RESEARCH & TECHNOLOGY DEVELOPMENT, BYPRODUCT MANAGEMENT AND PROSPECTS IN ERI CULTURE - A REVIEW

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ABSTRACT: Eri is the most popular and rapidly expanding sericulture in the Vanya silk map of India. The R&D of eri sector is primarily supported by Central Muga Eri Research & Training Institute, Lahdoigarh, Assam, Regional Eri Research Station, Mendipathar, Meghalaya and Shadnagar, Andhra Pradesh. These organizations are constantly engaged in providing R&D support to boost up Eri culture in the region. Certain important research activities particularly on maintenance of germplasm accessions of eri silkworm and host plants and their breeding approaches, molecular characterization of eri silkworm germplasm accessions, eri seed technological research and technologies development on different aspects are reviewed in this paper. Further byproduct management, constraints in eri culture and future strategies for development of eri culture are also discussed in the paper.

KEY WORDS: Eri silkworm, technologies, byproducts, germplasm.

North-East is one of the mega bio diversity centres of the world with flourishing green forests and suitable climatic conditions harbouring varied flora and fauna including the silk producing insects. Among all the five commercially exploited silk, four varieties are produced in the region including eri silk. The Brahmaputra valley of Assam and its adjoining foot hills is believed to be the original home of eri silkworm *i.e. Samia ricini* (Donovan). *S. ricini* silkworms are utilized for production of silk with unique thermal properties. Eri culture is mostly confined to the Brahmaputra valley of Assam in the tribal inhabited districts. It is also practiced in few districts of the neighbouring states mainly Meghalaya, Nagaland, Manipur, Mizoram and Arunachal Pradesh. Presently, eri culture is spreading in different non-traditional states like, Andhra Pradesh, Tamil Nadu, Karnataka, Gujarat, Jharkhand, Chhattisgarh *etc*. The eri silkworm is multivoltine and polyphagous in nature feeding on a number of food plants namely castor, *Ricinus communis*, Kesseru, *Heteropanax fragrans*, Tapioca, *Manihot esculenta*, Payam, *Evodia flaxinifolia* and Barpat, *Ailanthus grandis* and several others. Eri silkworm is reared indoor like that of mulberry silkworm for production of cocoons. eri culture is an agro-based small scale industry of North Eastern India consisting of multifarious activities like food plant cultivation, silkworm rearing, spinning of yarn and weaving. It is purely a traditional and a leisure time occupation limited to meet partly the sericulture family's clothing and food need. Among tribal people of the region, eri pupa is a delicacy. Ericulture still remains as backward venture of poor rural people and often lag behind in technology adoption mainly due to their poor living condition.

The R&D of eri sector is primarily supported by Central Muga Eri Research & Training Institute, Lahdoigarh, Assam and Regional Eri Research Station, Mendipathar, Meghalaya. Recently a new Regional Eri Research Station has been established at Shadnagar, Andhra Pradesh. Being agro-based, the eri cottage industry till recently remained in an unorganized form. Studies on different aspects of eri silkworm and their host plants began way back in 1974 with the establishment of the Central Muga Eri Resaerch Station at Titabar, Assam. Thereafter, research activities in eri were carried out at the Regional Sericultural Research Station, Titabar in 1982-1986. The Central Eri Research & Training Institute (now known as Regional Eri Research Station) was established at Mendipathar, East Garo Hills, Meghalaya during 1986 and the station is constantly engaged in providing R&D support to boost up eri culture in the region. Large number Eri food plants exist in nature there is scope for development using biotechnological tools and techniques (Sarmah and Gogoi, 2011). Certain important research activities particularly on breeding aspects of eri silkworm and host plants, biotechnology, eri seed technology and technologies development on different aspects are reviewed below:

HISTORICAL BACKGROUND OF SILK

The history of silk in Brahmaputra valley of Assam can be traced back to the Vedic literature (around 1600 BC). Silk from mighty river Brahmaputra valley was marketed to Mugadh, Mithila (ancient cities of India) and Brahmadesh (Myanmar) during 1340 BC. During the period of great King Bhaskar Barman of Kamrup (Ancient Assam) during 600-650 AD silk trade from Assam to North India was at peak stage. Buddhist visitor, Hieun Tsang mentioned in his writing about the place Suvarnkusi, presently known as Sualkuchi of Assam, India as an important silk producing centre and now it is now called as Manchester of east. King Harsha Vardhana of Kaunuj imported silk from Assam during 600-650 AD for making his royal dresses. Later during 1492-1520 AD, the great 'Ahom' King Sarna Narayan patronized silk industry of Assam.

