the other accessions. Maximum polymorphism was revealed by the marker, Dab2E07, originally identified from a related species viz., *D. abyssinica*. Da2F10, Dab2D11, Da3G04, Da3E10 and Dab2C12 also revealed high levels of polymorphism.

- Morphological and molecular characterization of 25 taro accessions from NEH regions showed high levels of diversity as shown by Shannon Weaver's (H'=0.87) and Simpson's diversity index (D=1.00) computed according to percentage distribution of the various traits. Molecular characterization using 10 polymorphic SSR markers (Ce1 A06, Ce1 B03, Ce1 C03, Ce1 C06, Ce1 F04, Ce1 H12, uq73-164, uq84-207, uq97-256 and uq201-302) gave high polymorphism as explained by the high values of Shannon's index (1.59-2.37), average number of alleles (6.0-12.57) and polymorphic marker ratio (0.76-1.0). No duplicates were identified.



Six per cent denaturing PAGE profile of 25 taro accessions using SSR marker Ce1 F04

- Preliminary yield evaluation was initiated in arrowroot collections for tuber traits. The fresh single tuber weight ranged from 69.90 g in the collection from Kerala to 100.50 g in the collection from Maharashtra and the dry matter percentage ranged from 31.90 in the Kerala collection to 33.80 in the Odisha collection. The per plant tuber yield ranged from 1.30 kg (Kerala) to 2.40 kg (Maharashtra), while the number of tubers per plant ranged from 17 in Odisha collection to 34 in the Maharashtra collection.
- At the regional centre, preliminary yield evaluation was done in taro (5-18 t ha^{-1}), elephant foot yam (8-24 t ha^{-1}), yam (8-25 t ha^{-1}) and yam bean (13.55-29.94 t ha^{-1}).
- Under IVAG, 88 pre-identified core collections of sweet potato; 100 accessions received from NBPGR; 48 cassava; 22 yams; 26 taro; 5 Chinese potato and 2 elephant foot yam varieties/pre-release varieties as well as elite lines are being maintained *in vitro*.

- Four varieties, two in cassava and two in greater yams were released in the Kerala State Varietal Release Committee 2015. Sree Swarna is a cassava variety having high yield (40.00 t ha^{-1}), early bulking (7 months), having good culinary quality, yellow flesh colour and tolerance to CMD, whereas, Sree Pavithra is a cassava variety with high yield (35-45 t ha^{-1}) at low levels of potassium (K) with excellent cooking quality, low cynogenic glucoside (25.80 ppm) and 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.
- Sree Swathy is a greater yam variety released for its high yield (30.00 t ha^{-1}), good culinary and nutritive quality and moderate tolerance to anthracnose disease, whereas, Sree Neelima is a high yielder (35.00 t ha^{-1}) with good culinary and nutritive quality and light purple flesh colour.

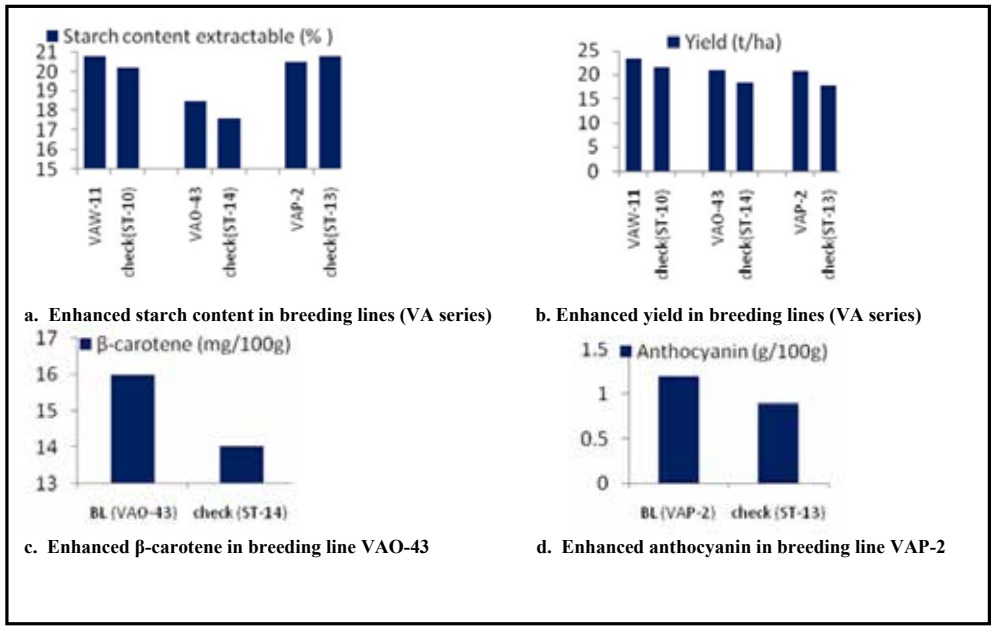

Sree Swarna


Sree Pavithra


Sree Swathy


Sree Neelima

- Three early maturing cassava hybrids, 8S-501-2 (5.88 kg $plant^{-1}$), 11S-30 (4.25 kg $plant^{-1}$) and 8W-5 (3.82 kg $plant^{-1}$) were identified, which matured at seven months.
- Sixteen germplasm lines and 35 hybrids of sweet potato were identified having the targeted traits of higher yield (more than 17 t ha^{-1}), starch (more than 18%), β-carotene (more than 14 mg $100g^{-1}$) and anthocyanin (more than 1g $100g^{-1}$) with reduced crop growth cycle (75-90 days) and weevil resistance (infestation less than 10%). Maturity of 75 days was recorded for 1 orange and 2 white-fleshed, whereas 90 days maturity was recorded for 15 white, 5 orange and 5 purple-fleshed sweet potatoes. Yield ranged from 17-22 t ha^{-1}, β-carotene 14-16 mg $100g^{-1}$ and anthocyanin more than 1g $100g^{-1}$. Comparison between improved breeding lines with parental source indicated higher yield with enhanced starch, β-carotene and anthocyanin.



a. Enhanced starch content in breeding lines (VA series)

b. Enhanced yield in breeding lines (VA series)

c. Enhanced β-carotene in breeding line VAO-43

d. Enhanced anthocyanin in breeding line VAP-2

Enhanced yield with starch, β-carotene and anthocyanin in breeding lines viz. VAW-11, VAO-43 and AP-2

- A purple-fleshed high yielding greater yam variety, Da-340 was identified for anthocyanin extraction.
- The white yam hybrid, Drh-657 with compact tuber shape, high yield and cooking quality, for release in Kerala and a dwarf clone, Drd-1157 with high yield (25 t ha^{-1}) and good culinary properties were identified.

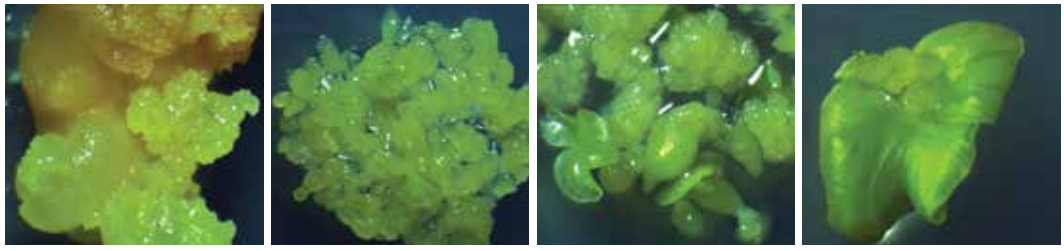
The early maturing cassava hybrid 8S-501-2

Da-340, a dark purple anthocyanin rich greater yam

Drh-657, a white yam hybrid with compact tuber shape, high yield and cooking quality

- Ten TLB tolerant taro accessions (C-84, C-203, C-370, C-388, C-565, C-679, C-690 (violet), C-717, C-723 and IC012470) and one high yielding flowering clone of elephant foot yam having good cooking quality and high multiplication rate (Puttur local) were identified.

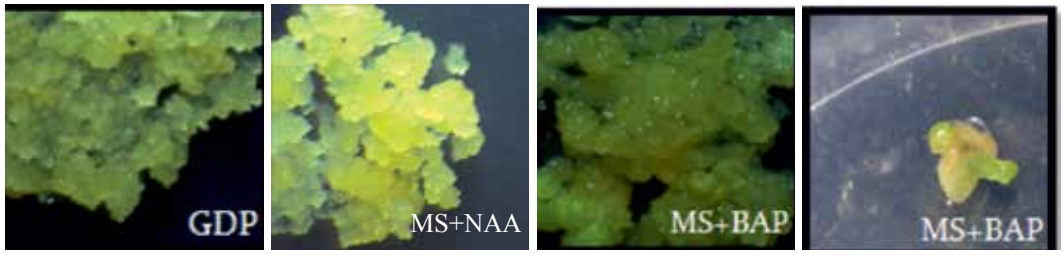
- Friable Embryogenic Callus (FEC) production from different cassava varieties viz., H-226, H-165, Sree Athulya and Sree Apoorva were initiated using different explants (unopened leaf lobes and embryogenic structures at different stages). Among these varieties, H-165 showing good response to FEC production was established.



