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Parasitoid *Encarsia flavoscutellum* establishes on woolly aphid *Ceratovacuna lanigera* in sugarcane germplasm at Kannur, Kerala!

Aphid in peninsular India

A native of north-eastern India, the woolly aphid *Ceratovacuna lanigera* invaded the south Indian States of Maharashtra, Karnataka (2002), Andhra Pradesh (2003) and Tamil Nadu (2004) in quick succession. Attacking sugarcane during the grand-growth phase and occurring round the year facilitated by staggered planting, the aphid caused perceptible quantitative and qualitative losses in the ruling cv Co 86032 and other varieties. After five years of intense coordinated research efforts predicated primarily on biological control, augmentative deployment of *Dipha aphidivora* and *Micromus igorotus*, and introduction and colonization of the parasitoid *Encarsia flavoscutellum* brought stability to the aphid populations leading to prevention of losses in peninsular India.

Occurrence in germplasm

Maintained as a crop island facilitated by the lack of large-scale commercial sugarcane cultivation, the world collection of sugarcane germplasm at the Research Center of the ICAR-Sugarcane Breeding Institute (ICAR-SBIRC), Kannur, Kerala State, India, is subject to minimal onslaught of resident or migratory pests. However, woolly aphid made its first appearance in sugarcane germplasm in 2004, almost concurrently with its occurrence in different parts of Tamil Nadu, and continued to occur in the subsequent years. Complying with zero-tolerance norm of pest or disease occurrence in the germplasm, prompt insecticide sprays were given as spot application in the initial years. With the appearance of predators in the subsequent years, soap solution sprays were applied to conserve and promote their establishment.

Aphid monitoring

As the aphid's persistent occurrence posed a threat to germplasm security, studies were initiated to not only monitor the progression of the aphid but also evolve long-term and lasting control tactics. The aphid colonized (Fig. 1a) Indian hybrids and accessions of four Saccharum spp., namely *S. officinarum, S. sinense, S. robustum* and *S. barberi* initially (April-June 2004) but spread to foreign hybrids too by March 2005. Attacking the grand growth phase of germplasm usually planted during January-February, the aphid predominantly colonized Indian hybrids and accessions of four *Saccharum* spp. at varying abundance levels in the subsequent years (2005-20).

Natural enemies

While the predator *Micromus* sp. was observed in 2004 along with the first occurrence of the aphid, webbings of the predator *D. aphidivora* were noticed in July 2005. In mainland sugarcane, woolly aphid-specific *D. aphidivora* was more predominant in Tamil Nadu whereas the general Micromus sp. was more active in Karnataka. *Dipha aphidivora* may have originated from sugarcane in the mainland and reached the germplasm whereas *Micromus* sp. may have dispersed from alternative host-host plants within the habitat. Destruction of aphid colonies by clipping of infested leaves and application of soap solution or insecticide may have prevented buildup of the predators.

Introduction of *E. flavoscutellum*

Encarsia flavoscutellum was introduced from Assam and colonized in tropical Indian States in 2005. An in situ culture of the parasitoid was maintained successfully in shade-net house at ICAR-SBI, Coimbatore, and this enabled dispatch of three consignments (Table 1) as parasitized aphid colonies on leaf bits held in plastic boxes to Kannur where the leaf bits were dispensed in the field by inserting them in leaf axils. Parasitoid adults that emerged during transit were released by opening and tapping the boxes in the canopy of colonized plants. Post-release parasitoid establishment was assessed by processing field-collected mature aphids in the laboratory and examining the cleared specimens under the microscope to assess parasitism levels at different intervals.

Establishment of *E. flavoscutellum*

The aphid appeared late in 2009-10 season apparently due to the first release of *E. flavoscutellum* in the previous year (2008-09). Although aphid sample examined in November 2014, i.e. immediately after the release of the second

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consignment, did not indicate parasitoid activity, initial signs of establishment were indicated by low levels of parasitism detected in April and June 2015. Notwithstanding the failure to detect parasitism in January 2019, clear-cut evidence of *E. flavoscutellum* establishment with high level of parasitism was observed in September 2021. At this stage, aphids exhibited pin-hole emergence passage ways of adult parasitoids on wax coating (Fig. 1b & c); processed aphids showed developing adults inside (Fig. 1d) with 24.0% parasitism; adults emerging from parasitized aphids congregated on colonized leaves (Fig. 1e & f). Another sample collected from three spots of germplasm 10 days later, i.e. in October 2021 indicated high parasitism levels (20.0-27.0%) in two accessions and low level of parasitism (6.0%) in the third accession planted in the border, probably due to the soap solution applied to prevent inward spread of the aphid.

