

Vol.:29

वार्षिक प्रतिवेदन
ANNUAL REPORT
2021-22

रेशमकीट बीज प्रौद्योगिकी प्रयोगशाला
SILKWORM SEED TECHNOLOGY LABORATORY



रेशमकीट बीज प्रौद्योगिकी प्रयोगशाला

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Vol.:27



Annual Report 2021-22

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Printed at:

Omkar Digital Printers,
Dommasandra post,
Anekal Taluk, Sarjapura Hobli,
Bangalore – 562125,
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प्रस्तावना

मुझे रेशमकीट बीज प्रौद्योगिकी प्रयोगशाला की वर्ष २०२१-२२ का वार्षिक प्रतिवेदन प्रस्तुत करने में अत्यंत प्रसन्नता हो रही है। यह संस्थान, केंद्रीय रेशम बोर्ड के अंतर्गत एक मात्र संस्थान है जो विभिन्न प्रकार के रेशम कीट बीजों पर शोधकार्य करता है। अनुसंधान सलाहकार समिति की अनुशंसा के बाद इस संस्था ने गैर-शहतूती रेशम कीटों के ऊपर भी शोधकार्य शुरू किये हैं। इस वर्ष के दौरान, संस्थान ने तसर रेशम कीट के बीज संरक्षण की तकनीकी विकसित की है, जिसके माध्यम से तसर बीजों के सम्पुटन को, बिना सम्पुटन अनुपात को प्रभावित किए, १८ दिनों के लिए आगे बढ़ाया जा सकता है।

यह संस्थान कर्नाटका, आंध्र प्रदेश एवं तमिलनाडु स्थित रेशम बीज गुणन केंद्रों एवं बुनियादी बीज भंडार में पेब्रिन रोग का निरंतर परिक्षण कर इस रोग के नियंत्रण में महत्वपूर्ण भूमिका निभा रहा है। इस संस्थान के वैज्ञानिकों ने एन. एस. एस. ओ. एवं सी. एस. आर. टी. आई. मैसूर के वैज्ञानिकों के साथ मिलकर कुनिगल एवं मगाडी क्षेत्रों में फैले पेब्रिन रोग के प्रकोप को नियंत्रित करने में सक्रिय भूमिका निभाई है। संयुक्त रेशमकीट रोग निगरानी सर्वेक्षण कार्यक्रम के अंतर्गत, इस संस्थान ने कुल १९४९ लॉट बाइवोल्टाइन एवं मल्टीवोल्टाइन रेशम कीटों का परीक्षण किया।

मानव संसाधन विकास कार्यक्रम के तहत कर्नाटका, आंध्र प्रदेश एवं तमिलनाडु के रेशम उत्पादन विभाग के ११७ कर्मचारियों को प्रशिक्षित किया गया। इसके साथ ही पंजीकृत बीज उत्पादक बनने के लिए ६ व्यक्तियों को बीज अधिनियम के बारे में प्रशिक्षण दिया गया।

इस संस्थान के वैज्ञानिक एवं कर्मचारी, रेशम बीज के क्षेत्र में किये गए अथक प्रयासों एवं अन्य संस्थानों जैसे एन. एस. एस. ओ., बी. टी. एस. एस. ओ. बिलासपुर एवं सी. टी. आर. टी. आई. रांची के साथ किये गए सहयोगात्मक कार्यों के लिए प्रशंसा के पात्र हैं।

डॉ. वी. शिवप्रसाद
निदेशक, रा रे बी सं

Foreword



I am pleased to present the annual report of Silkworm Seed Technology Laboratory for the year 2021-22. Silkworm Seed Technology Laboratory is one of the premiere institutes of Central Silk Board that carries out research exclusively on all types of silkworm seed. As per the recommendations of RAC, SSTL has also initiated research projects on non-mulberry sericulture. During the year, technology for Tasar silkworm seed preservation was developed for postponement of Tasar egg hatching for 18 days without affecting the hatching ratio.

SSTL is playing significant role in Pebrine disease control by constant monitoring different seed multiplication centres in KA, AP and TN for testing the basic seed stocks and ensured pebrine under check. SSTL scientists also played active role along with NSSO and CSRTI-Mysuru in the management of pebrine disease during the recent outbreak in Pure Mysore Seed Area of Kunigal and Magadi. Under Joint Silkworm Disease Monitoring Survey, a total of 1949 lots (Bivoltine and Multivoltine) were tested.

Under Human resource development programme, SSTL imparted training to DoS staff of KA, AP and TN (117 personnel). SSTL also involved in imparting training under Seed Act (6 persons) to become RSPs.

The strenuous efforts of SSTL staff is appreciated and so also their collaborative efforts in seed technology with NSSO, BTSSO-Bilaspur, CTRTI-Ranchi.

Dr. V. Sivaprasad
Director

वर्ष के दौरान किये गए अनुसंधान एवं विकास कार्यों की प्रमुख उपलब्धियाँ

डाबा बाइवोल्टाइन किस्म के तसर रेशम कीट बीजों को १५ तापमान पर ८०- ८५% सापेक्षिक आर्द्रता के साथ १५ दिनों संरक्षित करने पर भी ज्यादातर रेअरिंग और कोकून लक्षण, बिना संरक्षित तसर रेशम कीट बीजों के समान पाये गए। यह प्रयोग मानकीकृत तसर अंडा संरक्षण सारणी के अनुसार बी. टी. एस. एस. ओ. बिलासपुर में किया गया।

संयुक्त रेशमकीट रोग निगरानी सर्वेक्षण कार्यक्रम के अंतर्गत, १५ सर्वेक्षण कार्यक्रम आंध्र प्रदेश, कर्नाटका एवं तमिलनाडु में किये गए। सी. एस. आर. टी. आई. मैसूर के साथ सी. एस. जी. आर. सी. होसूर, पी-३ बी. एस. एफ. बेरिगै एवं अवलापल्ली, डी. ओ. एस. तमिलनाडु, एवं पी-३ बी. एस. एफ. मैसूर में रोग निगरानी सर्वेक्षण में भाग लिया। इसके अतिरिक्त कर्नाटका में पेब्रिन रोग के रोक थम के लिए ८ विशेष सर्वे किये गए। संस्थान ने कुल १९४९ लॉट (७७४२ बाइवोल्टाइन एवं मल्टीवोल्टाइन) रेशम कीटों के नमूनों का परीक्षण किया।

