

## 1. EXECUTIVE SUMMARY

ICAR-Directorate of Cashew Research, Puttur has the mandate to carry out research and extension activities on cashew. During 2018-19, the research activities were carried out under five major programmes i.e. management of genetic resources, crop improvement, crop management, crop protection and post harvest technology. A total of 21 institute projects and three externally funded research projects are being undertaken at this directorate and three institute projects were concluded during the year.

The cashew germplasm database was enriched with 700 images belonging to 80 germplasm accessions to better equip the users of decision support system on cashew germplasms. Under the evaluation of cashew hybrids, 2 hybrids were found promising for nut yield (6 to 8.5 kg tree<sup>-1</sup>) and one hybrid for both nut yield (4.60 kg tree<sup>-1</sup>) and apple quality (10°Bx) during 7<sup>th</sup> harvest. The evaluation of bold nut genotypes showed that a seedling selection of VTH-30/4 had high yield and sweeter apples (16°Bx). A draft genome sequence of cashew cv. Bhaskara has been developed. Crosses viz. NRC-492 × Vengurla-7, Vengurla-7 × NRC-492, NRC-492 × H-130, and NRC-492 × Taliparamba were made to develop populations to assay the potential utility of the new molecular markers being developed. To develop mapping populations for nut yield and Cashew Nut Shell Liquid (CNSL) content, crosses between Bhaskara × NRC-188 and Vengurla-7 × NRC-116 were made and a total 632 and 366 pseudo-F<sub>1</sub> nuts were produced. In the breeding trials to develop dwarf and compact hybrids, the lowest height was observed in the cross between Dhana × NRC-492 with 4.3 m height and 5.4 m average canopy spread. At 5<sup>th</sup> year after planting of back cross progenies, 16 plants found

to be promising with respect to yield and cluster bearing ability. In interspecific hybridization (Ullal-1 × *A. microcarpum*), one of the progeny was found to be consistently escaping Tea Mosquito Bug (TMB) damage. An effort is being made to improve the nut size in cluster bearing genotypes by crossing cluster bearing cultivars with the bold nut types. The evaluation of 14 cashew germplasm accessions for high nut yield and larger and better apple characteristics showed that larger apple was in NRC-389 and the apples with more appealing colour and fragrance were found in NRC-301.

A total of 138 SSR primers (from cashew and related trees) were screened in parents Ullal-3 and NRC-492 for identification of 39 polymorphic primers but were found insufficient to carry out the association analysis. In the genetic diversity study, eight polymorphic cashew SSRs (CSSRs) were used for genotyping 48 core accessions of cashew. Further, three of the CSSRs viz. CSSR5, CSSR8, and CSSR18 showed parental polymorphism and could identify the genetic purity of the interspecific hybrids. The rate of transferability of the newly designed MiEST-SSRs ranged from 24.2% in *A. microcarpum* to 69.7% in *A. pumilum*.

In phenological studies of cashew, seven major principal phenological stages were identified and described using Biologische Bundesantalt Bundessortenamt und Chemische Industrie (BBCH) scale and susceptible stages to foliar pest attack were delineated. The evaluation of soil nutrient status with respect to major and micronutrients in major cashew growing regions viz. Puttur, Vengurla, Bhubaneswar, Bapatla, Pilicode and Vridachalam showed the soils were low in nitrogen and phosphorus, medium to low in potassium. Further,



micronutrient deficiencies were observed for zinc and copper. Diagnostic norms were established for cashew using Diagnosis and Recommendation Integrated System (DRIS). A new project was initiated to assess the nutrient requirement under high density planting.

The chemical composition of female sex pheromone released by TMB has been identified through GC-MS at ICAR-Directorate of Medicinal and Aromatic Plants Research (ICAR-DMAPR), Anand. The analysis of feeding sounds of Cashew Stem and Root Borer (CSRB) grubs at C-DAC, Kolkata showed that the sounds are discontinuous and feeble indicating the need for sensors with higher sensitivity to precisely locate feeding grubs for CSRB management. Among inflorescence insect pests of cashew, two species of unidentified mirids and two species of unidentified flower beetles were observed to damage the calyx and feed on the pollen, which needs to be identified. Spraying Thiamethoxam at the rate of 0.2 g L<sup>-1</sup> was on par with the recommended insecticide,  $\lambda$ -cyhalothrin in inducing mortality of the pest, TMB, which can be recommended as an alternate insecticide for the management of TMB. To control CSRB through chemical means, swabbing with fipronil (2.0 ml L<sup>-1</sup>) on the cashew tree trunk was on par with the recommended insecticide chlorpyrifos (10.0 ml L<sup>-1</sup>) and can be recommended for the management of CSRB. In addition, the two entomopathogenic nematodes (EPN) viz. *Heterorhabditis* and *Steinernema* which induce mortality in the CSRB grubs were found to survive up to 150 days in the shaded ecosystem and maintained the virulence.