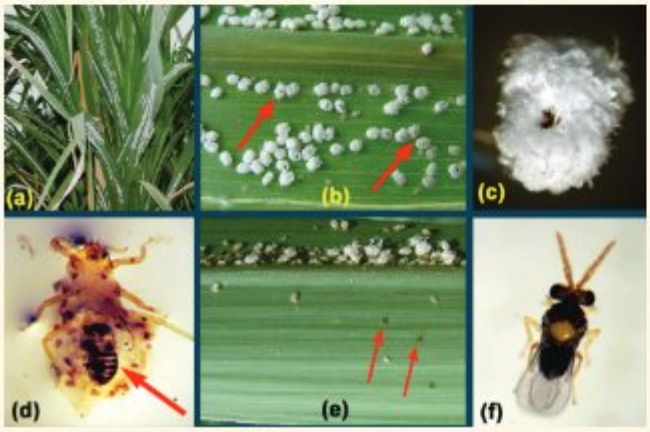

Figure 1. Activity of woolly aphid Ceratovacuna lanigera and parasitoid Encarsia flavoscutellum in sugarcane germplasm at ICAR-Sugarcane Breeding Institute Research Center, Kannur State, Kerala, India: (a) aphid colonies on sugarcane leaves (b) pin-hole emergence passage ways of parasitoid in wax coating of parasitized aphids (red arrows) (c) single parasitized aphid showing parasitoid emergence passage (magnified view) (d) developing parasitoid adult (red arrow) inside a parasitized aphid (e) parasitoid adults (red arrows) on aphid infested leaf (f) single parasitoid adult (enlarged view)

Encarsia flavoscutellum releases and parasitism rates in woolly aphid _Ceratovacuna lanigera_ at ICAR-Sugarcane Breeding Institute Research Center, Kannur

Date of parasitoid release	Date of parasitism assessment	Parasitism (%)
January 2009	-	-
November 2014	November 2014	0.0
June 2015	23 April 2015	3.5
	19 June 2015	2.0
	06 January 2019	0.0
	28 September 2021	24.0
	08 October 2021	6.0
		27.0
		20.0

Encarsia flavoscutellum introduced from Assam and colonized in tropical Indian States in 2005 established rapidly in about a year after first releases, probably due to favorable tropical climatic conditions and continuous availability of abundant host in the semi-perennial sugarcane habitat. However, at ICAR-SBIRC, Kannur, the parasitoid required longer time for establishment, despite similar tropical conditions, probably due to the low aphid abundance in the diverse germplasm and prompt control measures adopted to contain the aphid.

The previous season crop of the entire germplasm at ICAR-SBIRC is retained until June to ensure emergency seed material for the current season crop planted in January-February in the event of germination failure. The first consignment of *E. flavoscutellum* released in January 2009 at crop maturity stage and the second consignment released in November 2014 might have led to initial establishment of the parasitoid on the waning aphid populations. The third consignment released in June 2015 coincided with harvest of previous season crop, yet the current season crop might have provided adequate aphid populations and ensured continuity of the parasitoid. It is possible that the parasitoid may have perpetuated on the continuous aphid populations made available by the planting pattern of germplasm. Also, the parasitoid may have survived on woolly aphid colonizing alternative hosts in the habitat. Regardless of these possibilities, the field observations indicated the successful establishment of *E. flavoscutellum* at ICAR-SBIRC, Kannur, following its releases, despite the remote possibility of its immigration from distant aphid infested sugarcane plantations.