संस्थान ने विभिन्न कार्यक्रमों के अंतर्गत कुल ११५ व्यक्तियों को प्रशिक्षित किया।

प्रौद्योगिकी का हस्तांतरण के कुल ६ कार्यक्रम आयोजित किये गए एवं ११७ लाभार्थियों को तकनीकियों के बारे में सुग्राही बनाया गया।

संस्थान ने विभिन्न प्रशिक्षण कार्यक्रमों, व्यावसायिक हाईब्रिड बनाने के लिए बीज कोकून की आपूर्ति, परीक्षण शुल्क एवं रॉयल्टी (अनुसंधान एवं विकास उत्पादों के व्यावसायीकरण) के माध्यम से १९,७६८४३ का राजस्व उत्पन्न किया।

HIGHLIGHTS OF R&D ACTIVITIES

- ❖ DBV Tasar eggs (25 Dfls) were preserved at 15°C with 80-85% RH for 15 days through standardized Tasar egg preservation schedule at BTSSO, Bilaspur. Bioassay studies of said preserved eggs done and found that majority of the rearing & cocoon characteristics of preserved eggs at 15°C for 15 days were found to be on par with control.
- ❖ Microbial conversion of compounds is an alternative approach to conventional chemical method for the production of high active molecules. In this approach, *In vivo* studies revealed that converted compounds were effective and survivability increased in CSR2 and PMxCSR2 races against to *Staphylococcus* bacteria.
- ❖ Under Joint Silkworm Disease Monitoring Survey (JSDMS), conducted 15 survey programs in Andhra Pradesh, Karnataka & Tamil Nadu. Disease survey was also attended in collaboration with CSRTI, Mysore at CSGRC, Hosur; P3 BSFs Berigai & Avalapalli of DoS, Tamil Nadu and P3 BSF, Mysore. Additionally, 08 Special surveys were conducted to control pebrine disease in Seed areas of Karnataka. A total of 1,949 lots with 7,742 bivoltine and multivoltine samples were tested.
- ❖ A total of 115 persons were provided training under different programmes (109 under CBT and 6 under Central Seed Act).
- ❖ Under ToT programs, 6 events were conducted and 117 stakeholders were sensitized.
- ❖ Generated a total sum of Rs. 19,76, 843/- revenue through Royalty (for commercialization of R&D products), Training, Generation and supply of Seed cocoons for commercial hybrid seed production and Disinfectants/Silkworm / Embryonical Testing charges.

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Director	Dr. V. Sivaprasad
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Scientist-D	Dr. Chandrashekar R Hegde
Scientist-C	Dr. Sailaja Bandam Dr. R. Saravana Kumar
Scientist-B	Dr. Mala N.(From 30-09-2021)
Senior Technical Assistant	Mr. S. Muralidhara (Retd. April, 2021) Mr. R. Rajasekar Mr. V. Chandrashekara Reddy Mr. J. N. Chandrashekar Mr. B.V. Raviprasad Mrs. K. R. Rathnamma
Field Assistant	Mr. H. N. Harish
ADMINISTRATIVE PERSONNEL	
Assistant Director (Computer)	Mr. M. Thandapani (upto August, 2021)
Assistant Superintendent	Mr. S. Rajendra
UDC	Mr. Chandraiah
Driver	Mr. A. Satyaseelan Mr. Shivaji
Assistant Technician	Mr. M. S. Yogannachar
Multi Task Staff	Mr. L. H. Hemanna Gowda Mrs. N. Vijayalakshmi (upto August, 2021) Mr. Lakshminarayana

PART I: ON-GOING RESEARCH PROJECTS

MOE 09001MI: EVALUATION OF NEW TECHNOLOGIES FOR SEED PRODUCTION IMPROVEMENT

COMPONENT-1

Test verification of technologies developed for seed /seed cocoon preservation and regulation of erratic moth emergence in Tasar silkworm (*Antheraea Mylitta*, D). [Jan 2022-Dec 2023]

Dr. Sailaja B, Vishaka G V*, Dr. J.P. Pandey and Dr.B.Srinath***

[In collaboration with BTSSO*, Bilaspur and CTR&TI, Ranchi**]

ARP 3635 concluded project of 2021, technologies validation implemented in the form of continued program from June 2021 to August 2021 and after obtaining positive results in the bioassay studies validation of technologies taken in project mode under component 1 from January 2022.

Objective: Evaluation of the rearing performance of preserved seed through Bioassay studies in the natural rearing conditions

Methodology: DBV Tasar eggs were preserved through standardized Tasar egg preservation schedule at BTSSO, Bilaspur. Eggs preserved at 15°C with 80-85% RH for 15 days continuously in dark condition. These eggs were released from Cold storage after preservation duration of 15 days to the incubation room, where 25°C of temperature and 80-85% RH was maintained continuously.