FEC initiation in H-165 | 14th Day | 21st Day | Emerging shoots separated in regeneration media

FEC production in H-165

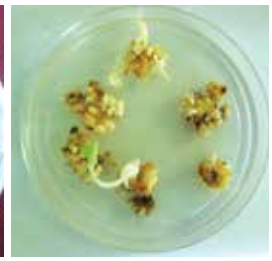
- In the experiment on genetic modification for quality improvement in cassava, standardization of transformation of cassava, TMS60444, Friable Embryogenic Callus (FEC) with *Agrobacterium* having *glgC* gene was done and the transformed cultures are in maturation media. Regeneration potential of cassava TMS60444 FEC was confirmed.



Regeneration of FEC of TMS60444

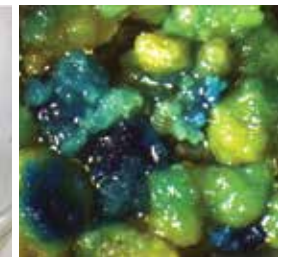
- DNA fingerprinting of 15 released varieties of cassava was done using four SSR markers using Genetic Analyser (ABI-3500). The primers SSRY 34 and SSRY 40 produced five alleles followed by SSRY 32 (four alletes) and SSRY 39 (three alleles)
- Parameters were standardized for developing transgenic elephant foot yam, which includes antibiotic concentration (Geneticin–20 mg l^{-1}; Hygromycin-5 mg l^{-1}; Ticarcillin–650 mg l^{-1}), acetosyringone (400 µM), number of days for co-cultivation (2-3 days) and co-cultivation temperature (28°C). Using GUS gene as marker, these parameters were validated and transgenic elephant foot yam having GUS gene was successfully developed.

Calli as explant for transformation



Transgenic calli in selection medium-after 6 months

Regenerated transgenic plant



GUS staining of transformed calli

Transgenic elephant foot yam having GUS gene

- In view of developing resistance to DsMV in *A. paeoniifolius*, a hairpin construct of DsMV (DsMV-hp) was designed containing the most conserved region in the CP gene of DsMV in the forward and inverted orientation separated by an intron, thereby resulting in a hairpin (hp) construct. The resistance against DsMV upon the hp construct expression was assessed in a model host, *N. benthamiana*. The construct was found to provide complete resistance towards DsMV upon challenge inoculation of transgenic lines as evidenced from the symptom score and molecular analysis.

Symptoms observed on challenge inoculation with DsMV in control and transgenic *N. benthamiana*

- Bioinformatics approach was applied to identify potential cassava miRNA regulated genes in cassava mosaic virus genome. Fourteen miRNA families were found to have the potential to target cassava mosaic virus genome with nearly perfect complementarities.

- Potential SNP markers were predicted in three classes of deletions, insertions and substitutions for cassava using the input sequences from Phytozome and EST sequences from NCBI. DNA polymorphism characterizations were carried out and gene ontology classification of the identified SNPs were carried out.

CROP PRODUCTION

- In a study to identify the best weed management practice in cassava, tuber yield was maximum (28.26 t ha^{-1}) under ordinary black polythene mulching (32.06% greater than Package of Practices, POP), which was on par with the use of weed control ground cover (WCGC) till final harvest (26.62 t ha^{-1}) and transparent plastic mulch (26.47 t ha^{-1}). However, considering the constraints such as scarcity, timely availability and high cost of labour, the WCGC method that generated a net profit of Rs. 1,55,795 ha^{-1} can be recommended for weed control in cassava.
- Fertigation studies in cassava indicated that the effect of different levels of N (75, 100 and 125 kg ha^{-1}) were on par with respect to tuber yield. However, K showed a positive response with increasing levels of drip fertigation up to 125 kg ha^{-1}.
- The cropping system, rice (var. Aiswarya)-black gram (var. Co-6)-short-duration cassava (var. Sree Vijaya) was productive, profitable and energy efficient. There was a possibility to save half FYM and N and full P to short-duration cassava in this system.

First crop of rice

Second crop of pulse

Third crop of short-duration cassava

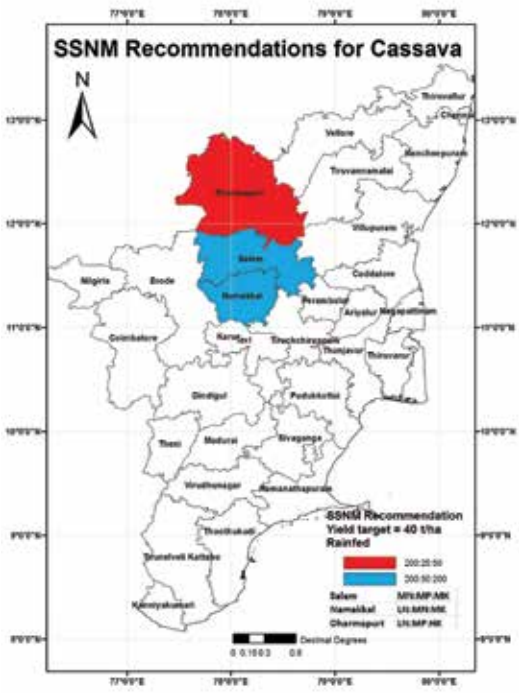
- Continuous application of manures and fertilizers on the sustainability of cassava production and soil productivity for the 10th consecutive season indicated that application of NPK @ 125:50:125 kg ha^{-1} produced the highest tuber yield (30.84 t ha^{-1}), which was on par with NPK @ 100:50:100 kg ha^{-1} (25.17 t ha^{-1}) and 50:50:100 kg ha^{-1} (25.13 t ha^{-1}). Soil test based application of NPK @ 78:0:48 kg ha^{-1} resulted in an yield of 22.57 t ha^{-1} on par with NPK @ 100:50:100 kg ha^{-1} (25.17 t ha^{-1}) and 50:50:100 kg ha^{-1} (25.13 t ha^{-1}).

- Continuous cassava cultivation for the 10th season without any manures and fertilizers resulted in an yield of 17.93 t ha^{-1}. Different organic manures tried, to substitute FYM viz., green manuring *in situ* with cowpea (27.29 t ha^{-1}), vermicompost (29.31 t ha^{-1}) and coir pith compost (28.31 t ha^{-1}) produced yield on par with FYM (25.17 t ha^{-1}).
- Soils treated with regular annual additions of organic manure in 10th season crop of cassava showed that NPK + vermicompost and NPK + coir pith compost had lowest values of bulk density (1.43-1.45 Mg m^{-3}) in comparison with absolute control (1.61 Mg m^{-3}). Surface soil moisture and soil temperature during the period, August-November 2014, among organic treatments and control ranged from 4.30 to 11.80% and 29.00 to 33.10°C respectively. Addition of coir pith compost resulted in low per cent of soil moisture depletion (36%) as against absolute control (49%).
- Water transmission properties determined in field using Guelph Permeameter for different organic and absolute control (AC) treatments indicated the lowest saturated hydraulic conductivity value of 1.57 cm h^{-1} in AC and highest value of 3.93 cm h^{-1} in treatment with integrated application of all the four organic manures. This treatment was also found to have the maximum matric potential and sorptivity values.
- Field demonstration trials conducted with six selected K efficient genotypes in three locations each during two seasons indicated Aniyoor and 7III E3-5 as the best, yielding 4-11 kg per plant without K and K @ 50 kg ha^{-1} as well as having good cooking quality.

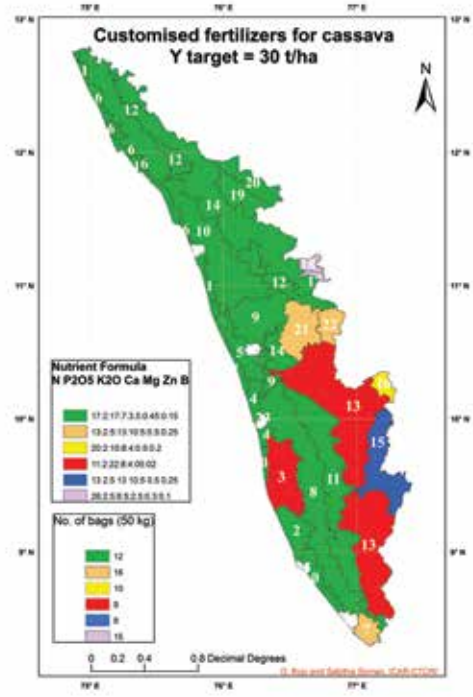
Aniyoor: K efficient genotype

Crop and tuber growth at 4 months in soils applied with ground cover sheets under complex risk prone and diverse zone at Pachamalai hills, Eastern Ghats of Tamil Nadu