PRODUCTION TREND

Eri sericulture consisting of different activities like food plant cultivation, silkworm rearing, spinning of yarn and weaving. Large quantities of eri silk are produced each year, mainly in India among the Asian countries. In India the production grew from 100 metric tons per year in 1950s to over 2460 metric tons in 2009 – 2010, which is remarkable (Table 1).

ERI SILK PRODUCING AREAS

Most of the silks are consumed domestically in India, leaving little for export. In India at the present time, most eri silk is produced in Assam, Manipur, Meghalaya, Nagaland, Arunachal Pradesh and Mizoram, *i.e.,* primarily in the northeastern India. Recently, eri culture is spreading in different non-traditional states *viz.*, Andhra Pradesh, Gujarat, Madhya Pradesh, Chhattisgarh, Tamil Nadu, Karnataka, Maharashtra, Uttaranchal, Uttar Pradesh, Jharkhand, Bihar, West Bengal, Orissa and Sikkim, where castor is grown in vast area as oil seed crop. The north eastern region of India alone produces more than 90% of the total amount of cut cocoons and spun silk in the country.

FAVOURABLE PHYSIOGRAPHIC ZONE FOR ERI SERICULTURE

The North Eastern Region of India is one of the 15 agro-climatic zones identified by the planning commission, Government of India. The varied physiography contributes to great climatic variations of the region, which has definite pockets representing temperate, sub-tropical and tropical areas. The climate of the region thus varies from near tropical in the plains of Assam, Tripura, southern Mizoram and Tarai zones of North Bengal to near alpine in the northern Sikkim and Arunachal Pradesh. The greater part of the region, however, lies in the sub-tropical zone. Despite diverse physiographic characters of the region, sub-regional variations in average seasonal temperatures are not striking. Thus, the region has four distinctly different seasons: winter, spring, summer and autumn in a year and which are congenial for eri culture. Spring (March-May) and autumn (October-November) are the most congenial seasons of the year.

ACCESSIONS OF ERI SILKWORM

Out of 19 species of eri silkworm under genus *Samia* all over the world, *S. canningi* (wild) and *S. ricini* (cultivated) are found in N E region of India. Since, establishment of CSB R&D set up in Assam several workers studied different aspects of pre-breeding and breeding aspects of eri silkworm. Few of the important work conducted on the breeding of eri silkworm are described here. The commercially exploited *S. ricini* is multivoltine and has several eco- races like, Nongpoh, Borduar, Titabar, Sille, Dhanubhanga, Mendipathar and Khanapara (Singh et al.). The eco-races were named based on the location of collection are maintained in the GPB. Detailed characterization of eri silkworm accessions and their documentation based on descriptor has been done (Chakravorty et al., 2008). Among the presently maintained eco-races in the GPB Borduar, Genung, Diphu, Kokrajhar are showing better performance. Listing of passport data of all accessions available in the GPB is presented (Table 3). Further, homozygous strains namely Greenish Blue Plain, Greenish Blue Spotted, Greenish Blue Zebra, Yellow Plain, Yellow Spotted and Yellow Zebra, based on external body markings, have been isolated from Borduar and Titabar eco-races are maintained in the GPB. Breeding to evolve suitable hybrid of eri silkworm was done (Singh et al., 2000). Six pure line strains of eri silkworm have been selected and crossed following the diallel crossing technique and analyzed following Griffing's method. After combining ability studies among the six pure line strains two eri crosses *viz*., ES-1 (YZxGBS) and ES-2 (GBSxGBZ) have been developed (Debaraj, 2001). Field trial of two eri crosses revealed better performance in ES-1 in terms of fecundity, hatching, cocoon weight, shell weight, shell ratio, and yield (Table 2). To develop high yielding breed of eri silkworm in term of shell weight and fecundity a project has currently under progress (Sinha, 2008). Borduar, Genang etc. high yielding races are utilized in this breeding work.