Table:1 Rearing performance of preserved seed at different locations @ different stations (25 df/s each for treatment & control; 1 st BV crop during Aug. 2021)									
Particulars		Hatching (%)	Worms brushed (#)	Larval duration (days)	V instar Larval weight (g)	Cocoon weight (g)	Shell weight (g)	Pupal weight (g)	SR (%)
Pali	Treatment	86	8600	29	32	7.54	1.07	6.47	14.70
	Control	88.5	8850	29	34	7.38	1.07	6.31	14.52
	IOC (%)	-3%	-3%	0%	-6%	2%	0%	2%	1%
Boridadar	Treatment	76	7600	29	33	9.75	1.14	8.61	11.88
	Control	94	9400	29	34	7.18	0.93	6.25	13.99
	IOC (%)	-19%	-19%	0%	-3%	36%	22%	38%	-15%
Bastar	Treatment	80	8000	32	32	10.87	1.14	9.73	10.70
	Control	83	8300	32	33.17	10.15	1.16	9.00	11.37
	IOC (%)	-4%	-4%	0%	-4%	7%	-1%	8%	-6%
Bhandara	Treatment	77	7700	31	31.25	8.01	0.95	7.07	12.00
	Control	82	8200	29	31.23	8.71	0.96	7.75	10.99
	IOC (%)	-6%	-6%	7%	0%	-8%	-1%	-9%	9%
Balaghat	Treatment	82	8200	28	33	7.14	0.92	6.22	12.89
	Control	80	8000	28	35	7.68	0.93	6.75	12.00
	IOC (%)	2%	2%	0%	-6%	-7%	0%	-8%	7%
Treatment: 15 days preservation (15°C & 80-85% RH) & 2-3 days normal Incubation (~25°C & ~80% RH) Control : 7-10 days for normal hatching from the date of moth laid eggs (~25°C & ~80% RH). IOC: Improvement Over Control									

Rearing performance of treated & control eggs (25 dfls each) were also conducted at five BSM&TCs under BTSSO, Bilaspur during BV 1st crop (Aug 2021). Results revealed that majority of the rearing & cocoon characteristics of preserved eggs at 15°C for 15 days were found to be on par with control.

COMPONENT-2

Test verification of synthetic blend (volatiles) developed for bivoltine silkworm seed production. [Jan 2022 to Dec 2022]

Dr. Chandrashekar R Hegde and Dr. K Chandrasekharan*

[In Collaboration with SSPC, K.R Nagar*]

Objective: To evaluate the impact of synthetic blend on oviposition in Foundation cross breeds

Test verification of the blend was conducted in FC1 X FC2 in three Silkworm Seed production Centres of NSSO during March, 2021 and egg yield per kg of cocoons improved by 11% through these positive results further technology validation taken in large scale in foundation cross breeds and further validation will be continued in project mode from April, 2022 onwards.

2. AIT06006 MI: MARKER ASSISTED SCREENING TO IDENTIFY SILKWORM GENETIC RESOURCES TOLERANT TO *BmNPV* AND *BmBDV* (Nov 2020- Oct 2023)

Dr. Ritwika sur Chaudhuri*, Dr. G. Punithavathy*, Dr. G. Lokesh*,

Dr. G. Ravikumar* and **Dr. R. Saravanakumar****

(In Collaboration with *CSGRC, Hosur and **SSTL as CI)

The project was taken up to screen the silkworm germplasm stock for presence of *BmNPV* and *BmBDV* tolerance genes using molecular markers and to validate the identified stocks through bioassay. The study was aimed at identifying silkworm germplasm breeds with better disease resistance that can be utilized to develop improved silkworm hybrids.

Objectives:

1. To identify silkworm resources tolerant to *BmNPV* and *BmBDV* using molecular markers.
2. To quantify the level of resistance/tolerance among selected tolerant genotypes.
3. To validate disease tolerance of the accessions through bio-assay studies.

4 MV and 3 BV races identified by CSGRC, Hosur as tolerance to BDV through Marker assisted screening and received for bioassay studies. Virus inoculum prepared by BDV infected larvae collected and confirmed for the presence of viruses in supernatant of midgut homogenate through PCR amplification.

BDV virus inoculated on 3rd instar 1st day larvae and rearing conducted up to spinning. 3 replications maintained and each replication 200 larvae kept for rearing. Larval and pupal survival percentage recorded by average of 3 replications for tolerance level. Multivoltine races (BMI 76 & 77) showed above 60 % tolerance and bivoltine race (BBE 190) recorded 42 % tolerance to BDV.

Table 1: Multivoltine and Bivoltine Silkworm breeds tolerance / susceptible status to BDV

Multivoltine	Race Name	Larval Survival %	Pupal Survival %
		Mean $\pm$ SD	Mean $\pm$ SD
BMI 73	BL67	9.67 $\pm$ 2.517	2.67 $\pm$ 1.528
BMI 76	APM-2	79.67 $\pm$ 6.110	70.00 $\pm$ 3.500
BMI 77	APM-3	76.33 $\pm$ 3.055	69.67 $\pm$ 3.215
BMI 84	NDV-6	0.00 $\pm$ 0.000	0.00 $\pm$ 0.000

Bivoltine	Race Name	Larval Survival %	Pupal Survival %
		Mean $\pm$ SD	Mean $\pm$ SD
BBE 190	36PC	53.67 $\pm$ 6.807	42.00 $\pm$ 4.000
BBE 225	JZH(po)	26.00 $\pm$ 4.583	11.67 $\pm$ 2.466
BBI 172	Boropolu	0.00 $\pm$ 0.000	0.00 $\pm$ 0.000
BBI 290	CSR2	0.00 $\pm$ 0.000	0.00 $\pm$ 0.000

PART II: CONCLUDED RESEARCH PROJECT

1. ARP-3634: Microbial transformation of eco-friendly compounds for the management of silkworm (*Bombyx mori* L) diseases (March 2018 - May 2021)

Dr. R. Saravanakumar and Dr. P. Sudhakara Rao

The crop loss due to different silkworm diseases is continuing during different seasons. There is a need to identify high active systemic compounds to control the diseases. Since production of compound functionalized by chemical methods is more complicated, microbial conversion method has been a new approach which can modify the compounds or convert into another form easily. Hence, this study aimed to develop new antimicrobial compounds with improved activity through biotransformation of existing chemicals that helps to control the silkworm diseases efficiently.