- Field experiments conducted for two seasons with three NPK efficient genotypes under four nutrient management practices showed that the genotypes, Acc. No. 905 and 906 as promising under low input management in terms of tuber yield (33.68 and 34.72 t ha^{-1} respectively) and B:C ratio (4.43 and 4.57, respectively). The low input management strategy could save P, K, Mg and Zn to the extent of 100.00, 11.50, 62.50 and 80.00%, respectively and the decrease in the cost of inputs under the low input practice over the POP recommendation was up to 55%.
- Field experiments conducted for the first season with thippi compost indicated the possibility of substituting thippi compost with other organic manures like FYM, green manuring *in situ*, crop residue, coir pith compost, vermi compost and fertilizers to the full extent and secondary nutrient (Mg) and micro nutrient (Zn).
- A new experiment initiated to study the spatial and temporal variations of soil properties as influenced by tillage and mulching practices with respect to hydro-physical, nutrient use and rooting characteristics of cassava revealed that saturated hydraulic conductivity and sorptivity of soils under conventional tillage was 26% and 41% higher respectively as compared to minimum tillage. Significant variation in surface soil moisture content was observed between ground cover sheet (12.40%, v/v) and no mulch plots (6.10%).
- The NPK use efficiency studies in rainfed cassava under complex risk prone and diverse zone at Pachamalai hills, Eastern Ghats of Tamil Nadu, has shown that the values were significantly higher in scientific practice (SP) (NPK use efficiency of 28, 42, 23% respectively) as compared to farmer's practice (FP) (23, 23, 10%) as well as in ground cover sheet applied soils (31, 13 and 20%) against no sheet (23, 12 and 17%) treatments. Better plant growth was also exhibited under scientific practice-ground cover treatment.
- Results of second year experiment at Pachamalai hills revealed the beneficial effect of porous ground cover sheets in respect of high soil water retention (8.60 %, v/v) against absolute control (AC) treatment (6.90 %) during dry periods in the month of February 2015. Biomass of cassava obtained for the SP-GC treatment was 169.50 g $plant^{-1}$ (on dry weight basis) as against 78.20 g $plant^{-1}$ for AC.
- Site specific nutrient management (SSNM) zonation maps were developed using geoinformatics tools based on QUEFTS model outputs, potential yield, indigenous nutrient supply, nutrient recovery fraction, benchmark soil series and/or agro-ecological units/zones for different yield targets of cassava, elephant foot yam and sweet potato in major growing environments of India.



SSNM recommendation for cassava



Customised fertilizers developed for six different zones of cassava in Kerala state for Y_{target} = 30 t ha^{-1}

- Customized fertilizers incorporating major, secondary and micronutrients were developed for cassava, elephant foot yam and sweet potato for all the major growing environments of India for different yield targets based on the SSNM zonation maps developed as well as the principles of fertilizer best management practices (FBMP).
- The climate-based ecological niche model, ECOCROP, has been calibrated and methodology was developed using geoinformatics tools for studying climate change impact on cassava, sweet potato, elephant foot yam and yams and for developing suitable management strategy to minimize climate change impact.
- Technology to develop site specific natural resource management at farm level (130 locations of ICAR-CTCRI farm) has been developed using geoinformatics tools. Based on the information generated, a decision support tool, Fertcalc_CTCRI was developed for nutrient management of the farm. The tool has been uploaded in www.ctcri.in.

- Samrat and CIP-440127 were identified as promising genotypes of sweet potato for cultivation in natural saline soils under island ecosystem of Andaman.
- In elephant foot yam, highest corm yield (35.20 t ha^{-1}) was obtained with drip fertigation at 3 days interval and 50 number of splits of recommended dose of fertilizers (RDF) (120:60:120 $N:P_2O_5:K_2O$ kg ha^{-1} water soluble fertilizer) at Bhubaneswar. The first dose of fertigation should start 10 days after planting. Fertigation up to 150 days after planting was essential for production of higher corm yield. Drip fertigation at 3 days interval with 50 number of splits of recommended dose of fertilizer realised fertilizer use efficiency of 61.70 kg kg^{-1}, which was 33.40 kg kg^{-1} higher than RDF.

Salt tolerant genotypes of sweet potato for natural saline soils

Drip irrigation in elephant foot yam

- In elephant foot yam, drip irrigation at 100% CPE during 13-24 weeks resulted in maximum yield (46.56 t ha^{-1}) followed by bed irrigation during the entire period of 1-24 weeks (40.41 t ha^{-1}) at Thiruvananthapuram. In elephant foot yam, water requirement was critical during 13-24 weeks, coinciding with tuber bulking phase compared to initial sprouting phase. Water requirement of elephant foot yam is worked out to be 4.30 mm per day for attaining a targeted yield of 46.50 t ha^{-1}.
- On-farm trials laid out to validate the on-station developed organic farming technologies for yams and taro indicated that the yields under organic management were 8, 17, 21 and 29% higher over chemical based farming in greater yam, lesser yam, dwarf white yam and taro, respectively. There was significant improvement in pH, organic C and available K status under organic management in the sites. Soil microbial population was also improved under organic practice in these sites.

On-farm trials on organic farming of yams and taro

Organically produced greater yam tubers at Anchal

- Studies on INM in yam bean indicated highest tuber yield (23.36 t ha^{-1}) for integrated application of lime, FYM, NPK and $ZnSO_4$ with a yield response of 136% over control. The increase in tuber yields for applications of 50, 100 and 150% NPK based on soil test values were 40, 72 and 124% over control.

- Soil samples collected from areas adjacent to chromium mining tract of Sukinda block in Jajpur district, iron mining areas of Joda and Banspal blocks of Keonjhar district and Thermal power plants and Aluminium factories of Talcher block of Angul district of Odisha showed that the mean available Zn and Cu was highest (4.96 and 0.71 mg kg^{-1}, respectively) in the iron mining areas of Keonjhar district. Highest Cr values were observed in the Cr mining areas of Jajpur district (135.23 - 178.25 mg kg^{-1}, with a mean of 152.75 mg kg^{-1}).

- A total number of 108 micro plants of different cassava varieties and 72 micro plants of elephant foot yam (var. Gajendra) were indexed. Popular cassava varieties multiplied were Sree Visakham, Sree Vijaya, Sree Jaya, Sree Athulya, Sree Apoorva, Vellayani Hraswa, Sree Swarna and CMR-100. Virus free planting materials of ten cassava varieties that were obtained from ICAR-CTCRI, Regional Centre, Bhubaneswar were multiplied through minisett technique.

CROP PROTECTION

- A field survey was conducted for borer pests in different states of Odisha, Assam, Meghalaya, Arunachal Pradesh, Uttar Pradesh and Jharkhand. In Odisha, the sweet potato weevil (SPW) *Cylas formicarius* was a major pest with 30 to 70% yield loss. Sweet potato weevil sex pheromone lures, distributed to farmers in 10 ha @ 10 traps per ha in Pamala, Shakarpur and Parvathiya villages of Dhenkanal (Odisha),

convinced the farmers to adopt pheromone trap technology during *kharif* season of 2014 in 150 ha and increased the yield up to 25%. The cost:benefit ratio of this technology was 1:7.3. The technology was widely accepted because of availability of sex pheromone lures.

Farmers use their own pheromone traps at Dhenkanal

Sweet potato farmers in Dhenkanal with pheromone traps

- Gamma irradiation of male sweet potato weevil *Cylas formicarius* @ 200 Gy h^{-1} decreased the chance of emergence of weevils by five times *in vitro*. Females after mating with irradiated males produced less number of weevils in the 1st generation (7 weevils per kg tubers) compared to 35 weevils per kg from the tubers infested with normal males and females.

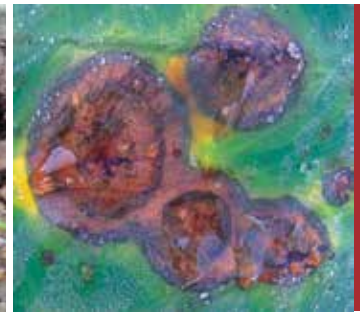
- The sweet potato plots applied with Thiomethoxam 25 WG and Imidachloprid 17.80 SL had lowest incidence of *Cylas formicarius*, 0.33 and 0.83 per plant, when compared to the control plots (5.23 weevil). In another experiment, the topical application of quinalphos @ 0.001% could control 100% sweet potato weevil after one day treatment, whereas Malathion was least toxic. The bioformulation Nanma at 5% also managed sweet potato weevil.

- Cassava mosaic disease (CMD) resistant transgenic line (TMS 60444) having resistance against ACMV available at ETH were imported to ICAR-CTCRI. CMD resistant clones (CR-43-7, CR-43-2, CR-24-4, 9S-127, 11S-33, 8S-501-2 and S-1284) were selected for multiplication for conducting on-farm trials in Tamil Nadu. *In vitro* cultures of high starch CMD resistant clones were established (30 cultures) for micropropagation. Planting material of released varieties, Sree Athulya, Sree Apoorva and H-226 were planted in the field for large scale multiplication.