HYBRIDIZATION

Hybridization and rearing performance with economic traits of *S. canningi* and *S. ricini* on their natural host plants was done (Sarkar, 2008). Hybrid worms of wild eri ♀ (*S. canningi*) X Cultivated eri ♂ (*S. ricini*) reared successfully several consecutive generations. Two types of worms were observed i.e. greenish blue plain and greenish blue spotted with prominent tubercle. Brown and brick red colour cocoons were found in four consecutive generations. The maximum fecundity (364.6±5.03) and hatching percentage (83 ±2.55) was recorded in F3 generation on *Heteropanax fragrans* and it was lowest on *Ailanthus grandis* in F1 generation as (299.2+4.44) and in F2 generation (70.6 ±4.04) respectively. The highest larval weight (8.51±0.38) and shell ratio (16.00 ± 1.70) was recorded on *Heteropanax fragrans* in F1 generation and it was lowest as 7.59±0.41 and 11.53 ±0.92 respectively in F2 generation. Highest cocoon weight (3.40±0.11), pupal weight (2.98±0.12) and shell weight (0.41±0.02) were recorded in F2 generation on *Heteropanax fragrans,* while it was lowest as 2.50 ± 0.08, 2.12 ± 0.10 and 0.34±0.01 on *Ailanthus grandis* respectively in F1 and F4 generation. Larval duration was highest in F4 generation and it was lowest in F1 generation on *Ailanthus grandis* and *Heteropanax fragrans* respectively (Sarkar, 2008). Analysis of the growth and economic traits of cocoon of different eri silkworm races revealed that eri silkworm accession viz. SRI-001, SRI- 010 and SRI- 024 are the most promising eri silkworm races for commercial exploitation in agro climatic condition of North eastern region of India. (Sarkar, 2008).

MOLECULAR CHARACTERIZATION OF ERI SILKWORM ACCESSIONS

Although numbers of eri silkworm accessions are maintained in the GPB molecular characterization work is very limited due to lack of adequate manpower and infrastructure facilities. A preliminary study on the DNA fingerprinting by Vijayan et al. (2006) using the six eco-races (Acc. No. 001 to 006) suggested that the gene flow between the populations of Acc. 003 and Acc. 005 is quite high (0.9035) and lowest (0.2172) is between Acc. 002 and Acc. 003, but have similar in phenotypic traits, such as cocoon colour. The genetic distance is lowest between Acc. 003 and Acc. 005 (0.0654) and highest between Acc. 002 and Acc. 006 (0.3811). Within populations heterozygosis is higher in Acc. 001 (0.1093) and lowest in Acc. 002 (0.0510). The high co-efficient of gene differentiation value (0.657) among populations combined with low gene flow contributes significantly to the genetic differentiation among *S. ricini* populations. The high phenotypic and genetic similarity as well as gene flow between populations of Acc. 002 and Acc. 005 suggests its common origin and later progression into different populations by adapting to the varying climatic conditions.