Objective

1. To derive natural/ eco-friendly compounds through microbial conversion for the management of silkworm diseases.

Materials and Methods

A total of 10 purified compounds/ plant crude extracts screened with 32 fungal and bacterial cultures collected from Microbial Culture Collection Centre (NCL, NCCS, ARI, Pune). The conversion experiments carried out in Potato dextrose both/Nutrient broth inoculated with microbial cultures (Fungi/Bacteria). On the suitable growth of the cultures, the substrate (parent compounds) added to the medium at 20mg/ml concentration. The reaction allowed to proceed with 25-28°C in an incubator shaker for 11 days. Converted/ new products extracted by ethyl acetate solvents and evaporated under reduced vacuum pressure in rotary evaporator to obtain the crude extract. The transformed products identified by Thin layer chromatography (TLC). The new metabolites confirmed through ¹H NMR analysis using Bruker bio spin and solvent DMSO used as reference peak (IISc, Bangalore). On post infection, various concentrations (0.1%, 0.5% and 1%) of converted product blend fed to the infected larvae for three days and observations recorded for disease control and mortality. Economic parameters of silkworm include larval weight, effective rate of rearing, cocoon weight, shell weight, shell ratio recorded to effect of the products to the silkworm.

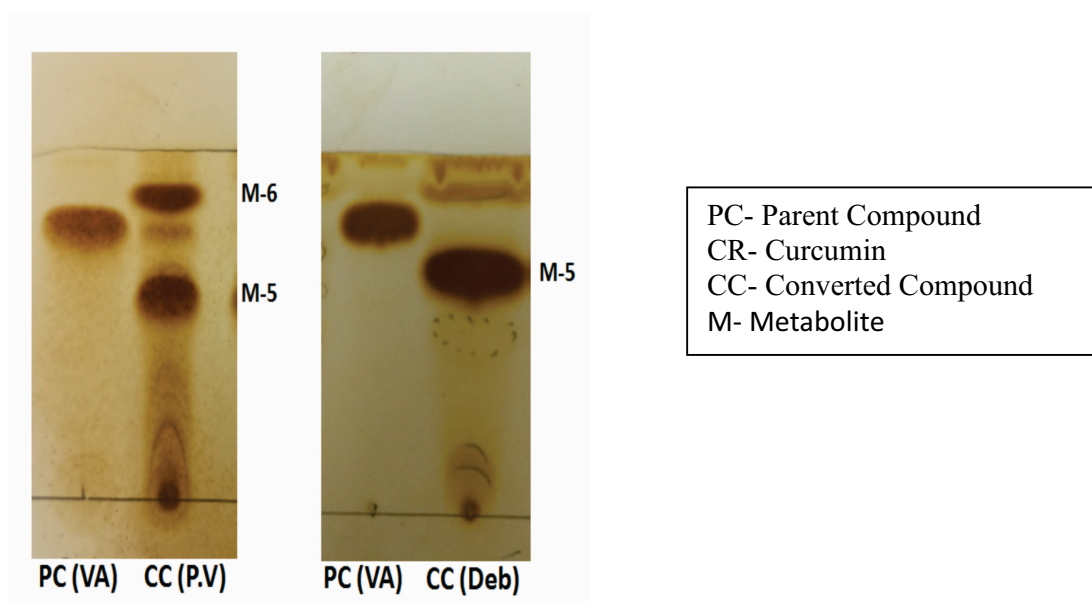
Results and Discussion

There are five fungi (*Schizophyllum*, *Debaromyces*, *Paecilomyces variotii*, *Alternaria alternate*, *Verticillium lecani*) and one bacterium (*Pantoea dispersa*) were found capable for converting antimicrobial compounds of Curcumin, Vanillin, Mulberry twig extracts and Agar wood (*Aquilaria malacensis*) twig extracts. A total of 8 different new metabolites produced from 4 selected parent compounds. Parent compound of Mulberry twig and Agar wood twigs altered after treatment with microorganisms.

Identification of converted compounds

The compound Curcumin converted into 4 metabolites by the fungus *Schizophyllum* and *Debaromyces*. All four new products appeared on 5th day of the reaction and persist up to 14th day in the reaction mixture. The compound vanillin converted into two metabolites by *Paecilomyces variotii* and (Fig.1). The crude extracts of Mulberry twigs (V1) extracts tested by fungal species *Verticillium lecani* and *Alternaria alternata*. Parent compound altered and produced a new product. The Agar wood twigs treated with its endophytic bacteria *Pantoea dispersa* and the bacteria altered the compounds and produced two metabolites in reaction mixture.

Fig. 1. Derived metabolites identified through Thin Layer Chromatography



The parent compounds and its derived metabolites were purified and analyzed through NMR spectroscopy. The ^1H -NMR spectra were recorded on a 400 MHz Bruker bio spin spectrometer. The chemical shifts (δ values) are presented in ppm and coupling constants are in Hertz. The ^1H -NMR spectra of isolated metabolites showed characteristics peaks. There are some differences in certain chemical shift regions which were caused by the microorganisms used for the conversion. The results were compared with previous reported data (Awin *et al.*, 2016) and were confirmed that observed metabolites are curcumin derivatives (Younis *et al.*, 2016).

Vanillin derived compound has more signals with higher intensities and the spectra matched that of Zhou *et al.* (2008) as vanillin derived product (Ronander *et al.*, 2018). The spectra of Mulberry twig appeared at region of 3.33 ppm, 2.50 ppm and 1.23 ppm in the range of 0.00 to 14.00 ppm. The chemical shifts of fungal treated sample found in 4.016 ppm, 3.504 ppm, 3.343 ppm, 1.485 ppm along with more signals with low intensity peaks observed. Agar wood signal peaks appeared in 3.329 ppm, 1.986 ppm, 0.848 ppm and 0.831 ppm in *Pantoea dispersa* treated sample and 3.3ppm, 7.0 to 7.6 ppm region reduced the peaks compared to the control. These results confirm the conversion of parent compounds through microbes with the evident of TLC spots.