Natural regulation of aphid

Encarsia flavoscutellum is likely to regulate the aphid in the germplasm similar to the manner in which it regulated woolly aphid populations following its establishment at Coimbatore. However, it is important to monitor the activity of woolly aphid and *E. flavoscutellum*, besides the possible complementary action of the previously colonized *D. aphidivora* and *Micromus sp.* The combined action of the parasitoid and predators may preclude the need for insecticidal control, yet spot application of soap solution may be resorted to as an emergency measure after retaining some unsprayed spots as refugia for their survival. In this context, it would be worthwhile to assess the toxicity of soap solution or other plant products to the parasitoid to ensure its survival in the germplasm.

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District Collector launches ICAR- SBI's Tribal Nutrition Awareness cum Training Campaign in Salem District of Tamil Nadu!

ICAR – Sugarcane Breeding Institute (ICAR-SBI), Coimbatore in collaboration with Tamil Nadu State Rural Livelihood Mission, Salem conducted a 'Tribal Nutrition Awareness cum Training Campaign, and launched its DAPSTC (Scheduled Tribe Component) project in Salem district, in the collectorate premises on 12 March 2024.

Thanking the ICAR-Sugarcane Breeding Institute for choosing Salem district to implement the project, Dr R. Brindha Devi IAS., Collector, Salem district, in her inaugural address outlined the importance of value-addition in tribal empowerment. Stressing the importance of ensuring community participation in development projects, she assured that the line departments serving in the district for tribal development would assist ICAR-SBI during project-implementation.

Releasing the extension pamphlets published by ICAR-Sugarcane Breeding Institute, Dr G. Hemaprabha, Director of ICAR-SBI, in her Presidential address mentioned that awareness of tribal folk on Central Government & State Government – sponsored development /social welfare schemes needs to be improved. Highlighting the success stories of tribal farmers who had won the Central-Government initiated 'Plant Genome awards' that are being given for conserving plant agro-biodiversity, she said that the tribals should realize the importance of education, health and well-being of tribal women and children.

Mentioning that Salem district tops in tribal population in the state of Tamil Nadu, Dr D Puthira Prathap, Principal Scientist and Nodal Officer, STC, in his introductory remarks, said that initially, a 'needs assessment' was conducted by the Institute among the Malayali tribes belonging to five tribal settlements viz., 'Molayanoor & Vilampattu in Chinna-Kalvarayan hills-Vadakku nadu panchayat and Thaloor, Valoothu & Pallikkadu of Aladipatti panchayat in order to identify their 'wants'. Accordingly, interventions were planned to promote sustainable livelihood systems for the tribal people through entrepreneurship development, for overall empowerment.

The campaigns, with tailor-made interventions, will continue to be held in the tribal settlements and all households in these settlements will receive farm tools, radio sets, household items, kitchen garden kits, improved varieties of ragi (Pearl millet) & samai (Little millet) and coconut seedlings, he added.

Shri.S.Singaram, Joint Director of Agriculture, Salem District, Shri. P.Venkatesan, Assistant Project Officer, Tamil Nadu State Rural Livelihood Mission & Shri N. Thiruverangan, Block Development Officer, Ayodhyapattinam listed out the schemes operated by their respective departments, for the welfare of tribal farmers. Prof. Saraswathy Eswaran, trained the tribal farmers on Millet value-addition & Entrepreneurship Development, while Dr M.Velmurugan handled a session on 'Setting up a nutrition garden in tribal households.

Shri. M.Elumalai, President, Aladipatti Panchayat and Shri. T. Venkatesan, President, Chinnakalrayan hills-Vadakku naadu Panchayat, to whose panchayats the adopted tribal villages belong to, offered felicitations. Dr. K. Mohanraj, Dr. P. Geetha and other senior officials from ICAR-Sugarcane Breeding Institute/Tamil Nadu Agricultural University, Subramaniya Siva Co-operative Sugar Mills Ltd., & All India Radio, Dharmapuri interacted with the participating tribals during the inaugural session and the training session that followed.