ERI SEED TECHNOLOGY

The R&D sector of eri seed technology is very limited. Although a lot of work was under taken in the past there was no any logical ending. Regarding hatching of egg, it was reported that eri eggs hatched between 6-8 hours in the morning with a peak at 8 AM and the favourable brushing time is at 8-10 AM (Viswakarma & Prasad, 1981). In respect of egg preservation it was reported that the eri silkworm egg can be refrigerated successfully up to 10 days at 4-5^{o}C from the 6th day of oviposition which show good hatching (79.2%), Rao & Kakati (1975). A comprehensive package of practice for eri grainage technology has been reported (Basumatary, 2003). Studies on alternative oviposition device like nylon net bag was reported (Debaraj et al., 2003) Highest fecundity of eri silkworm was reported during October (Debaraj et al., 2003). Similar observation was made in the study of grainage character of eri silkworm in different seasons (Sarkar et al., 2008). Considering the performance of different grainage characters such as good moth emergence, higher coupling realization, higher fecundity and higher hatchability of eggs the autumn season (September to November) was found as best for eri seed production and summer (May to July) was comparatively unsuitable for eri silkworm seed production with low coupling recovery, low fecundity, low hatchability of eggs and higher emergence of cripple moths.

EVALUATION OF ERI HOST PLANTS

In order to evaluate suitable castor genotypes for eri silkworm rearing 24 accessions were collected and maintained at Central Muga Eri Research Station (CMERS), Titabar. From the study it was reported that local variety *viz*. Borduar, Kokrajhar and Nagabat green showed higher leaf yield (5673kg/ha/year) in comparison to other accessions (Sengupta et al., 1973). In a similar study, 40 accessions of castor were collected from different places *viz.,* Salem, Silchar, Diphu, Mysore and Laos and evaluated during 1977-78 at CMERS, Titabar. The study revealed that accessions RC-4, RC-6 and RC-9 were found promising (Rajanna, 1977). In the latter studies it was recorded that RC-4, a non-bloomy local variety of Diphu showed highest leaf yield *i.e.,* 7380kg/ha/year (Isa et al., 1980). Four different castor varieties *viz*., T3, Tarai 4, Kalpi 6 and local ruling var. were evaluated at RERS, Mendipathar, Meghalaya and T3 was found better in rearing performance with maximum ERR 93.33% followed by 87.33% in Tarai-4 (Singh et al., 1988). Tapioca is also a promising perennial host plant of eri silkworm. However, effective rate of rearing is only 60% and shell weight is also less than 0.30 gm. Low survivability of eri silkworm may be attributed by high content of HCN in its leaves. Some reports suggest that HCN content is negatively correlated to the rise in environmental temperature. In view of this, tapioca may be exploited for rearing during summer season when scarcity of other food plants occurs. Further, low HCN content variety such as Co-2, ME-1 and ME-120 may be exploited for eri silkworm rearing (Ahmed & Sarmah, 2011). Regional Eri Research Station (RERS), Mendipathar undertook an evaluation study during 1997-2000, utilizing 41 accessions of castor, collected from different parts of India like DOR- Hyderabad, Bihar, Assam, Meghalaya and abroad (Laos). Based on leaf yield 10 promising accessions were selected, out of which, NBR-1 (Acc. ER-008) (a local non-bloomy red castor) was found as most promising variety for eri silkworm rearing with potential leaf yield of 12 MT/ha/year (Sarmah, 2002). Tolerance status of ten promising accessions of castor was studied against major insect pests were evaluated against Castor hairy caterpillar (*Euproctis lunata* Wlk.), Semilooper (*Achoea janata* L.), Jassids (*Empoasca flavescens* Fb.) and Capsule borer (*Dichrocrocis punctiferalis* Guen). Rate of infestation of these insect pests was recorded in different seasons. The accessions *viz*., ER-008, ER-009 and ER 001 were found to be resistant to Capsule borer and moderately resistant against Castor hairy caterpillar Semilooper and Jassids (Sarmah & Chakravorty, 2005). Besides, secondary host plants viz., castor, (*Ricinus communis*), Kesseru, (*Heteropanax fragrans*), Tapioca, (*Manihot esculenta*), Payam, (*Evodia flaxinifolia*) and Barpat, (*Ailanthus grandis*), Borkesseru, (*Ailanthus excelsa*) are maintained in the GPB. Besides, 72 accessions of castor are being maintained at CMER&TI, Lahdoigarh, collected from different parts of North East India under NATP programme. The accessions were characterized based on descriptor and 7 promising accessions *viz*., Acc 3, Acc 4, Acc 11, Acc 20, Acc 30, Acc, 36, Acc 56 were preliminarily selected on the basis of higher leaf yield with petiole (3.78 to 4.45kg/plant/year) (Gogoi, 2006). A project has been under taken to evaluate suitable variety of castor based on preliminary work on 72 accessions collected under NATP programme. Finally, evaluated two more Local castor (Acc 003 & Acc 004) as most promising genotype of castor for eri silkworm rearing Most important growth data, number of leaf and leaf biomass yield per plant was recorded highest in Acc 003 *i.e.*, 31.83 no. and 344.70 g respectively. Thus, 13.80 MT leaf can be harvested from one hectare of land within a year, which is considerably higher than earlier observation of 12 MT/ha/year. Similarly Acc-004 showed average leaf yield 334.50 g per plant per year, thus it has potentiality of 13.38 MT leaf yield per hectare, which is 33.80 % above benchmark and 11.50% than earlier record. (Sarmah et al., 2011).