- Among 135 isolates obtained from 70 soil samples collected from 10 states, 35 showed high inhibition of *Phytophthora colocasiae* and *Sclerotium rolfsii in vitro*. Based on consistent pathogen suppression, IAA production and growth promotion in cowpea, 13 bacterial isolates were selected and identified using 16s rRNA sequencing. Among them, *Bacillus subtilis, B. licheniformis* and *B. amyloliquefaciens* were selected for further field trials.
- Bio-priming of taro cormels with *B. subtilis, B. licheniformis* and *B. amyloliquefaciens* @10^8cfu ml^{-1} suspension reduced taro leaf blight incidence (from PDI of 30.50 to 11.80) and induced growth promotion. In a field trial on disease management in taro, the least TLB incidence (PDI of 14.80) was noted in metalaxyl 0.05% treated plots followed by vermicompost and vermiwash applied (18.20) ones. Addition of boron and silicon @ 100 (3 kg ha^{-1} and 50 kg ha^{-1} respectively) and 150% recommended dose (4.50 kg ha^{-1} and 75 kg ha^{-1}) significantly reduced taro leaf blight incidence in a pot culture study.
- In another field trial on disease management in elephant foot yam, least collar rot incidence (8.00%) and highest yield (36.60 t ha^{-1}) was obtained with incorporation of vermicompost (750 g per pit at the time of planting and 400 g per plant at 90 and 120 DAP) and vermiwash (10%).

Pot culture study with boron and silicon

Collar rot infection in elephant foot yam



Taro leaf blight incidence

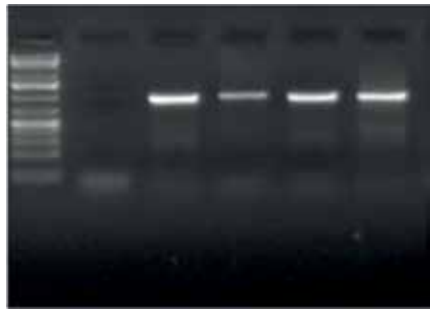
- Corm treatment with *Trichoderma* @ 5 g kg^{-1} + soil application of neem cake 200 g per pit + two sprays with ICAR-CTCRI bioformulation at 60 and 90 DAP resulted in least collar rot incidence (0.20%) and leaf blight incidence (4.40%) and highest yield (34.20 t ha^{-1}) in elephant foot yam under field condition.
- Twenty *P. colocasiae* isolates have been added to the existing collection from the farm of ICAR-CTCRI for studying yearly variation. All isolates were confirmed

to the species level using species specific PCR. Genetic diversity analysis was performed using Random Amplified Microsatellites (RAMS) Markers. A reliable method for screening resistance in taro accessions against leaf blight disease using real-time PCR has been standardized. Several genes expressed in *P. colocasiae* during a compatible interaction with taro variety Sree Kiran (leaf blight susceptible) was identified using Suppression Subtractive Hybridization (SSH) approach. Total genomic DNA was isolated from taro accessions with varying level of resistance to leaf blight. Resistant Gene Analogues (RGAs) are currently being amplified using available degenerate primers.

- *Colletotrichum gloeosporioides* causing greater yam anthracnose could survive in the sterilized dry and 20% moistened field soil up to three and nine months respectively *in vitro*. It could survive in crop debris up to one year. The major source of inoculum was air followed by tuber and soil and the disease progress was significantly high through air borne infection. The progress of the disease started from the month of August (fourth month after planting) after rainfall and reached maximum during October when the rainfall and number of rainy days were more. Soil treatment with *Trichoderma* @ 50 g of 10^7 cfu g^{-1} and tuber treatment with 5 g in fresh cow dung slurry per kg of tuber and foliar spraying of Carbendazim (Bavistin) 0.05% three times after the initiation of symptoms at 15 days interval followed by monthly spray for another four months drastically reduced the anthracnose intensity (66%) and increased the yield (22%) in greater yam. The toxin produced by *C. gloeosporioides* was purified through column chromtography. The UV absorbance of the fractions was recorded and leaf bioassay has been done for further identification.
- MS media with 2,4-D 3 mg l^{-1} supported good callus proliferation in greater yam var. Orissa Elite. The callus could be regenerated successfully in MS media with 1.5:1.5 mg l^{-1} NAA:BA.
- In the study on recovery phenomena of cassava mosaic disease, symptoms as well as virus titre of recovery types decreased over the growth period; while resistant line had low concentration of viral DNA even though there were no symptoms.
- An effective RT-LAMP assay has been developed for the easy detection of Dasheen mosaic virus (DsMV) in less than an hour and it was validated with field samples of elephant foot yam. For large scale indexing of samples, CP specific non-radioactive probe was developed and used in NASH with great reliability.

Greater yam callus regeneration

- The complete nucleotide sequence of DsMV was deduced from the transcriptome data and validated using PCR amplification of various overlapping regions with 11 set of primers, which was designed based on the assembled sequence obtained from the transcriptome data and subsequent sequencing of PCR products. The sequence of the virus of 10024 bases showed 83% identity with DsMV infecting *Z. aethiopica* (China), the only available whole genome sequence of DsMV at NCBI.
- Testing of different viruses in 22 taro leaf samples using PCR based method revealed the presence of DsMV (68%), Taro bacilliform virus (TaBv) (45%) and mixed infection (27%). The DsMV sequence showed maximum similiarity of 93% to DsMV isolate DsMV-Amp3polyprotein gene, DsMV isolate T10 (Accession KJ786965) and DsMV partial CP gene for coat protein of NiNG1 (Accession AM910398) and NiNG4 isolate (Accession AM910400), whereas the TaBV sequence showed maximum sequence similiarity of 92% to TaBV isolates (NC1, SI2 and S17) polyprotein gene.
- The PureLink RNA Mini kit and $LiCl_2$ method were the most appropriate for RNA isolation from greater yam leaf and tuber samples respectively.



YMMV full CP amplification

- A pair of species specific primers (YMacF1/R1) was designed to amplify the full CP gene of the *Yam Maclura virus in* greater yam. RT-PCR analysis with these primers provided an amplicon of ~1100 bp. The full CP gene was cloned into *E. coli* DH5α cells. BLAST analysis of the CP coding region revealed that the virus has maximum similarity to *Chinese yam necrotic mosaic virus* (ChYNMV) (70% nucleotide identity). Sequence and phylogenetic analyses revealed considerable variability; and the virus was in the same cluster as ChYNMV and *Yam chlorotic necrotic mosaic virus* (YCNMV). The virus coat protein gene exhibited only 65 to 70% nucleotide sequence identity with other *Maclura viruses*. The full CP region of *Yam mild mosic virus* (YMMV) could be amplified using highly sensitive and species specific primers, YMMV F and YMMV R in greater yam. Mining of different viruses in lesser yam (*D. esculenta*) showed the presence of only *Yam mild mosaic virus.*

CROP UTILIZATION

- Gluten-free spaghetti was developed from blends of sweet potato flour with native and pretreated rice flour.
- The annealed rice flour-sweet potato flour-whey protein concentrate-guar gum blend produced spaghetti with a low glycaemic index (GI) of 55.70.
- A low starch digestibility (GI 54.58) noodle was developed using NUTRIOSE® FB06.
- Technology was perfected for developing high protein starch noodles from sweet potato starch (SPS). Besides, the resistant starch content in SPS noodles could be enhanced through fortification with either banana starch (40%) or resistant starch (RS) enhanced (annealed) cassava starch (50%), which also had low *in vitro* starch digestibility and medium glycaemic index.

Gluten-free spaghetti from sweet potato

- Bioactive compound fortified sweet potato flour and starch noodles with high antioxidant activity were developed using betanin, anthocyanin, carotene, curcumin or their combinations.

Banana starch fortified sweet potato noodles (left) and annealed cassava starch fortified noodles (right)

- Betanin (1%) fortified flour noodles was found to be the best with high antioxidant activity and sensory quality. Betanin + anthocyanin (0.5% each) fortified starch noodles showed very high antioxidant activity.

- Field trials with sweet potato genotypes, ST-13 (with purple anthocyanin rich tuber) and Acc. No. 1468 (with anthocyanin rich leaf) were conducted under different treatments for enhancement of anthocyanin in leaves and tubers. The treatments viz., foliar spray of BA and humic acid significantly increased anthocyanin yield per plant in ST-13 as compared to control. In Acc. No. 1468, anthocyanin yield was maximum in the soil application of humic acid (5 g per plant) at 3rd week after planting. Anthocyanin yield per plant was greater in the leaves of Acc. No. 1468 than in the tubers of ST-13. The dried sweet potato leaves subjected to super critical CO_2 fluid extraction trials showed distinct bands of anthocyanin along with chlorophyll.