Distribution of First-aid kits to tribal women in the presence of District Collector, Salem

Tribal participants at the Campaign

Outreach

TISP-2024

Trainings

- Organized a Training on 'Scientific Sugarcane Cultivation' (TSSC) for the sugarcane farmers of Miraj Taluk, Sangli district, Maharashtra, during 22-23 February 2024
- A 'Training programme on Improving Sugarcane Productivity' (TISP-2024) was conducted on 28 March 2024 for 25 Scheduled Caste sugarcane farmers of Andhra Pradesh.
- A one- day farmers' training programme was organized for the farmers of Pragya Gramothan Sewa Samiti, Fatehpur (UP) at ICAR-SBIRC, Karnal on 31st Jan 2024
- A six - day farmers training of progressive sugarcane farmers of UP sponsored by Lal Bahadur Shastri Ganna Kisan Sansthan, Lucknow was organized at ICAR-SBI, Regional Centre, Karnal during 05-10 February 2024.

DDG (Education), ICAR handing over certificates to the participants of TSSC

National Science Day Celebrations!

School students at the Institute for the National Science Day Celebrations

ICAR – Sugarcane Breeding Institute celebrated the 'National Science day' as an 'open- day' under the theme "Indigenous Technologies for Viksit Bharat" on 28 February 2024.

The students/teachers of schools and colleges in and around Coimbatore visited seven locations in the Institute campus viz., Institute museum, Science Exhibition at Centralized Bio-technology lab & Tissue culture lab, sugarcane -based farming system unit, Agri-business incubator that displayed and demonstrated Institute-developed products, auditorium that screened video films and the sugarcane juice counter, by scanning the location QR-codes displayed in the premises.

The Director of the Institute, Dr G. Hemaprabha recalled the contributions of scientists and encouraged the visiting students to envision themselves as future contributors to the scientific progress of the nation.

During the occasion, Dr N Vijayan Nair, Former Director of ICAR-SBI delivered the National Science Day lecture on 'On the grass trail..'

In his engaging presentation, Dr Nair shared his exciting yet challenging journey of sugarcane germplasm explorations in the North Eastern states of Manipur, Mizoram & Arunachal Pradesh and in the Andaman & Nicobar archipelago. The historical background of the remote places along with display of exquisite photos of diverse sugarcane germplasm added spice to the presentation.

Dr N Vijayan Nair delivers National Science Day lecture on 'On the grass trail..'

During the event, Foundation day appreciation certificates were distributed to ICAR-SBI staff for their outstanding performance while Certificates of appreciation were given to those employees who had participated in the recently held *Vikshit Bharat Sankalp Yatra (VBSY)*. Senior staff members were honoured with a memento, for their dedicated service to the Indian Council of Agricultural Research.

Field day organized!

ICAR-Sugarcane Breeding Institute organized a field day in the villages, Pasur, Ramayampalayam, Vaiyapurigoundanpudur and Alagathiripalayam of Tirupur district in Tamil Nadu on 30 January 2024, covering an area of about 28.5 acres of sugarcane quality seed production field-plots.

Dr. G.Hemaprabha, Director of the Institute mentioned that the event was being organized as part of the AICRP on Seed (Crops) Sugarcane project. The harvesting process has already been initiated in the farmers' seed plots and the yield is expected to be about 40 tonnes/acre, she added.

During the interaction that followed, Shri B. Selvaraj, a farmer from Vaiyapurigoundanpudur informed that he could get about 62 tonnes / acre from his seed plot of Co 11015 variety, at 7 months of age. About 50 persons, including sugarcane farmers from the nearby villages and scientists of ICAR – Sugarcane Breeding Institute participated in the event.

Field day in Tiruppur district of Tamil Nadu

Academics

The Ph.D Viva-voce presentation of Smt. R.Vigneshwari (Guide: Dr.R.M.Shanthi, PS, Div. of Crop Improvement) on her thesis work entitled "Genetic analysis of full-sib families for commercial cane sugar yield and development of genic microsatellite markers for sucrose metabolic pathway enzymes in sugarcane" was held on 15th February 2024