***In vitro* activity of converted metabolites**

Antimicrobial activity of the metabolites measured by diameter of the growth inhibition zone around the disc and it ranged from 7.66 to 23.33mm. The maximum antibacterial activity observed in metabolite No.1 against *Staphylococcus* is 23.33mm and its control activity is 12.33mm. Antifungal activity of the metabolites observed in metabolite No.5 against *B. bassiana* 14.6mm and its control 7.66mm. No activity observed against *Serratia* except metabolite No.7 & 8. The minimum inhibitory concentration of the metabolites effectively inhibited the growth of all pathogens at 0.5%.

Bioactivity of converted products

The efficiency of the metabolites tested through *in vivo* studies on CSR2 and PM X CSR2 Silkworm breeds. Blend of converted compounds in various concentrations prepared (0.1, 0.5 and 1%) and evaluated for the effectiveness against silkworm pathogens. The pupal survival increased in treated batches against *staphylococcus* sp. 12 % in CSR2 and 14% in PM X CSR2 breeds at 1% concentration compared to inoculated control (53.33 ± 1.15 and $51.00 \pm 2.00\%$ respectively) (Table 1)

1) Economic characters of silkworm studied for the effect of treatment against *Staphylococcus* sp. Effective rate of rearing (ERR) increased 12% in treated batch (66.67%) than inoculated control (54.67%) significantly. Other parameters, larval weight, larval duration, cocoon weight, shell weight, silk ratio percentage observed p-value as non-significant (Table 2).

Table 1. Effect of converted compounds on silkworm survival percentage tested in CSR2 and PM x CSR2

CSR2	<i>Bacillus</i> sp.	<i>Staphylococcus</i> sp.	<i>Streptococcus</i> sp.	<i>Serratia</i> sp.	<i>B.bassiana</i>
Treatment	Mean± SD	Mean± SD	Mean± SD	Mean± SD	Mean± SD
T1 (0.1%)	49.67±2.08 ^b	53.33±1.15 ^c	51.33±1.53 ^a	72.67±1.53 ^a	0.0
T2 (0.5%)	52.33±1.53 ^{ab}	59.00±2.00 ^b	53.00±4.36 ^a	73.33±2.08 ^a	0.0
T3 (1%)	53.00±1.00 ^a	65.00±1.00 ^a	56.33±2.08 ^a	71.67±2.52 ^a	0.0
T4 (Ino. Control)	51.33±1.53 ^{ab}	53.33±1.15 ^c	51.33±1.15 ^a	73.67±2.52 ^a	0.0
PMxCSR2					
T1 (0.1%)	58.00±3.46 ^a	56.67±1.53 ^{bc}	50.33±2.52 ^a	67.66±2.51 ^a	0.0
T2 (0.5%)	54.66±4.61 ^a	62.00±3.61 ^{ab}	53.67±1.53 ^a	63.66±3.51 ^a	0.0
T3 (1%)	50.66±4.61 ^a	65.00±4.58 ^a	56.67±3.06 ^a	63.00±9.54 ^a	0.0
T4 (Ino.Control)	57.00±1.73 ^a	51.00±2.00 ^c	52.33±1.15 ^a	66.33±4.93 ^a	0.0

Values represented as Mean ±SD of 3 replications, T1, T2 and T3 are blend of converted compounds in different concentrations. T4 - (Inoculated control) treated with distilled water. 0.0 are no pupal survival, *abc*- superscripts are multiple comparison followed by a common letter are not significantly different, two treatments without a common letter are significantly different ($P < 0.05$), a is maximum value and c is minimum value.

Table 2. Rearing performance of CSR2 and PM x CSR2 after converted product treated against *Staphylococcus*

CSR2	Larval wt. (g)	Larval duration (days)	ERR (%)	Cocoon wt.(g)	Shell wt (g)	SR %
Treated	38.20±0.92	26.00±0.00	66.67±3.06	1.60±0.038	0.35 ±0.02	22.33±0.77
Inoculated control	38.17±0.76	26.00±0.00	54.67±2.52	1.60±0.05	0.36±0.02	22.58±0.55
p. value (t- stat)	NS	NS	0.0063	NS	NS	NS
PM x CSR2						
Treated	36.80±0.72	26.00±0.00	66.00±1.00	1.60±0.072	0.28±0.02	17.66±0.54
Inoculated control	36.33±0.58	26.00±0.00	52.33±2.52	1.59±0.031	0.27±0.02	16.90±1.08
p. value (t- stat)	NS	NS	0.001	NS	NS	NS

Inoculated control Values represented as Mean ±SD of 3 replications, NS - Non significant, Significance at $P < 0.05$

Conclusion

The study was carried out to enhance the activity of the compound to control the Flacherie and Muscardine pathogens. Microbial conversion of compounds is an alternative approach to conventional chemical method for the production of high active molecules. Selected compounds converted successfully through microbial cultures and activity of the converted compounds enhanced than the parent compounds. *In vivo* studies, converted compounds were effective and survivability increased in CSR2 and PMxCSR2 races against to *Staphylococcus* bacteria. Utility of the converted compounds is limited only to *Staphylococcus* sp. and not effective against *Serratia* sp., *Bacillus* sp., *Streptococcus* and *Beauveria bassiana*.

PART III: PROGRAMMES OF THE INSTITUTE

1. GENERATION OF TRAINED MANPOWER IN SEED PRODUCTION TECHNOLOGIES [UNDER CBT/HRD PROGRAM]

**Dr. Veeranna Gowda, Dr. Chandrashekhar R Hegde,
Dr. Sailaja B, Dr. R. Saravana Kumar, Dr. Mala N and R. Rajasekar**

Eight training programmes were organised for the stakeholders under CBT on different aspects of seed technology, covering 109 stakeholders (Table 1). Four training programmes under Central Seed Act were conducted on different activities of grainages to the RSPs recommended by NSSO, Bangalore for issuing of certificate to initiate a new private grainage.