Vibro sieving system

- The vibro sieving system developed at ICAR-CTCRI was installed at M/s T. A. Perumal Sago Industry**,** Salem and evaluated with cassava starch slurry. Samples collected from feed and two outlets of the machine showed that the sugar content and total cyanide content of the samples ranged from 0.43-0.85% and 0.35-1.00 µg g^{-1} respectively.
- Motorised cassava chipping machines were fabricated and supplied to TNAU KVK Yethapur, Salem district. The evaluation of the machine showed that the average outturn of the machine was up to 1.5 tonnes per hour for 3.23 mm thick chips (SD 1.09 and CV 0.3374).
- Microwave drying experiments were conducted in a hot air assisted microwave dryer (Enerzi Microwave System, India-Model No: PTF-2515). Change of belt speed from 5 to 15 mm s^{-1} significantly reduced the moisture content of wet starch. Increasing power input from 400 to 800 W and belt speed from 5 to 15 mm s^{-1} reduced the drying time and increasing the loading density from 1.40 to 2.80 kg m^{-2} increased the drying time. The final moisture content of wet starch ranged from 11.09 to 12.82% (w.b) and the total drying time varied from 1.19-3.15 h.
- The ozonisation trials were conducted with wet cassava starch. The treated samples were tested for colour values (L, a and b), water activity, HCN level and viscosity. Increase in flow rate of ozone from 500 to 1500 litres per minute increased the colour values 'a' and 'b' but decreased 'L' value. The increase in concentration of ozone from 30 to 90 ppm increased the colour value 'b' and no pronounced effect was found in 'L' and 'a'. Rise in residence time from 2 to 4 hours increased the colour value 'b' but lowered 'L'. No effect of residence time was found with the colour value 'a'. The water activities of the treated samples showed that a_w decreased with the increase in flow rate and concentration. The colour values of the treated samples ranged from L-76.3-83.61, a-1.45-1.69 and b-7.13-7.52. The a_w ranged from 0.932-0.936.
- A cassava prototype harvester developed at ICAR-CTCRI was evaluated in the Institue Farm and farmers' field, Chenkal village. Results showed that the use of manual harvesting tools are preferable on relatively dryer soils, whereas manual uprooting technique is best suited for soils with relatively higher moisture

contents. The field capacity and percentage of tuber breakage in operating the cassava prototype harvester ranged from 15.72-40.20 man h ha^{-1} and 2.14-8.61%, respectively.

- Elephant foot yam (var. Gajendra, Sree Padma and a local) corms were pickled by lactic fermentation by brining the cut and blanched de-skinned corms in brine (NaCl, 2-10%). The lacto-pickle with 8-10% brine had a pH 2.44-2.89; titratable acidity 1.8-3.0 g kg^{-1}, starch 5.5-6.0 g kg^{-1}, total sugar 0.8-1.2 g kg^{-1}, lactic acid 2.8-4.2 g kg^{-1}, ascorbic acid 41-66 mg kg^{-1} on fresh weight basis. The shelf life of the pickle without any preservative was 20 days; however, with addition of mustard or olive oil, there is no spoilage up till now (more than 45-60 days). Sensory evaluation rated the elephant foot yam lacto-pickle acceptable to consumers based on texture, taste, flavour and after taste.

- The process variations in the production of high quality cassava flour were studied in the external aided project "Improving the livelihoods of smallholder cassava farmers through better access to growth markets (Cassava Gmarkets)". Simulation studies were conducted to optimise loading density (3, 5 and 7 kg m^{-2}) of cassava chips during drying under open yard, solar yard and mechanical tray drying. It was found that the gratings of 3 kg m^{-2} loading density dried under poly-carbonated solar dryer yielded brighter colour.

- Electrical properties of cassava tubers were studied in the DST project. The capacitance, impedance, dissipation factor and phase angle values ranged from 1.14 $X1^{0-10}$ to 2.952 $X1^{0-7}$, 1.05-9.13, 0.052 kΩ-4.09 kΩ and -43.51 to -6.6°, respectively. The varieties C-43/11, CMR-73, CMR-15, CMR-1, CMR-8, CO-1, H-226, Co-4, Mnga, Sree Harsha, CMR-24-4, AVU-27, AVU-15, 9-S-125, 9-S-236, Pulladu Kappa, Sree Swarna, Sree Vijaya, Sree Hraswa and CMR-1 were analysed in the frequency range of 700 Hz to 1 MHz and correlated with biochemical attributes. The capacitance, impedance, dissipation factor and phase angle values ranged from 2.2 $X1^{0-10}$ to 4.657 $X1^{0-8}$, 0.64-6.06, 0.053-2.72 kΩ and -43.08 to -9.38°, respectively. Microwave studies were conducted in four varieties of cassava, Sree Jaya, H-226, M-4, CMR-100 using Vector Network Analyser in S-band frequency. The real (ε^{1}) and imaginary (ε'') part of di-electric constant varied from 5.31-84.92 and 0.0036-0.4368, respectively. Tanδ and loss factor values ranged from 0.422- 489.09 $X10^{-4}$,

respectively.The hardness of the peeled and unpeeled tubers varied from 1.184-3.033 N and 0.671-2.481 N, respectively. The hardness values were correlated with electrical and biochemical properties of tuber.

- Biodegradable films from modified starch-wax composites were prepared using modified starches with different waxes viz., carnauba wax, microcrystalline and candelilla wax by adding glycerol. Minimum water vapour transmission rate (WVTR) was obtained (0.0096 g mm cm^{-2}) for esterified-carnauba wax, minimum moisture content (8.16%) for etherified starch-microcrystalline wax and minimum water absorption (12.58%) for esterified starch microcrystalline wax composites.

Biodegradable films from modified starch-wax composites

Biodegradable films from modified starch-protein composites

Biodegradable films from native starch-keratin composites

- Biodegradable films from modified starch-protein composites were prepared by adding the protein sources with the modified starches. Among the different films, minimum moisture content (8.78%) was obtained for etherified starch-whey protein concentrate, minimum water vapour transmission rate (0.017 g mm cm^{-2}) for esterified starch-whey protein concentrate and minimum water absorption (22.74%) for etherified starch-casein composites.

- Biodegradable films from native/modified starch-keratin composites were prepared using the etherified and esterified starches with keratin. Starch in the filmogenic solutions varied from 3 to 5%, keratin from 2 to 6% and glycerol from 20 to 30%. The properties of the films made with native/modified starch with keratin showed that minimum moisture content (11.81%), maximum whiteness index (58.37), minimum WVTR (0.017 g mm cm^{-2}) was obtained for native starch-keratin composites.

Binding pastes based on cassava starch

- Caustic alkali free corrugating adhesives based on a preblended carrier starch component, which is a chemically modified cassava starch and a native starch component were developed.
- Corrugating adhesives based on broken sago were formulated and tested for tack and drying time.
- Adhesive pastes based on native as well as modified cassava starch were developed as multipurpose binding paste especially for paper industries. The properties were in consistent with those of commercial binding pastes.
- A Ready-to-Mix two-part moisture resistant adhesive with extended shelf life, which consists of two components, that can be mixed together at the time of use has been developed. The starch based adhesive pastes exhibited good storage stability at ambient temperature for more than six months without significant alteration in binding properties.

EXTENSION AND SOCIAL SCIENCES

- Of the seven cassava accessions evaluated for consumption purpose at Kadegaon, Sangli district, Maharashtra under supplementary irrigation, Sree Athulya produced significantly higher yield (52.00 t ha^{-1}) and was on par with Ci-888 and 2-18. Based on cooking quality and taste, M4 and 9S-127 were most preferred by the farmers.
- The survey on elephant foot yam production system conducted in the Nadia and 24-Parganas districts in West Bengal indicated that the varieties resembling Gajendra, from Bihar/Andhra Pradesh were popular among farmers and the recommended cultivation practices were well adopted by the farmers.

- Food choice survey conducted in Kerala, Tamil Nadu and Haryana revealed that health consciousness, familiarity and naturalness as well as sensory quality were the major factors that determined food choice of consumers. Sensory evaluation of tapioca crisps indicated that aroma is the principal factor that determined the consumers' acceptability.
- A SAS macro for generating letter displays in multiple comparison of means of interaction effects of factorial experiments has been developed. An Excel macro has been developed for creation of horizontal minimum average maximum chart from summary statistics.
- Electronic Crop (E-Crop) an electronic device for giving real-time agro-advisory was developed. The E-Crop collects real-time weather data at 15 minutes interval. Crop models generates agro-advisory based on the weather data collected. Agro-advisory is sent to the farmer as SMS. One device can generate agro-advisory for many crops. This is simple to install, cheap and cost effective.

E-Crop

- Sree Visakham Cassava Expert System (SVCES), a web based user friendly cassava expert system was developed and is available at the address http://www.ctcritools.in/cassavaexpert. Major components of the system are agro-techniques, varieties, cassava protector, nutrient management system, online market, machineries, agro-advisory, literatures and upload news.

Home page of Sree Visakham Cassava Expert System

- The North-Eastern Hill Region (NEH) programme of the Institute aiming at ensuring food security through tuber crops technologies continued this year in the four implementing states of Manipur, Meghalaya, Nagaland and Tripura. Performance appraisal of the demonstrated technologies, particularly the high yielding varieties, introduction of simple post-harvest value addition technologies, laying out demonstration plots in more farmers' fields, study of value chain analysis of cassava and taro and capacity building activities were the salient activities carried out during this period.