Awards and Recognitions

- S. Anusha, P. Geetha and V. Krishnapriya got first prize (Poster) for the paper entitled 'Selectivity and efficiency of herbicide application in sugarcane' in 3rd International Conference and Exhibition on "Sustainability: Challenges and Opportunities in Global Sugar Industry" during 12-14th January 2024 organized by Vasantdada Sugar Institute Pune
- Dr.K. Mohanraj received Best Oral Presentation Award in the National Conference "Plant Health for Food Security: Threats and Promises", held during February 1-3, 2024 at ICAR-Indian Institute of Sugarcane Research, Lucknow, Uttar Pradesh
- Dr. Mahadeva Swamy, HK received the best oral presentation award for the paper on "Development of association mapping panel and identification of markers for red rot resistance in sugarcane" under the theme "Breeding for Disease Resistance: Molecular Breeding and Genome Editing" in the National Conference "Plant Health for Food Security: Threats and Promises", held during February 1-3, 2024 at ICAR-Indian Institute of Sugarcane Research, Lucknow, Uttar Pradesh.
- Dr.C. Appunu received Best Presentation Award for the paper entitled "CRISPR/Cas9 mediated genome editing for improved tolerance to drought and salinity stresses in Sugarcane" in the 3rd International Conference & Exhibition on Sustainability: Challenges & Opportunities in Global Sugar Industries held during 12th – 14th January, 2024, VSI, Pune.
- Dr.C. Appunu received Best presentation Award for the paper on 'Vacuole isolation in sugarcane stem for Agriculture and Bio-Industrial Innovations' in the International Conference on New Horizons in Bioengineering: Fostering Academia – Industry Partnership (ICB-2024) organized by School of Bioengineering, SRM Institute of Science and Technology held during 14-16, February, Chennai.

FOUNDATION DAY RECOGNITIONS

- **Dr. A. Suganya** received the Certificate of appreciation of the Foundation Day 2023 for outstanding contribution under Principal Scientist category
- **Dr. G.S. Suresha** received the Certificate of appreciation of the Foundation Day 2023 for outstanding contribution under Senior Scientist category
- **Sh.S.T.Subramanyan,** UDC, received the Certificate of appreciation of the Foundation Day 2023 for outstanding contribution under Administrative Staff category
- **Sh. M. Rajeshkumar,** Sr. Technician, received the Certificate of appreciation of the Foundation Day 2023 for outstanding contribution under Technical staff category
- **Sh.S.Kandasamy, SSS** and **Sh. P. Chinnasamy, SSS** received the Certificate of appreciation of the Foundation Day 2023 for outstanding contribution under Supporting staff category

Media efforts/Other activities organized

- A radio feature on Impact evaluation of DAPSTC implementation in Bathripadugai tribal hamlet of Sathyamangalam Tiger Reserve was broadcast through All India Radio, Coimbatore on 11.01.2024 (FM 103 and MW 300.3)
- A radio feature on 'Tribal Nutrition Awareness cum Training Campaign" organized by ICAR-Sugarcane Breeding Institute and launch of DAPSTC (Development Action Plan for Scheduled Tribe Component) project in Salem district, Tamil Nadu' was broadcast through All India Radio, Dharmapuri on 13.03.2024 and streamed live on Newsonair app at 2.00 pm in its 'Vivasaaya arangam' programme.
- A webinar on "Managing Genetic Resources in Crop Improvement" was organised by SSRD (Society for Sugarcane Research and Development) in collaboration with ICAR-SBI and NAAS Chapter (Coimbatore) on 25th January 2024.
- Organized 21 day- ICAR sponsored Winter School on Climate Smart Sugarcane Agriculture for Food and Energy Security in India during 31st January to 20th February 2024.
- A one day workshop was organized on "Emerging Issues in Sugarcane Agriculture in Tamil Nadu" on 06.02.2024 under the collaborative project between ICAR-SBI and SISMA, Chennai Tamil Nadu.
- Signed an MoU with Chocolate Teddies Private Limited, Coimbatore, Tamil Nadu through Agri-business Incubator, ICAR-SBI, Coimbatore.
- International Women's Day was celebrated on 8th March 2024.

Altogether 46 officials from the Institute participated in the I, II and III phase nationwide campaign *"Viksit Bharat Sankalp Yatra"*, a nationwide campaign launched to provide awareness about various government schemes by organising camps at various locations, with a vision of developed India by the year 2047, during December 2023 – January 2024.

Shri M.Kannaiyan receiving the appreciation certificate for participation in Viksit Bharat Sankalp Yatra.