PROVEN TECHNOLOGIES DEVELOPED

- A comprehensive package of practices developed for raising and maintenance of kesseru and castor plantation**.**
- Package of practices for raising of kesseru nursery (above 90% survival) has been evolved and adopted in the field.
- Agronomical practices in perennial cultivation of castor utilized for eri silkworm rearing has been developed with spacing 1.0 x 1.5 m and pruning at 1.0 m height during March.
- Evaluated Local castor (NBR-1) variety as promising one with 12MT leaf yield/ha/year. Moreover, evaluated two more Local castor (Acc 003 & Acc 004) with 13.80 MT and 13.38 MT with leaf yield potentiality per hectare.
- Improved rearing technology of eri silkworm has been developed.
- Eri silkworm rearing is usually performed in trays made up of bamboo, sometimes through bunch feeding. Both the systems of rearing require more space, intensive labour and high cost involvement. To overcome this, an innovative new low cost device (3 tier platform made up of bamboo) is fabricated and found to be very cost effective and labour saving. Utilizing this device, rearing capacity can be increased to three fold in a unit area. It also improves all the cocoon characters over control (Debaraj, 2003).
- The new nylon net bag measuring 20x25 cm fabricated for oviposition of eri silkmoth is more effective with higher oviposition index (0.83) and consumes less time as compared to the traditional kharika.
- Bamboo strip mountage gives 99% cocoon recovery with 2.69g, 0.37g and 13.94% cocoon weight, shell weight and shell ratio as compared to 90% cocoon recovery with 2.07g, 0.26 g and 12.53% respectively in traditional jali.

BYPRODUCT MANAGEMENT

Waste and byproduct management can generate additional income from eri culture (Sarmah, 2010). Besides, it will ensure considerable value addition to the product and additional employment generation. Both on-farm and off-farm sectors of the culture have potential to convert their wastes into useful byproducts of commercial value. There are several industrial units in countries like China for converting sericultural wastes into useful products that are useful not only in research and medicinal lines, but also for the common people. The tribal people use Eri pupae as delicious food. Judicial utilization of silkworm as a source of food is practiced many countries of the world. For the tribal in northeastern India, the eri chrysalid [pupa] is a delicacy and the cocoon is more or less a byproduct (Sarmah, 2011). Different recipe preparation like boiled pupa, fried pupa, chilli pupa, pupa masala *etc*. are possible from eri pupa. The dried pupae contain about 25% oils and 50% protein. De-oiled pupa contains about 11% nitrogen. It can be used as feed for livestock, fish, poultry, piggery etc. Oil can be used in soap making industry. The castor seeds contained 50% oil and used for the manufactures of soap, medicine, lubricants, detergent etc. The oil cable contains about 4.5% nitrogen and it can be used as manure and as an antidote to white ants in the field. Castor stem may be used for paper industry. Tapioca is one of the most efficient photosynthesizing plants known. The tuber accumulates starch in large than thicken storage containing 25-35% on dry weight. The content may reach a level of 90%. Its productivity appears to be significantly higher than any other staple food crops/unit area and time in terms of calories. The high photosynthetic efficiency and presence of large quantity fermentable sugar in hydrolyzed starch make the tuber an attractive source of renewable energy. For preparation of Alcohol, it is an excellent source of carbohydrate other than molasses. Fresh tubers are used for production of Ethanol. The hill regions of eastern India have ample scope for expansion of tapioca cultivation not only as a source for supplementary diet for the people but also increasing the quantum of leaf for eri cocoon productions. The litter of eri silkworm may be used as manure and it is said that the ash of eri litters is an effective insecticides. It also contains carotene. Ailanthus is soft-wood suitable for "farm forestry". The wood, being light and week is used for carts, match splints and box, box planking and news print grade pulp and plywood. Ailanthus seeds are used for cooking oil. Ailanthus bark is used for extraction of tannin. An infusion of the bark has used to treat Tapeworms, Leucorrhoea and Diarrhea. Leaves of Ailanthus contain three components Quasinoid (alkaloids) that are effective against Malaria. Crushed leaves of A. excelsa emit a characteristic odour of strong and unpleasant nature due to presence of small glands, which repels cattle and predators.