Table 1: Details of Training programmes conducted under CBT and Central Seed Act

#	Name of the training	Period	Total Number of Trainees				
			KAR	TN	AP	TOTAL	
Capsule / regular training programmes (approved by CBT of CSB)							
1	Pebrine detection in Silkworm (I Batch)	26-28/07/2021	11	5	-	16	
2	Pebrine detection in Silkworm (II Batch)	05-07/08/2021	14	5	-	19	
3	Pebrine detection in Silkworm (III Batch)	11-13/08/2021	11	-	-	11	
4	Seed production techniques	23-28/08/2021	8	5	-	13	
5	Artificial hatching methods for Bivoltine silkworm eggs	07-08/10/2021	7	5	-	12	
6	Quality Silkworm Seed Cocoon	16-18/11/2021	9	5	-	14	
7	Pebrine detection in Silkworm (III Batch)	14-16/12/2021	8	5	-	13	
8	Pebrine detection in Silkworm (IV Batch)	10-12/01/2022	11	-	-	11	
Sub total			79	30	-	109	
Training programmes conducted under Central Seed Act for RSPs							
			KAR	TN	AP	MAH	TOTAL
1	I Batch: Silkworm Seed Production Techniques (3 Months)	23.08.2021 to 20.11.2021	1	-	1	-	2
2	II Batch: Silkworm Seed Production Techniques (3 Months)	20.09.2021 to 18.12.2021	1	-	-	-	1
3	II Batch: Silkworm Seed Production Techniques (3 Months)	18.10.2021 to 15.01.2022	2	-	-	-	2
4	II Batch: Silkworm Seed Production Techniques (3 Months)	30.12.2021 to 29.03.2022	1	-	-	-	1
Sub total			5	-	1	-	6
GRAND TOTAL			84	30	1	-	115

2. SILKWORM DISEASE SURVEYS

2.1. Joint Silkworm Disease Monitoring Survey (JSDMS) in Southern India

**Dr. Veeranna Gowda, Dr. Chandrashekhar R Hegde, Dr. Sailaja B,
Dr. R. Saravana Kumar, R. Rajasekar, B.V. Ravi Prasad and
K. R. Rathnamma**

SSTL Scientists visited seed areas (Karnataka-Kunigal / Magadi, Anekal and Attibele; Andhra Pradesh - Madanapalli / Hindupur; Tamil Nadu - Hosur / Denkanikottai) in three Southern States in different seasons and tested total **1,575 lots with 3200 samples** of Larval/ Pupal / and mother moths (Table 2).

Table 2: Joint Silkworm Disease Monitoring Survey (JSDMS) in three Southern States					
#	Place	Date of visit	Lots / Samples		Remarks
			BV	MV	
ANDHRA PRADESH					
1.	Madanapalle / Kuppam seed area	31-07-2021	8/16	1/2	No Pebrine incidence
		09-09-2021	11/150	1/10	
		15-02-2022	8/80	1/10	
2.	Madakasira/ Hindupur	12-07-2021	10/10	1/08	No Pebrine incidence
		08-09-2021	10/10	-	
		21-12-2021	10/20	-	
Total			57 / 286	4 / 30	
KARNATAKA					
1.	Kunigal / Magadi Multivoltine Seed area	02/03-07-2021	-	325/657	No Pebrine incidence
		21/22-08-2021	-	318/525	3+
		27/28-10-2022	-	322/658	1-3%
2.	Anekal/ Attibele Bivoltine seed area	07-07-2021	21/42	-	No Pebrine incidence
		07-09-2021	18/36	-	
		07-12-2021	20/40		
Total			59 / 118	965 / 1840	
TAMIL NADU					
1.	Hosur / Denkanikottai seed area	14-07-2021	26/52	-	No Pebrine incidence
		06-09-202``	30/60	-	
		02-12-2021	24/120	-	
Total			80 / 232		
ADDITIONAL SURVEY PROGRAMS IN KARNATAKA SEED AREA					
1	Kunigal / Magadi Multivoltine Seed area	14-09-2021	-	45/122	No Pebrine incidence
2		16-09-2021	-	96/114	2%
3		17-09-2021	-	51/54	
4		18-09-2021	-	73/134	2%
5		20-09-2021	-	15/23	2%
6		22-09-2021	-	45/90	No Pebrine incidence
7		23-09-2021	-	35/57	1%
8		24-09-2021	-	50/100	No Pebrine incidence
Total			-	410 / 694	
Grand Total			196 / 636	1,379 / 2564	



2.2. SILKWORM DISEASE MONITORING SURVEYS OF SEED AND COMMERCIAL CROP REARINGS OF SOUTH INDIAN STATES (Collaboration with CSR&TI, Mysuru, CSGRC, Hosur and NSSO, Bangalore)

Dr. Veeranna Gowda, Dr. Chandrashekhara R Hegde, Dr. Sailaja B , Dr. R. Saravana Kumar

A total of 06 disease monitoring surveys (Table 2.1) were conducted during seed crop rearings at P3 BSF, Avalapalli and Berigai. Under disease monitoring survey programme 02 and 10 visits made to CSGRC, Hosur and P3 BSF, Mysuru respectively (Table 2.1).

Table 2.1: Joint Silkworm Disease Monitoring Survey (JSDMS) in three Southern States					
Collaborative programmes with CSR&TI,Mysuru					
#	Place	Date of visit	Testing stage	Lots / Samples	Remarks
1.	P3 BSF, Avalapalli	30-04-2021 21-09-2021 11-11-2021 28-03-2021	V Instar 4 th & 5 th day	12/74	No Pebrine Incidence
2.	P3 BSF, Berigai	21-09-2021 11-11-2021	V Instar 4 th day	4/30	
Total				16/104	
Collaborative programmes with NSSO unit and CSGRC					
#	Place	Date of visit	Testing stage	Lots / Samples	Remarks
1.	P2 BSF, Mysore	15-09-2021 14-12--2021	Mother moth (BV)	8/535	No Pebrine Incidence
2.	CSGRC, Hosur	28-09-2021 04-10-2021 15/16-11-2021 20-12-2021 06-01-2021 10-02-2022 22/23-02-2022 29/30-03-2022	Egg shell / Mother moth (Both BV & MV)	562/4643	
Total				570/5,178	



Disease monitoring survey during seed crop at P3 BSF, Avalapalli

3. EXTENSION ACTIVITIES

3.1 Transfer of Technology programmes (ToT):

During the period under report, 01 Awareness (Magadi Seed Area, Karnataka) and 05 Technology Demonstration programs were conducted for the benefit of Sericulture Department staff of the southern States. A total of 117 persons were sensitized (Table 3).