Participants of Winter School

Mrs Priya Senthil, a motivational speaker addressing the staff on International Women's Day

- Smt.L.Tholasiammal, Skilled Support Staff retired on superannuation on 31.01.2024(AN).
- Smt.M.Lalitha Rani, Private Secretary retired on superannuation on 29.02.2024(AN).
- Sh.N.K.Nagarajan, Skilled Support Staff retired on superannuation on 29.02.2024 (AN).
- Sh.R.Narayanasamy, Senior Technician retired on superannuation on 31.03.2024(AN).
- Sh.S.Balan, Skilled Support Staff retired on superannuation on 31.03.2024(AN).

Visit of Dignitaries

- Dr. R.C. Agarwal, DDG (Education), ICAR visited the Institute on 23.02.2024.
- Shri. Manoj Ahuja, Secretary, Ministry of Agriculture and Farmers Welfare, Govt. of India and his team visited the Institute on 09.03.2024 and interacted with the scientists.

Appointments / Transfers / Retirement

- Dr.V.Sreenivasa, Senior Scientist transferred to ICAR-IIHR, Bengaluru on 20.03.2024 (AN).
- Dr.K.Chandran, Principal Scientist, ICAR-SBIRC, Kannur retired on superannuation on 31.01.2024(AN).
- Smt.K.Kanageswari, Assistant, retired on superannuation on 31.01.2024(AN).

Shri, Manoj Ahuja, Secretary, Union Ministry of Agriculture and Farmers Welfare interacting with ICAR-SBI scientists

Marching towards Ethanol Blending Programme (E20) in India

Commercial production and distribution of ethanol-blended gasoline began in January 2003. In its first phase, 5% ethanol blending was mandated in nine states and four union territories. Despite policy backing and surplus sugarcane, the 5% target remained elusive due to operational challenges and less competitive pricing. C-heavy molasses of sugarcane which was the only source of fuel ethanol for the EBP (Ethanol-Blended Petroleum), had supplied 1,535 million litres in 2017-18 and achieved blending of 4.2 %. However, the new biofuel policy paved way for using sugarcane juice, B-molasses, maize and broken grains as feedstock for fuel ethanol production. Subsequently, B-heavy molasses emerged as a major contributor, as its ability to produce both ethanol and sugar offered economic advantages. The fuel ethanol production from sugarcane surged from 400 million litres in 2013-14 to 3,485 million litres in 2022-23.

Total quantity of ethanol produced from different feedstocks of sugarcane between 2013-14 and 2022-23

Year	Ethanol from cane juice (million lit.)	Ethanol from B Heavy molasses (million lit.)	Ethanol from C heavy molasses (million lit.)	Total qty of ethanol supplied through sugarcane (million lit.)
2013-14	0	0	400	400
2014-15	0	0	700	700
2015-16	0	0	1100	1100
2016-17	0	0	700	700
2017-18	0	0	1505	1505
2018-19	7.5	343	1535	1886
2019-20	148	681	741	1571
2020-21	459	1950	614	3023
2021-22	793	2702	127	3622
2022-23	850	2533	102	3485

Source: Computed by authors based on data from Union Ministry of Petroleum & Natural Gas.

Ethanol blending (%) PSU OMCs

*Note: *Public Sector Undertaking (PSU); Oil marketing companies (OMCs)*

In 2014-15, the ethanol blending rate was 2.3 % representing a modest achievement for the EBP programme. By 2018-19, India achieved a 5% blending rate, driven by new policy directives and fair pricing mechanisms. As of 2023-24, the blending rate was 14.6%, with around 68.8% of fuel ethanol originating from sugarcane. With rising gasoline demand, the ethanol blending rate could reach 25-30% by 2030, with total ethanol production projected to reach 13 billion litres by 2030. Despite challenges in scaling feedstock supplies, expansion to non-sugarcane sources such as rice, wheat, and coarse grains is expected to bolster production.

P.Murali, P. Jagadeshwaran and D. Puthira Prathap

Institute's Co 449 variety wins a State-level Crop Yield Competition – 58 years ago!


MADRAS STATE CROP YIELD COMPETITION

Certificate of Merit

This certificate shows that Shri R Thiruvenkadam, a sugarcane farmer (of present-day Tiruvannamalai district, Tamil Nadu) had won the State-level Crop Yield Competition growing Co 449 Sugarcane Variety; 1966-67

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