CONSTRAINTS IN ERI CULTURE

Although is being practiced since time immemorial, it is still confined to the domestic demand and remains unorganized. There is a wide gap between the potential and realized outcome from eri rearing. In N.E. India the rearers are practicing the culture mainly for eri pupae, which has high protein value and oil and silk layers are used for production of spun yarn. Moreover, they are not much aware of its remunerative nature. The constraints hindering proper development of the culture are identified as below:

1. Absence of systematic plantation of eri food plants in NE India for a steady supply of leaves for rearing.
2. The reluctance of the people to change their age-old tradition to adopt the recommended technology is the main hindrance.
3. Lack of assured eri dfl supply, because the layings produced by the farmers are not properly examined.
4. The poor rearers have no proper infrastructures like rearing houses and disinfection appliances / facilities.
5. Though eri silkworms are hardy in nature and can withstand adverse conditions in comparison to other silkworms, occurrence of diseases often leads to total crop loss.
6. Non-utilization of eri pupa and lack of skill in removal of pupa in non-traditional states.
7. Absence of assured marketing facilities for disposal of end products.
8. Absence of awareness for production of diversified products.

CONCLUSION

- *In-situ* and *ex-situ* conservation of the wild eri silkworm to protect the same from being extinct.
- Development of high yielding breed of eri silkworm in respect to different agro- climatic zone of India.
- Development of suitable cocoon/egg preservation technique of eri silkworm.
- Development of region specific low cost rearing and grainage technology.
- Development of suitable pupa removal device.
- Emphasis on evaluation of suitable variety of tapioca/kesseru for eri silkworm rearing.
- DNA fingerprinting of eri silkworm genotypes presently available should be the priority area.
- Molecular characterization of eri host plant and silkworm gene pools and development of transgenic plants/silkworm.
- Biotechnological approach to evolve high yielding disease tolerant race / strain in eri silkworm.
- Identification and isolation of virus and bacterial diseases of eri host plant/silkworm and molecular characterization of the pathogens.
- Development of integrated pest management technique for eri host plant castor.
- Development of rapid diagnostic techniques for detection of viral and bacterial diseases of eri silkworm.
- Emphasis in product diversification of eri fabrics.
- Popularization of human consumption of pupa or utilization of pupa as poultry, fishery and piggery feed *etc.* for more remuneration particularly in non-traditional states.

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Table 1. Trend of growth in Eri Raw Silk Production (1951-1952 to 2009-10).