Demonstration plot of taro var. Muktakesi at Nagaland

Processed tuber products for sale at Nagaland

- High yielding varieties, Sree Jaya and Sree Vijaya in cassava, Muktakeshi in taro and Gajendra in elephant foot yam were preferred by farmers. The value chain analysis of cassava in Nagaland indicated that both the tubers as well as the leaves were used for human consumption and as pig feed. As in the case of cassava, in taro too, value addition enabled the farmers to get good price for their product, "Anishi" - a semi-processed food from fermented taro leaves in Nagaland, which was mostly used as a vegetable substitute.
- In the area of post-harvest value addition, tiny interventions such as use of cassava slicer, chipping machine, grater etc. improved the efficiency of preparation of various value added products. In addition to the beneficiary farmers, additional number of farmers covering an approximate area of 30 ha was brought under demonstration programme in the implementing states. The necessary planting materials for this was mobilized from the beneficiary farmers and from the Institute, 4000 cassava stems, 3 tonnes of taro and 500 kg each of elephant foot yam and greater yam were supplied.

Processing of cassava tubers into flakes

Farmer's seminar cum training on tuber crops at Kolasib, Mizoram

- ICAR-CTCRI Tribal Sub Plan continued this year with Ramakrishna Mission, Narayanpur, Chattisgarh, Ramakrishna Mission, Ranchi, Jharkhand, ORRISSA (NGO), Kandhamal, PRAGATI (NGO), Koraput as the collaborating partners. A total of 254 beneficiaries from seven villages were chosen for intervention. Quality planting materials of elephant foot yam (var. Gajendra) 6800 kg, taro (var. Muktakeshi) 6000 kg, yam (var. Orissa Elite) 6000 kg, cassava stems 3500, yam bean 100 kg and sweet potato cuttings 1.1 lakhs were distributed to 260 tribal farmers of Jharkhand, Chhattisgarh and Odisha. Distribution of chicks, ducks, poultry birds, farm implements, training programmes on production and value addition of tuber crops, demonstration trials on improved cultivation of elephant foot yam and integrated disease management were the major highlights of the programme.

ALL INDIA COORDINATED RESEARCH PROJECT ON TUBER CROPS

- A total of 347 new accessions of various tuber crops were added to the field gene bank, thus maintaining a total of 4400 accessions in the different AICRP centres. During 2014-2015, IC numbers were obtained for 119 germplasm accessions and details of 509 accessions were submitted to NBPGR for obtaining IC numbers. A team from ICAR-CTCRI and AAU, Jorhat made an exploration trip to North-East regions during November 2014 and collected 42 germplasm of different tuber crops.
- The finger printing of the collections of taro and elephant foot yam were validated to find out the duplicates. Expressed sequence tag-PCR based markers as well as corresponding primers were developed from ESTs and were successfully screened in 70 genotypes of taro.
- Under MLT on Cassava Mosaic Resistant entries, TCMS–7 was superior at VR Gudem and Dapoli and TCMS-1 at Thiruvananthapuram and all the entries were symptom free at different locations. Under MLT on orange-fleshed sweet potato entries, maximum marketable yield was recorded from NFSP-1 (27.69 t ha^{-1}) at Imphal. The MLT of elephant foot yam with the promising lines conducted across the centres revealed that BCA-3 was superior at Kalyani centre. Gajendra gave highest yield at Kovvur, whereas Appakudal local gave maximum yield at Coimbatore. Under MLT on Banda, IGB-5 produced maximum yield at Jagdalpur, BCB-2 at Kalyani and IG Col E-9 at Jagdalpur (22.19 t ha^{-1}). In lesser yam, highest

and significantly superior mean tuber yield of 15.10 t ha^{-1} was recorded in the entry DE-17 at Ranchi and RAU-2 at Jorhat. These varieties may be promoted for release in the respective states.

- Site specific nutrient management studies conducted in cassava and elephant foot yam indicated that maximum yield and B:C ratio were recorded with soil test based application of nutrients in most of the locations, however this was on par with the application of recommended dose of nutrients. Farming system studies involving tuber crops implemented in Khanjuguda (village), Chakapada (block), Kandhamal (district), Odisha state resulted in 1739.10 kg of rice equivalent yield and net return of Rs 34770/0.4 ha, whereas sole crop of paddy produced 800 kg of rice and net return of Rs 13000/0.4 ha. Under farming system studies involving tuber crops in tribal areas of Port Blair, the tribal farmers generated an amount of Rs. 5500 to Rs. 9650 from pigs and the total income generated from the system ranged from Rs. 29000 to Rs.52650.Tuber crops based farming system implemented in unit area of 0.26 ha generated a net income of Rs. 53453 along with year round employment to the family in Assam.
- Under integrated management of sweet potato weevil, mulching with cassava leaves and spraying of biopesticide Nanma had good effect against weevil infestation in sweet potato. Among the seven coded taro entries evaluated against taro leaf blight disease, the entries viz., TC bl 12-4 and TC bl 12-5 exhibited lower level of disease incidence and higher cormel yield. Soil application and tuber treatment with *Trichoderma* and Carbendazim spray (1%) was effective in reducing the Anthracnose incidence and increasing yield in greater yam.

Elephant foot yam variety NDA - 9 (Narendra Asha) recommended for release in the state of UP during 14th AGM, AICRPTC


Taro variety RNCA – 1 recommended for central release from Dr. YSRHU, Rajendranagar, Andhra Pradesh

General

TRAINING AND OTHER PROGRAMMES

- Fifty nine exposure trainings on "Production and Processing of Tuber Crops" were conducted. The programmes benefitted about 1000 farmers, 110 extension officers and 871 students from Kerala, Tamil Nadu, Arunachal Pradesh and Maharashtra.
- Four Farmers Training-cum-Workshop were organized at Kolasib (Mizoram), West Tripura (Tripura), West Garo Hills (Meghalaya) and Pheren (Nagaland). Over 300 beneficiary farmers were trained on improved technologies for tuber crops production and utilization.
- Three Training Programmes of five days duration each on "Tuber Crops for Livelihood and Nutritional Security in Watershed Areas of Keonjhar, Odisha" during 30 April-4 May 2014, 20-24 May 2014 and 9-13 June 2014. The training programmes were sponsored by Project Director, Watersheds, Keonjhar, Odisha. A total of 90 farmers in three batches had been imparted three days training on various agricultural technologies including tuber crops technologies and two days field visits.
- Training on "Group Enterprises for Value Addition in Agricultural and Allied Sector" with a lecture on "Promotion of rural agro-processing centre by farmers and promotion of farmers interest group for management of PHT and value addition" on 11 June 2014 organized by SAMETI, Thiruvananthapuram.

Workshop on Tuber Crops Technologies held at West Tripura

- A Training Programme on "Production and Value Addition in Tuber Crops" in collaboration with PRAGATI NGO at Dayanidhiguda, Koraput block of Koraput district, Odisha on 23 July 2014. About 60 farmers and farm women attended the training programme. The event was marked by trainings on agro-techniques and preparation of home-made products from tuber crops, distribution of yam bean seeds to farmers, visits to FLDs and tuber crops nursery plots being laid out by SOVA NGO, sweet potato fields (cv. ST-14) and nursery plot of tuber crops being maintained by PRAGATI NGO in collaboration with ICAR-CTCRI.
- A Farmers' Seminar-cum-Training Programme on "Production and Value Addition in Tuber Crops" and "Improved Agro-techniques in Tuber Crops Cultivation with Perspective to Mizoram" in collaboration with ICAR Research Complex for NEH Region, Mizoram Centre, Kolasib, Mizoram on 4 August 2014 under the ICAR-CTCRI-ICAR NEH project "Enhancing food security and sustainable livelihoods in the North-Eastern India through tuber crops technologies". About 60 farmers and farm women from Bilkhawthlir and Kolasib blocks of Kolasib district, Mizoram attended the training programme. Distributed yam bean seeds to the farmers as an introduction of new technology.
- Training on "Tuber Crops Production and Processing" for 50 farmers of Kanyakumari district sponsored by National Horticulture Mission through Department of Horticulture, Tamil Nadu, during 1-5 September 2014.
- Harvest festival on 30 October 2014 at ICAR-CPCRI Kasaragod, where the banana fields were treated with ICAR-CTCRI developed biopesticide.
- Training Programme on "ICAR-CTCRI Developed Biopesticide" at Kootilangadi and Mankada, during 28-29 January 2015.
- Training programme to ATMs of ATMA on "Value Addition in Tuber Crops" on 26 February 2015.
- Training programme on "Value Added Products from Tuber Crops", at Techno-Incubation Centre, ICAR-CTCRI, during January-March 2015.
- Training programme on "Advanced Production Technology of Tropical Tuber Crops and their Value Addition" sponsored by Government of Assam during 15-21 February 2015. Fifteen farmers from the state and two officials from the Department of Agriculture participated in the training.