Empirical models were developed involving shelling percentage in terms of outturn, moisture content and nut count to assess the quality of raw cashewnuts. Modified vertical rotary disc blade

and horizontal rotary disc mechanical slicers were developed in association with ICAR-Central Institute of Agricultural Engineering, Bhopal for processing the cashew apples, and its performance was evaluated. A non-destructive moisture meter was developed in collaboration with M/S Environment Measurement and Control, Kochi, and calibrated for the on-site measurement of moisture content in raw cashewnuts of domestic varieties. Diagnostic investigation of cashewnut processing industries indicated that the cost of processing varied with the quantum of processing, degree of mechanization, Kernel Percent Recovery and Whole Kernel Recovery (KPR and WKR) in packaging, labour wages and perks, and optimization of technical parameters at all stages of processing is needed for the success of these industries. The analysis of quality parameters in the sprouts at different stages of germination showed that the cashew sprouts 8-10 days after sowing (i.e. just before the chlorophyll formation in the cotyledons and which are easily separable) recorded increased fibre, total phenols and minerals such as calcium, iron, manganese, zinc and copper, and lower fat content compared to the cashew kernel. A mouth freshener was prepared from cashew apple and is being evaluated for biochemical characteristics, acceptance and storage life.

Under the project funded by RKVY-RAFTAAR, fifty-nine farmer participatory field research trials/demonstrations were conducted in three districts of Karnataka viz. Dakshina Kannada, Udipi and Uttara Kannada and training and field exposure visits to the demonstration plots were undertaken. During the year DCR participated in Krishi Mela and Agri Expo - 2018 conducted at ICAR-Central Plantation Crops Research Institute, Regional Centre, Kidu and 'Yantra Mela-2019' conducted at Vivekananda College of Engineering and Technology (VCET), Puttur, Karnataka. Farmers visiting the Directorate



were given exposure to activities of different sections of ICAR- DCR and field and nursery visits were arranged. An android mobile app on “Cashew Cultivation” is being developed with funding support from Directorate of Cashewnut and Cocoa Development, Kochi. A software and mobile app on nutrient management were developed and launched with funding support from RKVY-RAFTAAR. Offline software on soil health card generator was also developed. To showcase the advanced technologies in cashew production and processing to visiting farmers a modern museum is being developed with funding support from RKVY-RAFTAAR and phase I work was completed during 2018-19. During the year four M.Sc. students’ projects were guided. The Annual Group Meeting (AGM) of Scientists of AICRP on Cashew was organized at the Odisha University of Agriculture and Technology (OUAT), Bhubaneswar from 6 to 8 December 2018.

The technology “Dual mode dryer for raw cashewnuts” developed at this Directorate was given non-exclusive licensing for commercialisation. Collaborative research was initiated with M/S Environment Measurement and Controls (EMCON), Kochi, Kerala for developing moisture meter for cashew.

The Quinquennial Review Team (QRT) reviewed the work done by the ICAR-Directorate of Cashew Research, Puttur and All India Coordinated Research Project (AICRP) on Cashew for the period 2013-2018 and submitted its report to ICAR. The Directorate organised various events such as Foundation day, International day of yoga, Swachhata Hi Sewa campaign, Vigilance awareness week, World soil day, Annual cashew day, Webcasting of *Mann Ki Bath* and launching of Pradhan Mantri Kisan Samman Nidhi (PM-KISAN) and International women’s day. The Directorate conducted one workshop on intellectual property rights and two interface meetings with scientists, farmers, officials of the department and exporters of cashew. The Hindi cell of the Directorate conducted Hindi week and also quarterly and half-yearly Hindi workshops.

During the year, the Directorate generated Rs. 141.23 Lakhs revenue and supplied 1 lakh cashew grafts to farmers. The Soil Science laboratory of the Directorate was upgraded with purchase and installation of modern instruments such as Micro-wave Plasma Atomic Emission Spectrometer (MP-AES, Agilent 4210), UV-Visible Spectrophotometer (Shimadzu, UV-1900) and eight minor equipments.