Table 3: Details of Extension Communication Programmes		
Programmes	No. of events	Persons sensitized
Technologies Demonstration		
1. Demonstration on Mother moth examination	1	16
2. Demonstration on disinfection and hygiene	1	19
3. Mother moth examination for pebrine detection	1	11
4. Embryo isolation techniques	1	14
5. Demonstration on disinfection and hygiene	1	26
Total	5	86
Awareness programme		
1. Silkworm diseases and management	1	31
Grand Total	6	117



Transfer of Technology programmes (ToT) & Awareness programme

4. TESTING OF SAMPLES

4.1 Testing of disinfectants/ silkworm samples

Dr. R. Saravana kumar and K.R. Rathnamma

Silkworm Seed Technology Laboratory is recognized under Central Seed Act to do quarantine testing and issuing of quarantine certificate for exporting silkworm eggs to other countries. Regularly SSTL lends services to the stakeholders, by conducting testing of disinfectants and larvae/pupae/egg shell samples in Silkworm Seed Pathology division.

- ❖ **Quality testing of disinfectants**
11 samples of Decol received from M/s. Kamath Chlorotech (05), M/s. Durga biotech (02) and DoS Karnataka (04) were tested for quality standards.
- ❖ **Egg shell testing**
16 samples of egg shells from P2 BSF, Yelagiri Hills were tested for pebrine disease freeness.
- ❖ **Larval testing**
84 larval samples received from different farmers, DoS Karnataka and Tamilnadu were tested for finding disease incidence.
- ❖ **Quarantine seed testing**
Bivoltine Double hybrid seed received in 4100 dfls from NSSO, Bangalore were tested and issued quarantine certificate as per provisions of Central Silkworm Seed Act for export to Dokki Cairo, Egypt.

4.2 Testing of silkworm eggs/Embryo testing

Dr. Sailaja Bandam

Embryonic health of silkworm eggs tested at Silkworm seed technology and physiology division. 3 lots of Bivoltine hybrid eggs (FC1 x FC2 and FC2 x FC1) received from F1- State Government Grainage, Palamaner, Andhra Pradesh on 16-01-2022 for knowing non-hatching motives. Embryonic tests conducted and detailed report was issued on 18-01-2022.

PART IV: GENERAL / OTHER ACTIVITIES

1. Farm Management

Dr. Chandrashekhar R Hegde and V. Chandrasekhar Reddy



Maintained 02 Acres of mulberry garden at the institute and utilising the leaf for R&D works and experimental rearings.

2. Bivoltine Seed Cocoon Production and Revenue Generation

Dr. Veeranna Gowda, Dr. Mala N and J.N Chandrashekar

Under revenue generation programme, two batches of FC1 and FC2 seed crops of bivoltine were reared. The Seed cocoons generated were supplied to SSPC, NSSO. The amount generated was accounted under Revenue.



REARING PERFORMANCE OF BIVOLTINE SEED CROPS							
Crop No.	Race / FC	No. of Dfls	Crop yield		SCW (g)	SSW (g)	SR (%)
			by No.	Wt. (Kg)			
1	FC1	25	13,650	19.50	1.78	0.370	20.79
	FC2	25	12,500	20.50	1.89	0.389	20.58
2	FC1	25	11,840	16.00	1.52	0.32	21.07
	FC2	25	13,660	20.00	1.62	0.359	22.13

3. Tree Plantation

Economically important trees like, Jamun, Jack fruit, Pongamia, Shivane, Beete mara, Tore matti, Kadu badami, etc., (Total 1,728 tree saplings) were planted in about 12 ha. area during 2020 as a part of conservation of soil in the vacant area and the maintenance of these tree plantations continued during the year 2021-2022 with the co-operation of Forest department.

4. राजभाषा कार्यान्वयन/ Official Language Implementation

श्री. आर. राजशेखर

संस्थान ने अपने प्रयासों के माध्यम से भारत सरकार, गृह मंत्रालय, राजभाषा विभाग द्वारा जारी वार्षिक कार्यक्रम के अनुसार केंद्र सरकार के कार्यालयों में हिंदी नोटिंग सहित निर्धारित 65% लक्ष्य के तुलना में 87.22% का लक्ष्य प्राप्त किया है। रिपोर्टाधीन वर्ष के दौरान इस संस्थान के अधिकारियों/कर्मचारियों ने हिंदी कार्यशालाओं में भाग लिया। हिन्दी पखवाडा/दिवस दिनांक 14.09.2021 से 27.09.2021 तक रेशमकीट बीज प्रौद्योगिकी प्रयोगशाला द्वारा आयोजित किया गया। रेशमकीट बीज प्रौद्योगिकी प्रयोगशाला में 28.06.2021, 15.09.2021, 22.12.2021 और 19.03.2022 को चार राजभाषा कार्यान्वयन समिति के बैठकें आयोजित की गईं।

श्रीमती जयश्री, सहायक निदेशक (राजभाषा) और श्री. राम्तु बाषा, उप निदेशक, एसबीआरएल, केंरेबो, बेंगलुरु द्वारा दिनांक 17.09.2021 को राजभाषा कार्यान्वयन कार्यों का निरीक्षण किया गया। डॉ. आर. सरवनकुमार, वैज्ञानिक-सी और श्रीमती के आर रत्नम्मा, वरिष्ठ तकनीकी सहायक ने प्रबोध और प्रवीण पाठ्यक्रम सफलतापूर्वक पूरा किया।

The Institute has achieved 87.22 % of the assigned target of 65% along with notings towards the Hindi correspondences to Central Government offices as per OLIC Annual programmes of Ministry of Home affairs. Hindi workshops were attended by officers/officials of this Institute during the year under report. SSTL organized Hindi Pakhwada / Hindi Fortnight from 14.09.2021 to 27.09.2021. A total of four OLIC meetings were conducted at SSTL on 28.06.2021, 15.09.2021, 22.12.2021 and 19.03.2022, respectively.