- Training on "Value Addition in Tuber Crops" for the field level functionaries of ICAR-CTCRI NEH and TSP programmes during 24-29 March 2015.
- More than 125 classes on production, protection, processing and value addition aspects were handled by scientists of various divisions under different programmes within and outside the institute that benefitted department officials, subject matter specialists, students and farmers all over the country. The specific topics covered were improved varieties, tissue culture, agro-techniques with special focus on organic management, INM, IPM, vermicomposting, biopesticides and biocontrol strategies, post-harvest management and value addition.

TOP EVENTS

Programme	Date
40th Annual Institute Research Council of ICAR-CTCRI	31 March to 2 April 2014
ICAR Regional Committee (VIII) Meeting	2-3 May 2014
Review Meeting of EU FSTP Funded Project "Improving the livelihoods of smallholder cassava farmers through better access to growth markets (Cassava Gmarkets)" was organized at Hotel Mascot, Thiruvananthapuram	14-19 May 2104
Fifth H.H. Sree Visakham Thirunal Endowment Lecture organized by Indian Society for Root Crops (ISRC) held at ICAR-CTCRI	17 May 2014
A one day training programme on "Writing better research proposals for early career for root and tuber crops scientists" was organized jointly by the ISRC and the International Society of Tropical Root Crops at ICAR-CTCRI	20 May 2014
51st Foundation Day Celebration of ICAR-CTCRI	31 July 2014
Mid-term Review Meeting of AICRP on Tuber Crops, held at Regional Centre, ICAR-CTCRI, Bhubaneswar	9 September 2014
Tuber Crops Day	5 December 2014
12th Institute Management Committee Meeting	20 December 2014
First Meeting of Research Advisory Committee VII	24-25 February 2015
National Science Day Celebrations	26-27 February 2015

Inauguration of the Techno-Incubation Centre by Shri. Oommen Chandy, Hon'ble Chief Minister, Kerala

National Science Day 2015

Fifth H.H. Sree Visakham Endowment Lecture 2015

Participants of one day training programme on "Writing better research proposals"

PARTICIPATION IN EXHIBITIONS

ICAR-CTCRI participated in 16 exhibitions at Kerala, Tamil Nadu, Bihar and Maharashtra states in India.

VISITS ABROAD

Twelve scientists visited abroad for international conferences, meetings, short courses, training programmes, fullbright fellowship programme, study tour and consultancy.

PUBLICATIONS

- Research papers in journals: 86
- Books: 3
- Book chapters: 14

- Technical bulletins: 2
- Popular articles: 12
- Folders/leaflets/pamphlets: 5
- Papers in conferences/proceedings/seminars: 35
- Other publications: 10
- Doordarshan programmes: 6
- Radio talks: 2

ONGOING PROJECTS

- Institute projects: 17
- Externally aided projects: 24

AWARDS

- Dr. S. K. Chakrabarti received the Shri. L. C. Sikka Endowment Award of National Academy of Agricultural Sciences for the biennium 2013-2014 for his outstanding contribution towards ensuring food and nutritional security.
- Dr. S. K. Chakrabarti received the Dr. S. Ramanujam Award of ICAR-Central Potato Research Institute for the block year 2008-2011 for his outstanding research/ leadership in potato improvement/production.
- Dr. A. Jeevalatha, Dr. R. Baswaraj, Dr. Ravinder Kumar, Dr. S. K. Chakrabarti and Dr. B. P. Singh received the Indian Potato Association-Kaushalaya Sikka Award for the year 2014 for their outstanding contribution in the field of potato disease diagnostics.
- Dr. G. Padmaja, Dr. J.T. Sheriff, Dr. M.S. Sajeev, Dr. A.N. Jyothi and Ms. L. Rajalekshmi received the ICAR Team Research Award for outstanding Interdisciplinary Team Research in Agriculture and Allied Sciences for the biennium 2011-2012.
- Dr. K. Susan John received the International Potash Institute (IPI)-Fertilizer Association of India (FAI) Award-2014 for promoting balanced and integrated fertilizer use with emphasis on potassium considering the research and extension accomplishments for the last 10 years. The award carried Rs. 50000, gold medal, certificate and a citation.

- Dr. R.C. Ray bagged the Samanta Chandrasekhar Award for the year 2013 for outstanding contribution in the field of Life Sciences, instituted by Odissa Vigyana Academy, Department of Science and Technology, Govt. of Odisha.
- Dr. R. C. Ray received the Eminent Agricultural Scientist Award 2014, awarded by Odisha Krushaka Mancha, Odisha.
- Dr. Archana Mukherjee received the EAES International Award 2014.

Dr. S. K. Chakrabarti receiving IPA-Kaushalaya Sikka award from Her Excellency Smt. Urmila Singh, Hon'ble Governor, Himachal Pradesh and Dr. N. K. Krishna Kumar, DDG (HS), ICAR.

Dr. G. Padmaja, Dr. J.T. Sheriff, Dr. M.S. Sajeev, Dr. A.N. Jyothi amd Ms. L. Rajalekshmi who received the ICAR Team Research Award with Dr. S. K. Chakrabarti, Director, ICAR-CTCRI

Dr. K. Susan John receiving the International Potash Institute (IPI)-Fertilizer Association of India (FAI) Award-2014 from Shri. J.P. Mohapatra, Secretary, Ministry of Chemicals and Fertilizers at New Delhi

Best stall in exhibitions

- The Regional Centre Stall got second prize at the Regional Agriculture Fair held at Central Potato Research Station, Patna, during 19-22 March 2015.

- The Regional Centre Stall got second prize in National Farmers Fair and Vegetable Show at ICAR-Indian Institute of Vegetable Research, Varanasi, during 30-31 January 2015.

Best oral presentation awards

- Ms. K. B. Vinutha, bagged the Second position for the Best Paper in the UGC sponsored National Seminar-cum-Workshop on Plant Systematics and Herbarium Techniques-Celebrating Diversity in the Understanding of Science organized by the Department of Botany, KKTM Govt. College, Kodungallur in collaboration with Botanical Survey of India and Association for the Advancement of Biodiversity Science during 24-25 September 2014.
- Ms. Tanmayee Samantaray and Dr. Rajasekhara Rao Korada received the Best Oral Paper Award for the paper "Sweet potato weevil pheromone technology: A messiah for weevil management" at the National Entomologists' Meet, held at Indian Institute of Natural Resins and Gums (IINRG), Ranchi, Jharkhand, India, during 5-7 February 2015.

Best poster presentation awards

- Dr. R. Muthuraj bagged Best Poster Award for the work entitled "Aeroponic technology an alternative efficient method for potato seed production" presented at the 6th Indian Horticulture Congress: An International Meet on Horticulture for Inclusive Growth held at TNAU, Coimbatore, during 6-9 November 2014.
- Ms. Tanmayee Samantaray and Dr. Rajasekhara Rao Korada bagged the Best Poster Award for the paper titled "From the discovery to the field: A successful journey of sweet potato weevil sex pheromone" at the National Symposium on Entomology as a Science and IPM as a Technology-the Way Forward, held at CAU, Pasighat, Arunachal Pradesh, India, during 14-15 November 2014.
- Ms. S. Kamala and Dr. T. Makeshkumar, received the Best Poster Award for the research paper titled "A reverse transcription loop mediated isothermal amplification assay for rapid detection of *Dasheen mosaic virus* in *Amorphophallus paeoniifolius*" at the 67th Annual Meeting of IPS and National Symposium on Understanding Host–Pathogen Interaction through Science of Omics, held at ICAR-IISR, Kozhikode, during 16-17 March 2015.

Award of Ph.D.

- Ms. P. Parvathy Chandran has been awarded Ph.D. degree in Chemistry by University of Kerala for her thesis entitled "Starch based superabsorbent polymers: Synthesis, characterization and water sorption behaviour" undertaken under the guidance of Dr. A. N. Jyothi.
- Ms. S. Kamala has been awarded Ph.D. degree in Biotechnology by University of Kerala for her thesis entitled, "Diagnosis and management of *Dasheen mosaic virus* infecting *Amorphophallus paeoniifolius* through biotechnological approaches" undertaken under the guidance of Dr. T. Makeshkumar.

Institute awards

The Sardar Patel Outstanding Agricultural Institute Award for 2005 was won by this Institute. The Award money was received in 2006. The interest from the money was utilized to award the following best technical, administrative and skilled support staff of ICAR-CTCRI for 2014.

- Shri M. Easwaran, Technical Officer: Best technical staff award
- Shri. M. Padmakumar: Best administrative staff award
- Shri. Bijoykumar Naik: Best skilled support staff award

Recognitions

- Dr. S. K. Chakrabarti was Chief Guest for the inauguration of World Space week by Vikram Sarabhai Space Centre, Thiruvananthapuram, Kerala.
- Dr. T. Makeshkumar was conferred as Fellow of Indian Phytopathological Society and recognized as Co-organising Secretary, VIROCON 2014.
- Dr. M. N. Sheela was recognized as member of the National Accreditation Committee of the Seed Farm of the National Horticultural Board
- Dr. G. Byju was recognized as Member, Academic Council, Kerala Agricultural University and Member, Executive Committee, National Institute of Plant Science Technology (NIPST), Mahatma Gandhi University, Kottayam, Kerala.
- Dr. P. Sethuraman Sivakumar was awarded Outreach Lecturing Fund of the International Institute of Education, Washington DC, USA to deliver the Fulbright invited lecture on functional foods at the University of Hawaii, Hilo, USA during 28-29 January 2014.