Year	Production of raw silk (MT)	Year	Production of raw silk (MT)
1951-52	100	1981-82	147
1952-53	102	1982-83	213
1953-54	99	1983-84	270
1954-55	104	1984-85	279
1955-56	127	1985-86	352
1956-57	130	1986-87	392
1957-58	143	1987-88	522
1958-59	143	1988-89	565
1959-60	112	1989-90	589
1960-61	110	1990-91	624
1961-62	132	1991-92	704
1962-63	137	1992-93	NA
1963-64	194	1993-94	NA
1964-65	204	1994-95	NA
1965-66	201	1995-96	745
1966-67	208	1996-97	745
1967-68	200	1997-98	814
1968-69	213	1998-99	970
1969-70	218	1999-00	974
1970-71	161	2000-01	1089
1971-72	168	2001-02	1160
1972-73	143	2002-03	1316
1973-74	141	2003-04	1352
1974-75	115	2004-05	1448
1975-76	123	2005-06	1442
1976-77	106	2006-07	1485
1977-78	56	2007-08	1530
1978-79	120	2008-09	2038
1979-80	183	2009-10	2460
1980-81	135	2010-11	2645

Table 2. Performance of two elite crosses of eri silkworm at farmers' level.

Particulars	**ES-1**	**ES-2**	**Control**
Fecundity (nos)	473.55	468.99	447.44
Hatching (%)	92.49	90.27	89.77
Cocoon weight (g)	3.52	3.42	3.30
Shell weight (g)	0.51	0.47	0.45
Shell ratio (%)	14.44	13.99	13.83
ERR (%)	90.17	87.33	86.04
Cocoon Yield (nos)/ 100 dfls	39,540	37,213	34,658

Table 3. Listing of Passport data of eri silkworm accessions.

Sl. No.	Accession No.	Race name	Donor	Origin	Class	Parentage
1	SRI-001	Borduar	RERS, MEG	ASM	O(RCU)	OR
2	SRI-002	Titabar	RERS, MEG	ASM	O(RCU)	OR
3	SRI-003	Khanapara	RERS, MEG	ASM	O(RCU)	OR
4	SRI-004	Nongpoh	RERS, MEG	MEG	O(RCU)	OR
5	SRI-005	Mendipathar	RERS, MEG	MEG	O(RCU)	OR
6	SRI-006	Dhanubhanga	RERS, MEG	ASM	O(RCU)	OR
7	SRI-007	Chuchuyimlang	CMERTI, ASM	NAL	N	OR
8	SRI-008	Lahing	CMERTI, ASM	ASM	N	OR
9	SRI-009	Barpathar	CMERTI, ASM	ASM	N	OR
10	SRI-010	Diphu	CMERTI, ASM	ASM	N	OR
11	SRI-011	Adokgri	CMERTI, ASM	MEG	N	OR
12	SRI-012	Lakhimpur	CMERTI, ASM	ASM	N	OR
13	SRI-013	Dhemaji	CMERTI, ASM	ASM	N	OR
14	SRI-014	Kokrajhar	CMERTI, ASM	ASM	N	OR
15	SRI-015	Imphal	CMERTI, ASM	MAN	N	OR
16	SRI-016	Cachar	CMERTI, ASM	ASM	N	OR
17	SRI-017	Dhakuakhana	CMERTI, ASM	ASM	N	OR
18	SRI-018	Genung	RERS, MEG	MEG	N	OR
19	SRI-019	Jonai	CMERTI, ASM	ASM	N	OR
20	SRI-020	Dhansiripar	CMERTI, ASM	NAL	N	OR
21	SRI-021	Sadiya	CMERTI, ASM	ASM	N	OR
22	SRI-022	Tura	CMERTI, ASM	MEG	N	OR
23	SRI-023	Jona Kachari	CMERTI, ASM	ARP	N	OR
24	SRI-024	Barpeta	CMERTI, ASM	ASM	N	OR
25	SRI-025	Ambagaon	CMERTI, ASM	ASM	N	OR
26	SRI-026	Rongpipi	CMERTI, ASM	ASM	N	OR

SRI – *Samia ricini*, RERS – Regional Eri Research Station, CMERTI – Central Muga Eri Research & Training Institute, MEG – Meghalaya, ASM – Assam, NAL – Nagaland, MAN – Manipur, ARP – Arunachal Pradesh, O – Old, RCU – Race in current use, N – New, OR – Original Race.