Inspection works under Official Language Implementation was conducted by Smt. Jaishree, Assistant Director (OL), NSSO, CSB, Bengaluru along with Shri Ramtu Basha, Deputy Director (OL), SBRL on 17.09.2021. Dr. R. Saravanakumar, Scientist-C and Smt. K. R. Rathnamma, Senior Technical Assistant completed Prabhodh and Praveen courses successfully.



Hindi Pakhwada / Hindi Diwas from 14.09.2021 to 27.09.2021

PART V: PUBLICATIONS

1. Sudhakara Rao P, Sailaja B, Vijaya Kumari K. M, Saravana Kumar R and Mishra R.K. (2021). Anekal thalukina dvithali datthu bitthane belegarara yashogathegalu *Reshme Krishi*. P 24-27.
2. Vemananda Reddy G., Vijaya Kumari K. M., Sudhakara Rao P., Sailaja B., Saravana Kumar R and Mishra R.K. (2021). New concepts in Silkworm seed preservation and their advantages. *Indian Silk*. 11 (59), No .6: 18-20.
3. Mala N. and Vijila K. (2021). Effect of feed fortification on nutritional indices traits of silkworm, *Bombyx mori* L. *Int. J. Chem. Stud.*, 9(6):18-23.
4. Mala N., Jena K and Baig M. M. (2021). Half male half female - A rare prodigy of gynandromorphism in Tasar silkworm *Antheraea mylitta* D. (Saturniidae: Lepidoptera) with special reference to its procreative behaviour. *J. Entomol. Zool. Stud.* 9(6): 97-102.
5. Veeranna Gowda (2021). Reshme Udhyamadalli Mahila Sabaleekarana. *Reshme Vaani*, 2(1):2.

PART VI: SEMINARS / TRAININGS / WORKSHOPS/ PROGRAMMES

#	Title of Programme	Venue and Date	Persons Participated
1	Extension Management Approaches for Promotion of Sericulture Industry. 03 days Online training	Manage, Hyderabad 15/18.06.2021	Dr. B.Sailaja
2	Introduction to genomics and Bioinformatics” organized by C-CAMP and Bengaluru Genomics centre. Virtual mode	CSGRC, Hosur 22/ 24.09.2021	Dr. R.Saravana Kumar
3	Brainstorming workshop on Silkworm improvement. Virtual mode conducted by CSTRI, Mysuru.	SSTL, Kodathi 18.08.2021	Dr. ChandraShekar Hegde Dr. B.Sailaja
4	Five days online training program on Leadership and Organization Development for Women Scientists / Technologists sponsored by DST and organized by COD Hyderabad	SSTL, Kodathi 25/29.10.2021	Dr. B.Sailaja
5	53 rd RC meeting of SSTL	SSTL, Kodathi 04.10.2021	Dr. V. Sivaprasad , Director, NSSO and all SSTL Scientists
6	Hands on training on Application of statistical tools in sericulture research (Batch-1).	CSB, Bangalore 23/24.11.2021	Dr. ChandraShekar Hegde Dr. R.Saravana Kumar Dr. Mala N
7	Commercialization of Technologies and establishment of incubation centres. Guest lecture	CSB, Bangalore 06.12.2021	Dr. Veeranna Gowda Dr. ChandraShekar Hegde Dr. B.Sailaja
8	Workshop on socio-economic assessment of sericulture technologies. (Batch-1)	CSB, Bangalore 20/23.12.2021	Dr. B.Sailaja Dr. R.Saravana Kumar
9	Brainstorming meeting on Pebrine disease management.	KSSRDI, Thalagattapura 04.01.2022	Dr. ChandraShekar Hegde Dr. R.Saravana Kumar
10	Hands on training on Application of statistical tools in sericulture research. (Batch-2)	CSB, Bangalore 06/07.01.2022	Dr. B.Sailaja
11	15 th RAC meeting of SSTL	CSB, Bangalore 15.03.2022	RAC Members and SSTL Scientists
12	Action plan meeting for the year 2022-2023	CSB, Bangalore 20/21.03.2022	Dr. Veeranna Gowda
13	Hindi workshops	SSTL, Kodathi 26.06.2021. SBRL, Kodathi 24.06.2021 SBRL, Kodathi 31.03.2022	SSTL officials / officers

PART VII: BUDGET DETAILS

A sum of Rs. 19,76,843/- was generated as revenue for the financial year 2021-22 and remitted to Central Office.

REVENUE GENERATION DURING THE YEAR 2021-2022

#	Particulars	Amount (Rs.)
1	Royalty received for Decol and CRH	17,6766.00
2	Income from Hostel rent, Training course fee, etc.	1,30,000.00
3	Others (Testing charges, Sale of books, Cut cocoons, Mulberry leaf and Quarantine Charges)	79,183.00
Total		19,76,843.00

Training programs conducted for different stakeholders under CBT



ADDITIONAL SURVEY PROGRAMS CONDUCTED BY SSTL SCIENTISTS AT KUNIGAL AND MAGADI SEED AREA, KARNATAKA TO MONITOR PEBRINE DISEASE DURING SEPTEMBER, 2021



PEBRINE DISEASE SURVEY PROGRAMME AT KUNIGAL SEED AREA



PEBRINE DISEASE SURVEY PROGRAMME AT MAGADI SEED AREA



15th RAC meeting of SSTL