DISTINGUISHED VISITORS

- Her Excellency the Governor of Kerala, Smt. Shiela Dixit
- Shri. Oommen Chandy, Honourable Chief Minister, Kerala
- Shri. K. P. Mohanan, Honourable Minister for Agriculture, Kerala
- Shri. M. A. Vaheed, Honourable Member of Legislative Assembly, Kazhakuttom, Thiruvananthapuram
- Dr. S. Ayyapan, Secretary, DARE and Director General, Indian Council of Agricultural Research
- Dr. G. Madhavan Nair, former Chairman of Indian Space Research Organisation and Secretary to the Department of Space, Government of India
- Dr. M. Chandradathan, Director, Vikram Sarabhai Space Centre (Indian Space Research Organization), Thiruvananthapuram
- Dr. K. E. Lawande, Vice Chancellor, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra
- Dr. Vijayan Nair, Director, Sugarcane Breeding Institute
- Prof. George Varghese, Director, Kerala State Council for Science, Technology and Environment, Sasthra Bhavan, Pattom, Thiruvananthapuram
- Dr. Jitendra Kumar, Director, ICAR-Directorate of Medicinal and Aromatic Plant Research, Anand
- Dr. Keith Tomlins, Professor of Food Science, Natural Resources Institute, University of Greenwich, United Kingdom
- Dr. Francis Alacho, African Innovation Institute, Uganda
- Prof. Lateef Sanni, Federal University of Agriculture, Abeokuta, Nigeria
- Shri. K. Jyothishkumar, Doordarshan Kendra, Thiruvananthapuram
- Dr. Ram C. Chaudhary, Chairman, Participatory Rural Development Foundation, Gorakhpur
- Dr. Maria Andrade, Sweet Potato Breeder, International Potato Centre (CIP)
- Dr. Subba Reddy Palli, Professor of Entomology, University of Kentucky

LIBRARY SERVICES

Library continued the information support services to the research activities of the institute. During the period, 21 journals and 23 books were added to the stock at ICAR-CTCRI, Thiruvananthapuram, and seven books at Regional Centre, ICAR-CTCRI, Bhubaneswar. E-resources on Database software (Indiastat.com) and NSSO data set (2011-2012) were also procured. Springer online demonstration on e-books was also organized for the awareness of users on 24 July 2014. Library continued to provide services like ready reference, circulation of books, CD searches, CeRA and photocopying to the users.

INSTITUTE TECHNOLOGY MANAGEMENT UNIT (ITMU)

The Institute Technology Management Unit (ITMU) has been active in carrying out the following IP activities during the period 2014-2015.

- Value added fried products and fried chips from tapioca on a consultancy mode to CARD-KVK, Kolabhagom Post, Thadiyoor, Thiruvalla, Pathanamthitta, Kerala; Mr. Pradeep Kumar, M/s Avita PB Nutriments Pvt. Ltd., Thiruvananthapuram; Mitraniketan-KVK, Vellanad, Thiruvananthapuram.
- Licensing of technology for the production of quick cooking dehydrated cassava tubers to CARD-KVK, Kolabhagom Post, Thadiyoor, Thiruvalla, Pathanamthitta, Kerala.
- Collaborative (contractual) agreement for product development of mineral and biomineral fertilizer with M/s. Swamy Engineering Consultants, 22-A, Kumar Nagar South, IIIrd Street, Tirupur, Tamil Nadu.
- Licensing of technology for the production of low-moist gelatinized dough for using in cassava (tapioca) papad making machine to M/s Boosters International, 7-72/2, Nedumangadu Road, Aravaimozhi, Kanyakumari Dist., Tamil Nadu.
- Integration of sweet potato production and processing in Belgaum on a consultancy mode with M/s Belgaum Minerals, 91 Vinaya Nagar, Hindalga Road, Belgaum.
- A cassava-rice based extruded product developed under Contract Research Project sponsored by M/s Kalady Rice Millers Consortium was released by the firm in the brand name ”LALA” on 31 July 2014.
- Fabrication and supply of hand operated cassava chipping machine, mobile starch extraction plant and cassava harvester to CIP-SWCA, Bhubaneswar; NEH; AICRP on Tuber Crops, Kalyani Centre and P.K. Devadasan, Calicut.

- Apart from these, the unit had taken initiative in filing two patent applications. Bioactive multinutrient rock mineral fertilizer (Application No.6247/ CHE/2014) and multinutrient rock mineral fertilizer (Application No.6248/CHE/2014).

Agriculture Knowledge Management Unit (AKMU)

Our Institute has established a fully fledged Local Area Network connecting various Divisions, Administration, Accounts and farm sections of ICAR-CTCRI through a fiber optic network. The entire network is supported by state of the art equipments such as Routers, Firewalls, Core switches and structured fiber optic cabling as its backbone. The servers are powered with Microsoft Windows 2012 operating system. The network consists of Windows 2012 staff server, Windows 2012 student server, storage Server, internet proxy server, 178 computers, Laser Printers, Inkjet printers, Scanners, DTP and multimedia workstations. A VPN connectivity is established for Global Access to the servers. Legal Licensed versions of popular software packages are installed for various types of applications.

AKMU is established in an area of 1400 Sqft consisting of 17 state of the art work stations with centralized facilities for printing, scanning etc. ARIS cell also houses a centralized server room and a power room supplemented with a 10 KVA online UPS and supported with centralized generator facility. Our AKMU became one of the nodal points of National Knowledge Network of India (NKN) for effective sharing of scientific resources. A high speed 1 Gbps fiber optic connectivity was established for internet communication and can be accessed through the Local Area Network. A 2 mbps broadband connectivity from BSNL is also established to supplement/backup the internet bandwidth. ICAR-CTCRI has set up a home page on the Internet. This can be accessed at http://www.ctcri.org, which provides a comprehensive picture about the various activities of the Institute.

Planting material production during 2014-2015

Crop	Quantity produced
Cassava stems (nos)	95000
Elephant foot yam (Gajendra) (kg)	30000
Yams (Sree Keerthi, Sree Roopa and Sree Shilpa) (kg)	11000
Sweet potato vines (nos)	508231
Arrowroot (kg)	100
Tannia (kg)	215
Taro (kg)	2307
Chinese potato cuttings (nos)	3307
Yam bean seeds (kg)	300

RETIREMENT

The following scientific, technical and skilled support staff retired from service during 2014 – 2015

Dr. S. Chandra Babu, Chief Technical Officer

Shri. M. Manikantan Nair, Assistant Chief Technical Officer

Dr. G. Padmaja, Head and Principal Scientist, Division of Crop Utilization

Smt. K.S. Sudhadevi, Assistant Chief Technical Officer

Dr. C.S. Ravindran, Head and Principal Scientist, Division of Crop Production

Shri. Kalakar Mallik, Assistant Administrative Officer

Shri. S. Sam, Skilled Support Staff

Shri. K. P. Somasekharan, Skilled Support Staff

PROMOTION/NEW JOINING/TRANSFER

Shri. S. Natarajan was promoted as Technical Officer

Shri. Niranjan Pattanaik and Shri. B.K. Sahoo were promoted as Senior Technical Assistants

Shri. Luke Armstrong was promoted as Technical Assistant

Shri. V.R. Sasankan was promoted as Senior Technical Officer

Shri. S. Hareendrakumar was promoted as Assistant

Shri. P. C. Noble was promoted as Assistant Administrative Officer

Dr. A. Asha Devi was promoted as Principal Scientist

Shri. N. Appu, Skilled Support Staff, obtained the next grade in the MACP scheme

Ms. Geetha Nair, UDC, obtained the next grade in the MACP scheme

Ms. Namrata Ankush Giri joined as Scientist in the Division of Crop Utilization

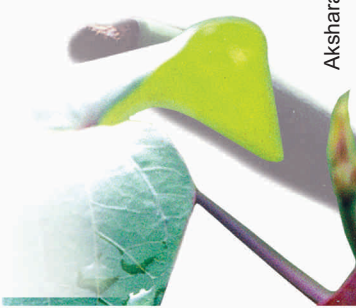
Dr. R. Muthuraj joined as Senior Scientist in the Division of Crop Production

Shri. A. Sabu, Chief Technical Officer was transferred to RS of ICAR-IIOR, Palode

भाकृअनुप
ICAR

हर कदम, हर डगर
किसानों का हमसफर
भारतीय कृषि अनुसंधान परिषद

Agrisearch with a human touch



Akshara Offset, Tvm. #2571174